

Plastics Thriving in Building & Construction

From Luxury Vinyl Flooring to Solar Roofing — and Most Everything in Between — Material Advances are Enhancing Today's Homes

By Robert Grace



Showcasing The New American Home

This 8,245-square-foot, single-story show home in Orlando, Fla. — dubbed The New American Home — showcases new building products. This 2017 version, the 34th such home in the series, features contemporary, energy-efficiency design that enables it to claim “net zero” energy status — meaning it generates as much energy as it consumes. It also features numerous other novel innovations. Among them is a tough new insect barrier wrap by Ennis, Texas-based Polyguard Products Inc. called Term. Polyguard CEO John Muncaster said his firm worked with entomologists at Texas A&M University to develop the wrap. It has a thick polyethylene backing to keep bugs, particularly termites, at bay. The top layer is made of a polypropylene fabric so that concrete can bond with the fibers if it’s used as a barrier for the underslab, which is a common entry point for subterranean termites. A proprietary sealant is used to hold the plastic fiber and film together. For more details, go to www.tnah.com.

Photo by Jeff Davis, courtesy of NAHB

Plastics continue to penetrate, insulate, decorate, and generally enhance American homes and buildings.

Advances in materials technology are helping architects and builders to create greener, more sustainable buildings, while also providing design flexibility and lower-maintenance options, all at competitive costs.

Plastics, in one form or another, find their way into piping, plumbing fixtures, windows, doors, trim, flooring, roofs, wire and cable, wall coverings, decking, fencing, handrails, insulation and more. Building and construction is a massive market, consuming some 9% of all U.S. plastics production, according to the American Chemistry Council. In 2014, ACC reported, that amounted to more than 12.6 million pounds of plastics on a dry weight basis. Only the packaging sector — at 26 million pounds — consumes more resin annually.

Globally, building and construction plastics was valued at \$35.9 billion in 2012 and is expected to reach \$57.5 billion

in 2019, posting a compound annual growth rate of 7.1% between 2013 and 2019, according to New York-based Transparency Market Research.

U.S. home builders, of course, took a pounding in the 2008-09 economic recession and, while the market is on the upswing now, it is still far from pre-recession levels. At the International Builders' Show in Orlando in January, the National Association of Home Builders projected new, single-family housing starts in 2017 would rise 10%, to 855,000 units, followed by a further 12% increase next year, to about 961,000 starts.

SHIPMENTS OF PRIME WINDOWS, 2009–2018F (Millions of Units)

New Construction	2009	2010	2011	2012	2013	2014	2015	2016F	2017F	2018F
Wood	2.5	2.8	2.6	2.7	3.0	3.1	2.9	3.3	3.6	3.6
Aluminum	1.9	1.7	1.8	2.5	3.1	3.5	3.5	3.9	4.3	4.3
Vinyl	6.3	6.7	6.6	8.6	10.6	11.7	12.9	14.8	16.4	16.8
Fiberglass*	0.5	0.5	0.5	0.6	0.7	0.7	0.8	0.9	1.1	1.1
Other	0.1	0.2	0.2	0.2	0.3	0.3	0.4	0.4	0.5	0.6
Sub Total	11.4	11.9	11.7	14.7	17.6	19.2	20.4	23.3	25.8	26.4
Remodeling & Replacement	2009	2010	2011	2012	2013	2014	2015	2016F	2017F	2018F
Wood	6.1	6.1	5.1	4.6	4.7	4.7	4.3	4.4	4.5	4.5
Aluminum	1.0	1.0	0.7	0.7	0.7	0.7	0.6	0.6	0.5	0.5
Vinyl	19.1	21.1	19.1	18.9	19.6	20.0	20.7	21.4	22.1	22.8
Fiberglass*	0.7	0.8	0.7	0.7	0.7	0.7	0.8	0.8	0.9	0.9
Other	0.5	0.6	0.5	0.6	0.7	0.7	0.7	0.8	0.8	0.9
Sub Total	27.5	29.6	26.1	25.4	26.3	26.8	27.1	27.9	28.8	29.7
Total Construction	2009	2010	2011	2012	2013	2014	2015	2016F	2017F	2018F
Wood	8.6	8.9	7.7	7.3	7.7	7.8	7.2	7.7	8.0	8.1
Aluminum	2.9	2.8	2.5	3.2	3.7	4.2	4.0	4.5	4.8	4.9
Vinyl	25.5	27.8	25.7	27.5	30.2	31.6	33.7	36.2	38.4	39.6
Fiberglass*	1.2	1.4	1.2	1.2	1.4	1.4	1.6	1.7	1.9	2.0
Other	0.7	0.7	0.7	0.8	0.9	1.0	1.1	1.2	1.4	1.5
Total	38.9	41.6	37.9	40.1	43.9	46.0	47.6	51.3	54.6	56.0

Wood segment includes vinyl clad wood and metal clad wood units. Due to rounding, totals may not equal the sums of individual values. Source: Ducker Worldwide

Table 1: These shipment numbers clearly demonstrate vinyl's dominance in the overall U.S. window sector.

Courtesy of AAMA's 2015-16 U.S. National Statistical Review & Forecast (April 2016)

Even so, by the end of 2018, home building will have reached only about three-quarters of the level of the 1.3 million starts seen in 2002-03, NAHB said. But the group does at least see the home-building recovery continuing for the foreseeable future.

That said, multi-family starts are expected to remain flat, at about 384,000 in 2017. And the NAHB forecasts the remodeling sector to grow only slightly — by about 1% in this year, and 2% in 2018.

Undeterred, plastics companies continue to develop a variety of product and process innovations for the building sector. A strong focus on conserving energy and lowering carbon footprints is driving much of those efforts.

The International Code Council (www.iccsafe.org) develops model codes and standards used in the design, build and compliance process to construct safe, sustainable, affordable and resilient structures. It updates its International Building Code every three years, most recently in 2015. The biggest leap in code changes designed to promote energy conservation took place between 2006 and 2012, experts say, but regular, incremental changes continue to be enacted. And states — often led by California — also move to enact their own, more demanding standards.

In mid-2015, for example, the California Public Utilities Commission and the California Energy Commission launched a residential Zero Net Energy Action Plan (www.californiazinehomes.com) to build a self-sustaining market for all

new homes to be net-zero energy by 2020. Zero-net-energy (ZNE) buildings produce as much energy as they consume, usually through a mix of high efficiency and clean, on-site generation. The definition requires that a home create as much energy as it uses over the course of an entire year, rather than on a real-time basis.

Another factor of increasing importance, says Jack Armstrong, is the lifecycle analysis (LCA) of structures that considers the ongoing maintenance and durability of various construction products. Plastics frequently play an important role in reaching such goals.

Sealing the envelope

Armstrong, a former BASF official, is now president at Acumen Consulting LLC in Fort Lauderdale, Fla., as well as executive director of the Structural Insulated Panel Association. He noted how current building codes pay much closer attention to the airtightness of buildings (e.g., how “leaky” they are). Using what is called the “blower door test,” builders or energy auditors seal a house and, using a calibrated, variable-speed fan, raise and lower air pressure within the house, and measure its degree of air leakage.

Measured in “air changes per hour,” or ACH, a typical house often leaks its entire volume of air 15-20 times per hour, Armstrong said. But, he noted, the 2012 building codes stipulated that new construction should have no more than five ACH in warmer climates (climate zones 1 and 2), and just

Resin Sales into the U.S. Building & Construction Market (2011-2015)

	2011	2012	2013	2014	2015	Total
In millions of pounds						
LDPE	418.9	412.2	468.1	460.1	416.7	2,176.0
LLDPE	436.9	476.7	510.9	518.6	535.7	2,478.8
HDPE	2,862.0	2,960.5	3,107.4	3,214.5	2,887.8	15,032.2
PP	570.0	617.3	657.1	645.1	659.6	3,149
PS+EPS	549.9	538.3	556.2	533.7	550.7	2,728.8
PVC	6,197.9	6,699.3	6,987.6	7,180.2	7,031.7	34,096.7
Epoxy	65.4	63.0	59.0	65.3	57.4	310.1
Total	11,101.0	11,767.3	12,346.3	12,617	12,139.6	59,971.7

PE, PVC and EPS data includes Canada; PP and PS data includes NAFTA; Epoxy data includes U.S.
Source: ACC Plastics Industry Producers Statistics Group, as compiled by Vault Consulting Inc.

Table 2: More than 12 billion pounds of resin are sold into the U.S. building and construction every year.

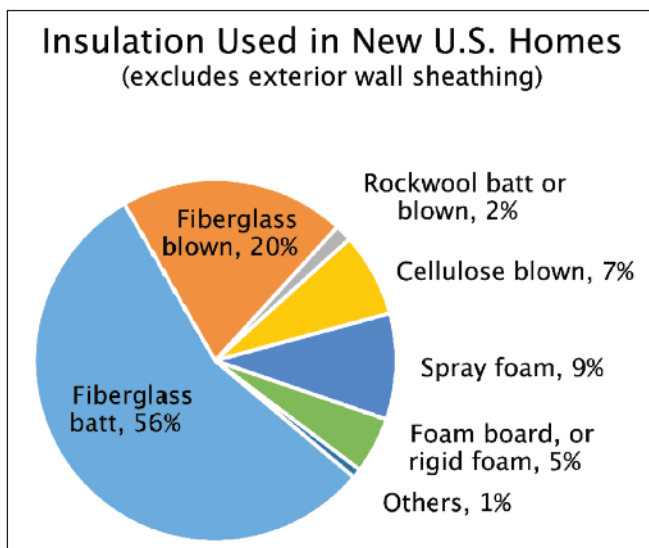


Figure 1: While fiberglass still dominates new U.S. home insulation, companies are developing many innovative new panelized and “continuous insulation” systems.

Source: Annual Builder Practices Reports, Home Innovation Research Labs

three ACH in colder regions (climate zones 3 and above), at 50 pascals of pressure. These demands have driven development efforts to improve the building “envelope” and its level of airtightness and thermal performance.

This, in turn, has prompted greater use of “continuous insulation,” which also was introduced to the building codes in 2012, Armstrong noted. Previously the common approach was to fill the gaps between a building’s structural wooden studs with insulating material such as fiberglass batting, and nail up insulating panels that required extensive taping and caulking. In addition to be labor-intensive, this process tends to result in numerous air gaps.

Exterior rigid insulation, or continuous insulation, on the other hand, runs *over* the wood structural sheathing struc-

tural — frequently plywood or oriented strand board (OSB) — and helps to greatly minimize so-called thermal bridging.

Builders used to have to take two full trips around the house they were building — first to construct the frame and then to apply the insulation. Now, with the advances made in structural sheathing, products that combine the insulation material and structural sheathing into a single product can build walls in a single trip, saving both time and money. (One such product is called a structural insulated panel, or SIP).

Various insulation options

There are numerous ways to apply insulation — fiberglass batt, blown fiberglass, blown cellulose, spray foam, foam board or rigid foam, etc. — but new methods are constantly being developed. One of the newer forms is structural

insulated sheathing (or SIS) that primarily uses either polyisocyanurate (or polyiso) foam or Dow Chemical Co.’s Styrofoam-brand of closed-cell extruded polystyrene foam adhered to a thick craft board or to OSB or plywood.

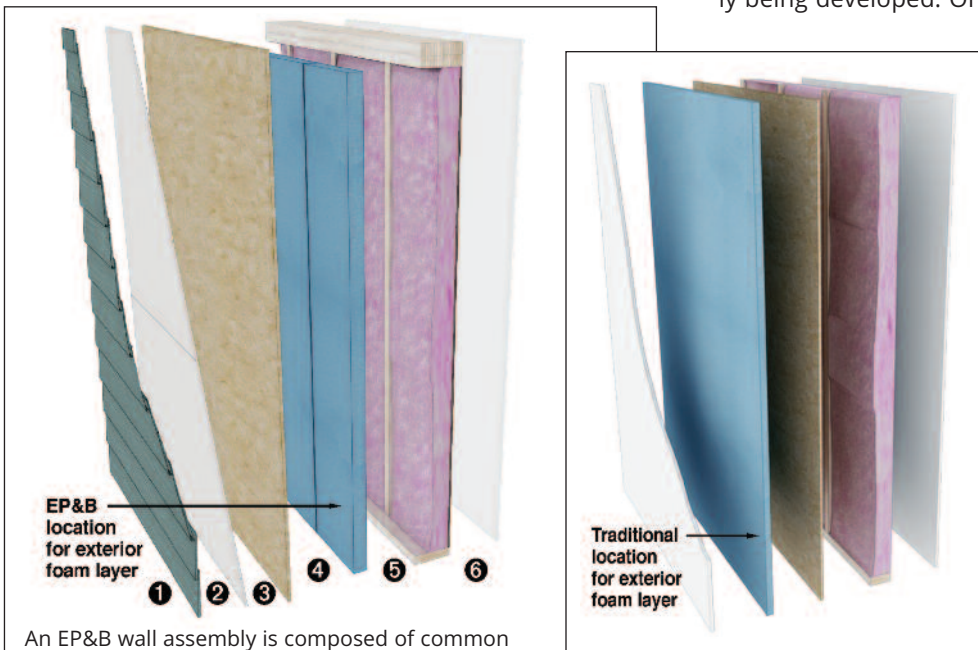
These SIS boards can be used as braced wall panels attached next to other rigid insulated sheathing or as continuous structural insulated sheathing over the entire wall line. It has the dimensional stability and racking strength to meet or exceed tough building codes.

These SIS products still command only about 2% share of the U.S. residential market, noted Ed Hudson, director of market

research for the Upper Marlboro, Md.-based Home Innovation Research Labs, “but it’s growing fairly quickly and we’re seeing a lot of new players” join the fray. Home Innovation — formerly the NAHB Research Labs — is a unit of the National Association of Home Builders.

Hudson estimates that 17-18% of all exterior wall sheathing sold today in the U.S. includes some type of foam product — including either these newer SIS products, or those where foam acts as either a primary or secondary layer.

Extruded polystyrene foam (XPS) has been the dominant exterior sheathing material for some time, due to its relatively higher “R-value” for thermal resistance, but Hudson says expanded PS foam (EPS) is growing now, due to advances that



An EP&B wall assembly is composed of common wall framing materials:

1. Exterior siding (or other cladding)
2. Water Resistant Barrier
3. Wood structural sheathing
4. Rigid foam insulation
5. Framing and cavity insulation (with interior vapor retarder, if required)
6. Interior gypsum drywall

The rigid foam insulation is laid to fit between the extended 2x6 bottom and top plates. The remainder of the wall framing is standard 2x4 construction.

Figure 2: The new Extended Plate & Beam Wall System being introduced by Home Innovation Research Labs uses familiar materials, including rigid foam sheathing, but configures the layers differently.

Courtesy Home Innovation Research Labs

allow it to offer improved fire resistance while also matching the R-value of XPS, but at a lower cost. Polyiso also continues to perform fairly well, he said.

Home Innovation Research Labs (www.homeinnovation.com) itself, meanwhile, is developing its own continuous insulation system, called the Extended Plate & Beam Wall System, according to Vladimir Kochkin, one of the group's division directors. Already in a handful of custom-built demonstration homes, the EP&B system "is based on tried-and-true lumber construction methodologies, integrating rigid foam sheathing with standard framing practices into a system that preserves many conventional construction features and minimizes builder risk." Home Innovation notes that the system consists of familiar wall materials, but in a different configuration.

Typically, foam sheathing is located to the exterior of the structural sheathing and requires special attachment of windows, doors and siding. The EP&B system, however, locates the structural sheathing *exterior* to the rigid foam sheathing (either XPS, EPS or polyiso), thereby simplifying installation. Windows, doors, the drainage plane, and the water-resistant barrier are located as in standard frame wall systems with well-known installation methods.

Advancing PU spray foam

In yet another example of innovation, Houston-based Lapolla Industries Inc. said at the builders' show that it has developed the fourth generation of its Foam-Lok closed-cell, spray polyurethane foam insulation product that has a slightly lower density, and is said to deliver a 20% increase in yield while lowering material and labor costs.

Lapolla uses Honeywell International Inc.'s non-flammable, liquid blowing agent called Solstice to make Foam-Lok.

The resulting end product is low in hydrofluorocarbons, which are greenhouse gases that negatively impact the environment. Lapolla officials say applicators can spray the product at 5½ inches in one pass, which was not previously possible. This means the latest version of Foam-Lok yields about 6,500 board feet — a huge leap from the previous 4,000 board feet of foam.

Looking beyond insulation, there are widely varying perceptions of plastics in different building applications, Home Innovation's Hudson noted.

"Plastic in some applications tends to be seen as the cheap product; in other applications, it's the expensive product. If you look at plastic decking materials, plastic trim, handrails, fences — that tends to be the more expensive, compared to the primary product, which is wood lumber. But if you look at siding or flooring, that tends to be less expensive" — although he acknowledged that is changing a bit, as relatively new products such as luxury vinyl tile gain favor and are closing the price gap with more traditional, higher-end flooring products such as hardwood and stone.

Let's start underfoot

The category known as "resilient flooring" has grown in popularity to where it now is second only to carpet in floor covering sales in North America.

A relatively new segment is luxury vinyl tile, or LVT, whose double-digit growth is expected to continue through 2017. Advanced manufacturing techniques allow vinyl planks and tiles to closely mimic the look of high-end hardwood and stone. To make LVT, manufacturers use four distinct layers fused together to yield the final product — a resilient vinyl backing, a vinyl color layer, a photographic film layer, and a polyurethane or aluminum oxide top layer.



Luxury Vinyl Tile is a fast-growing flooring category, due in part to its increasingly realistic ability to mimic the look of hardwood and natural stone. Left & Center: "Aspecta Ten" is part of Metroflor Corp.'s new Isocore collection, which touts waterproof, sound-mitigating benefits and underfoot comfort, plus an UltraFresh treatment that helps to inhibit bacterial growth. Right: Mannington's "Infused" LVT line dispenses with the natural look in favor of five bold, graphic patterns, inspired by five cities, that are connected through line quality and a palette of bright and neutral colors. The tiles feature a subtle pearlescent sheen. Images by Metroflor and Mannington, courtesy of the Resilient Floor Covering Institute



The naturally water-resistant flooring uses a photogravure process to produce incredibly realistic photo replications of natural materials. This involves a print cylinder that spins around while the vinyl's core layer (called the gel coat) passes underneath. The cylinder systematically prints various colored ink dyes to create the desired pattern.

The protective top layer, meanwhile, is key to the product's durability. The highest-quality LVTs have so-called "wear layers" that are as much as 40 mil thick. Light-traffic areas should use LVTs with at least a 20-mil top layer.

One of the big players in this sector has just taken durability to the next level. Armstrong Flooring Inc. says it uses its patent-pending "Diamond 10 technology" to literally add diamond particles to the firm's newest LVT product. These Vivero-brand planks mimic the look of wood or stone.

Armstrong touted the new product at the International Builders' Show, where company officials explained that cultured diamond particles are infused directly into the vinyl. "It's not a coating; it penetrates the surface," they noted. Armstrong, which makes the product just down the road from its Lancaster, Pa., headquarters, has big plans for this



Armstrong Flooring's new Vivero-brand luxury vinyl tile literally infuses diamond particles into the base material, which the firm claims makes it the most scratch-resistant LTV on the market today. Image by Armstrong Flooring Inc., courtesy of the Resilient Floor Covering Institute

technology, calling this first Vivero product "just the beginning for us."

The diamond particles — nature's hardest substance — help to make the end product more scratch resistant than competitive LVTs, Armstrong said, while also touting Vivero for being stain resistant, waterproof and easy to clean.

Floor Covering Weekly recently offered its take on five trends to watch this year in the LTV segment:

- Lighter colored wood looks (especially taupes and whitewashed looks)
- Mix-and-match planks (in sizes, shapes and colors)
- More realistic visuals
- Long and wide rectangular planks
- Continued rise of rigid core products (commonly known as WPC, or wood plastic composites), which hit the market in 2012.

Climbing the walls

As with most other parts of buildings, sustainability has come to the wallcovering industry. Manufacturers and distributors of wallcoverings worked with the global public health organization NSF International and with the Wallcovering Association to develop a new standard — NSF/ANSI 342, the American National Standard for Sustainable Wallcoverings. Its goal is to help architects, designers, retailers and consumers identify sustainable and environmentally preferable wallcoverings.

NSF Sustainability, a division of NSF International, has certified 897 wallcovering styles to the new standard. Meanwhile, seven companies have qualified to distribute NSF/ANSI 342-certified wallcoverings.

Similar to LEED (Leadership in Energy and Environmental Design) certification for buildings, NSF's Sustainable Wallcovering Standard assigns point values in a number of categories. Unique to this standard is the requirement to combine points from both the manufacturer and distributor to determine the product certification level as Conformant, Silver, Gold or Platinum. Each organization is responsible for its own rating and applies for certification individually.

This sustainability push is leading some companies to develop more environmentally friendly products that are finding use primarily in commercial buildings.

Louisville, Ky.-based LSI Wallcovering, a leading commercial maker of vinyl wallcoverings and the exclusive producer of Versa Wallcovering, not only was one of the first firms in its industry to eliminate solvent inks, it also has developed what it calls its Second-Look® recycling technology.

Available through Versa, Second-Look wallcoverings have

a minimum of 20% pre-consumer recycled content. Versa offers vinyl wallcoverings for corporate, healthcare, hospitality, education and retail applications.

Versa Wallcovering® also has developed VersaGuard™, a flexible wall protection that is more durable than Type II wallcovering and more affordable than rigid panels. Made with Second-Look recycled technology, VersaGuard contains 20% recycled content by weight, including 10% post-consumer. The heavy-duty, 33-oz. vinyl construction and durable protective top film provides an attractive wall surface that is four times more impact resistant than Type II wallcovering, according to independent testing.

“Options were previously limited to Type II wallcovering that did not always perform against heavy use, or rigid panels that are costly, less attractive and only available in 4’x8’ sheet,” said Versa Marketing Director Beth Rich. The product’s enhanced durability and cleanability makes it ideal for heavy-use areas in hospitals, schools, hospitality, corporate and public spaces.

Turning bottles into wallcoverings

Meantime, decorative textile supplier Hytex Industries Inc. of Randolph, Mass., has further advanced the concept of recycled wallcoverings. Its Eco-A.R.T. line is the only non-woven wallcovering product made in the United States from



Hytex Industries Inc. uses 15 post-consumer PET bottles to produce each yard of its Eco-A.R.T. acoustical wallcovering. Doing so already has diverted an estimated 25 million bottles from the landfill. The end product also incorporates Fosshield, a patented antimicrobial technology from Foss Manufacturing Co. LLC. Courtesy Hytex Industries Inc.

U.S. Vinyl Markets – 2015
Domestic Resin Consumption: 10.0 Billion Pounds

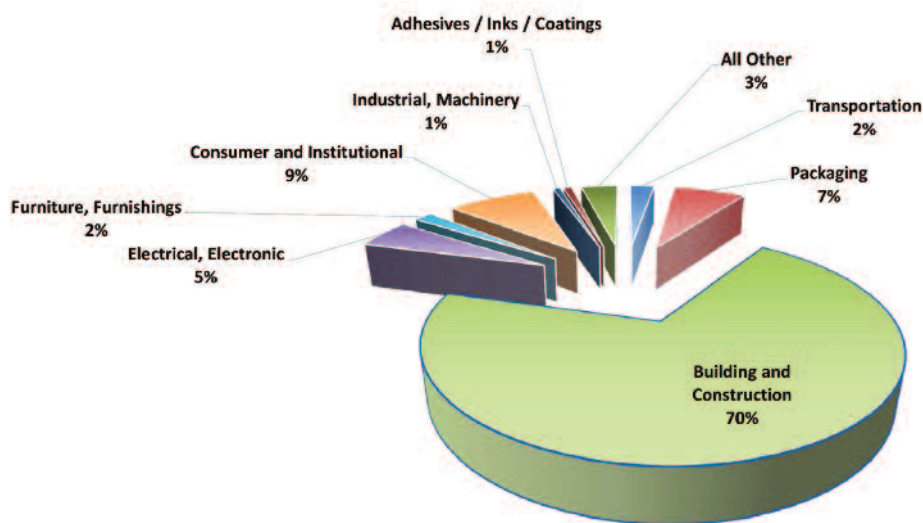


Figure 3: This clearly shows how important the building and construction sector is to vinyl producers.

Source: ACC Plastics Industry Producers’ Statistics Group

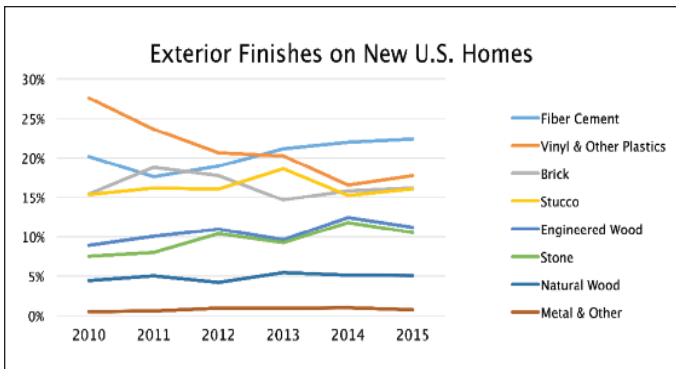


Figure 4: Vinyl, long the dominant exterior siding material on U.S. homes, is trending downward the past few years, while fiber cement is on the rise.

Source: Annual Builder Practices Reports, Home Innovation Research Labs

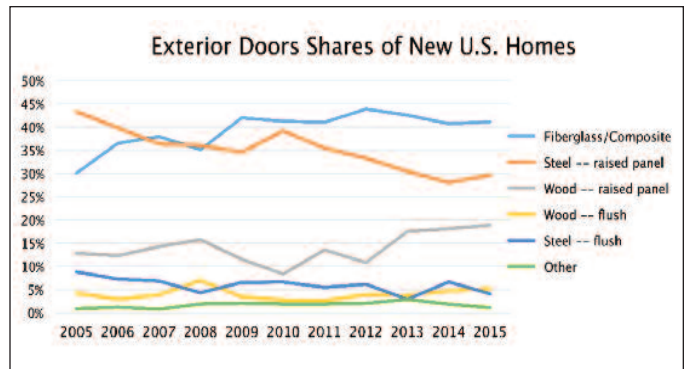


Figure 5: Fiberglass and composites remain strong as the material of choice for exterior residential doors in homes, overtaking steel a few years ago.

100% post-consumer recycled bottles. The technology uses 15 PET water or soda bottles to create each yard of acoustical wallcovering that can be recycled back into fiber at the end of its useful life. (The “A.R.T” in the name stands for Acoustic Recycled Tiles.)

So far, the firm estimates it has used more than 33 million recycled bottles for its wallcoverings. Using a ratio of 3:1 (non-recycled vs recycled disposable), this translates into approximately 25 million bottles being diverted from landfill so far, according to Hytex Chief Operating Officer Dick Blosz.

Eco-A.R.T. uses Fosshield®, a patented material science and fiber technology that incorporates silver and copper ions into the root fiber. Developed by Hampton, N.H.-based Foss Manufacturing Co. LLC using antimicrobial technology it calls Naturion, this acts to naturally attack microbes, delivering antimicrobial surface protection, in addition to odor, mold and bacteria resistance. The technology has been cleared by the U.S. Food & Drug Administration.

“The fiber technology featured in Fosshield works against the types of airborne bacteria we are most concerned about,” said Dr. Charles Gerba, a professor of microbiology and environmental sciences at the University of Arizona. “This type of ‘capture and kill’ technology is ideal. It’s the silver bullet against bacteria.”

Eco-A.R.T., meanwhile, also helps to mitigate sounds. It combines superior acoustical dampening performance with a dimensional fabric that is made of 100% recycled, solution-dyed polyester fiber. It offers Noise Reduction Coefficient (NRC) sound-absorption rating options up to 0.25, depending the pattern used.

Hytex explains that the plastic bottles it uses come from

recycling centers. They work primarily with Albany, N.Y.-based recycler UltrPET LLC, which sorts by type and color, removes the labels and caps, washes the bottles, and then crushes and chops them into small flakes. They then melt down the flakes, and mix in the color and Fosshield additive. Hytex stresses that Eco-A.R.T. is the only acoustical wallcovering using this technology.

Exterior cladding

Much is happening, as well, on building exteriors. Vinyl siding remains tremendously popular — with the biggest market share of all exterior cladding materials in the U.S. every year since 1995, though that share has been slipping in recent years. Fiber cement is growing fast as a cladding material, and there are many other polymeric choices (such as polypropylene siding, polymer shakes and shingle siding, pultruded-fiberglass siding, etc.), along with all the other obvious options such as brick, stucco, cedar, aluminum and much more. PVC makers, meantime, also are pushing the concept of insulated vinyl siding, whereby form-fitted expanded polystyrene insulation is permanently built into the back side of the double-four courses of vinyl siding.

CertainTeed Corp., a unit of France’s Compagnie de Saint-Gobain SA, currently is the largest North American maker of polypropylene shake, under its Cedar Impressions® Polymer Siding and Northwoods® product lines. For its Cedar Impressions range, the firm employs a process called TrueTexture™, in which real cedar shake boards are used to transfer their exact textures to the cedar shake siding product.

But changes also continue among the players in the sector. At the January builders’ show, for instance, Quebec-based

Novik Inc. rolled out a new, dual-brand strategy for its premium synthetic shake and stone following Novik's acquisition last June of Exteria Building Products. Novik's former president, Ralph Bruno, is now president of the newly launched Tando Building Products brand aimed at professional builders. The Exteria brand is going away, and the Novik brand will serve the do-it-yourself market.

The firm says it will market its new polypropylene-based Tando shake and stone products as TandoShake and TandoStone. Novik added that it uses a proprietary Novik process in which a polymer shake is infused with real wood stain and a proprietary Exteria UV coating.

Many new applications also are emerging for various types of composite building materials — with some moving from their more traditional uses as decking and onto the sides of homes as cladding, or even into applications such as cabinetry, and as roofing. Hudson at Home Innovation says he understands that composite roofing is now about a \$65 million market in U.S. — mostly in the remodeling sector, since asphalt shingles continue to dominate in new construction.

Up on the roof

But while asphalt shingles are still the usual new-construction roofing material in North America, the quest for energy-efficient buildings is keeping alive the goal of durable, cost-effective and aesthetically pleasing solar roofs. A solar roofing tile is made of a glass layer, some films and then solar cells. Sun shines on the tiles, through the glass and the films, and through to the underlying solar cell, which converts the light into electricity.



Elon Musk, the audacious billionaire entrepreneur, just placed a \$2 billion bet that his Tesla SolarCity solar roofing system can succeed where Dow Chemical Co. and its now-defunct PowerHouse Solar Shingles failed.

Dow Chemical Co. in 2009 launched its PowerHouse Solar Shingles to much fanfare, but then announced last June that it planned to cease making the product, and auctioned off all related manufacturing assets at the end of last year. Dow's product was designed to integrate directly into the roof, rather than attaching (often ugly) solar panels to an existing roof.

The failure of a multinational like Dow to succeed in this market might deter many others from trying the same approach. But not Elon Musk.

The 45-year-old, South African-born billionaire businessman and entrepreneur who founded SpaceX and co-founded electric automaker Tesla Motors Inc., doubled down on the concept last October by paying \$2 billion to acquire SolarCity Corp. Time will tell if Musk can succeed where others have failed. But he's already placed a very large bet that he can — and, once again, plastic is playing a key role in an innovative, new technology (see sidebar).

The polymer applications in building and construction are numerous and growing almost daily. They play a central role in uses that range from the crosslinked polyethylene (PEX) tubing that delivers radiant, underfloor heating to warm your toes; to increasingly high-end resilient flooring; to cellular PVC that's finding use in trim and shutters; to recycled, acoustic vinyl wallcoverings, to natural-looking polymeric exterior cladding, to wood plastic composites that occupy the high end of decking and fencing materials, and now to specialized films that may adorn the roofs of tomorrow's Zero Net Energy buildings.

That seems to be something that America clearly can build upon.

SPF Speed Interviews @ ANTEC® 2017
Wednesday, May 10

4spe.org/antecspeedinterview

Tesla SolarCity Ramping Up for Commercial Launch by Mid-Year

Tesla SolarCity, leveraging film technology from 3M Co. and battery expertise from Japan's Panasonic Corp., continues to develop solar roofing systems based on building-integrated photovoltaic (BIPV) technology, as opposed to the currently more common building-applied photovoltaics, or BAPV, which refers to solar that is retroactively integrated into a building.

CEO and co-founder Elon Musk told Tesla shareholders last fall that the firm's product will be equivalent in cost, or slightly cheaper, than a normal roof and that installations will begin in volume in mid-2017. At a media event last October, Tesla introduced four roof styles — a clay-colored Tuscan glass tile, plus slate glass tile, textured glass tile, and smooth glass tile. Tesla has said it plans to manufacture the roofs at a new SolarCity factory in Buffalo, N.Y.

While sharing few technical details, Musk said SolarCity's durable glass shingles are "made of quartz" and are nearly unbreakable. Tesla declined an interview for this story, suggesting more information would be forthcoming later this year. But in an interview with *Fortune* magazine last November, the firm pulled back the curtain a bit on the technology involved. This is an excerpt from that story:

3M corporate scientist Andrew Ouderkirk told *Fortune* that 3M developed a new solar film specifically for Tesla to enable Tesla's solar roofing tile to both efficiently convert sunlight into electricity and also to appear to be a different color when viewed from the street.

When the solar roof tile is viewed from the ground, tiny louvers in the film can make the tile appear to be the color of slate or an earth tone. "It's like a micro venetian blind," said Ouderkirk, explaining that it works in a similar manner to a privacy film that goes on a computer screen that blocks anyone from the side from trying to look at the screen.

Ouderkirk said that Tesla came to 3M with the concept and that 3M was able to collaborate with the company and turn around the film "fairly quickly."

3M makes a variety of solar films that do things like boost efficiency, protect solar cells, or enable panels to be flexible. 3M wouldn't comment on the business relationship with Tesla or how long the companies worked on the solar film.

On Tesla and SolarCity's call [on Nov. 1], Musk briefly discussed some of these materials and processes in more depth. He said that the tiles would use "hydrographic coloring," (basically using a water-based printing process) and that the micro-louvers on the films would make the various roof tile colors possible.

He described the micro-louvers as basically "very durable plastic." He also explained how the tiles would snap into a basic structure to integrate into a roof.

Musk went on to say, "We'll have the best [solar] cell at the lowest price." Hydrographic coloring is an inexpensive process, the micro-louver film made in volume is very low cost, and large volumes of glass are cheap, he explained. "I don't know why nobody's done this before. It blows my mind," Musk said.

— By Robert Grace



Tesla is offering its solar roof in four styles to complement a variety of architectural styles. Each is engineered so that the photovoltaic cells are invisible. Customers can choose which sections of their roof will contain the hidden solar technology while still having the entire roof look the same. Tesla has said it expects to launch commercial production in mid-2017.

Courtesy of Tesla SolarCity