

# Energy Design Update®

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## INDUSTRY NEWS

### Gradual Progress In the Vapor Retarder Wars

The 2007 Supplement to the International Energy Conservation Code (IECC) includes new vapor retarder requirements reflecting up-to-date findings by researchers at the Oak Ridge National Laboratory (ORNL). The new code requirements are the result of a five-year campaign by a group of building scientists to bring obsolete elements of the energy code into alignment with current scientific knowledge.

Among the strongest voices for eliminating code requirements for vapor retarders in warm climates

were Building Science Corporation principals Joseph Lstiburek and Betsy Pettit, the hosts of a 2002 conference on the topic (see *EDU*, August 2002). "All of this started in 2002," explained Achilles Karagiozis, an ORNL researcher who has helped develop the vapor retarder recommendations. "That was when we had building science turmoil. We heard people say, 'Poly is bad!' There were revolutionary ideas and chaos in the country."

The vapor-retarder reform movement achieved its first major success when the 2004 Supplement to the International Energy Conservation Code (IECC) eliminated vapor retarder requirements in the southern US. According to section 402.5 of that code, vapor retarders are no longer required in climate zones 1 (southern Florida), 2 (the Gulf Coast region), 3 (e.g., Oklahoma, Arkansas, South Carolina), or 4 (e.g., Missouri, Kentucky, Virginia, Maryland).

#### A Code Change Proposal Meets Resistance

The campaign's second attempt at reform -- a complicated proposal presented at the 2004 vapor-retarder conference (see *EDU*, August 2004) -- did not fare as well. The proposal called for vapor retarder requirements to vary according to the climate zone and the combined permeance of a building's siding and exterior sheathing. The proposal failed to be adopted by the IECC after critics contended that it lacked adequate scientific basis.

Many of the building scientists engaged in the drawn-out political controversy over vapor retarders, Karagiozis included, ended up bruised. At the Buildings 10 Conference on Exterior Envelopes in Clearwater Beach, Florida, in December 2007, Karagiozis joked about the contentious nature of the code-change process. "The vapor retarder is a political animal," said Karagiozis wryly. "Researchers should get combat pay for this."

Among the stakeholders involved in the vapor-retarder wrestling match, the most aggressive contender

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appears to have been the National Home Builders Association (NAHB). In a phone interview with *EDU*, Lstiburek's reflections echoed those of Karagiozis. "I was exhausted by this," Lstiburek told *EDU*. "It was a bruising fight for five years."

### Hygrothermal Analysis

After the failure of the 2004 proposal, the US Department of Energy (DOE) agreed to fund a research effort to look into vapor-retarder performance in a wide range of North American climate zones. ORNL researchers, spearheaded by Karagiozis, performed hundreds of hygrothermal load analyses of wall assemblies using a sophisticated computer modeling program, Moisture-Expert 2.0. The research findings have been published in a paper, "Scientific Analysis of Vapor Retarder Recommendations for Wall Systems Constructed in North America," authored by Karagiozis, Lstiburek, and André Desjarlais; the paper was presented by Karagiozis at the Buildings 10 conference in Florida.

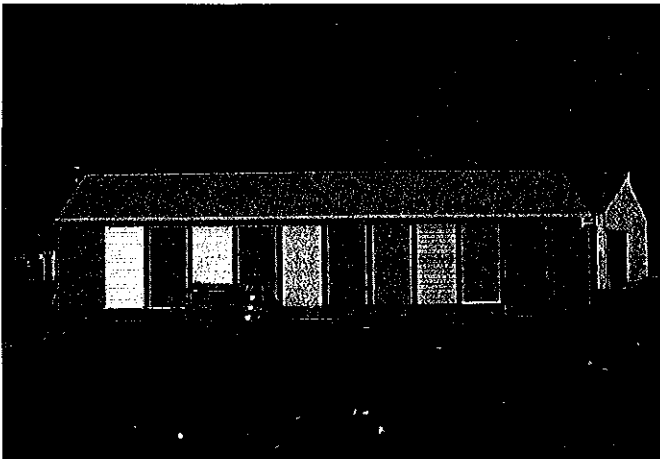


Figure 1. This test hut near Charleston, South Carolina is operated by the James Hardie Company, a siding manufacturer that participated in research conducted by Oak Ridge National Laboratory and the Building Science Corporation.

ORNL's computer modeling work was just one element of a larger project (see Figure 1). "This modeling study was not done in isolation," Lstiburek told *EDU*. "We spent five years doing field testing; we built seven test huts. We had a lot of field information, and the field results validated the model. The modeling allowed us to ask the questions in a more refined manner. But there was a lot of field work that set the stage for the modeling."

The modeling and field data formed the basis for a new code-change proposal, and this proposal, much simpler than the 2004 version, was submitted to the IECC.

After a rough-and-tumble bargaining process between stakeholders, the proposal was adopted as part of the 2007 Supplement to the IECC.

### Determining Moisture Loads

Karagiozis's computer modeling considered the effects of wind-driven rain as well as interior moisture. "Moisture loads are extremely important," Karagiozis noted. "Until we dissected his issue, the answer wasn't clear enough. Moisture loads on the inside were the greatest unknown." Karagiozis based his interior moisture assumptions on the work of Anton TenWolde, a supervisory research physicist at US Forest Products Laboratory in Madison, Wisconsin. For the past several years, TenWolde has developed design values for interior moisture as part of his work on proposed ASHRAE Standard 160P, "Design Criteria for Moisture Control in Buildings" (see *EDU*, December 2002, and "News Briefs," December 2006).

Karagiozis continued, "We used real climatic loads. We looked at what happens with systems that have water penetration, which is a big issue." For most of the simulation runs, the researchers used wind-driven rain data for nine cities: Boston, Massachusetts; Atlanta, Georgia; Chicago, Illinois; Kansas City, Missouri; New York, New York; St. Louis, Missouri; Omaha, Nebraska; Norfolk, Virginia; and Seattle, Washington. "Wind-driven

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rain is a critical hygrothermal load," the researchers reported. "Indeed, in most instances, this load is several times greater than all other loads combined." The researcher ran simulations for walls oriented toward the greatest exposure to wind-driven rain.

According to Karagiozis, simulations were run for more than just the nine cities included in the final research report; cold climates were not ignored. Lstiburek commented, "We had already done work prior to this in very cold climates. After the stuff I had done through Building America, it was clear that everyone agreed about vapor-retarder recommendations in the south and in the north. There was little disagreement about zone 7 in the north, or about zones 1, 2, and 3 in the south. The cities that were less clear were in zones 4, 5, and 6."

### **Wood-Framed Walls, Two Types of Siding**

Simulations were run for wood-framed walls (either 2x4 or 2x6 construction, depending on the climate zone). The simulations looked at wall assemblies with 5/8-inch interior gypsum wallboard, R-13 or R-19 batts (depending on the climate zone), 1/2-inch OSB sheathing, and one layer of 60-minute building paper.

The researchers chose to look at two types of siding: vinyl and brick veneer. (The brick veneer was assumed to be separated from the building paper by a 1-inch air space.) According to the researchers' paper, "These two wall systems ... were selected because they represented the extremes of wall cladding hygrothermal performance (brick system represents a sorptive 'reservoir' cladding that can absorb and store a copious amount of rainwater, whereas the vinyl siding system has no absorption and is very air permeable)."

In each climate zone, simulations were run for four different vapor control strategies:

- No vapor control except 8-perm interior latex primer and finish paint;
- Kraft paper facing on the interior side of fiberglass batts;
- 4-mil polyethylene under the drywall; and
- MemBrain smart vapor retarder under the drywall.

### **Walls Are Assumed To Be Airtight**

The researchers assumed:

- 1% of wind-driven rain penetrated the sheathing membrane; except for 1% water penetration at the interface between the building paper and the sheathing, no other system imperfections were assumed to exist.
- The walls were airtight.

Lstiburek was asked whether the airtight-wall assumption affected the validity of the simulation results. "The paper deals with diffusion; air leakage had nothing to do with the study," Lstiburek responded. "We wanted to do the calculations in a conservative manner, so we assumed the walls are airtight. In very cold climates, air leakage is a problem, but in a moderate climate air leakage actually aids drying. Air leakage hurts us in the extremes -- in the cold and in the hot humid climates. In mixed climates it is my view that it helps us on balance -- it helps us [from a moisture perspective] but makes the wall more energy inefficient. Remember, getting consensus from people in building science is impossible. Building science is dominated by cults -- there is the cult of the air barrier, and there was a cult of the vapor barrier, at least until we killed it. In this case my argument carried the day, although this issue was not without significant discussion among the study team."

Disagreeing with Lstiburek, Karagiozis argued that the computer simulations should have considered air leakage. "I was reluctantly convinced not to take into account air leakage," Karagiozis explained in an e-mail to EDU. "The main reason that I did not include air flow is that I did not have air leakage characteristics for the various wall systems (plus the effects of home geometries)." According to Karagiozis, the vapor-retarder recommendations resulting from the researchers' work may need to be adjusted in the future: "With the new air barrier project that we just started with the Air Barrier Association of America, I believe we will address this important issue [air leakage], and correct the vapor retarder guidelines where needed."

### **"Catastrophic Failure" In Seattle**

The researchers assumed that wall failure occurred if the moisture content of the interior face of the OSB rose to 16% or higher. "The modeling showed brick doesn't work in Seattle without a vapor retarder," said Karagiozis. "So we started arguing. But with 8-perm paint in Seattle you have catastrophic failure. There are four or five months during the year where the relative humidity of the OSB is at 100%, so you are in trouble. In this case you need poly for better performance."

In Zones 5 and 6, the simulations showed that omitting an interior vapor retarder caused problems in houses with brick veneer over an unvented air space. Conversely, including a poly vapor retarder caused problems in zones 3, 4, and 5. The new code addresses the first of these potential problems, but not the second, since the IECC allows the use of vapor retarders in warm climates.

Karagiozis said, "The bottom line is, we were able to come up with a simple recommendation to the IECC, and we were able to pass it in the 2007 Supplement to the IECC. We now have some comprehensive recommendations in our code that will allow us to do our job."

**Three Classes of Vapor Retarder**

For years, building codes have defined a vapor barrier (or retarder) as "a material having a permeance rating of 1.0 or less when tested in accordance with ASTM E 96." In contrast, the 2007 Supplement to the IECC and the 2007 Supplement to the International Residential Code (IRC) divide vapor retarders into three classes:

- Class I: Less than or equal to 0.1 perm [e.g., polyethylene].
- Class II: Greater than 0.1 perm but less than or equal to 1.0 perm [e.g., kraft facing].
- Class III: Greater than 1.0 perm but less than or equal to 10 perm [e.g., latex paint].

Like the 2006 IECC, the 2007 Supplement to the IECC specifies that the permeance of a vapor retarder should be determined by ASTM E96 Procedure A (known as the "dry cup" method) rather than by Procedure B, the "wet cup" method.

**Kraft or Poly In Zones 5 Through 8**

In section 402.5, the code now requires that walls in climate zones 5 (e.g., Nevada, Ohio, Massachusetts), 6 (e.g., Vermont, Montana), 7 (e.g., northern Minnesota), 8 (e.g., northern Alaska), and marine zone 4 (Western Washington and Oregon) have a Class I or Class II vapor retarder -- in other words, kraft facing or polyethylene.

There are exceptions to these vapor retarder requirements. Three of the exceptions are listed in section 402.5, which notes that vapor retarders are not required on a basement wall, on the below-grade portion of any wall, or on a wall constructed of materials that cannot be damaged by moisture or freezing.

Further exceptions are allowed in section 402.5.1. According to this section, in climate zones where a Class I or Class II vapor retarder would normally be required, a less stringent vapor retarder -- a Class III retarder, consisting of latex paint -- can be used under the conditions listed in Table 402.5.1. Only certain types of wall assemblies are worthy of this exception; they must have either an adequate layer of exterior foam sheathing or "vented cladding" (see Table 1).

**"Vented Cladding": Clear As Mud**

Unfortunately, the code shies away from the task of defining "vented cladding." Although section 402.5.3 takes a stab at the task, the result (clearly the product of political wrangling) falls well short of a clear definition. According to section 402.5.3, there are three types of vented cladding:

- "1. Vinyl lap or horizontal aluminum siding applied over a weather resistive barrier as specified in Table R703.4 of the International Residential Code."
- "2. Brick veneer with a clear airspace as specified in Section R703.7.4.2 of the International Residential Code."
- "3. Other approved vented claddings."

Item 3 is the semantic equivalent of throwing one's hands in the air; it leaves it up to the local building official to determine the minimum depth of an acceptable air space, and whether an air space needs to have an open air inlet at the bottom of the wall

**Table 1 -- Wall Vapor Retarder Exceptions in Climate Zones 4 Through 8**

Climate Zone	Class III vapor retarders permitted for:
Marine 4	Vented cladding over OSB Vented cladding over plywood Vented cladding over fiberboard Vented cladding over [exterior] gypsum [sheathing] Insulated [foam] sheathing with R-value ≥ R2.5 over 2x4 wall Insulated [foam] sheathing with R-value ≥ R3.75 over 2x6 wall
5	Vented cladding over OSB Vented cladding over plywood Vented cladding over fiberboard Vented cladding over [exterior] gypsum [sheathing] Insulated [foam] sheathing with R-value ≥ R5 over 2x4 wall Insulated [foam] sheathing with R-value ≥ R7.5 over 2x6 wall
6	Vented cladding over fiberboard Vented cladding over [exterior] gypsum [sheathing] Insulated [foam] sheathing with R-value ≥ R7.5 over 2x4 wall Insulated [foam] sheathing with R-value ≥ R11.25 over 2x6 wall
7 and 8	Insulated [foam] sheathing with R-value ≥ R10 over 2x4 wall Insulated [foam] sheathing with R-value ≥ R15 over 2x6 wall

Table 1. This table is based on Table 402.5.1 in the 2007 Supplement to the International Energy Conservation Code. "Vented cladding" is defined in Section 402.5.3 of the code.

or an open outlet at the top. Ironically, two of the cladding types that have experienced very high rates of wet-wall problems -- stucco and manufactured stone -- fall into category 3. As a result, local inspectors will be left to determine how much venting, if any, is required for a manufactured stone siding installation to be considered "vented."

Lstiburek explained, "We proposed a lengthy table that defined what ventilation meant for various claddings -- stucco, fiber cement, manufactured stone veneer. At that point NAHB's rep had a meltdown. They were concerned that once this definition of ventilated cladding was in the code, people would make it a requirement for using these products. Because of the politics, we said, 'Fine.' This was a giant act of compromise. This process required goodwill from everybody -- the building scientists, NAHB, the fiberglass manufacturers. Everybody had to give a little bit. So, the language on ventilated cladding was simplified and reduced."

### Walls, Not Ceilings

Before the most recent code change, IECC vapor-retarder requirements in section 402.5 referred to ceilings and floors as well as walls: "Above-grade frame walls, floors and ceilings not ventilated to allow moisture to escape shall be provided with an approved vapor retarder." (Similar language exists in section R318.1 of the 2006 IRC). In the recently adopted

version of the code, however, the references to floors and ceilings have been eliminated: "Class I or II vapor retarders are required on the interior side of frame walls in Zones 5, 6, 7, 8 and Marine 4."

Although ceilings aren't mentioned in 402.5, other code sections do mention ceiling vapor retarders. For example, section R806.2 of the 2006 IRC reduces the requirement for roof ventilation "when a vapor barrier having a transmission rate not exceeding 1 perm is installed on the warm side of the ceiling."

Lstiburek calls IRC section R806.2 "a glaring error." He explained, "According to the code, if you put a vapor barrier in your ceiling -- even in Florida -- you can reduce the roof ventilation rate by one half. That is pretty stupid. In zones 1, 2, 3, and 4, the roof ventilation rate should be independent of whether there is a vapor retarder." Alas, the code-improvement work of vapor-retarder crusaders will probably never cease.

### Weatherstrip Your Access Hatches

The 2007 Supplement to the IECC includes at least one other noteworthy change: One item -- "attic access openings" -- has been added to the list of mandatory air-sealing locations in section 402.4.1. Like the other items in the list, attic access openings "shall be caulked, gasketed, weatherstripped or otherwise sealed."

## Code Requirements For Cathedralized Attics

The 2007 Supplement to the International Residential Code (IRC) has clarified a confusing code section listing requirements for cathedralized attics. Also known as a conditioned unvented attic, a cathedralized attic brings attic ductwork inside a home's conditioned space. Such attics can perform very well, as long as the insulation is detailed to prevent moisture accumulation in the roof sheathing.

The 2006 IRC includes a section (R806.4) listing requirements for unvented conditioned attics. Among these requirements:

- No interior vapor retarders -- that is, materials with a permeance of 1 perm or less -- can be installed on the ceiling side (attic floor) of the unvented attic assembly.
- In all zones except 2B (southwest Texas and southwest Arizona) and 3B (West Texas, southern New Mexico, and southern California), the insulation installed in the rafter bays must be air-impermeable (a stipulation that excludes the use of fiberglass batts).

- The insulation must be applied in direct contact with the underside of the roof sheathing.
- In warm humid climates, the roof must have a vapor-retarder roof underlayment (1 perm or less) above the roof sheathing.

The most confusing part of section R806.4 of the 2006 IRC concerns climate zones 3 through 8. In these climate zones, the code requires that "sufficient insulation is installed to maintain the monthly average temperature of the condensing surface above 45°F (7°C). The condensing surface is defined as either the structural roof deck or the interior surface of an air-impermeable insulation applied in direct contact with the underside/interior of the structural roof deck. ... For calculation purposes, an interior temperature of 68°F is assumed. The exterior temperature is assumed to be the monthly average outside temperature." This paragraph is a code requirement that only a building scientist can love. For the average builder -- or, for that matter, the average code official -- the paragraph might as well be in Swahili.

## Untangling the Code

The spectacularly confusing paragraph in R806.4 has been rewritten in the 2007 Supplement to the IRC, and the new version is an improvement. Formerly, builders were left to scratch their heads, wondering how the code writers expected them to demonstrate that they were successfully maintaining the correct monthly average temperature in their roof sheathing; the latest version of the code actually tells builders how to accomplish that goal.

Section R806.4 now requires: "Either Items a, b or c shall be met, depending on the air permeability of the insulation directly under the structural roof sheathing:

- a. Air-impermeable insulation [e.g., spray foam] only. Insulation shall be applied in direct contact to the underside of the structural roof sheathing.
- b. Air-permeable insulation [e.g., fiberglass batts] only. In addition to the air-permeable installed directly below the structural sheathing, rigid board or sheet insulation shall be installed directly above the structural roof sheathing as specified in Table R806.4 for condensation control.
- c. Air-impermeable and air-permeable insulation [e.g., "flash and batt"]. The air-impermeable insulation shall be applied in direct contact to the underside of the structural roof sheathing as specified in Table R806.4 for condensation control. The air-permeable insulation shall be installed directly under the air-impermeable insulation."

The minimum R-values of the required insulation are listed in a table in the code (see Table 2).

Unfortunately, the 2007 Supplement to the IRC has introduced a new error. The latest version of the code still requires that "no interior vapor retarders" be installed on the ceiling side (attic floor) of the unvented attic

assembly. Confusingly, however, vapor retarders are defined in a different manner in the 2007 Supplement than they were in the 2006 IRC. Whereas vapor retarders were formerly defined as materials with a permeance of 1 perm or less, they are defined in the 2007 Supplement as materials with a permeance of 10 perms or less. (Vapor retarders are now subdivided into three classes with different permeance ranges.) As an unintended result of the redefinition of vapor retarders, the 2007 Supplement appears to forbid the installation of even latex paint under a cathedralized attic. Hopefully, a future code revision will correct this remaining error by changing "no interior vapor retarders" to "no interior Class I vapor retarders."

For more information, visit the following Web resources:

- <http://resourcecenter.pnl.gov/cocoon/morf/ResourceCenter/article/1520> ;
- [www.iccsafe.org/cs/codes/2007-08cycle/2007Supplement/IRC07S.pdf](http://www.iccsafe.org/cs/codes/2007-08cycle/2007Supplement/IRC07S.pdf) ;
- [www.energycodes.gov/news/sts/pdfs/standard\\_november07.pdf](http://www.energycodes.gov/news/sts/pdfs/standard_november07.pdf) .

**Table 2—Insulation For Condensation Control Above Cathedralized Attics**

Climate Zone	Minimum Rigid Board or Air-Impermeable Insulation R-Value
2B and 3B, tile roof only	0 (none required)
1, 2A, 2B, 3A, 3B, 3C	R-5
4C	R-10
4A, 4B	R-15
5	R-20
6	R-25
7	R-30
8	R-35

Table 2. The information in this table is derived from Table R806.4 in the 2007 Supplement to the International Residential Code. According to a note accompanying the table, the listed R-values "contribute to but do not supersede Chapter 11 energy requirements."

## NEWS BRIEFS

### Energy Bill Signed Into Law

WASHINGTON, DC -- On December 19, 2007, President Bush signed into law the latest energy bill, the Energy Independence and Security Act of 2007. Manufacturers of solar equipment were disappointed to learn that, as a result of last-minute negotiations, the act does not include an extension of federal tax credits for new PV and solar thermal equipment beyond the scheduled expiration of the tax credits at the end of 2008.

According to a Renewable Energy Access article by Scott Sklar, the most significant programs established by the Energy Independence and Security Act are the act's energy loan guarantees: "The bill provides \$25 billion for nuclear, \$10 billion for renewables, \$10 billion for coal to liquids, \$2 billion for uranium enrichment, and \$2 billion for coal to gas. That means \$39 billion for iterations of conventional energy and \$10 billion for renewables." Among the act's provisions:

- By amending the Energy Policy and Conservation Act, the act establishes new minimum efficiency standards for dishwashers, dehumidifiers, residential boilers, walk-in coolers, and external power supplies.
- The act directs the DOE to develop new efficiency standards for refrigerators and clothes washers.
- The act authorizes the DOE to abandon uniform nationwide efficiency standards for heating appliances and air conditioners, and to substitute new regional climate-specific standards.
- The act establishes new light-bulb efficiency standards which will lead to the phase-out of incandescent bulb sales by 2020. The new standards require that, compared to today's incandescent bulbs, future bulbs must improve lumen output per watt by 25% in 2013 and 35% in 2020.
- The act creates an Office of High-Performance Green Buildings to promote green construction practices in new federal buildings.

The act requires new federal buildings to be designed to use 55% less fossil-fuel energy by 2010 and 100% less fossil-fuel energy by 2030; in other words, the act requires federal buildings to meet the goals of Ed Mazria's 2030 Challenge. To read a summary of the act's provisions, visit [www.aceee.org/energy/national/07nrgleg.htm](http://www.aceee.org/energy/national/07nrgleg.htm).

### **NREL Gets A Cash Infusion**

GOLDEN, CO -- Thanks to a special Congressional appropriation, the National Renewable Energy Laboratory (NREL) received an unexpected \$100 million cash infusion in 2007, raising its budget from \$209.6 million in 2006 to \$309.7 million in 2007. The windfall allowed NREL to engage in a "hiring spree," according to the *Rocky Mountain News*; the lab is working to fill 100 new positions, including scientists and support staff. NREL's current prosperity stands in sharp contrast to the lean days of early 2006, when a budget shortfall led NREL to lay off 32 employees (see "News Briefs," *EDU*, April 2006). When news of the layoffs threatened to overshadow the hoopla surrounding President Bush's feel-good visit to NREL in February 2006, embarrassed DOE employees came up with a last-minute \$5 million appropriation in hopes that the lab could rehire some of the laid-off employees. Looking ahead to 2008, NREL expects to receive an additional \$55 million to build a new 130,000-square-foot facility to research the integration of distributed electrical generation facilities (photovoltaic and wind systems) with the electrical grid.

### **Rating States For Net Metering Regulations**

NEW YORK, NY -- The Network for New Energy Choices, a New York nonprofit organization, has

issued a report rating US states on the friendliness of their net-metering laws and interconnection standards for producers of renewable electricity. Regulations considered to be favorable to producers of renewable energy include regulations making it easy for utility customers to hook up a photovoltaic array or wind generator to the grid; regulations that reimburse utility customers for excess electricity at the full retail rate; and regulations that permit month-to-month carryovers of credit for excess electricity. Regulations considered unfavorable include high fees for connecting equipment to the grid, regulations that don't provide credit for excess electricity, and unnecessary red tape. According to the report, "Freeing the Grid," five states get an A: New Jersey, Colorado, Pennsylvania, Maryland, and California. Seven states get a B: Oregon, Delaware, Iowa, Nevada, Connecticut, Ohio, and New Mexico. Five states or districts get an F: Utah, the District of Columbia, Georgia, North Carolina, and Wisconsin. To read the full report, visit [www.newenergychoices.org/uploads/FreeingTheGrid2007\\_report.pdf](http://www.newenergychoices.org/uploads/FreeingTheGrid2007_report.pdf).

### **DOE Studies Homeowners' Tolerance Of Utility-Controlled Appliances**

RICHLAND, WA -- How willing are US homeowners to turn over control of their electric water heaters and clothes dryers to their local electric utility? If the results of a new study are to be believed, quite willing -- as long as you offer participants free appliances. In a study conducted by researchers from the Pacific Northwest National Laboratory, 50 homeowners in Washington and Oregon were offered a free electric dryer and a free electric water heater in exchange for participation in a study called the Grid Friendly Appliance Project. It was explained to the homeowners that the new appliances included devices allowing their heating elements to be remotely controlled. The control devices turned the heating elements off during certain peak load periods, "to help reduce pressure on the grid." Describing what might be termed "stealth load shedding," the researchers explained, "Anyone's willingness to supply demand-side responsiveness will be influenced by the inconvenience they must endure to supply the response. ... The 'grid-friendly' dryer used in this demonstration simply stopped powering the heating elements, leaving the dryer drum to tumble until the heating elements could come back online. Significant power was thereby shed without an observable inconvenience to the dryer owner." According to the researchers, "the vast majority of homeowners in the study stated they would be willing to purchase an appliance configured with such grid-responsive controls." For more information, visit [http://gridwise.pnl.gov/docs/gfa\\_project\\_final\\_report\\_pnnl17079.pdf](http://gridwise.pnl.gov/docs/gfa_project_final_report_pnnl17079.pdf).

### Major Homebuilder Will Spec Only Energy Star Appliances

LOS ANGELES, CA -- KB Home, one of the largest builders of new homes in the US, has announced that, as of 2008, only Energy Star appliances will be installed in all of its new homes. According to KB Home's president, Jeffrey Mezger, the upgraded appliances will "help our homeowners join in the global effort to reduce carbon emissions and conserve natural resources, while achieving substantial savings in utility costs over the long-term." Over the past few years, KB Home has built over 42,000 Energy Star homes.

### PV Cell Prices Still Rising

TAIPEI, TAIWAN -- Persistent silicon shortages will cause photovoltaic (PV) cell prices to rise during the first quarter of 2008, according to Digitimes, a Web-based news service. The article noted that representatives from four PV cell manufacturers -- Gintech Energy, E-Ton Solar Tech, Neo Solar Power, and Motech Industries -- admitted that PV cell prices are likely to rise, and that "high material costs from a shortage of polysilicon is the primary reason for the increase."

### Three States Sue DOE Over Furnace Efficiency Standards

NEW YORK, NY -- The attorneys general of New York, Connecticut, and Massachusetts have joined the Natural Resources Defense Council in suing the US Department of Energy (DOE) for its failure to establish appropriate furnace efficiency standards as required by the Energy Policy Act of 1992. According to an Associated Press article, the plaintiffs are frustrated by the DOE's latest furnace standards, which "will require all residential gas furnaces to be at least 80 percent efficient by 2015, compared to the current minimum of 78 percent. ... Environmental groups have laughed off those changes as nearly meaningless. Almost all gas furnaces now sold in the US already meet that standard, meaning the new rules are obsolete." The issue is before the 2nd US Circuit Court of Appeals, which could invalidate the DOE's new standards if they are determined to be arbitrary or capricious.

### Boulder Adopts Strict New Residential Energy Code

BOULDER, CO -- Boulder County commissioners have approved a plan to significantly increase the stringency of Boulder's energy code (see "News Briefs," *EDU*, January 2008). Called BuildSmart, the package of measures requires large homes to meet more stringent standards than smaller homes. New homes between 1,000 and 3,000 square feet will be required to have a maximum HERS score of 60; for homes larger than

5,000 square feet, the maximum allowable HERS score will drop to 10. Moreover, the new regulations will forbid the demolition of existing buildings without a plan for deconstruction and material salvage; at a minimum, all reusable cabinets, doors, windows, flooring, fixtures, lumber, and sheathing will be required to be salvaged. The Boulder County Land Use Department is now writing building code regulations to implement the BuildSmart principles; once finalized, the regulations will be brought back to the county commissioners in April for a final vote. For more information, visit [www.co.boulder.co.us/lu](http://www.co.boulder.co.us/lu).

### Vermont Study Group Proposes Doubling Weatherization Funding

MONTPELIER, VT -- To address the rising cost of heating fuels, the Vermont legislature should work to double the size of the state's low-income weatherization program. Moreover, total investments in weatherization programs should be significantly increased from the current level of \$1.7 million to as much as \$24 million by 2017, and the Vermont energy code should be made more stringent. These recommendations are contained in a new report by Rich Sedano, former head of the Vermont Department of Public Service, and Richard Cowart, former chairman of the Vermont Public Service Board. The two consultants were hired by the Vermont legislature to investigate ways to reduce the cost of heating Vermont buildings. The average Vermont household now spends about \$3,000 per year on heating fuel. While most of the money Vermonters spend on fuel oil and propane leaves the state, "Money spent on weatherization stays in Vermont and creates jobs," Cowart told Vermont Public Radio. Sedano and Cowart recommend increasing state taxes on heating oil and propane to pay for the recommended weatherization programs.

### Promoting Net-Zero-Energy Commercial Buildings

WASHINGTON, DC -- A group of building industry organizations has formed the Commercial Buildings Initiative (CBI) to promote the development of net-zero-energy commercial buildings. The CBI is a public/private partnership supported by the American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE), the American Institute of Architects, the United States Green Building Council, the World Business Council for Sustainable Development, the US Department of Energy, Lawrence Berkeley National Laboratory (LBNL), and the Alliance to Save Energy (ASE). For more information, contact Jeff Harris at the ASE ([jharris@ase.org](mailto:jharris@ase.org)), Stephen Selkowitz at LBNL ([SESelkowitz@lbl.gov](mailto:SESelkowitz@lbl.gov)), or Paul Ehrlich ([Paul@buildingintelligencegroup.com](mailto:Paul@buildingintelligencegroup.com)).

### **Massachusetts Bill Would Require Energy Audits Of Homes Offered For Sale**

BOSTON, MA -- A bill pending in the Massachusetts legislature would require homes to undergo an energy audit before they could be offered for sale. According to the *Boston Globe*, "The bill would require the board of registration for professional home inspectors to draw up regulations for the program after consulting with the state Board of Building Regulations and Standards, the Division of Energy Resources, and the Energy Efficiency Advisory Council. The bill gives inspectors the right to require utilities or heating oil distributors to hand over billing information if sellers cannot or refuse to provide it. It would apply to all single-family homes and multifamily residences of fewer than five units." The Massachusetts Association of Realtors opposes the bill.

### **Gore Completes Energy Retrofit Of His Mansion**

BELLE MEADE, TN -- At Al Gore's mansion in Belle Meade, a suburb of Nashville, contractors recently completed several energy-efficiency projects, including the installation of a photovoltaic array and a ground-source heat pump. Gore's reputation as a crusader against global climate change was bruised last year when it was revealed that he was using 16,000 kWh per month at his Belle Meade home (see "News Briefs," *EDU*, April 2007 and May 2007). Gore's 2007 electricity bills were 11% lower than those of 2006. According to the Associated Press, "Electricity usage at the home remains well above regional averages." Stephen Smith, executive director of the Southern Alliance for Clean Energy, pointed out that, in light of the home's size (10,000 square feet), opportunities to save energy are somewhat limited. "We all need to evaluate what we legitimately need in square footage," said Smith.

### **Leasing PV Arrays To Minnesota Homeowners**

MINNEAPOLIS, MN -- A Minneapolis entrepreneur, Gerardo Ruiz, has started a company called Freener-g that will lease photovoltaic (PV) arrays to Minnesota homeowners. Beginning next summer, Freener-g will install PV arrays on 50 homes as a pilot project. Homeowners will pay a deposit plus a monthly lease of about \$200; the PV equipment will be owned by Freener-g. For more information, visit [www.freener-g.com](http://www.freener-g.com).

### **Hybrid Solar Panels Produce Electricity and Hot Water**

HOUSTON, TX -- A company called Global Warming Solutions is promoting a hybrid solar panel that produces both electricity and hot water. Equipped with reflectors and two-sided silicon PV cells, the so-called Light Electric Thermal Generator (LETG) modules are

said to have a peak output of 300 watts of electricity and 1,000 watts of heat per square meter. For more information, visit [www.globalwarmingsolutions.com](http://www.globalwarmingsolutions.com).

### **Hybrid Solar Hot Air and PV Systems Get Canadian Research Funding**

OTTAWA, ONTARIO -- Gary Lunn, Minister of Natural Resources, has announced a grant of \$1.1 million for four demonstration projects employing hybrid systems combining photovoltaic (PV) arrays with solar hot air collectors. "These hybrid demonstration projects will turn the exteriors and roofs of homes and businesses into clean-energy systems," said Minister Lunn. Developed by Conserval Engineering of Toronto, the hybrid systems combine PV modules with Solar Wall hot air collectors. The demonstration projects are located in Ontario and Quebec.

### **Scientist Calls US Biofuels Policy "Disastrous"**

OXFORD, UNITED KINGDOM -- Crispin Tickell, the director of the Policy Foresight Programme at Oxford University's James Martin Institute of Science and Civilization, recently told a Reuters News reporter that US ethanol policy has been "disastrous." Tickell joins a growing list of scientists decrying the effects of biodiesel and ethanol incentive programs on food supplies for the world's poor. The Reuters News article quoted Robert Watson, the chief scientist of Britain's farm ministry, who said, "Rising production of biofuels has distorted government budgets, helped to drive up food prices and led to deforestation in south-east Asia." In a similar vein, the *New York Times* recently reported, "A startling change is unfolding in the world's food markets. Soaring fuel prices have altered the equation for growing food and transporting it across the globe. Huge demand for biofuels has created tension between using land to produce fuel and using it for food. ... No category of food prices has risen as quickly this winter as so-called edible oils."

### **Oregon Provides Tax Credits For HVAC Equipment**

SALEM, OR -- Oregon's residential energy tax credit program now offers incentives on some models of ductless mini-split heat pumps and some clean-burning wood stoves. To qualify for a tax credit of up to \$400, a mini-split heat pump must have an inverter-based variable-speed compressor, and must provide at least 50% of rated capacity when the outside air temperature is 17°F. Five manufacturers (Daikin, Fujitsu, Friederich, Mitsubishi, and Sanyo) produce mini-split heat pumps that meet the program's specifications. To qualify for a tax credit of up to \$300, a wood stove must meet specific criteria for low smoke production, and must be installed with a dedicated outside combustion air

intake. For more information on Oregon's heat-pump tax credit, visit <http://oregon.gov/ENERGY/CONS/RES/tax/HVAC-DuctlessHP.shtml>. For more information on Oregon's wood stove tax credit, visit <http://oregon.gov/ENERGY/CONS/RES/tax/HVAC-Biomass.shtml>.

### **Government Goal: 30% of Japanese Homes Will Be PV-Equipped by 2030**

TOKYO, JAPAN -- The Japanese government has announced the goal of equipping 30% of Japanese homes with photovoltaic (PV) systems by 2030. To reach the goal, the number of Japanese homes with PV arrays would need to rise from the current level of 400,000 homes to 14 million.

### **Utah City Establishes PV Rebate Program**

LOGAN, UT -- The Logan Municipal Council has voted to establish a local photovoltaic (PV) rebate program. The city will provide homeowners who install PV systems with rebates of \$2 per watt of installed capacity, up to a maximum of \$6,000. According to an Associated Press article, one of the council members who voted in favor of the program, Steve Thompson, was lukewarm in his support. "At this point, the cost exceeds the value," said Thompson. "But there will be very few folks who put their money where their mouths are."

### **Kansas Town Commits To Green Future**

GREENSBURG, KS -- The City Council of Greensburg, Kansas, which was heavily damaged by a massive tornado on May 4, 2007, has passed a resolution declaring that all new city-owned buildings over 4,000 square feet will aim for LEED Platinum certification. Mayor John Janssen said, "This is just another important step in our recovery and our intentions to come back as one of the greenest towns in America."

### **Massachusetts Home Is LEED Platinum**

TRURO, MA -- Jeff Rogers has received word that his North Truro home is the first LEED Platinum home in Massachusetts. According to the *Cape Cod Times*, Rogers' Icynene-insulated home includes a 3.5-kW photovoltaic system; most of the system's \$27,000 cost was covered by incentive programs. The home's HVAC system, which includes a ground-source heat pump, cost \$32,000. The Rogers home is also equipped with evacuated-tube solar collectors and a heat-recovery ventilator.

### **Developer Touts Green Features of 4,300-SF North Carolina Home**

RALEIGH, NC -- A North Carolina developer, Cherokee Investment Partners, has built a 4,300-square-foot photovoltaic-equipped home in the Meredith Woods subdivision in Raleigh. The house

is owned by Jonathan Philips, a senior director for Cherokee. The Philips home includes a \$90,000 photovoltaic system with a peak output of 10 kilowatts, a ground-source heat pump, and a solar thermal system. Philips said, "We're not feeling ashamed of the size of the house. If we're going to ask Americans to give up a lot of luxuries, builders will not embrace green building because they believe the public doesn't really want to buy the houses." One of the builders, Fred Thornhill of Corban Homes, called the project "difficult and time-consuming."

### **Energy-Efficient Homes In Mississippi**

HATTIESBURG, MS -- Architect James Polk is planning to build an eco-community in Hattiesburg called Lily Valley. Each house will be equipped with a photovoltaic array and a solar hot water system. According to the *Jackson [Mississippi] Free Press*, "The development will be pedestrian-friendly, with shuttle buses running within the shopping district and out to local hospitals, colleges and universities. Energy usage in the buildings will be 30 to 50 percent better than code; builders plan to use the latest green technologies such as low-flow showerheads, LED traffic signals and parking decks with green roofs for Leadership in Energy and Environmental Design (LEED) certification."

### **Scientific American Publishes "Solar Grand Plan" Proposal**

NEW YORK, NY -- The US could derive 69% of its electricity from photovoltaic (PV) arrays and solar thermal generating plants by 2050, according to an article in the January 2008 issue of *Scientific American*. Three solar experts -- Ken Zweibel, James Mason, and Vasilis Pthenakis -- describe a "Solar Grand Plan" costing \$420 billion in government subsidies between 2011 and 2050, with the funds raised by a new carbon tax on fossil fuels. The plan calls for the installation of PV arrays and solar thermal collectors on thousands of square miles of land in the southwestern US. Excess electricity would power large compressors; compressed air would be stored in underground caverns. The compressed air could be used to power generators at night. The authors calculate that implementation of the plan would lower the US trade deficit by \$300 billion per year. "Americans know our country has energy problems," Zweibel said. "We have a lot of coal, some natural gas and dwindling domestic oil. The number of energy choices is getting smaller. What we're saying is that solar is a major choice and it's now ready. It's a big deal that should seriously be considered." The article is posted online at [www.sciam.com/article.cfm?id=a-solar-grand-plan](http://www.sciam.com/article.cfm?id=a-solar-grand-plan).

### British Report Questions Cost-Effectiveness Of Urban Wind Turbines

LONDON, UNITED KINGDOM -- A recent report published by the Britain's Building Research Establishment Trust questions the cost-effectiveness of small wind turbines installed in urban areas. After investigating wind turbines installed in Manchester, Wick, and Portsmouth, the researchers concluded, "In windy locations, micro-wind turbines can generate enough energy to pay back their carbon emissions within a few months or years but in large urban areas, micro-wind turbines may never pay back their carbon emissions. Life cycle costing suggests that, even in favorable urban locations, financial payback is unlikely for all but the most durable, efficient and low maintenance turbines." The report, "Micro-Wind Turbines in Urban Environments: An Assessment," can be purchased at [www.brebookshop.com/details.jsp?id=287572](http://www.brebookshop.com/details.jsp?id=287572).

### German Feed-In Tariffs Fuel PV Boom

BERLIN, GERMANY -- A recent Reuters News Service article explains how Germany's generous feed-in tariffs have led to a boom in residential photovoltaic (PV) installations. Over 300,000 PV systems have been installed in Germany; that number is expected to triple by 2013. The article notes, "In Germany and a growing

number of countries, solar power can give you more than just a feeling of 'doing something' for the environment. It can also give you a steady stream of income." According to Erik Kirschbaum, who installed a 7-kW PV array on his roof, "My roof has been turned into a cash machine. ... The 34 sleek black panels ... generate annual revenues of some 3,600 euros (\$5,300). ... The local utility is required, by law, to buy it off me at a fixed rate of 49 cents per kilowatt -- guaranteed for 20 years."

### Quote Without Comment

"Skepticism aside, the real reason that green building will become a critical element of residential construction -- green's dirty little secret -- is that the movement toward green construction will be driven more by financial interests than the broader interest of helping the environment. That's right; the green that everyone is talking about in the residential construction industry is the color of the money they'll be making by taking advantage of this critical business trend. ... As it did in the commercial construction marketplace, the green building movement is generating cash for companies and creating new winners and losers in the marketplace." ["What Does It Mean to be 'Green' in Residential Construction?" by Carl Cullotta, on HGTVPro (The Site For Homebuilding Professionals)]

## RESEARCH AND IDEAS

### Low-E Storm Windows

Energy experts routinely lament that many cost-effective energy measures are rarely performed. The storm window industry presents a particularly glaring example of such lost opportunities. For all intents and purposes, the storm window industry hasn't changed much in 50 years. Although storm windows are installed in over 800,000 US homes each year, only a tiny percentage of these storm windows have low-e glass.

There are two basic types of low-e coating: sputtered (also called soft-coat) and pyrolytic (also called hard-coat). While either type of low-e coating is suitable for use in a sealed insulated glazing unit, only pyrolytic coatings are hard and durable enough for storm windows. When used on a storm window, the low-e coating faces the interior. Since most pyrolytic coatings have a higher solar heat gain coefficient than most sputtered coatings, pyrolytic coatings are particularly appropriate for cold climates.

Research has shown that an old single-glazed window fitted with a low-e storm window performs

as well as a new double-glazed low-e window. In a 2002 paper, "Measured Winter Performance of Storm Windows," Joseph Klems, a researcher at Lawrence Berkeley National Laboratory (LBNL), concluded, "The addition of low-e storm windows to the prime [single-glazed] window provided performance very similar to that of the replacement window [with low-e argon-filled sealed double glazing]." Klems' paper is posted on the Web at <http://repositories.cdlib.org/cgi/viewcontent.cgi?article=2373&context=lbnl>.

### Low-E Storm Windows In Chicago

A more recent study measured energy savings in Chicago houses fitted with low-e storm windows. The research was supported by the US Department of Energy and the US Department of Housing and Urban Development, and was conducted by Craig Drumheller, a senior energy engineer with the NAHB Research Center; Christian Köhler, an LBNL software developer; and Stefanie Minen, a consultant with Utilivate Technologies of Chicago. The researchers' report, "Field Evaluation of Low-E



Figure 2. The photo shows one of the homes (House #4) enrolled in the Chicago-area study of storm window performance. The house is typical of Chicago bungalows built in the 1920s and 1930s.

Storm Windows,” was presented by Drumheller at the Buildings 10 conference in Clearwater Beach, Florida, in December 2007.

During his presentation, Drumheller pointed out that many low-income weatherization programs exclude storm window installation because the work has such a long payback period. The researchers set out to explore whether a simple change in specifications -- from clear-glass storm windows (U-1.04) to low-e storm windows (U-0.65) -- would appreciably change the cost-effectiveness of the measure. Since an estimated 43% of US homes have single-pane windows, a potentially huge market exists for cost-effective measures to improve the performance of residential windows.

The researchers selected six occupied homes in the Chicago area; all of the homeowners met the income qualifications for the low-income weatherization program. The houses ranged in size from 1,125 to 2,500 square feet, and were between 37 and 87 years old (see Figure 2). Drumheller described the houses as “very energy inefficient” homes.

Some of the homes had existing storms installed on at least some of the windows. To obtain baseline energy measurements, all existing storm windows were removed, and blower-door tests were performed at all of the houses.

After monitoring the performance of the homes for

several weeks, four of the homes were equipped with low-e storm windows (Pilkington Energy Advantage low-e glass), and the two remaining homes were equipped with clear-glass storm windows. Two of the houses that received low-e storms were later eliminated from the study because of problems with monitoring equipment and “data correlation problems.”

The cost of installing clear-glass storms was about \$122 per window (\$1,344 at a house with 11 windows, and \$2,661 at a house with 22 windows), while the cost of installing low-e storm windows was about \$158 per window (\$1,738 at each of two houses with 11 windows). The upcharge for low-e glazing was about \$37 per window.

After the storms were installed, blower-door tests were again performed. For several more weeks, the researchers monitored the performance of the houses. A variety of data-logging equipment was installed at the houses, including sensors to measure indoor temperature and humidity and equipment to measure furnace run-time.

**Low-E Storms Provide Quicker Payback**

Installing storm windows improved the homes’ airtightness between 5.7% and 8.6%. At 50 pascals, air leakage was reduced between 231 and 335 cfm.

Energy used for heating was reduced by 8% to 18% in the homes that received clear-glass storm windows, and by 19% to 23% in the homes that received low-e storm windows (see Table 3).

Although low-e storms cost more than clear-glass storms, they were shown to be far more cost-effective. The simple payback period for the two houses with clear-glass storms was 8.4 and 12.1 years (average, 10.3 years); at the two houses with low-e storms, the payback periods were 3.5 and 5.1 years (average, 4.3 years).

**Table 3—Chicago Low-E Storm Window Study**

	House #2	House #3	House #4	House #5
Type of storm window installed	Low-e	Clear glass	Clear glass	Low-e
Number of windows per house	11	11	22	11
Cost to install storm windows	\$1,738	\$1,344	\$2,661	\$1,738
Heating energy savings	19%	8%	18%	23%
Annual savings at \$1.39/therm	\$490	\$111	\$317	\$341
Simple payback period	3.5 years	12.1 years	8.4 years	5.1 years

Table 3. The researchers started out with six houses, but House #1 and House #6 were dropped from the study due to problems with monitoring equipment. The simple payback period for clear glass storm windows was an average of 10.3 years; for low-e storm windows, only 4.3 years.

Because of the significant difference in payback periods, some low-income weatherization programs may conclude that low-e storm windows are a cost-effective measure, even when clear-glass storms don't clear the cost-effectiveness hurdle. "Considering the magnitude of the savings and relatively quick payback, low-e coated storm windows show potential as a weatherization option," the researchers wrote.

During his presentation, Drumheller concluded that, in cold climates, "If you are going to put storm windows on, it's a no-brainer to put in low-e storms." In a later interview with *EDU*, Drumheller noted, "The storm

window industry doesn't usually get a lot of attention. The word needs to get out about low-e storms, and I think the weatherization programs are important. According to most weatherization programs, clear storm windows have been deemed not cost-effective, and replacement windows have been deemed not cost-effective. But this solution fills that gap."

For more information, contact S. Craig Drumheller, National Association of Home Builders Research Center, 400 Prince George's Boulevard, Upper Marlboro, MD 20774-8781. Tel: (301) 430-6307; E-mail: [cdrumheller@nahbr.org](mailto:cdrumheller@nahbr.org).

## NEW PRODUCTS

### Termite-Resistant Styrofoam

Dow Building Materials has developed a termite-resistant version of Styrofoam called Blueguard. Like regular Styrofoam, Blueguard is an extruded polystyrene (XPS) foam panel rated at R-5 per inch (see Figure 3).

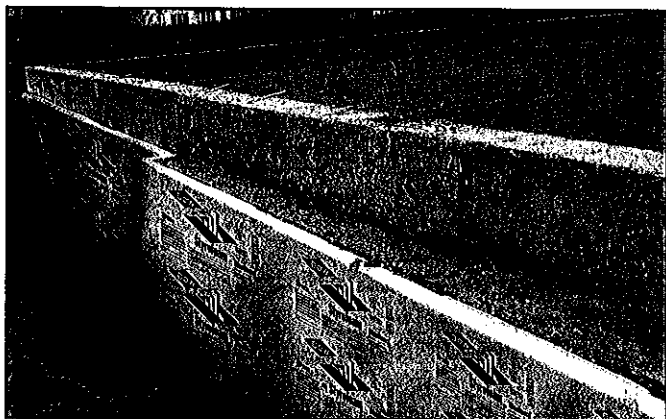


Figure 3. Termites are less likely to tunnel through Blueguard, which is impregnated with an insecticide, than through conventional Styrofoam.

When given the opportunity, termites often tunnel through foam insulation; if foam is installed on the exterior of a foundation, it can provide an easy access route between the soil and a home's wood framing. That's why building codes generally restrict the use of rigid foam insulation as exterior foundation insulation in such termite-infested regions of the US as South Carolina, Georgia, Florida, Mississippi, Alabama, Louisiana, and in some areas of Texas and California.

For example, section R320.5 of the International Residential Code states, "In areas where the probability of termite infestation is 'very heavy' as indicated in

Figure R301.2(6), extruded and expanded polystyrene, polyisocyanurate and other foam plastics shall not be installed on the exterior face or under interior or exterior foundation walls or slab foundations located below grade. ... Exceptions: When in addition to the requirements of Section R320.1, an approved method of protecting the foam plastic and structure from subterranean termite damage is used."

#### Waiting For Code Approval

The International Code Council Evaluation Service (ICC-ES) has not yet ruled on Dow's request for an evaluation report on Blueguard. Although Dow is confident that local code officials are likely to rule that Blueguard is "an approved method of protecting the foam plastic" for the purposes of section R320.5, an evaluation report to facilitate such approval does not yet exist. Dow representative John Hammer told *EDU*, "The ICC-ES ESR confirming IRC and IBC compliance of Styrofoam Blueguard for use in very heavy termite infestation areas is currently being processed."

Blueguard includes a termite-repellent additive called deltamethrin. Deltamethrin is a synthetic pyrethroid insecticide; when incorporated into Styrofoam in a ratio of 1,000 parts per million, the chemical provides the foam with "termite contact repellency."

Dow has conducted a five-year field performance study of Blueguard demonstrating that deltamethrin does not leach out of the foam. Pieces of Blueguard buried near wood bait showed little termite damage, while adjacent untreated XPS foam showed extensive damage.

### Not a Termite Barrier

Deltamethrin protects the foam, not the house. Jeffrey Alcott, a senior development specialist at Dow, points out that Blueguard is "not intended to be a termite barrier." Since termites can still access a house by traveling behind the Blueguard, an inspection strip and termite flashing are still required. Dow recommends that builders using Blueguard include "a 2-inch to 6-inch termite inspection strip consistent with local code requirements ... showing the foundation wall between the wall finish and the top of the foundation."

Because it is impregnated with insecticide, Blueguard should not be handled without gloves. Installers are also advised to wear a long-sleeved shirt and long pants when working with Blueguard.

Blueguard has a minimum compressive strength of 25 p.s.i., and is available in three thicknesses -- 1 inch, 1 ½ inch, and 2 inches. The foam panels can be ordered with square edges on all four sides or with shiplap edges on the long side and square edges on the short sides. For the time being, Dow is distributing Blueguard only in areas subject to heavy termite infestation. According to Dow, Blueguard will be sold at a "price premium" compared to conventional Styrofoam.

For more information on Blueguard, call Dow Building Materials, 200 Larkin Center, Midland, MI 48674. Tel: (989) 636-1000 or (866) 583-2583; Fax: 989-832-1465; Web site: [www.dowbuildingmaterials.com](http://www.dowbuildingmaterials.com).

## INFORMATION RESOURCES

### A Guide To Diagnosing Moisture Problems

Gary Proskiw of Winnipeg, Manitoba, is a mechanical engineer specializing in residential energy issues. Proskiw is a veteran moisture sleuth. "We were doing airtightness tests back in 1979, when we didn't really know what we were doing, using homemade equipment," Proskiw recalled recently.

In a recent paper, "Case Studies of Moisture Problems in Buildings," Proskiw recounts the circumstances surrounding seven examples of building failure. "I prepared a list of the problems caused by moisture in buildings: wood rot, freeze/thaw damage, mold, and so on," Proskiw explained at the Buildings 10 conference in Clearwater Beach, Florida, where he presented his paper in December 2007. "I was going to add 'litigation' in there, but then I decided -- you already know that."

#### Keep An Open Mind

Proskiw begins any moisture investigation by asking, "Where is the water and where did it come from?" Proskiw advises beginners to avoid the temptation of jumping to a quick conclusion. He wrote, "Understanding and diagnosing building moisture problems requires sound observational skills and a working knowledge of building science and local construction practices, coupled with a little intuition (luck also helps). Faced with a new problem in an affected building, it is tempting to leap to possible solutions, especially solutions which are within the investigator's experience. However, this should be

avoided. It is important to keep an open mind and identify all relevant information, including that which does not fit the initial paradigm."

After identifying "some key characteristics of the six moisture transport/deposition mechanisms," Proskiw prepared a diagnostic guide for cold-climate moisture problems in the form of a useful table (see Table 4, page 15).

Proskiw's diagnostic tools include airtightness tests, pressure diagnostics, infrared thermography, and dew-point calculations. His table also mentions three other tests that may require explanation: the polyethylene test, the standing water test, and the spray test.

#### Standing Water Isn't Caused By Capillary Action

The polyethylene test requires an investigator to tape a 2 ft. by 2 ft. piece of clear polyethylene to a suspect surface (usually concrete) with duct tape. After two or three days, the poly is examined. Water drops under the poly indicates capillary action; if there is no visible moisture under the poly, moisture is not moving across the surface by capillary action. If condensation forms on *top* of the poly, the source of the moisture is the interior of the building.

Proskiw's "standing water test" is not really a test; it is an observation. The investigator simply observes any horizontal surface to see whether or not there is standing water. Proskiw points out that, since "capillary action

**Table 4—Diagnostic Guide For Cold-Climature Moisture Problems**

Transport/Deposition Mechanism	Location of Symptoms	Are Symptoms Widespread or Discrete?	When Are Symptoms Most Evident?	Material Characteristics	Time Period Over Which the Event Typically Occurs	Prevalence	Diagnostic Tools
Air leakage	Usually at, or near, top of building	Generally discrete	Mid-winter and spring thaw	Requires air leakage pathways in envelope	Months	Very common	Airtightness tests, pressure diagnostics, infrared thermography
Vapor diffusion	Anywhere in building envelope	Widespread	Spring thaw	No obvious fault may be visible	Months	Very rare	
Capillarity	Concentrated at or near bottom of building	Widespread	Whenever water temperature is above freezing	Occurs through porous materials	Months	Common	Polyethylene test
Gravity	Water source is required above affected area	Discrete	Whenever water temperature is above freezing	Requires leakage paths below water source	Hours to months	Common	Standing water test
Wind-driven rain	Prevailing wind direction	Generally widespread	After heavy, driving rains	Requires water leakage pathways in envelope	Hours	Common	Spray test, standing water test
Surface condensation	On any cold surface	Generally discrete	During coldest part of the year	Condensate may be absorbed into porous surfaces	Hours to days	Occasional	Infrared thermography, dew-point calculations

Table 4. Gary Proskiw (Proskiw Engineering, Winnipeg, Manitoba) created this table as a guide for diagnosing moisture problems in cold climates.

is not capable of transporting water to a surface in sufficient quantities for standing water to develop," the existence of standing water points to the likelihood that the water entered the building by gravity flow.

Proskiw's "spray test" requires the use of "a specially constructed spray rack (which contains a number of regularly spaced nozzles) or a hose" to spray water over the suspect area for five to fifteen minutes. He writes, "The building interior (and exterior, if necessary) are then examined for evidence of water penetration."

One of Proskiw's most important observations is that different categories of moisture problems show up at different times of the year. "I've gone through several iterations of the table, and I'm always open to suggestions on how it could be improved," Proskiw told *EDU*.

For more information, contact Gary Proskiw, Proskiw Engineering, 101-1555 St. James Street, Winnipeg, MB R3H 1B5, Canada. Tel: (204) 633-1107; E-mail: pel@mts.net.

## READERS' FORUM

### Short and Memorable Tenets

Dear Martin,

Thanks for registering a public complaint about the green-washing of the building performance industry (Back Page, January 2008).

Many folks, homeowners and professionals alike, believe that they can buy their way into sustainability. And the marketers of building products are more than willing to provide the stuff to create a "green" lifestyle. Yet simple physics will dictate that the most sustainable housing is old, small, and shared with other people.

Your four tenets are short and memorable. I've transcribed them to my white board, and will attempt to integrate their messages into my work. I expect that many readers of *EDU* will take notice and do the same.

Thanks for using your respected pulpit to such good advantage.

Chris Dorsi  
Saturn Resource Management  
Helena, Montana

## BACK PAGE

### Goosing Cellulose R-Value

A company called Working Chemical Solutions ([www.workingchemicalsolutions.com](http://www.workingchemicalsolutions.com)) claims to have invented a chemical additive that raises the R-value of cellulose insulation from R-3.5 per inch to as much as R-7.5 per inch. Technical experts have reacted to the claim with skepticism.

The company's Web site describes Working Chemical Solutions as "a Christian-based company located in El Dorado, Arkansas." The "miracle" product is PolyCell Composite 7, an additive that is "designed to be applied at the manufacturing level." According to Working Chemical solutions, adding PolyCell Composite 7 to cellulose results in a "decrease of thermal transfer."

Working Chemical Solutions claims to have contracted with a testing lab, National Calibration & Validation Laboratories (NCVL), to perform ASTM C518 tests on cellulose insulation treated with PolyCell Composite 7. According to a document posted on the Working Chemical Solutions Web site, the test showed "Thermal Resistance Range R-5.9 to 7.5 per inch (ASTM C-518)."

*EDU* obtained a photograph of a bag of PolyCell-treated cellulose manufactured by EnviroMate Insulation (also known as FLG) of Moulton, Alabama (see Figure 4). The label displays the logo of the NCVL testing lab, along with these words: "Mean R-value 7.1 per inch of applied material."

Among the insulation contractors offering to install PolyCell-treated cellulose is a Freeport, Florida, company called Insul8. The Insul8 Web site notes, "PolyCell is a an insulation additive for cellulose ... [that] decreases the thermal transfer in cellulose fiber insulation." When contacted by phone, an Insul8 representative explained that the best source for technical information on PolyCell Composite is EnviroMate Insulation, Insul8's cellulose supplier.

*EDU*'s call to EnviroMate (Moulton, Alabama) was answered by a person identifying himself as Stuart (or Stewart). Expressing an attitude that is rare in US business, he told *EDU*, "I don't think it's a good business practice to provide information over the phone. If you want information, you would have to come in face to face."

*EDU* then sought out NCVL, the laboratory that performed the ASTM C-518 test yielding the unlikely

numbers. As it turns out, NCVL has the same address (1015 North West Avenue, El Dorado, Arkansas) as Working Chemical Solutions, the manufacturer of the miracle additive. The NCVL telephone number (870-863-4013) is answered by the same woman as the Working Chemical Solutions telephone number (870-863-9398).

*EDU*'s phone calls to Working Chemical Solutions were eventually answered by Robert Smith, the company's president. "We are being slow and methodical on how we perform the testing and the launch of the product," Smith told *EDU*. "Some independent labs have been doing testing on R-values, and we are getting ready to announce the next round of test results. We know they are in the R-7 per inch range -- they match what we have been expecting."

*EDU* asked Smith for a copy of any laboratory reports that might back up the company's R-value claims. He promised to e-mail *EDU* a report within two days; the report did not arrive.

*EDU* asked David Yarbrough, a research engineer at R & D Services in Cookeville, Tennessee, and a well-known insulation expert, to comment on the claims made by Working Chemical Solutions. "There aren't any cellulose products that achieve R-7 per inch," said Yarbrough. "Some types of cellulose have achieved maybe R-3.8. I've gone on record that on R-4 per inch is the most we're ever going to see for a cellulose product."

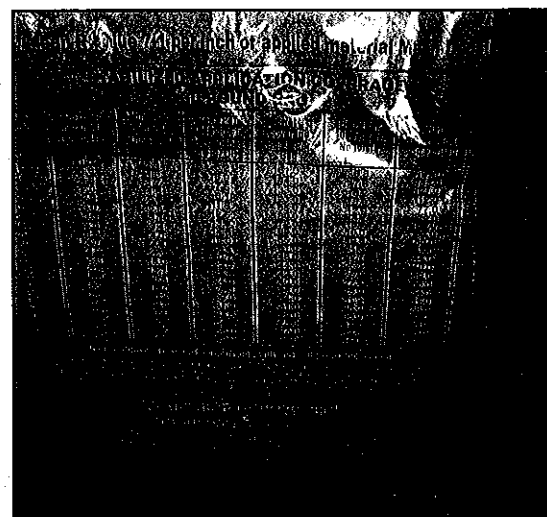


Figure 4. This bag of EnviroMate cellulose insulation is labeled "PolyCell Composite 7-E." At the top of this photo are the words, "Mean R-value 7.1 per inch of applied material." The NCVL logo is in the lower left corner of the photo.