Today's Vinyl Siding: Verifiably Green

Sustainable Solutions CORPORATION

VINYL SIDING INSTITUTE VSI

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Introduction

By definition, the U.S. Environmental Protection Agency (EPA) says green building – also known as sustainable or high performance building – is the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life cycle from siting to design, construction, operation, maintenance, renovation and deconstruction. This practice expands and complements the typical building design concerns of economy, utility, durability and comfort.

The green building movement has gained momentum in recent years and many builders, remodelers, developers and homeowners are evaluating an ever-increasing variety of green building standards to determine how to build a green home. The current standards provide opportunities to utilize materials and products that can contribute to earning points toward green building certification.

The Vinyl Siding Institute, Inc. (VSI) worked with Sustainable Solutions Corporation, a sustainability consulting firm, to collect clear, factual data from many sources on a variety of exterior cladding. Analysis of that data demonstrates the exceptional environmental performance of vinyl siding. This report summarizes these findings.

Data was collected from published studies, manufacturers and in a large part from Building for Environmental and Economic Sustainability (BEES). BEES was developed by the National Institute of Standards and Technology (NIST) as a way to compare building products from a life cycle perspective. BEES data has resulted in life cycle models of hundreds of building products, including a range of exterior cladding options, and provides analysis of their life cycle impacts.

From its start with the two simple and natural building blocks of salt and natural gas, to its efficient manufacturing process and modest transportation energy use, this paper presents evidence verifying that vinyl siding has lower environmental impacts throughout its life cycle, especially when compared to other exterior cladding.

Using recognized life cycle assessment tools and fact-based data, vinyl siding and insulated siding demonstrate exceptional environmental performance.

Building for Environmental and Economic Sustainability (BEES) is a life cycle analysis tool developed by the National Institute of Standards and Technology (NIST) that makes use of the environmental life cycle assessment approach specified in ISO 14040 series standards. BEES analyses include the effects of all life cycle stages, including raw material acquisition, manufacture, transportation, installation, use and waste management. All BEES exterior cladding analyses are based on comparison of a functional unit of one square foot of wall coverage. BEES is now available online at http://ws680.nist.gov/Bees. All of the graphs contained in this report were produced using the BEES software, unless otherwise noted.

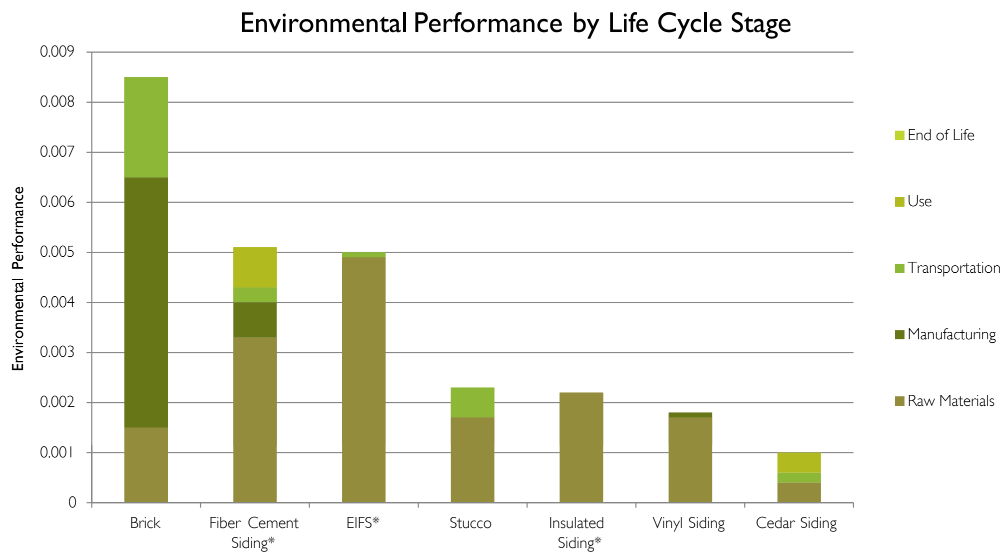
Data for fiber cement siding, insulated siding and EIFS come from publicly available data submitted to BEES by individual companies. James Hardie Building Products has not submitted data to BEES, but the fiber cement siding data (without recycled content) currently in BEES is thought to be comparable to James Hardie fiber cement.

The pages that follow show how vinyl siding and insulated siding compare to other exterior cladding on a variety of life cycle environmental impacts.

Overall Environmental Performance

Vinyl siding has excellent environmental performance when compared to other exterior cladding options. The chart in Figure 1.1 was produced using BEES software and shows overall environmental impact by life cycle stage.

Brick has nearly five times the environmental impact of vinyl siding and nearly four times the impact of insulated siding. Fiber cement has nearly three times the environmental impact of vinyl siding and more than double the environmental impact of insulated siding.



Source: BEES Online, National Institute of Standards and Technology; http://ws680.nist.gov/Bees; October 2012.
*Insulated siding, EIFS and fiber cement siding without recycled content data submitted to BEES by individual companies.
Note: Lower values are better

Figure 1.1 Overall Environmental Performance by Life Cycle Stage

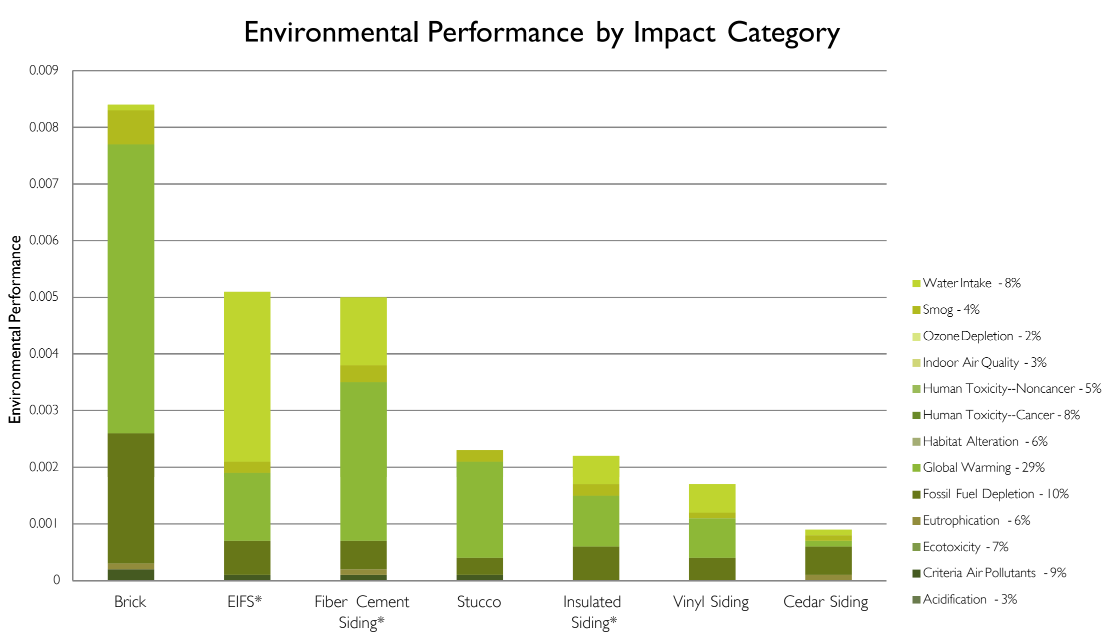


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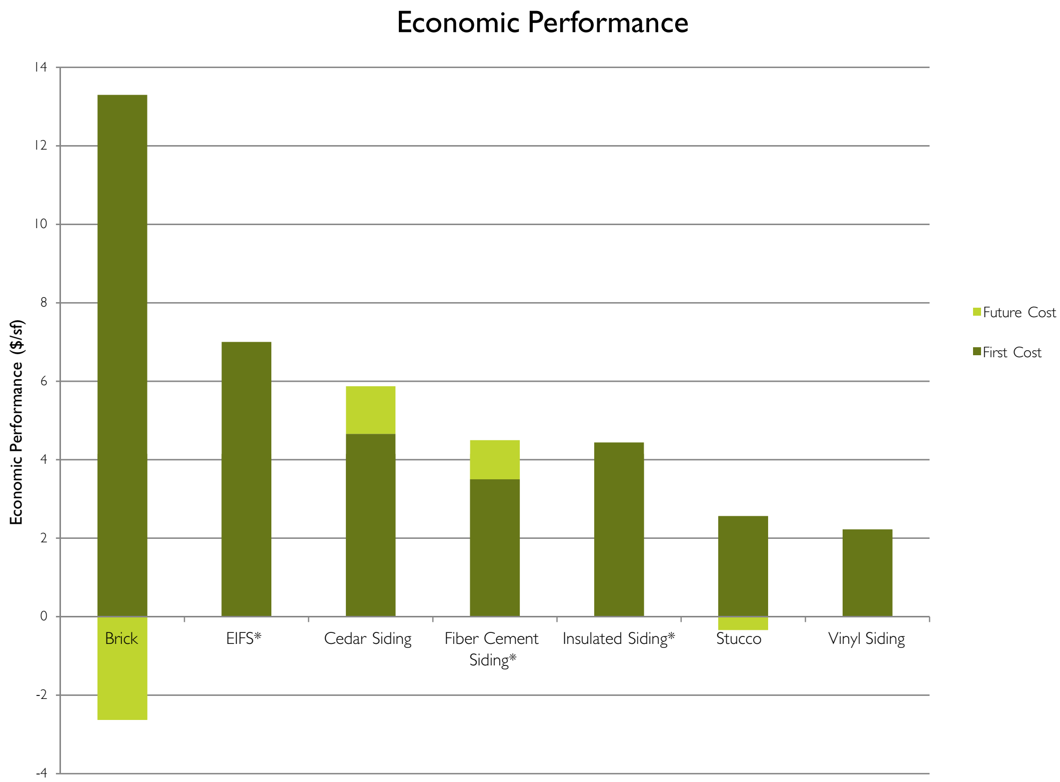
Figure 1.2 Overall Environmental Performance by Impact Category

Economic Performance

An important aspect of sustainability is economic performance. Vinyl siding provides a balance of both environmental and economic performance. Vinyl siding's installed cost is typically lower than that of cedar siding, fiber cement, stucco, brick or stone. Vinyl siding also has the advantage of simple maintenance. It never requires painting, staining or sealing and can be cleaned with mild soap and water. This lowers the cost of maintaining vinyl siding and ensures that it is not responsible for releasing harmful solvents into the environment, as typically happens with painting and staining.



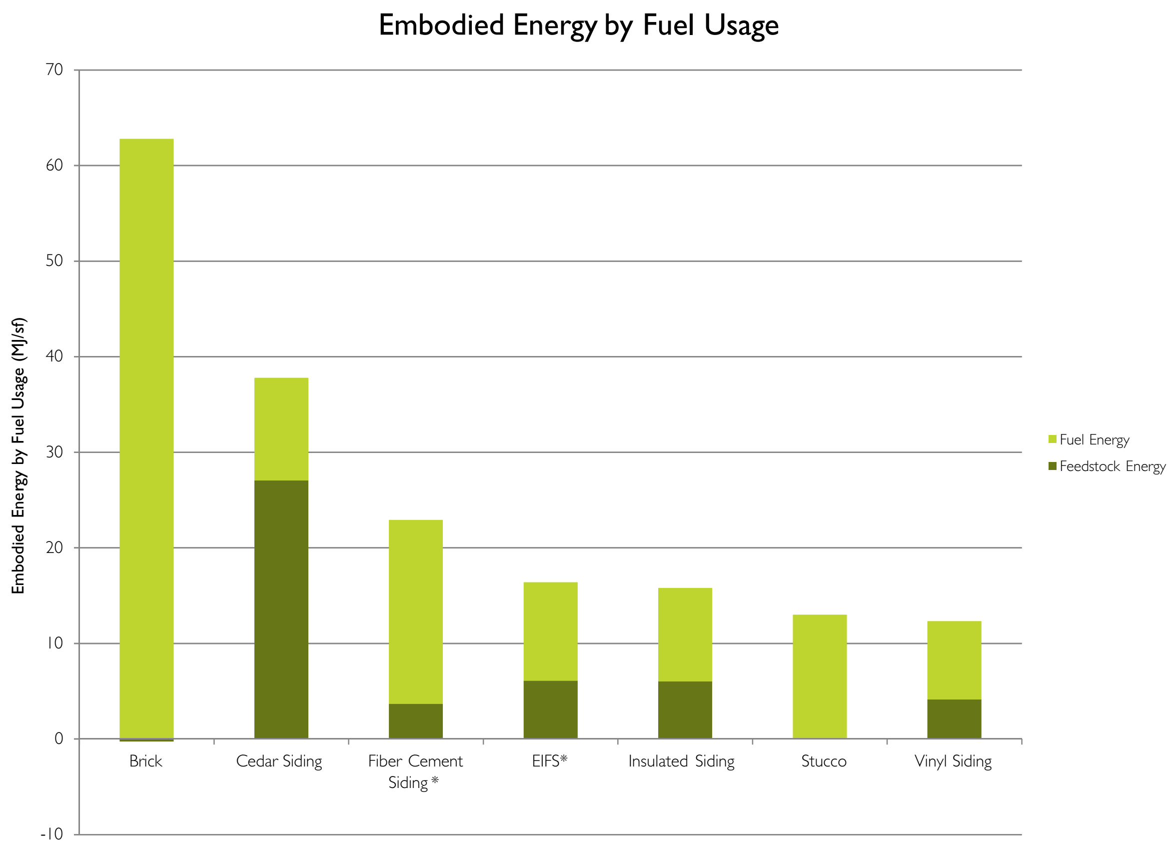
Source: BEES Online, National Institute of Standards and Technology; http://ws680.nist.gov/Bees; October 2012.
*Insulated siding, EIFS and fiber cement siding without recycled content data submitted to BEES by individual companies.
Note: Lower values are better

Figure 1.3 Cladding Economic Performance Comparison

Embodied Energy

Embodied energy is all of the energy that goes into a product over its life cycle, including energy for extraction, processing, manufacturing, transportation, use and disposal. Feedstock energy is the potential energy of the material used in the product; for vinyl siding, the feedstock source would be from the natural gas used to make ethylene. The fuel energy is the energy released when fuel is burned to manufacture the product. Unlike fuel energy, feedstock energy is not consumed in the process of fabricating the product and does not contribute to the creation of CO2 or other pollutants.

As illustrated in Figure 1.4 below, approximately five times more energy is required to manufacture brick and mortar than vinyl siding or insulated siding. The manufacture of fiber cement siding requires almost twice as much energy than the manufacture of vinyl siding and nearly one and a half times more energy than insulated siding.



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*Insulated siding, EIFS and fiber cement siding without recycled content data submitted to BEES by individual companies.
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Figure 1.4 Embodied Energy Comparison

Global Warming Potential

Carbon dioxide and other greenhouse gases are emitted whenever fossil fuels are burned and from a number of other human activities. These gases can trap heat close to the Earth, contributing to global warming, also known as climate change. A general increase in temperature can alter atmospheric and oceanic temperatures, which can potentially lead to alteration of ocean currents and weather patterns as well as rising sea levels. The global warming potential of an activity emission is calculated on the basis of the grams of carbon dioxide equivalents.

Due to the modest amount of energy used in the manufacturing of vinyl siding and the reduced transportation impact associated with vinyl’s lighter weight compared to other cladding, vinyl siding contributes significantly less to global warming than many other siding products. Compared to vinyl siding, brick contributes nearly seven times more to global warming and fiber cement contributes almost four times as much. And compared to insulated siding, brick contributes more than five times more to global warming and fiber cement contributes almost three times as much. This is illustrated in Figure 1.5 below.

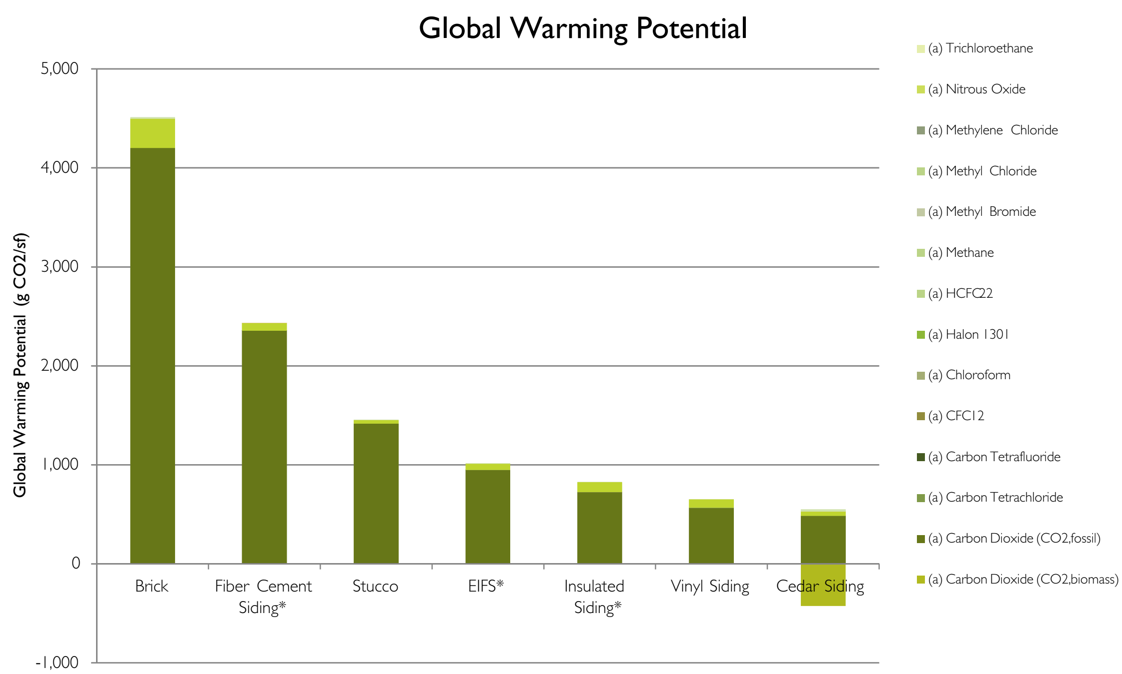

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Figure 1.5 Global Warming Potential Comparison

Criteria Air Pollutants

These are commonly found air pollutants. They include particle pollution (often referred to as particulate matter), ground-level ozone, carbon monoxide, sulfur oxides, nitrogen oxides and lead. These pollutants can cause harm to human health and the environment. This impact measures the amounts of the criteria air pollutants: nitrogen oxides, sulfur oxides and particulate matter. Lead, ground-level ozone and carbon monoxide are captured in other impacts. As illustrated in Figure 1.6 below, brick contributes more than six times more air pollution/criteria air pollutants than vinyl siding and nearly five times more than insulated siding. Fiber cement contributes more than three and a half times more air pollution/criteria air pollutants than vinyl siding and almost three times more than insulated siding.

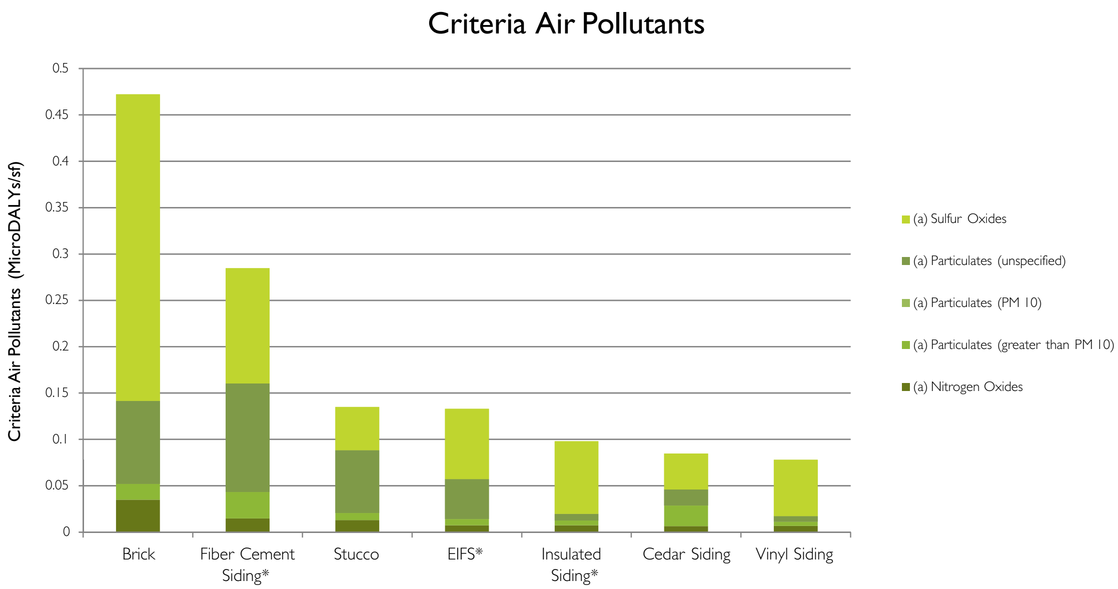

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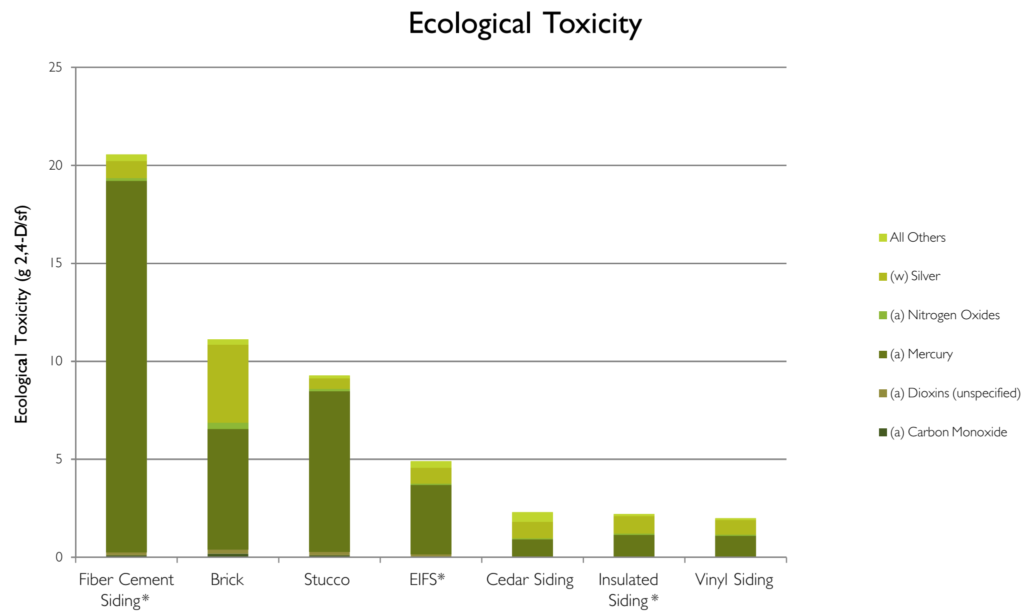
Figure 1.6 Criteria Air Pollutants Comparison

Ecological Toxicity

Ecological toxicity measures the potential of a chemical released into the environment to harm terrestrial and aquatic ecosystems. This potential is measured in terms of 2,4-dichlorophenoxy-acetic acid (2,4-D) equivalents. Compared to many other siding options, vinyl siding is responsible for the emission of significantly lower levels of toxic chemicals, including mercury and silver, into the environment. This is clearly illustrated in Figure 1.7. Vinyl siding and insulated siding have very low ecological toxicity impacts. Fiber cement has approximately 10 times the ecological toxicity impact of vinyl siding and insulated siding while brick has more than five times the ecological toxicity.

The *VSI Product Certification Program*, sponsored by the Vinyl Siding Institute and administered by an independent third-party quality control agency, requires that products meet or exceed the requirements of specific ASTM standards. The ASTM D3679 standard, used to certify vinyl siding, includes a prohibition on use of lead and cadmium. The vinyl siding industry led efforts to have ASTM add that requirement to ASTM D3679, referenced by the International Residential Code and the International Building Code.



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Note: Lower values are better

Figure 1.7 Ecological Toxicity Comparison

Human Health

This impact assesses the potential health impacts of more than 200 chemicals. These health impacts are general, based on emissions from the various life cycle stages, and do not take into account increased exposure that may take place in manufacturing facilities. In measuring the potential contribution to cancer, the Toxic Equivalency Potential for each chemical is determined and is displayed in terms of benzene equivalents. In measuring contribution to health impacts other than cancer, the Toxic Equivalency Potential for each chemical is determined and is displayed in terms of toluene equivalents.

The production of cement creates significantly more dioxin than does the production of PVC. Because of this, cement-based products, including fiber cement and mortar, are generally responsible for the creation of more dioxin than vinyl siding. In the graphs below (Figures 1.8 and 1.9), it can be seen that brick and mortar are responsible for almost 300 times the human health impact of vinyl siding, and fiber cement is responsible for more than 200 times the impact of vinyl siding.

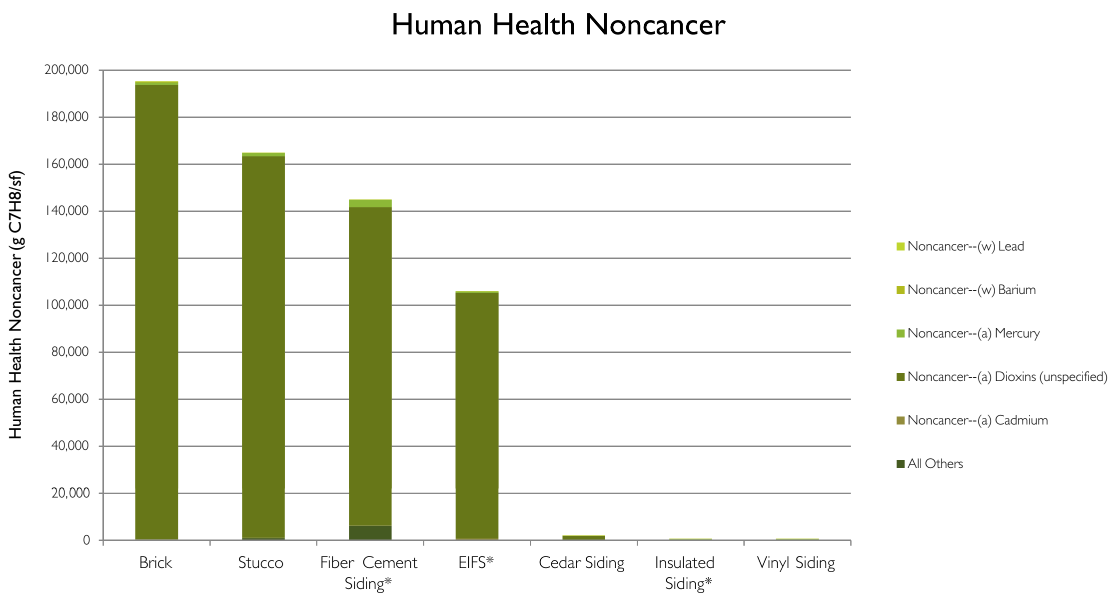

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Figure 1.8 Human Health Noncancer Impact Comparison

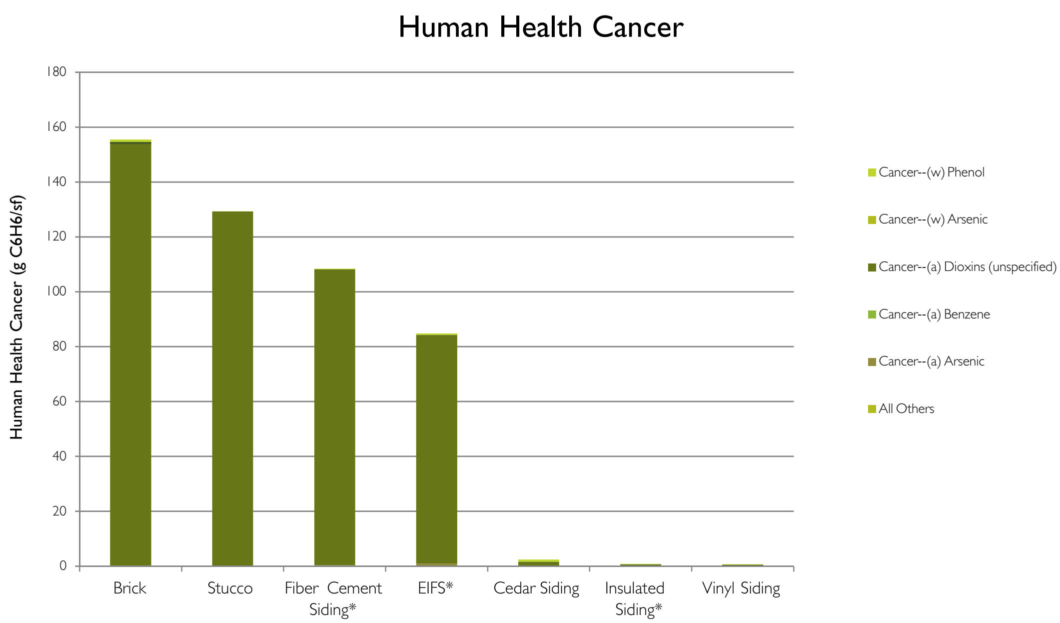

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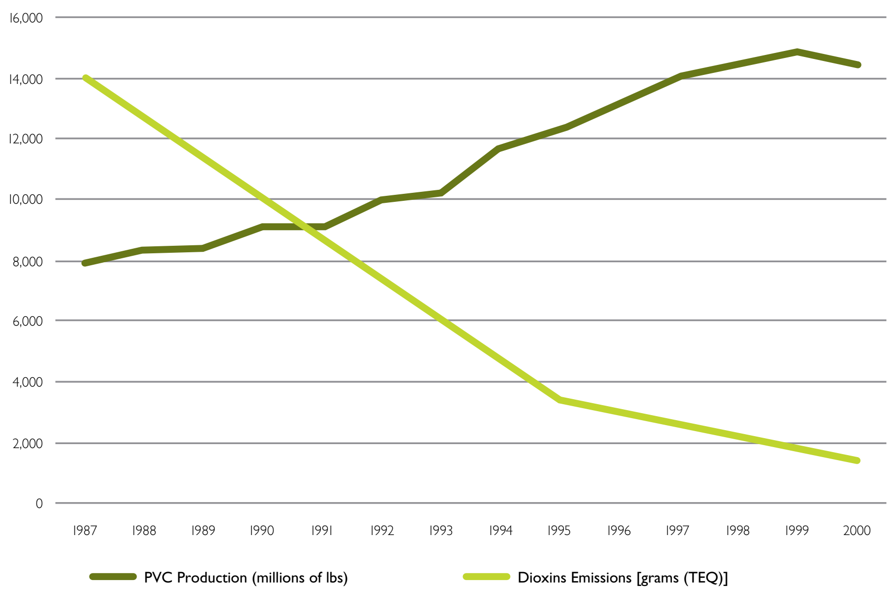
Figure 1.9 Human Health Cancer Impact Comparison

Total Dioxin Emissions

Despite considerable growth in the production of vinyl (also known as PVC or polyvinyl chloride) products, including vinyl siding, in the past 25 years, the level of dioxin released to the environment each year has decreased by nearly 90 percent over the same time period, as illustrated in Figure 1.10 below.

In the year 2000, PVC production was responsible for less than 2 percent of the (total) dioxin released to the environment in the United States. By comparison, diesel trucks (approximately 5 percent), heavy equipment (approximately 2 percent) and industrial wood burning (approximately 3 percent) are each responsible for the production of more dioxin on an annual basis than PVC production.



U.S. EPA, An Inventory of Sources and Environmental Releases of Dioxin-Like Compounds in the United States for the Years 1987, 1995 and 2000 (EPA/600/P-03/002f, Final Report, November 2006) http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=159286#Download

Figure 1.10 United States Production of PVC Compared to Total Environmental Releases of Dioxin-Like Compounds

Smog

Under certain climatic conditions, air emissions from industry and transportation can be trapped at ground level where, in the presence of sunlight, they produce photochemical smog, a symptom of photochemical ozone creation potential (POCP). While ozone is not emitted directly, it is a product of interactions of volatile organic compounds (VOCs) and nitrogen oxides (NOx). The Smog indicator is expressed as a mass of equivalent NOx.

As illustrated in Figure 1.11 below, fiber cement has more than double the smog impact and brick has more than five times the smog impact of vinyl siding. Compared to insulated siding, fiber cement has nearly twice the smog impact and brick has nearly four times the smog impact.

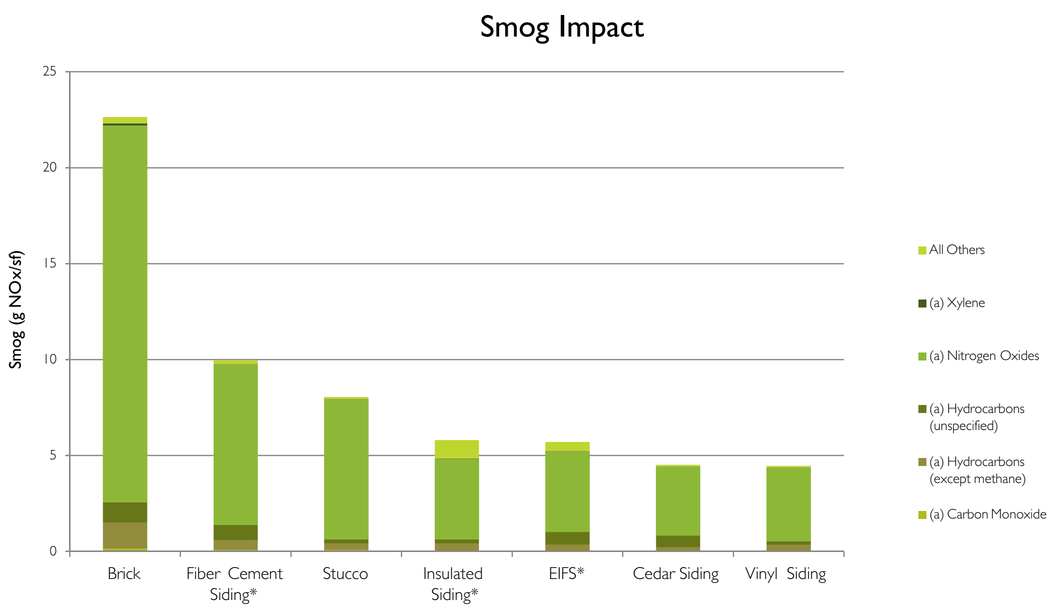


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Figure 1.11 Smog Impact Comparison

Insulated siding helps improve a home's energy efficiency.

Buildings and homes use significant amounts of energy over their lifespan, and durable homes need to be extremely energy efficient in order to be sustainable. A significant source of heat loss in homes is thermal bridging, the direct transfer of heat through a home's framing members (studs). When heat passes through the framing members, it bypasses the wall cavity insulation, providing a more direct pathway for energy loss.

Insulated siding, vinyl siding with rigid foam insulation laminated or permanently attached to the vinyl siding panel, provides continuous insulation over the studs of a home, increasing the exterior wall's R-value. This added R-value reduces energy consumption over the lifetime of the building or home and reduces its overall carbon footprint.

As of April 2013, the *VSI Product Certification Program* allows manufacturers of insulated siding to certify that their products meet or exceed ASTM D7793, the standard for insulated vinyl siding, as verified by an independent quality control agency. Insulated siding certified through VSI's program must demonstrate thermal resistance (R-value) of at least R-2.0.

Insulated Siding Recognition

The International Energy Conservation Code (IECC) serves as the major regulatory tool for energy-efficient residential construction. Insulated siding is listed in the 2012 IECC among the building materials that can be used as continuous insulation outside of the building framing to provide the required total wall R-value for buildings in the coldest climate zones. Generally speaking, builders and remodelers are able to use insulated siding to meet the R-value/U-factor requirements of the IECC.

Due to its ability to reduce thermal bridging, insulated siding has been added to ENERGY STAR® Qualified Homes Version 3.0. Builders who want to earn the ENERGY STAR label can use insulated siding to comply with Section 4.3 (thermal bridge reducer). In order for insulated siding to qualify under the ENERGY STAR Qualified Homes program, the insulated siding must exhibit a minimum R-value of 3.0 (Climate Zones 1 to 4) to 5.0 (Climate Zones 5 to 8) by itself or used in combination with insulated sheathing.

As part of its High-Performance Residential Development Challenge designed to examine affordable energy efficiency, the New York State Energy Research and Development Authority (NYSERDA) conducted studies on two homes in 2008 and 2009. The studies concluded that insulated siding contributed to greater energy savings and reductions in carbon dioxide emissions and energy consumption than James Hardie fiber cement siding.

For more information on the NYSERDA study and insulated siding, visit www.insulatedsiding.info.

Maximize resource efficiency with vinyl siding and insulated siding – virtually no manufacturing waste, fuel-efficient transport, minimal installation scrap and safe to install.

Manufacturing Vinyl Siding

Vinyl, also known as PVC or polyvinyl chloride, starts with two simple building blocks: 57 percent from common salt, one of the Earth's most common compounds, from which chlorine is extracted, and 43 percent from natural gas, from which ethylene is made. Natural gas is abundant in the United States. Our reserves of natural gas are estimated to last 100 years at current consumption rates. In fact, natural gas is the only fossil fuel for which the available stocks are growing. The switch from other fossil fuels to natural gas in the United States also has led to a decrease in greenhouse gas emissions over the past five years.

Vinyl siding manufacturing is an extremely efficient process requiring relatively low inputs of energy and water. The ability to immediately return scrap and off-specification materials (regrind) directly into the manufacturing process results in virtually no manufacturing waste.

Fiber cement requires more water and energy to manufacture per square than does vinyl siding, and the scrap from vinyl siding can be fed back into the manufacturing process while fiber cement manufacturers typically send production scrap to landfills.

Currently, some manufacturers are using recycled content in the manufacture of vinyl siding. Several others are exploring this option for future consideration.

Water is not one of the constituents of vinyl siding and only is used for cooling the siding after it has been extruded. The integration of closed-loop water systems saves millions of gallons of water each year per facility. The amount of water used per square foot of vinyl siding manufactured has dropped by 84 percent in the past five years. The increased use of closed-loop water conservation technology is largely responsible for this decrease, demonstrating the vinyl siding industry's commitment to continuous improvement and efficiency.

Fuel-Efficient Transport

Most of the raw materials used to manufacture fiber cement are typically shipped by truck, while a majority of the raw materials for vinyl siding are shipped via pipeline or rail, which are much more efficient shipping methods. Rail and pipelines require less energy to ship an equivalent volume of material compared to trucking, which results in lower CO2 emissions and resource consumption. Vinyl siding also does not require any additional finish, which decreases trips made to the worksite.

Bricks also are much heavier than vinyl siding, requiring significantly more energy to ship per square foot than vinyl siding.

Low Installation Scrap

The installation of vinyl siding generates very little waste compared to other exterior cladding. Studies have shown that average scrap rates from vinyl siding installation are less than 1.9 percent (120 to 150 pounds) of total construction waste generated for a typical 2,000-square-foot home with three sides of the home clad in vinyl siding. If the home were sided with fiber cement instead of vinyl siding, the same 1.9 percent scrap rate would result in almost 900 pounds of waste. For a typical 2,000-square-foot home, masonry waste, primarily composed of scrap generated from the installation of brick veneer on the home's front facade, yields 1,000 pounds of waste, or 12.5 percent of the total construction waste. (NAHB Research Center, 2001. NAHB Construction Waste Estimate of a Typical 2,000 Sq. Ft. House.) Vinyl siding scrap also can be recycled back into new vinyl siding, further reducing impacts of waste management for home construction.

The U.S. Environmental Protection Agency (EPA) benchmark report, Characterization of Building-Related Construction and Demolition Debris in the U.S., lists 36 typical constituents in the construction and demolition debris stream. Vinyl siding is not listed among them. Also, Bill Franklin, president of Franklin Associates and the contractor who conducted the EPA studies, stated that, "Vinyl siding is a very minor portion of the materials in a building. In fact, siding is not a component of building that has been characterized in C&D literature."

Installers of vinyl siding who are certified through the *VSI Certified Installer Program* receive instruction in waste reduction techniques, including proper material estimating and installation to reduce waste generation, as a part of their training. These source reduction techniques ensure that the installation of vinyl siding produces as little scrap as possible.

Safe to Install

Vinyl siding does not utilize any materials that can cause adverse health effects to the installers – or to anyone. Fiber cement contains a micro-silica material (sand) that can potentially cause adverse health effects to installers from long-term exposure to dust when cutting fiber cement during installation. Repeated and prolonged overexposures to dust containing crystalline silica can cause silicosis (scarring of the lung).

The Material Safety Data Sheet (MSDS) for HardieBoard specifically outlines the dangers associated with working with silica-based fiber cement, while vinyl siding does not require an MSDS at all. (James Hardie, 2008. Material Safety Data Sheet, Issue 22, http://www.jameshardie.com/homeowner/pdf/msds.pdf)

Vinyl siding and insulated siding are engineered to last and certified for performance.

Sustainability is not possible without durability, and vinyl siding industry initiatives have focused on improved durability. As the only exterior cladding with both third-party product certification and certified installer programs, vinyl siding offers the following characteristics that make it durable:

- Low maintenance
- Service life
- Wind resistance
- Color retention
- Water resistance
- Resistance to insect damage
- Chemical resistance
- Energy efficiency

Vinyl siding and insulated siding certified through the *VSI Product Certification Program* are verified to meet or exceed ASTM standards for quality.

As an engineered product, vinyl siding is undergoing constant improvement. Its expected service life continues to increase as improvements are made to color retention and other key areas of durability.

Low Maintenance

Unlike other cladding options, vinyl siding does not require painting or caulking during installation and only requires periodic cleaning with mild soap and water. Brick will require re-pointing of the mortar; fiber cement siding requires periodic painting and caulking; cedar siding requires frequent painting and staining; and stucco requires maintenance, including painting and sealing. Avoiding the use of harsh cleaning chemicals, re-pointing, paints and solvents reduces the overall environmental impact of vinyl siding as compared to other siding products for the construction and product use life cycle phases.

Also, the fact that vinyl siding does not need to be painted helps to contribute points in green building certification programs.

Service Life

Building for Environmental and Economic Sustainability (BEES) uses a 50-year lifetime for vinyl siding. This corresponds with other life cycle assessment studies conducted on siding and many manufacturer warranties. NAHB has cited "Lifetime" as the estimated life expectancy of vinyl siding on a home in its Study of Life Expectancy of Home Components, published in February 2007. According to the Chemical Resistance Database, published by Cole-Palmer in 2008, vinyl siding is resistant to many chemicals, including corrosive chemicals. In fact, it has a very high resistance to nitric and sulfuric acids, the main components of acid precipitation.

Moisture Performance

Vinyl siding, unlike some other exterior cladding, has "built-in" rainscreening performance that reduces accumulation of water that can reach the underlying water-resistive barrier. A water-resistive barrier system (also called weather-resistant wall envelope) includes water shedding materials and water diversion materials. Water-resistive barrier systems commonly consist of a combination of exterior cladding, such as vinyl siding; flashed wall openings and penetrations; water-resistive barrier material; and sheathing. Effective exterior wall systems shed the water initially, control moisture flow by capillary and diffusion action, and minimize absorption into the wall structure. The level of water resistance required is determined by the applicable building code, structure and climate.

Vinyl siding includes weep holes at the edge of panels, allowing water to be funneled away while allowing air in to help moisture evaporation. Proper installation of vinyl siding with a water-resistive barrier allows materials behind the cladding to "breathe." Moisture accumulation that does end up behind the cladding drains efficiently and effectively while controlling moisture flow and minimizing moisture retention and absorption into the wall assembly. Vinyl siding is not nailed tight to the wall assembly, but is hung. This creates a de facto drainage plane and vented clear airspace, which eliminates the need for a vapor barrier.

Many green building programs now recognize rainscreening as a way to enhance durability and sustainability. The ICC 700 National Green Building Standard 2012 update awards points for use of a rainscreen wall design for exterior wall assemblies in section 602.1.9 (5).

Third-Party Certification

Since 1998, the Vinyl Siding Institute has sponsored the *VSI Product Certification Program*, administered by Architectural Testing, Inc. of York, PA, as a means for manufacturers to independently verify the quality of the vinyl siding and insulated siding they produce.

Vinyl siding certified through the *VSI Product Certification Program* meets requirements in ASTM D3679 for weatherability, windload resistance, heat shrinkage, impact resistance, surface distortion, length, width, thickness, gloss and color uniformity, which provide for manufacturing consistency, dimensional stability and a neat appearance on the wall. The requirements ensure that vinyl siding withstands the effects of sunshine, rain and heavy winds of at least 110 mph. Under VSI's program, vinyl siding colors certified to meet or exceed ASTM D6864 or D7251 will also resist major color changes in a variety of climates.

As of April 2013, the *VSI Product Certification Program* allows manufacturers of insulated siding to certify that their products meet or exceed ASTM D7793, the standard for insulated vinyl siding. In addition to the requirements mentioned above, insulated siding certified through VSI's program must demonstrate a minimum thermal resistance (R-value) of at least R-2.0. As with vinyl siding, insulated siding can also be color retention certified.

Approximately 98 percent of the vinyl siding squares in the United States (by companies reporting in 2011) were certified through the VSI-sponsored program and can be found on VSI's *Official List of Certified Products and Colors* found at www.vinylsiding.org.

Achieve points in leading green building programs by using vinyl siding and insulated siding.

Vinyl siding can assist with certification of a building through both the Leadership in Energy and Environmental Design (LEED) and the ICC 700 National Green Building Standard (NGBS) green building rating systems by contributing to earning points for the credits listed in the tables on the following pages. Certification to green building standards are typically voluntary; however, there has been exponential growth over the last few years in green building certifications. In addition to the green building standards, there are now green building codes that will require new construction of certain building types to integrate green building practices as part of the building code. The International Green Construction Code (IgCC) and the California Green Construction Code (CalGreen) set mandatory requirements for green building in the jurisdictions where they are adopted. The applicable code requirements that vinyl siding can satisfy are listed in the tables that follow.

Vinyl siding's performance as a sustainable building material contributes to achieving points for certification in the leading green building standard certification programs, including LEED and the NGBS. Vinyl siding can contribute to obtaining points for resource efficiency in the NGBS since vinyl siding requires no additional finish, is termite resistant, may contain recycled content and may qualify as an indigenous material depending on manufacturing location in relation to the building site. In addition, vinyl siding can contribute to earning points in the Life Cycle Analysis Practice since vinyl siding data is published in BEES.

The U.S. Green Building Council's Technical and Scientific Advisory Committee (TSAC) investigated using alternatives to PVC for siding, flooring, windows and pipe. The TSAC used a combination of Life Cycle Assessment and Risk Assessment in their analysis. These represent state-of-the-art techniques for evaluating environmental and human health impacts. The TSAC concluded that pushing builders toward the uses of alternate materials only was advisable in a few cases. According to the TSAC, "The evidence indicates that a credit that rewards the avoidance of PVC could steer decision makers toward using materials that are worse on most environmental impacts."

LEED-NC, LEED-CS, LEED for Schools, LEED for Healthcare, LEED for Retail and LEED for Canada (2009)

Materials & Resources 2 – Construction Waste Management (1 or 2 points)	Recycle and/or salvage nonhazardous construction and demolition debris. Develop and implement a construction waste management plan that, at a minimum, identifies the materials to be diverted from disposal and whether the materials will be sorted on-site or co-mingled. Some vinyl siding manufacturers have take-back and recycling programs for vinyl siding, which can contribute to earning this credit.
Materials & Resources 3 – Sustainably Sourced Materials and Products (Healthcare only) (1-4 points)	Reduce the environmental burdens of materials and products acquired to construct a building and to upgrade building services. One point and up to a maximum of four will be awarded for each 10% of the total value of all building materials and products used in the project (based on cost) that meet recycled content and/or regionally sourced/manufactured criteria.
Materials & Resources 4 – Recycled Content **(NC, CS, Schools, Retail)** (1 or 2 points)	Use materials with recycled content such that the sum of post-consumer recycled content plus one-half of the pre-consumer content constitutes at least 10% (20% for two points), based on cost, of the total value of the materials in the project.
Materials & Resources 5 – Regional Materials **(NC, CS, Schools, Retail)** (1 or 2 points)	Use materials that have been extracted, harvested or recovered, as well as manufactured, within a specified distance of the project site for a minimum of 10% (20% for two points), based on cost, of the total materials value.
Indoor Environmental Quality 7 – Thermal Comfort – Design and Verification **(CS, Healthcare)** (1 point)	Provide a comfortable thermal environment that supports and promotes occupant productivity and well-being and provide for the assessment of building occupant's thermal comfort over time. Design heating, ventilating and air conditioning (HVAC) systems and the building envelope to meet the requirements of ASHRAE Standard 55-2004, Thermal Comfort Conditions for Human Occupancy, and local codes or current 2010 FGI Guidelines.
Indoor Environmental Quality 7.1 – Thermal Comfort – Design **(NC, Schools, Retail)** (1 point)	Design heating, ventilating and air conditioning (HVAC) systems and the building envelope to meet the requirements of one of the options below. 1. ASHRAE STANDARD 55-2004 OR NON-U.S. EQUIVALENT 2. ISO 7730: 2005 & CEN STANDARD EN 15251: 2007

Energy & Atmosphere Prereq. 2 – Minimum Energy Performance (Required)	*For insulated siding* To establish the minimum level of energy efficiency for the proposed building and systems to reduce environmental and economic impacts associated with excessive energy use. • Option 1. Whole Building Energy Simulation • Option 2. Prescriptive Compliance Path: ASHRAE Advanced Energy Design Guide • Option 3. Prescriptive Compliance Path: Advanced Buildings Core Performance Guide
Energy & Atmosphere 1 – Optimize Energy Performance Option 1 (1-19 points) Option 2 (1 point) Option 3 (1-3 points)	*For insulated siding* Option 1. Whole Building Energy Simulation • Demonstrate a percentage improvement in the proposed building performance rating compared with the baseline building performance rating. Calculate the baseline building performance according to Appendix G of ANSI/ASHRAE/IESNA Standard 90.1-2007 using a computer simulation model for the whole building project. Insulated siding may contribute to this credit. Option 2. Prescriptive Compliance Path: ASHRAE Advanced Energy Design Guide • Comply with the prescriptive measures of the ASHRAE Advanced Energy Design Guide. Project teams must comply with all applicable criteria as established in the Advanced Energy Design Guide for the climate zone in which the building is located. Option 3. Advanced Buildings Core Performance Guide • Comply with the prescriptive measures identified in the Advanced Buildings Core Performance Guide developed by the New Buildings Institute.

Pilot Credit 61: Material Disclosure and Assessment	To increase the use of products and materials with life cycles, ingredients and attributes understood and optimized to improve overall environmental, economic and social performance.
	
	Option 1. Assessment and Optimization of Non-Structural Products
	
	• Use a minimum of 20%, by cost, permanently installed nonstructural products and elements meeting at least one of the criteria below.
	    • Industry Wide (Generic) EPD
	    • Product Specific Declaration
	
	Option 2. Assessment and Optimization of Structure and Enclosure
	
	• Use a minimum of 20%, by cost, structure and enclosure meeting one of the criteria below.
	    • Industry Wide (Generic) EPD
	    • Product Specific Declaration

LEED for Homes and LEED for Canada (2009)

Materials & Resources 2.2 – Environmentally Preferable Products (EPP): Materials (0.5 points)	For siding to qualify as an EPP, the siding must contain 25% post-consumer or 50% pre-consumer recycled content.
Materials & Resources 2.2 – Environmentally Preferable Products: Local (0.5 points)	Use materials that have been extracted, processed and manufactured within 500 miles of the home ("local").
Energy & Atmosphere 1 – Optimize Energy Performance (1-34 points)	*For insulated siding* – Exceed the performance of ENERGY STAR® for Homes. Use the Home Energy Standards (HERS) Index to the appropriate number of LEED points.

ICC 700 National Green Building Standard (2012 Update)

601.7 Site-Applied Finishing Materials (12 points max)	Use building materials or assemblies that do not require additional site-applied material for finishing. • 90% or more of the installed building material or assembly listed in the Standard (5 points each) • 50% to less than 90% of the installed building material or assembly listed in the Standard (2 points each) • 35% to less than 50% of the installed building material or assembly listed in the Standard (1 point each)
602.1.6 Termite-Resistant Materials (2-6 points)	In areas of slight to moderate termite infestation probability for the foundation, all structural walls, floors, concealed roof spaces not accessible for inspection, exterior decks and exterior cladding within the first two feet above the top of the foundation.

602.1.9 Flashing (2 points Max)	Flashing is provided to minimize water entry into wall and roof assemblies and to direct water to exterior surfaces or exterior water-resistive barriers for drainage. Flashing details are provided in the construction documents and are in accordance with the fenestration manufacturer's instructions, the flashing manufacturer's instructions, or as detailed by a registered design professional. (1) Flashing is installed at all of the following locations, as applicable: (Mandatory) (a) around exterior fenestrations, skylights and doors (b) at roof valleys (c) at deck, balcony, porch or stair to building intersections (d) at roof-to-wall intersections, at roof-to-chimney intersections, at wall-to-chimney intersections and at parapets (e) at ends of and under masonry, wood or metal copings and sills (f) above projecting wood trim (g) at built-in roof gutters (h) drip edge is installed at eaves and rake edges (2) All window head and jamb flashing are self-adhered flashing complying with AAMA 711-07. (2 points) (3) Pan flashing is installed at sills of all exterior windows and doors. (2 points) (4) Seamless, preformed kickout flashing, or prefabricated metal with soldered seams, is provided at all roof-to-wall intersections. The type and thickness of the material used for roof flashing, including but not limited to kickout and step flashing, is commensurate with the anticipated service life of the roofing material. (2 points) (5) A rainscreen wall design is used for exterior wall assemblies. (2 points) (a) a system designed with minimum ¼" inch air space exterior to the water-resistive barrier, vented to the exterior at top and bottom of the wall, and integrated with flashing details. (2 points) OR (b) either a cladding material or a water-resistive barrier with enhanced drainage, meeting 75% drainage efficiency requirement of ASTM E2273. (1 point) (6) A drip cap is provided above windows and doors that are not flashed or protected by covering in accordance with Section 602.1. (2 points) (7) Through wall flashing is installed at transitions between wall cladding materials or wall construction types. (2 points) (8) Flashing is installed at expansion joints in stucco walls. (2 points)

604.1 Recycled Content (2-6 points)	Use recycled-content building materials for two minor and/or two major components of the building with a recycled content of 25% or more.
605.3 Recycled Construction Materials (6 points max)	Construction materials are recycled offsite (1) A minimum of two types of materials are recycled (2) For each additional recycled material Some vinyl siding manufacturers have take-back and recycling programs for vinyl siding, which can contribute to earning this credit.
608.1 Resource-Efficient Materials (9 points max)	Products containing fewer materials are used to achieve the same end-use requirements as conventional products. (3 points per material – maximum of 9 points)
610.1 Life Cycle Analysis (3-15 points)	Select the more environmentally preferable product or assembly for an application based upon the use of a Life Cycle Assessment (LCA) tool compliant with ISO 14044 or other recognized standards that compares the environmental impact of building materials, assemblies or a whole building. • Per product/system comparison (2-3 points – maximum of 15 points) • Whole building life cycle analysis (15 points) • Two or more products with the same intended use are compared based on LCA and the product with at least a 15% average improvement is selected. Number of points awarded is based on the number of environmental impact measures compared. The environmental impact measures to be considered are chosen from the following: (10 points max) 1) Fossil Fuel Consumption 2) Global Warming Potential 3) Acidification Potential 4) Eutrophication Potential 5) Ozone Depletion Potential
611.1 Manufacturer’s Environmental Management System Concepts (1-10 points)	Product manufacturer’s operation and business practices include environmental management system concepts and the production facility is ISO 14001 certified or equivalent. (1 point per percent of aggregate value of building products from such a facility)
702.2 Energy Cost Performance Levels (30-100 points)	*For insulated siding* – Increase building energy efficiency by implementing energy-efficiency features to achieve energy cost performance that exceeds IECC by 15-50%. Insulated siding may contribute to this practice.
703.1 Building Envelope (10-18 points)	*For insulated siding* – Total building thermal envelope UA improved by 10-20% over that required by IECC. Insulated siding may contribute to this practice.

International Green Construction Code (IgCC 2012)

The IgCC currently is adopted and administered statewide in Oregon, Florida, Maryland and Rhode Island. Administered at state and/or local level in Colorado, Arizona, Washington, North Carolina and New Hampshire	
303.1 Whole Building Life Cycle Assessment	The assessment shall demonstrate that the building achieves at least 20% improvement in environmental performance in at least three of the following impact measures, one of which must be global warming potential: primary energy use, global warming potential, acidification potential, eutrophication potential, ozone depletion potential, smog potential.
503.1 Construction Waste Management	Not less than 50% of nonhazardous construction waste shall be diverted from disposal. Materials are to be diverted from disposal by efficient usage, recycling, reuse, manufacturer's reclamation or salvage for future use; donation or sale shall be specified.
505.2 Material Selection	Recycled content building materials – 505.2.2 • Option 1: Contain at least 25% combined post-consumer and pre-consumer recovered material, and be classified as a recyclable building material. The pre-consumer recycled content shall be counted as one-half of its actual content in the material. • Option 2: Contain not less than 50% combined post-consumer and pre-consumer recovered material. The pre-consumer recycled content shall be counted as one-half of its actual content in the material. Recyclable building materials – 505.2.3 • Building materials shall be manufactured for recyclability with a minimum recovery rate of 30% through recycling and processing. Indigenous materials – 505.2.5 • Shall be composed of resources that are recovered, harvested, extracted and manufactured within a 500-mile radius of the building site. Where resources are transported by water or rail, the distance to the building site shall be determined by multiplying the distance that the resources are transported by water or rail by 0.25, and adding that number to the distance transported by means other than water or rail.

602 Modeled Performance Pathway Requirements	*For insulated siding* – 602.1.1 zEPI • Performance-based designs shall demonstrate a zero energy performance index (zEPI) of not more than 51 and shall demonstrate a CO_2eq. emissions reduction. • The building shall be designed and constructed to have a zEPI Point of Entry not greater than 51. 602.1.2 Base annual energy use index • The proposed energy use index (EUIp) of the building and building site shall be calculated in accordance with ASHRAE 90.1. • The annual energy use shall include all energy used for building functions and its anticipated occupancy.
803.2 Thermal Environmental Conditions for Human Occupancy	*For insulated siding* – Buildings shall be designed in compliance with ASHRAE 55 – 04, Sections 6.1, "Design," and 6.2, "Documentation."

California Green Construction Code (CALGreen 2010)

(includes both mandatory and voluntary requirements)

5.507.4.1 Exterior Noise Transmission	*For insulated siding* – Employ building assemblies and components with Sound Transmission Coefficient (STC) values determined in accordance with ASTM E90 and ASTM E413.
A4.405.1 Prefinished Building Materials	Utilize prefinished building materials that do not require additional painting or staining when possible.
A4.405.3 Recycled Content	Use materials, equivalent in performance to virgin materials, with post-consumer or pre-consumer recycled content value (RCV) for a minimum of 10% of the total value.
A5.203.2 Energy Performance	*For insulated siding* – It is the intent of this code to encourage green buildings to achieve exemplary performance in the area of energy efficiency.
A5.405.1 Regional Materials	Compared to other products in a given product category, select building materials or products for permanent installation on the project that have been harvested or manufactured within 500 miles of the project site.

A5.405.4 Recycled Content, Tier 1/Tier 2 [DSA-SS] Recycled Content	Use materials, equivalent in performance to virgin materials, with post-consumer or pre-consumer recycled content value (RCV) for a minimum of 10% (15% for Tier 2) of the total value, based on estimated cost of materials on the project.
A5.406.1 Choice of Materials	Service life – A5.406.1.1 • Select materials for longevity and minimal deterioration under conditions of use. Reduced maintenance – A5.406.1.2 • Select materials that require little, if any, finishing. For those with surface protection, choose materials that do not require frequent applications of toxic or malodorous finishes. Recyclability – A5.406.1.3 • Select materials that can be reused or recycled at the end of their service life in the project.
A5.409.1 Material and System Assemblies	Select material assemblies based on life cycle assessment of their embodied energy and/or greenhouse gas emission potentials.

Vinyl siding manufacturers have partnered with recyclers to increase access to recycling facilities for vinyl siding

Because recycling is very regional in nature and very little scrap is generated during installation, collection of enough siding to recycle is difficult, both logistically and economically. Additionally, the long service life of vinyl siding inhibits the collection of substantial volumes for recycling. However, some manufacturers have partnered with recyclers at the local level to collect post-consumer vinyl siding for various end uses, where feasible.

The Vinyl Institute has two databases on its website www.vinylinfo.org concerning recycling of vinyl products. These include both recyclers and companies who make recycled products.

Conclusion: Today's Vinyl Siding is Verifiably Green

As green building continues to play a vital and growing role in the long-term health of our planet, today's vinyl siding delivers many recognized benefits. The life cycle data illustrates that vinyl siding has lower environmental impacts and better environmental performance than other exterior cladding.

By using vinyl siding, builders, remodelers, architects, designers, contractors, planners and homeowners can reduce environmental impacts for their homes during construction and the life of the building, doing their part to make communities – and our planet – sustainable.

For more information on vinyl siding visit www.vinylsiding.org. For life cycle assessment data for vinyl siding visit BEES online at http://ws680.nist.gov/Bees.

About the Author and Sustainable Solutions Corporation

Tad Radzinski, co-founder and president of Sustainable Solutions Corporation (SSC), has nearly 30 years of diversified experience providing sustainable manufacturing, building and operations, marketing, and training and education services. Tad has conducted life cycle assessments and developed Environmental Product Declarations for numerous companies across a wide range of industries. He has assisted clients with the development and integration of sustainable product development programs and has been instrumental in assisting clients with developing more sustainable products and Extended Producer Responsibility (EPR) programs. Tad also has experience with the Health Product Declaration Pilot Program.

Tad has a B.S. in Mechanical Engineering from Drexel University (1991) and a M.S. in Water Resources and Environmental Engineering from Villanova University (1995). He is a Registered Professional Engineer (PE), LEED Accredited Professional (LEED AP), and Certified Sustainability Facility Professional® (SFP). Tad serves as an Adjunct Professor at Villanova University teaching graduate classes in Principles of Sustainable Development, Sustainable Manufacturing, Advanced Life Cycle Assessment, and Introduction to Sustainable Product Design. Tad also assisted Villanova with the development of the Master of Science Degree in Sustainable Engineering.

SSC has developed and implemented programs and activities that resulted in over 50 buildings receiving ENERGY STAR and LEED certification, saving customers and building owners millions of dollars in operating costs. Tad has certified close to 30 buildings to the LEED rating systems, including New Construction, Commercial Interiors, Core and Shell, LEED for Homes, and LEED for Existing Buildings Standards.

In 2007 and again in 2012, SSC was retained by the Vinyl Siding Institute, Inc. to help identify and verify the facts about vinyl siding and sustainability.

For more information on Sustainable Solutions Corporation, visit www.sustainablesolutionscorporation.com.

About the Vinyl Siding Institute, Inc.

The Vinyl Siding Institute, Inc. (VSI), located in Washington, DC, represents manufacturers of vinyl and other polymeric siding and suppliers to the industry. VSI is the sponsor of the *VSI Product Certification Program* and the *VSI Certified Installer Program*.
For more information on vinyl siding, visit www.vinylsiding.org.