



Life Cycle Assessment:

Evaluating the environmental impact of vinyl siding, fiber cement and other exterior cladding

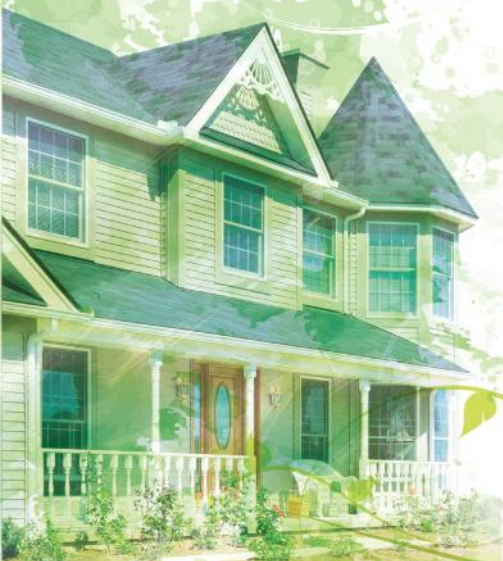
Presented by Jesse Sherry, M.S., LEED AP



This webinar will use Voice over Internet Protocol (VoIP). Please make sure your speakers are turned on.



About the Vinyl Siding Institute



About the Vinyl Siding Institute (VSI)

- VSI is the trade association for manufacturers of vinyl and other polymeric siding and suppliers to the industry
- Located in Washington, DC
- VSI priority programs
 - Product certification
 - Installation, including the *Certified Installer Program*
 - Technical work
 - *America Sides with Vinyl (ASwV)* marketing initiative
 - Code and regulatory projects



Sustainability Research

- VSI established a Green Team consisting of members to help the industry's sustainability efforts
- Commissioned Sustainable Solutions Corporation to study vinyl siding's sustainability
 - Sustainable Solutions Corporation president, Tad Radzinski, is LEED AP and was formerly with the U.S. Environmental Protection Agency



What We Will Cover

- Basics of Life Cycle Assessment (LCA)
- Review of tools used to compare building products
- Detailed comparison of vinyl siding, fiber cement and other exterior cladding
- Future use of LCA



Poll #1



What is Life Cycle Assessment (LCA)?



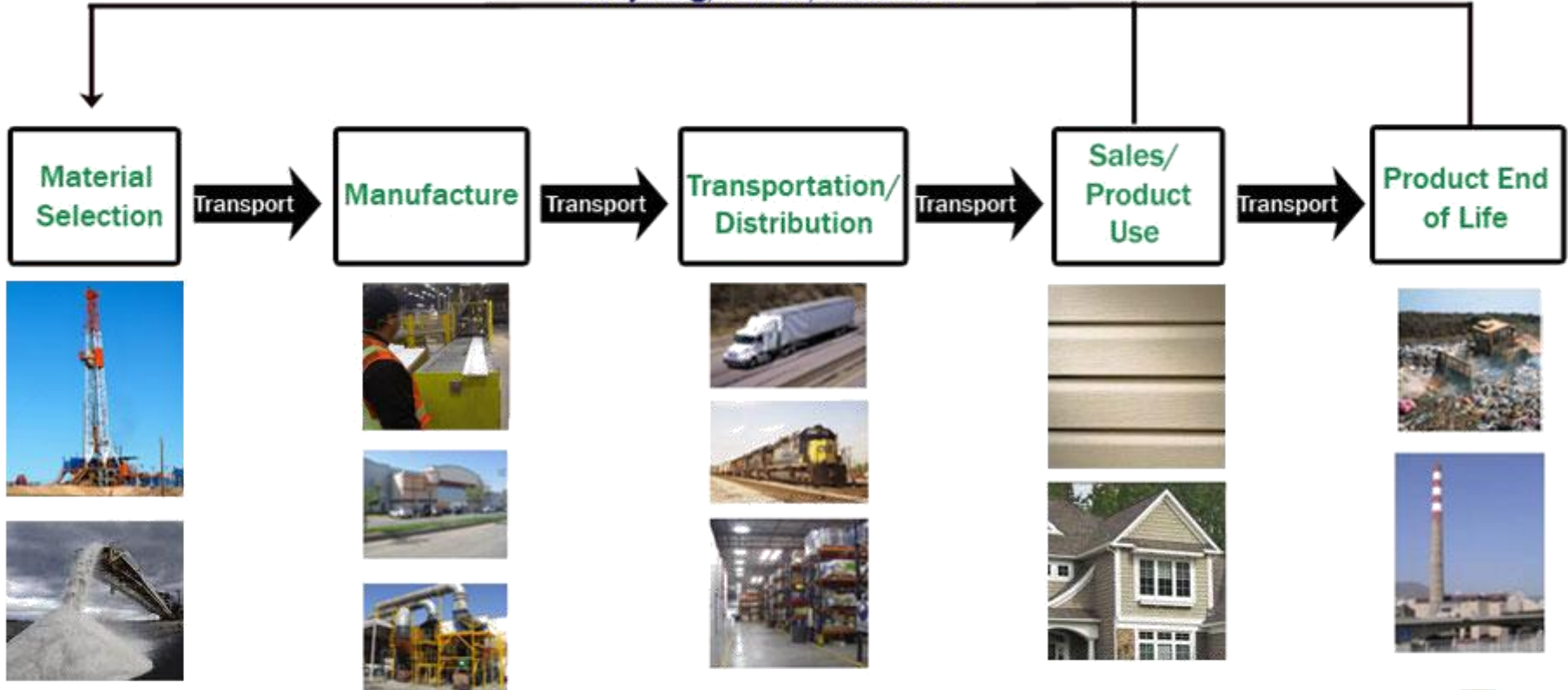
Life Cycle Assessment

- Life Cycle Assessment (LCA) is a method for identifying the environmental impacts of a product, process or activity over its entire lifespan
- LCA considers the entire life cycle of the product
 - Extraction and processing of raw materials
 - Manufacturing
 - Transportation and distribution
 - Use, reuse, and maintenance
 - Recycling and final disposal
- LCA can be used to develop single attribute data, such as carbon footprinting or embodied energy, as well as comprehensive environmental impacts



Vinyl Siding Product Life Cycle

Recycling, Reuse, Take Back



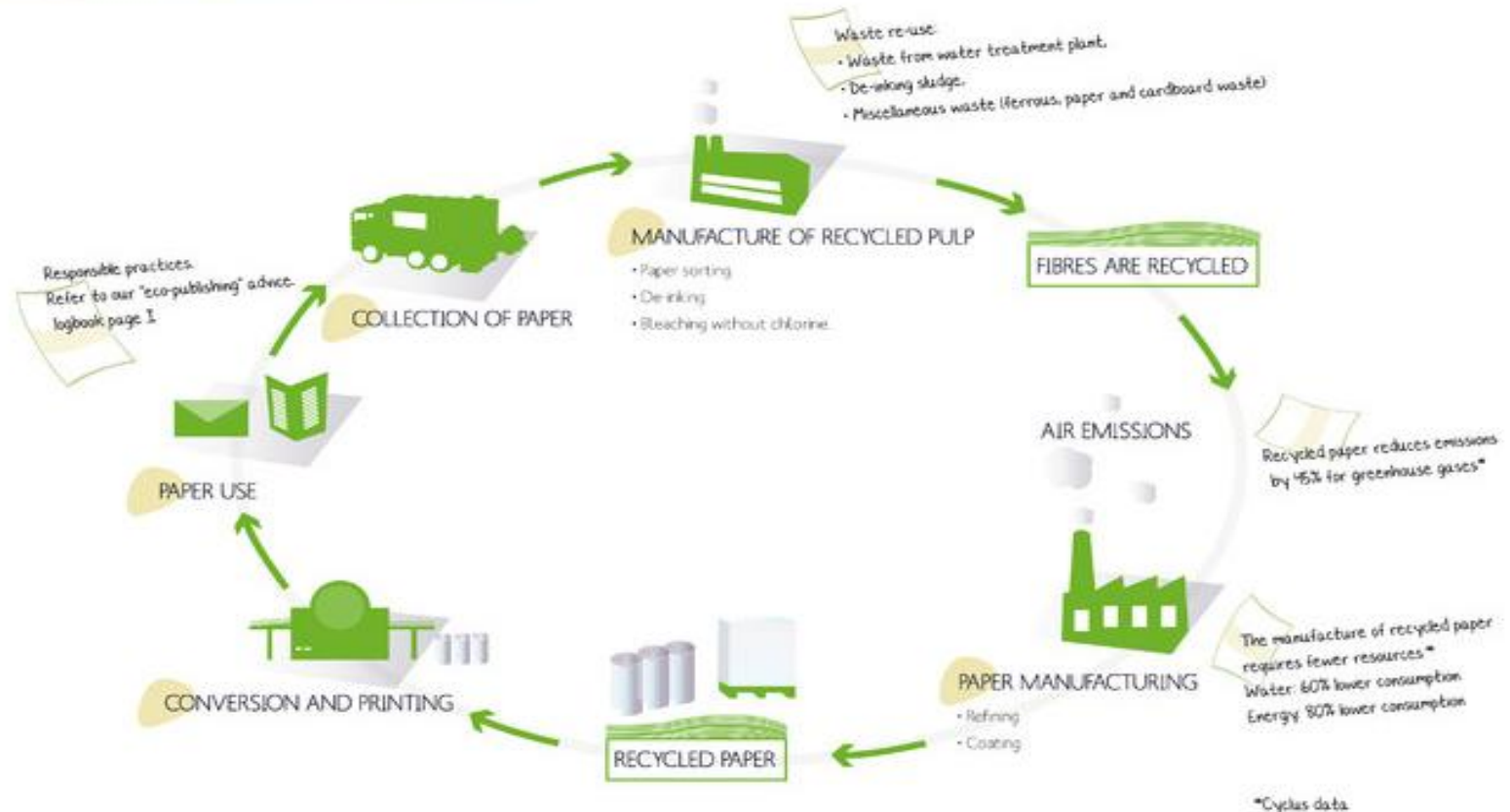
Life Cycle Impacts

- Most products create many environmental impacts before they come into our hands
- Drilling for natural gas, mining metals, fertilizing fields, and other methods for obtaining raw materials all have significant environmental impacts that are hard to see in the final product
- LCA allows us to identify the most environmentally sound products, rather than relying on recycled content, renewable materials and other single issue measures



Product Life Cycle

THE LIFE CYCLE OF RECYCLED PAPER



Typical Impact Categories

- Air: Smog, ozone depletion, criteria air pollutants
- Water: Use, eutrophication, acidification
- Human Health: Cancer and non-cancer
- Global warming potential
- Fossil fuel depletion
- Indoor air quality
- Habitat alteration
- Ecotoxicity



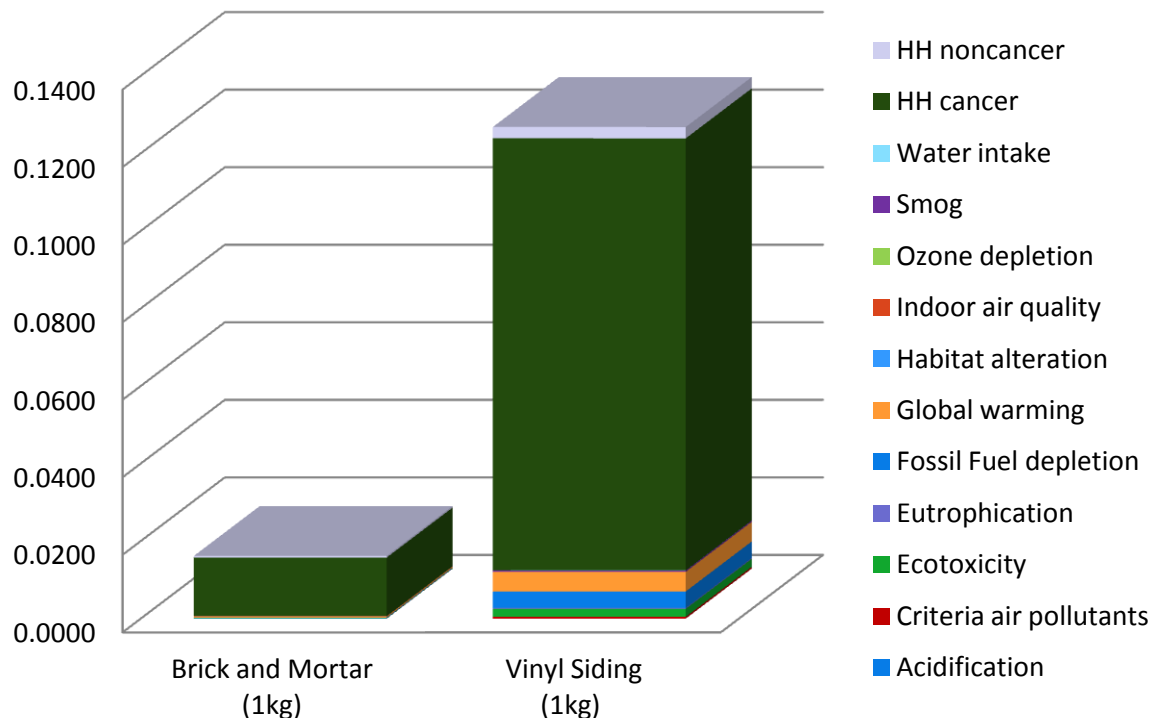
Poll #2



Functional Unit Example

- Some marketing pieces use the wrong units for comparison or don't explain which units they are using

Comparison by weight, not functional unit



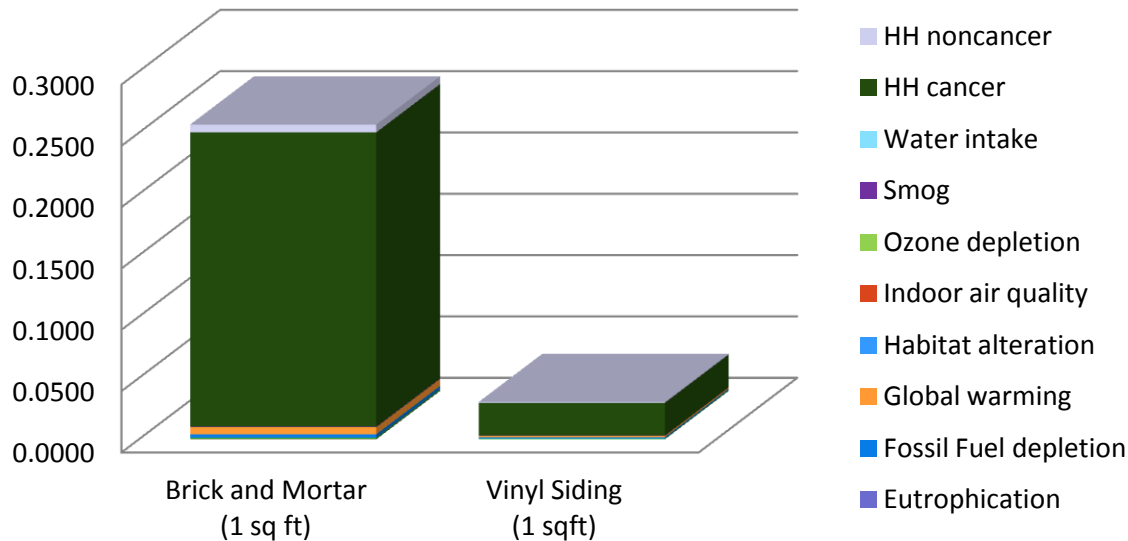
Brick siding weighs almost 35 lbs. per square foot of wall coverage, while vinyl siding only weighs only half a pound per square foot

Note: Lower Values are Better

Source: BEES 4.0e

Functional Units

- Comparisons of LCA results should always be made using *functional* units
- Functional units are based on how the product is used
- For exterior cladding the functional unit is area of wall covered



Note: Lower Values are Better

Source: BEES 4.0e

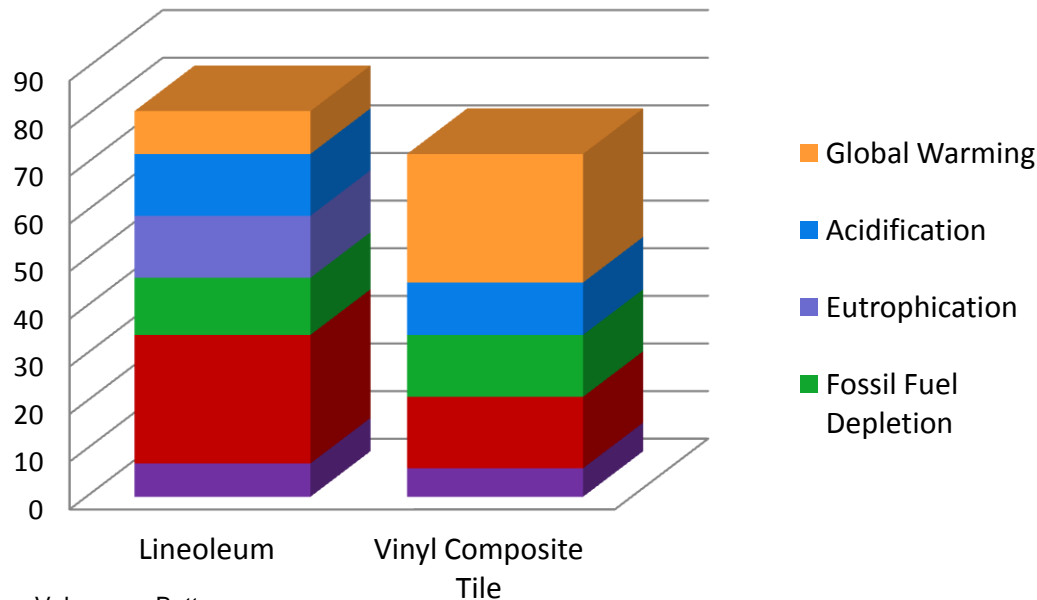
Choosing the “Greenest” Product

- The results of LCA can be counter-intuitive, because we are not always aware of the impacts involved in manufacturing a product
- Linoleum, for example, is made primarily from linseed oil and jute, both rapidly renewable products, but the raw materials and the final product must be shipped long distances to reach consumers in the United States
- Vinyl Composite Tile (VCT) is manufactured from petroleum products and limestone, but is usually made in the United States, close to consumers

Choosing the “Greenest” Product

- Choosing the most environmentally sound product is not always as simple as choosing the *natural* material, or the one with high recycled content

Comparison of 1 sq. ft. of flooring



Despite being made from rapidly renewable materials, linoleum from Europe is slightly worse than VCT in terms of life cycle impact

Note: Lower Values are Better

What is Being Done with LCA?

- Many companies and industry associations are completing LCA for their products
- This data is being published in BEES, the NREL LCI database and as EPD's
- LEED has developed a Pilot LCA credit, and future LEED Standards are expected to integrate credits for product selections based on LCA
- The ICC-700-2008 National Green Building Standard and the California Green Building Code (CALGREEN) provide credit for selecting materials using LCA
- Retail companies, such as Walmart, are using LCA to analyze consumer products and provide information to consumers

Consumer Products LCA Efforts

- Walmart is helping create a consortium of universities to develop a global database of information on the life cycle of various consumer products
- The final step of the project will be to create a label, similar to a food label, that will provide customers with product information as a simple, easy-to-understand rating

Nutrition Facts	
Serving Size: 2 oz. (60 ml)	
Servings Per Container 1	
Amount Per Serving	
Calories 68	Calories from Fat 0
% Daily Value*	
Total Fat <1g	0%
Saturated Fat 0g	0%
Cholesterol 0mg	0%
Sodium 30mg	1.5%
Total Carbohydrate 17g	4%
Dietary Fiber 0g	0%
Sugars 7g (from natural fruit juices)	
Protein 1g	2%
Vitamin A 45 IU <1%	Vitamin C 2mg <1%
Vitamin B-12 6mcg 100%	Calcium 0%
Iron 0%	Niacin 20mg 100%
<small>*Percent Daily Values are based on a 2,000 calorie diet.</small>	

Ingredients: Purified Water, Organic Agave, Proprietary blend of the following concentrates: Cranberry, Pomegranate, Passion Fruit, Aronia Berry, Lime, Orange, Ginger, Rose, Ylang Ylang, Neroli, Geranium, Frankincense, Tulsi, Turmeric, Peppermint, Nutmeg and Astaxanthin, Guarana Powder, Rosemary Antioxidant, Niacin, Vitamin B-12, Ionic Sea Trace Minerals.

LCA Comparison Tools



BEES[®]



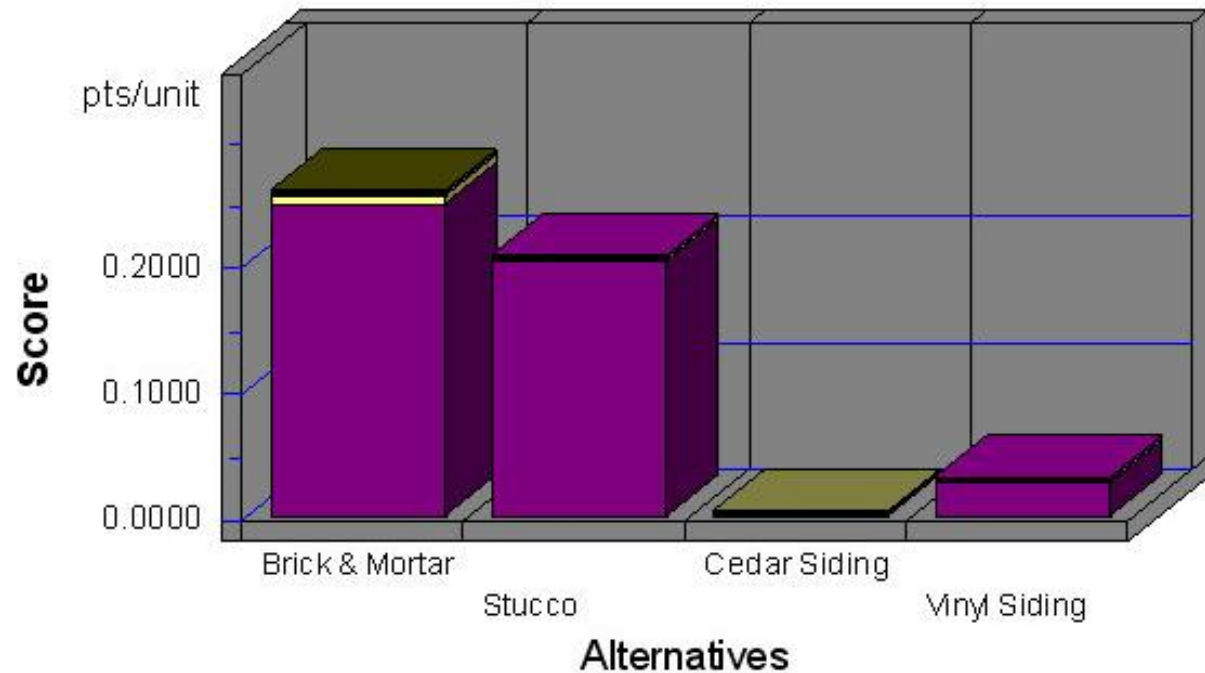
- The BEES (Building for Environmental and Economic Sustainability) tool is a software program developed by the U.S. government to aid in selecting environmentally friendly and cost-effective building products
- BEES provides the ability to compare many building products based on LCA and cost data, allowing the user to choose the best product according to their preferences
- A web-based version of BEES will be released this fall
- BEES is free and available at the website

http://www.bfrl.nist.gov/oea/software/bees/please/bees_please.html

BEES Results

Environmental Performance of Common Cladding Products

Acidification
Crit. Air Pollutants
Ecological Toxicity
Eutrophication
Fossil Fuel Depletion
Global Warming
Habitat Alteration
Human Health
Indoor Air
Ozone Depletion
Smog
Water Intake



Note: Lower Values are Better



- The ATHENA tools allow the comparison of whole building assemblies, rather than specific products and can be used to create a whole building LCA
- EcoCalculator, the free version, is spreadsheet based tool useful for comparing assemblies
- Impact Estimator, the advanced tool, is useful for creating whole building LCA's
- More information on Athena is available at <http://www.athenasmi.org/about/lcaModel.html>

TOTAL IMPACTS BY BUILDING COMPONENT	Primary Energy (MJ) TOTAL	Weighted Resource Use (tonnes) TOTAL	GWP (tonnes CO2eq) TOTAL	Acidification Potential (moles of H+ eq) TOTAL	HH Respiratory Effects Potential (kg PM2.5 eq) TOTAL	Eutrophication Potential (g N eq) TOTAL	Ozone Depletion Potential (mg CFC-11 eq) TOTAL	Smog Potential (kg NOx eq) TOTAL
INTERIOR WALLS	0	0	0	0	0	0	0	0
WHOLE BUILDING TOTAL	0	0	0	0	0	0	0	0

F. INTERIOR WALLS

IN THE YELLOW CELLS BELOW, ENTER THE AMOUNT OF SQUARE FOOTAGE THAT EACH ASSEMBLY IS USED IN YOUR BUILDING

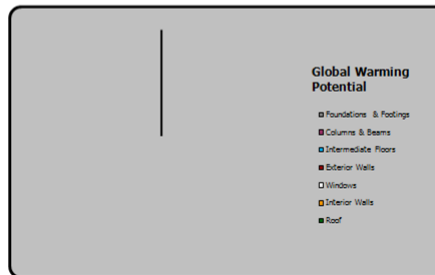
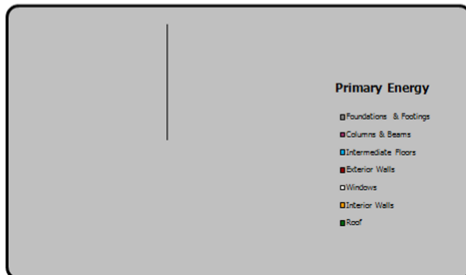
	ASSEMBLY TYPE (gypsum and paint are on BOTH SIDES of the interior walls)	Square footage	Percentage of total	Primary Energy Consumption per ft ² (MJ)	Weighted Resource Use per ft ² (kg)	Global Warming Potential per ft ² (kg CO2 eq)	Acidification Potential per ft ² (moles of H+ eq)	HH Respiratory Effects Potential per ft ² (g PM2.5 eq)	Eutrophication Potential per ft ² (mg N eq)	Ozone Depletion Potential per ft ² (mg CFC-11 eq)	Smog Potential per ft ² (g NOx eq)
Average across interior walls:				45.00	7.54	2.53	1.12	12.53	477	0.01	7.07
1	2x4 Wood stud wall 16" o.c. 5/8" Gypsum board + 2 coats Latex paint	0		30.70	4.9663	0.99	0.48	9.36	167	0.01	3.08
2	2x4 Wood stud wall 24" o.c. 5/8" Gypsum board + 2 coats Latex paint	0		30.14	4.5543	0.98	0.48	9.32	154	0.01	3.06
3	2x4 Wood stud wall 24" o.c. 2 x 5/8" Gypsum board + 2 coats Latex paint	0		43.27	7.0448	1.61	0.82	12.27	221	0.01	4.17
4	1-5/8" x 3-5/8" Steel stud 16" o.c. 5/8" Gypsum board + 2 coats Latex paint	0		35.65	4.4073	1.50	0.59	9.71	271	0.00	4.26
5	1-5/8" x 3-5/8" Steel stud 24" o.c. 5/8" Gypsum board + 2 coats Latex paint	0		33.85	4.1328	1.36	0.55	9.58	231	0.00	3.94
6	1-5/8" x 3-5/8" Steel stud 24" o.c. 2 x 5/8" Gypsum board + 2 coats Latex paint	0		46.98	6.6232	1.99	0.89	12.52	298	0.00	5.05
7	6" Concrete block 5/8" Gypsum board + 2 coats Latex paint	0		78.55	12.2852	6.26	2.46	23.20	1392	0.01	18.31
8	6" Concrete block 2 coats Latex paint	0		65.42	9.7947	5.63	2.12	20.26	1325	0.01	17.21
9	Clay brick (4") unpainted	0		40.40	14.05	2.43	1.65	6.50	233	0.00	4.58
TOTAL INTERIOR WALL SQUARE FOOTAGE		0									

Version 3.3
Location: New York City
ASHRAE climate zone 4
Low-rise structures (Up to 4 stories)

ENVIRONMENTAL IMPACT SUMMARY

ASSEMBLY	Total area	Primary Energy (MJ) TOTAL	Weighted Resource Use (tonnes) TOTAL	GWP (tonnes CO2eq) TOTAL	Acidification Potential (moles of H+ eq) TOTAL	HH Respiratory Effects Potential (kg PM2.5 eq) TOTAL	Eutrophication Potential (g N eq) TOTAL	Ozone Depletion Potential (mg CFC-11 eq) TOTAL	Smog Potential (kg NOx eq) TOTAL
Foundations & Footings	0	0	0	0	0	0	0	0	0
Columns & Beams	0	0	0	0	0	0	0	0	0
Intermediate Floors	0	0	0	0	0	0	0	0	0
Exterior Walls	0	0	0	0	0	0	0	0	0
Windows	0	0	0	0	0	0	0	0	0
Interior Walls	0	0	0	0	0	0	0	0	0
Roof	0	0	0	0	0	0	0	0	0
TOTALS		0	0	0	0	0	0	0	0

Primary Energy	Weighted Resource Use	Global Warming Potential	Acidification Potential	Human Health Respiratory Effects Potential	Eutrophication Potential	Ozone Depletion Potential	Smog Potential
0%	0%	0%	0%	0%	0%	0%	0%
0%	0%	0%	0%	0%	0%	0%	0%
0%	0%	0%	0%	0%	0%	0%	0%
0%	0%	0%	0%	0%	0%	0%	0%
0%	0%	0%	0%	0%	0%	0%	0%
0%	0%	0%	0%	0%	0%	0%	0%
0%	0%	0%	0%	0%	0%	0%	0%



Environmental Product Declaration (EPD)

- Environmental Product Declarations (EPD) are simplified presentations of the results of an LCA
- They present quantified environmental data for products or systems
- EPD's are well established in Europe, but the necessary standards are still being developed in the United States
- EPDs are generally produced by the product manufacturer
- The Green Standard is responsible for much of the work to develop EPD's in the U.S.
- More information and sample EPD's are available on their website http://thegreenstandard.org/EPD_System.html



THE GREEN STANDARD

Environmental Product Declaration

In accordance with ISO 14025



Convert™ Design Platform by InterfaceFLOR®

Modular carpet tile made with post-consumer content type 6,6 nylon and post-consumer content non-virgin PVC backing.



The Green Standard Environmental Product Declaration System

www.TheGreenStandard.org

Declaration Number: TGS – 1000409 – 0411 – B

InterfaceFLOR®

convert

Manufacturing Location
1503 Orchard Hill Road
LaGrange, GA 30240

Environmental Product Declaration

TRACI, Acidification Potential	2.5	mol H+ Equiv.
TRACI, Eutrophication Potential (Water & Air)	0.01	kg N-Equiv.
TRACI, Global Warming Potential	10.57	kg CO ₂ -Equiv.
TRACI, Ozone Depletion Potential	9.5 x 10 ⁻⁷	kg CFC 11-Equiv.
TRACI, Smog Air	4.6 x 10 ⁻⁷	kg NOx-Equiv.
<u>CML 2002</u>		
CML2002, Acidification Potential	0.05	kg SO ₂ -Equiv.
CML2002, Eutrophication Potential	0.01	kg Phosphate-Equiv.
CML2002, Global Warming Potential (GWP 100 years)	10.7	kg CO ₂ -Equiv.
CML2002, Ozone Layer Depletion Potential (ODP, steady state)	8.9 x 10 ⁻⁷	kg R11-Equiv.
CML2002, Photochem. Ozone Creation Potential (POCP)	0.005	kg Ethene-Equiv.
CML2002, Abiotic Depletion	2.4 x 10 ⁻⁵	kg Sb-Equiv.

Figure 14. Life cycle stages as a percentage of total impacts

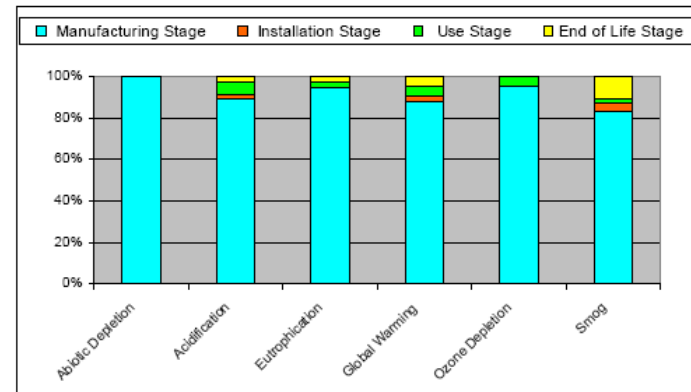


Figure 15. Distribution of the environmental impacts to the different stages of the life cycle

Impact Category	Manufacturing Stage	Installation Stage	Use Stage	End of Life Stage
Acidification	89.32%	2.64%	5.56%	2.47%
Eutrophication	94.29%	0.94%	2.71%	2.06%
Global Warming	87.98%	2.49%	4.87%	4.65%

The Green Standard Environmental Product Declaration System

www.TheGreenStandard.org

Declaration Number: TGS – 1000409 – 0411 – B

LCA Comparison of Exterior Cladding



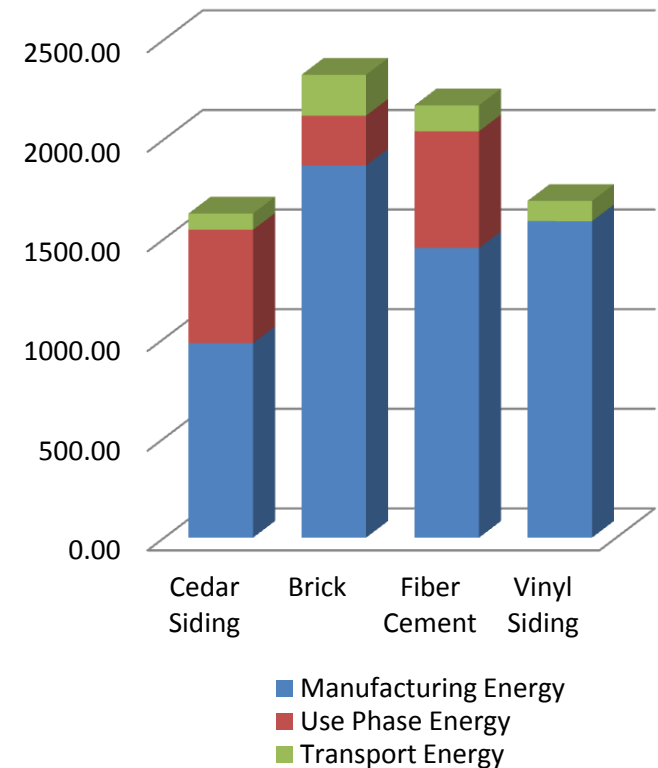
Comparisons of Exterior Cladding

- Until recently, the main source of LCA data for comparing various exterior cladding options was BEES
- BEES currently does not have any data on fiber cement which makes a direct comparison of vinyl siding and silica-based fiber cement impossible
- The Western Red Cedar and Lumber Association has recently published a report comparing four cladding options: Western red cedar, brick, vinyl siding, and fiber cement
- The results of this analysis provide the first published data that allows the comparison of silica-based fiber cement to other cladding in terms of environmental impacts
- Fiber cement data for this report was developed from patent documents, published fiber cement data from Europe and a James Hardie Building Products technical bulletin

Energy Use Comparison

- **Manufacturing Energy:**
Producing raw materials and manufacturing the final product
- **Use Phase Energy:**
Producing and applying paint and other finishes
- **Transport Energy:**
Transporting raw materials and final product

Life Cycle Energy Usage
100 sq. ft.

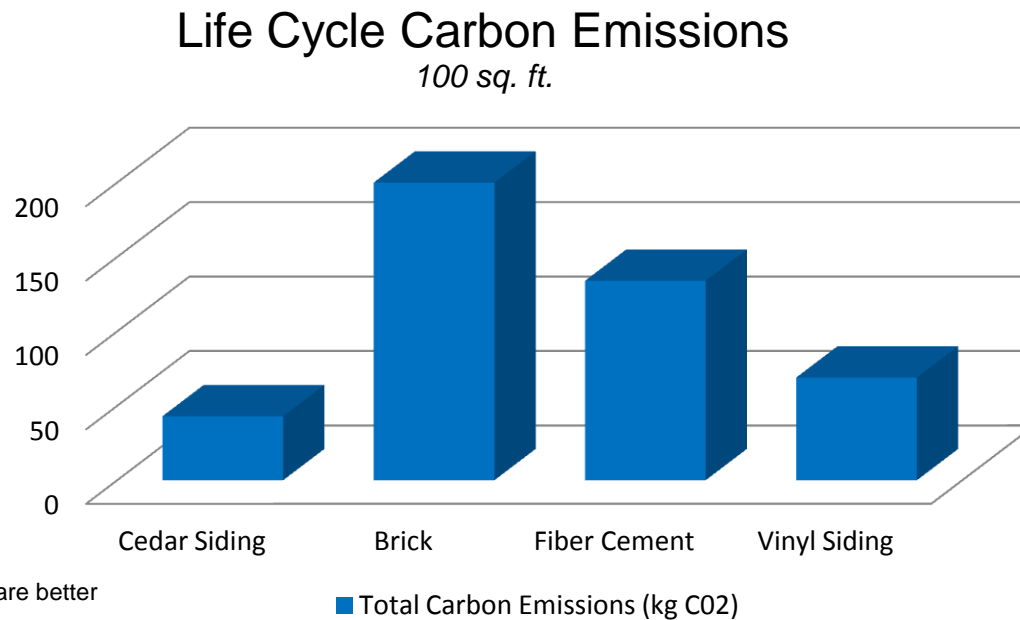


Note: Lower values are better



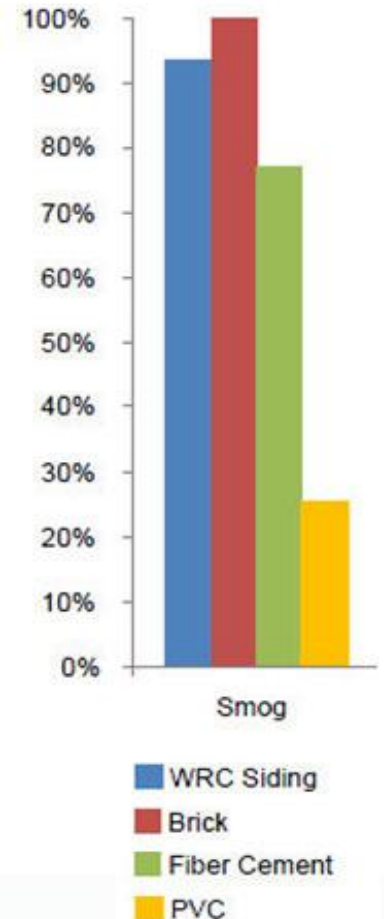
Global Warming Comparison

- Carbon dioxide and other greenhouse gasses are emitted at every stage in the manufacturing process
- Measured in CO₂ equivalents



Smog Comparison

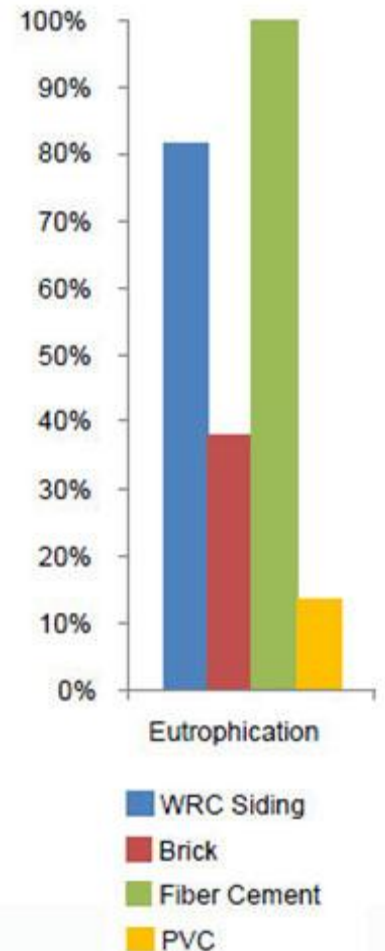
- Nitrogen oxides (NO_x) and other volatile organic compounds (VOCs) are released into the air from manufacturing and transportation
- These chemicals, in the presence of sunlight, produce photochemical smog, which can cause respiratory and other health problems
- Measured in Nitrogen Oxide (NO_x) equivalents



Note: Lower values are better

Eutrophication Comparison

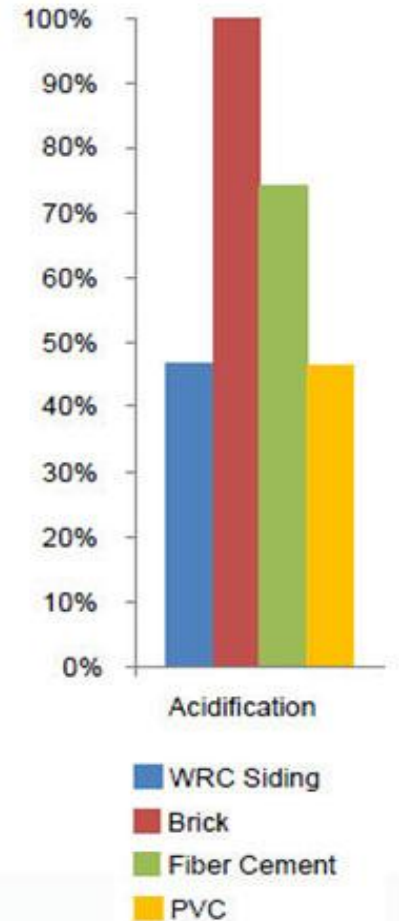
- Eutrophication results from excess nutrients being added to surface waters
- These nutrients cause a rapid growth of algae, which can absorb the oxygen from the water, killing fish and other wildlife
- Fertilizer runoff from farms is a major contributor to eutrophication
- Measured in Nitrogen equivalents



Note: Lower values are better

Acidification Comparison

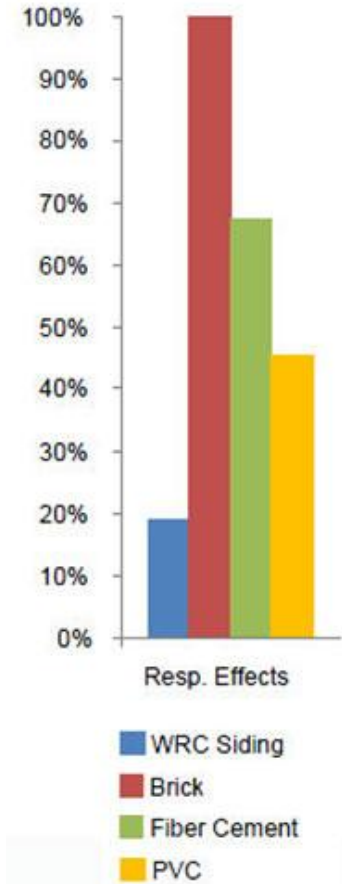
- Acidification results primarily from the release of Sulfur Dioxide (SO_2) into the atmosphere
- This leads to the creation of acid rain, which can kill trees and increase the acidity of lakes and soil
- Measured in H^+ equivalents



Note: Lower values are better

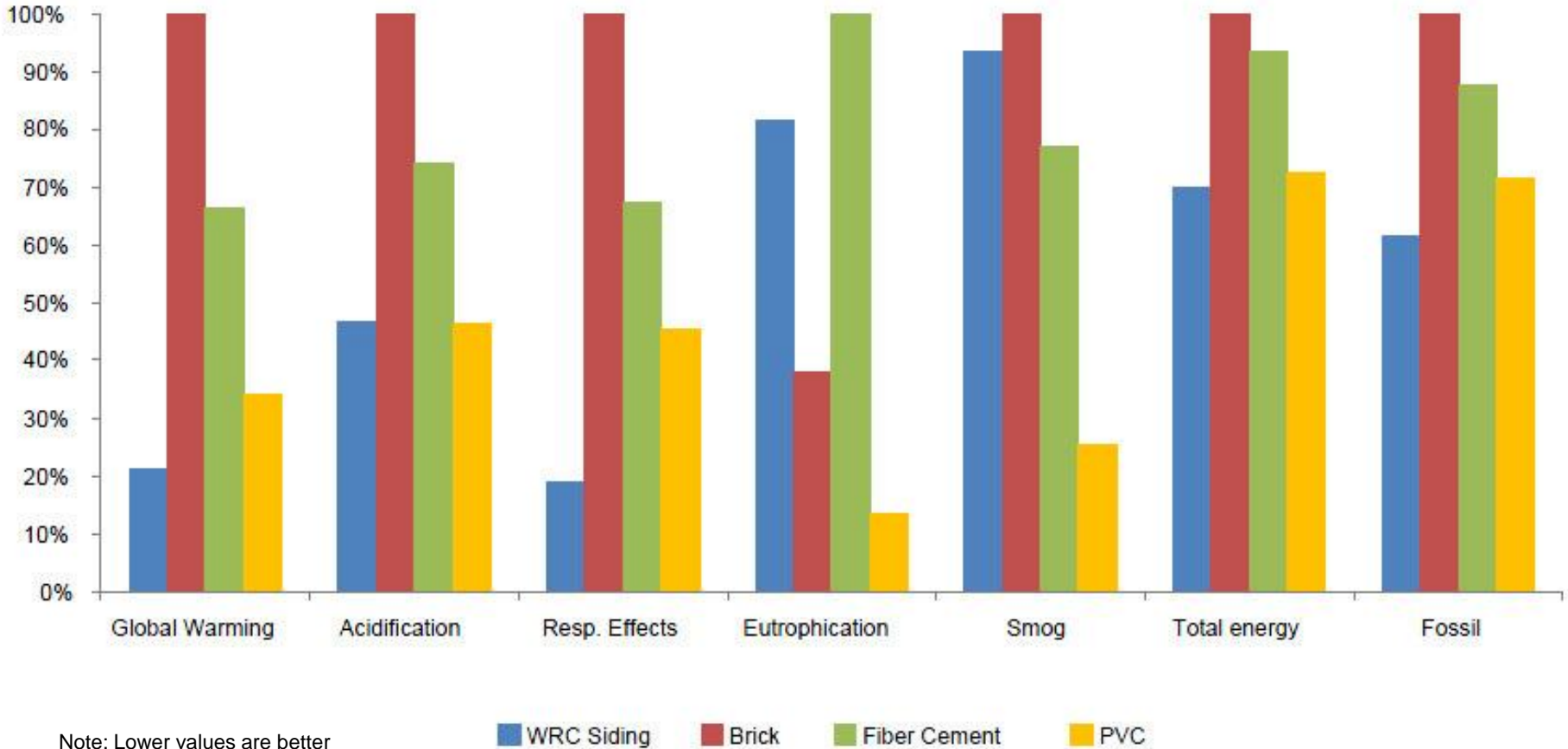
Particulate Health Comparison

- Particulate matter has a considerable impact on human health
- The EPA has identified “particulates” (from diesel fuel combustion) as the number one cause of human health deterioration due to their impact on the human respiratory system – resulting in asthma, bronchitis, acute pulmonary disease, etc.
- Measured in PM_{2.5} equivalents



Note: Lower values are better

Life Cycle Impact: Exterior Cladding Comparison



Vinyl Siding vs. Silica-based Fiber Cement

- Compared to silica-based fiber cement, like James Hardie siding products, vinyl siding is a greener exterior cladding in many categories, including
 - Water and energy used to manufacture
 - Waste from manufacturing process
 - Embodied energy
 - Release of toxic chemicals
 - Transportation energy
 - Job site finishing and maintenance



LCA in Green Building



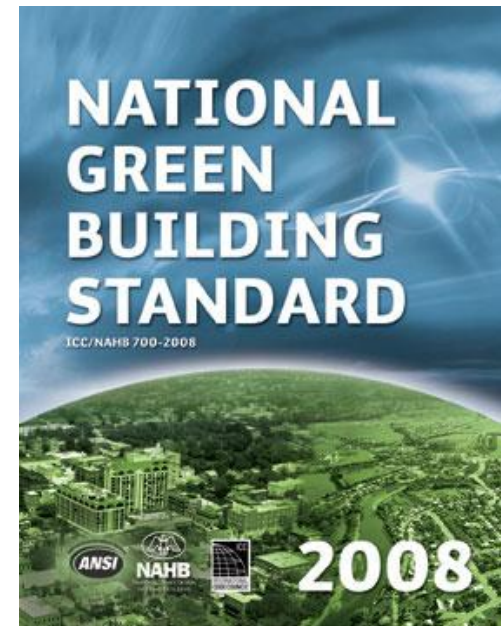
LEED Pilot Credits

- LEED has created an LCA Pilot credit with the goal of encouraging the use of environmentally preferable building materials and assemblies
- This credit is still being tested, but it requires the use of an LCA tool to choose the most environmentally sound product or assembly
- Currently this credit only applies to the commercial LEED systems, such as LEED-NC



National Green Building Standard Credits

- 609.1 Life Cycle Analysis
 - A more environmentally preferable product or assembly is selected for an application based upon the use of a Life Cycle Assessment (LCA) tool compliant with ISO 14044 or other recognized standards that compare the environmental impact of building materials, assemblies, or the whole building
 - (1) Pre-product/system comparison
 - (2) Whole building LCA analysis



How Does Vinyl Siding Fare?

- Use of vinyl siding on a building can support certification through both LEED® for Homes (H) and LEED® for New Construction (NC)
- By using vinyl siding, points can be obtained for resource and energy efficiency in the ANSI approved ICC-700-2008 National Green Building Standard™ (NGBS)
 - No additional finish on site
 - Termite-resistant materials
 - May contain recycled content
 - Indigenous materials
 - Life cycle analysis
 - Innovative practices
 - Building energy efficiency
- Most green programs will qualify vinyl siding for points based on its durability and low maintenance



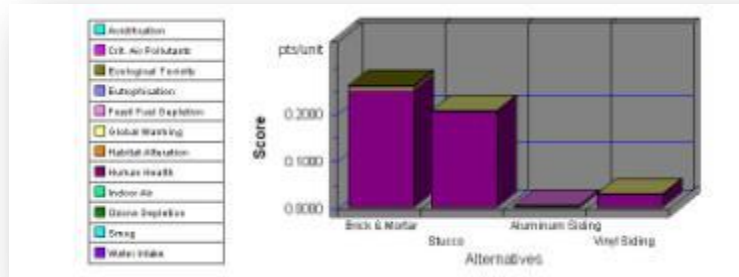
Life Cycle Thinking

- True sustainability of buildings requires a thorough understanding of the impacts of products and materials
- It is important to use life cycle thinking as we design and renovate buildings

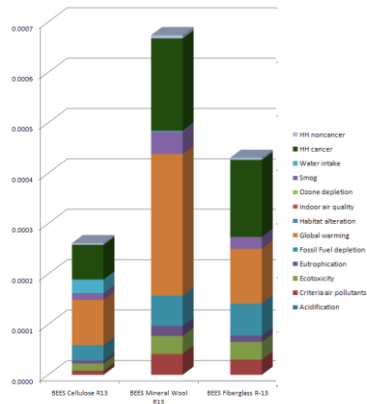


The Future of LCA

Product LCAs can be used to create building LCA's



Product LCA's



Whole Building LCA



What You Can Do

- Don't assume a product is *green* because advertising claims it is
- Educate yourself on the life cycle of products and how to use LCA to make comparisons between products
- Use life cycle thinking in your selection of products and materials – BEES is a good tool to begin this process
- Ask the manufacturer if they have an LCA, EPD or any information on life cycle impacts of their products
- Look for whole building LCA in the future



Poll #3



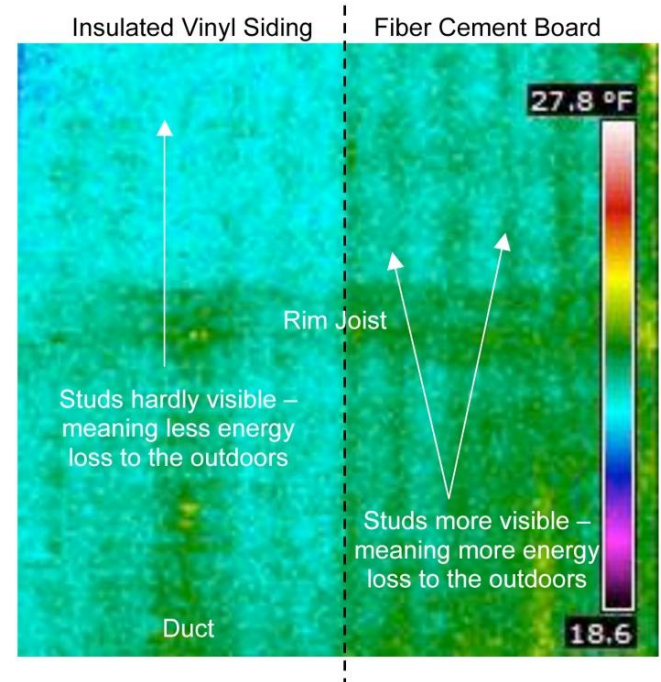
Insulated Siding Boosts R-value



Energy Efficiency

- Durable buildings need to be energy efficient to be sustainable
- In wood frame construction, energy escapes through studs by way of a process called thermal bridging
- Using insulated siding for continuous insulation on the exterior of a home is one way to increase the energy efficiency of the structure
- Insulated siding can increase the effective R-value of a wall
- The added R-value reduces the energy consumption over the lifetime of the building and reduces the carbon footprint

Thermal Imaging Side-By-Side Field Test



The Future of Insulated Siding

- Insulated siding received initial approval from the International Code Council's International Energy Conservation Code Committee to be included in the 2012 edition of the *International Energy Conservation Code*
- Insulated siding has been added to the checklist of building products or methodologies that can help qualify homes under the *ENERGY STAR 2011 Qualified New Homes Program*
- The U.S. House of Representatives included insulated siding in Home Star Gold as an option for improving the energy efficiency of remodeled homes

The Facts About Vinyl Siding and Sustainability



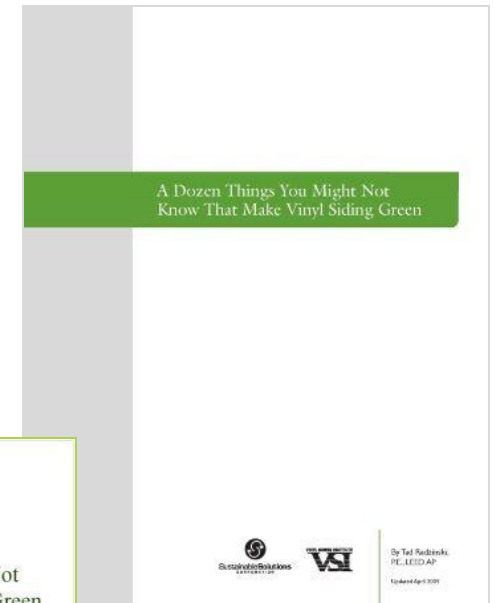
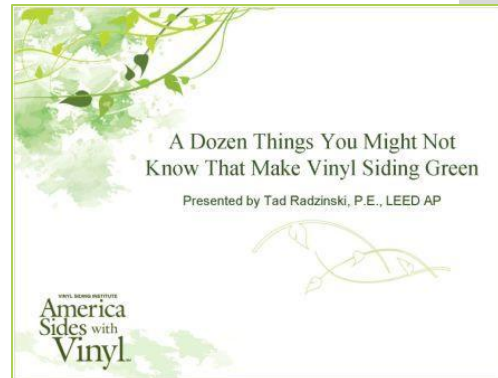
A Dozen Things You Might Not Know That Make Vinyl Siding Green

- Can contribute to points in leading green building programs
- Boosts a home's R-value
- Generates less waste during manufacturing
- Produces little waste when installed
- Required few resources to maintain beauty
- Is engineered to last
- Offers better environmental performance
- Balances economic with environmental performance
- Contributes less to global warming than brick
- Releases fewer toxic chemicals than other exterior cladding throughout its life cycle
- Emits less dioxin than other exterior cladding
- Installs safely



Additional Resources

- *A Dozen Things You Might Not Know That Make Vinyl Siding Green*
 - Green Paper
 - www.vinylsiding.org/greenpaper
 - Webinar
 - Available for on-demand viewing on VSI website (www.vinylsiding.org)





Questions?

For more information on life cycle analysis
and other benefits of vinyl siding visit

www.vinylsiding.org

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America
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