SustainableSolutions CORPORATION

Responses to Matt Powers' Questions

1. **Lack of third party research on durability and life cycle. Although many claims are made about vinyl's long life and durability, it's impossible to find any data on vinyl siding lifespan...or vinyl window lifespan. I hear anecdotally from builders that it doesn't hold up...at least the old stuff prior to better UV inhibitors.**

There is, unfortunately, very little research available on the viable lifetime of vinyl siding and many other, newer building products. This is due to the fact that there simply hasn't been sufficient time for vinyl siding, particularly the newer, more durable formulations, to demonstrate the ability to endure for decades. There are examples of homes that have had vinyl siding for 30-40 years without the need for replacement, and examples of homes that have needed to replace their vinyl siding more frequently; however, the numerous claims about vinyl siding's durability and long life are based on several key factors. These factors include the 50-year and lifetime warranties offered by manufacturers as well as the improved UV resistance and impact resistance of current vinyl siding products.

It is important to note that today there is an ASTM standard for siding that set high standards for quality and durability. *ASTM D3679* "establishes requirements and test methods for the materials, dimensions, warp, shrinkage, impact strength, expansion, appearance, and windload resistance" of vinyl siding. Ninety-seven percent of vinyl siding in the U.S. is certified to *ASTM D3679* through the *VSI Product Certification Program*. *ASTM D6864* and *D7251* focus specifically on color retention, which essentially sets standards for UV resistance.

Fifty -year and lifetime warranties have become the standard for the vinyl siding industry, demonstrating that manufacturers have confidence that the product will endure for decades on a home.

Life cycle assessments (LCA) of building products have been conducted by various groups. Building for Environmental and Economic Sustainability (BEES)[1], a program created and operated by the National Institute for Standards and Technology (NIST), uses a 40-year lifetime for vinyl siding, and a recent LCA of four decking and siding products conducted by the Western Red Cedar Lumber Association (WRCLA) points out that "Many manufacturers offer a 50-year lifetime warranty on vinyl siding. Therefore, it does not require any replacement during the 50-year service life."[2] In addition, both of these LCA sources point out an additional aspect of vinyl's durability – the fact that it requires minimal maintenance, only simple washing, over the course of its life, significantly

[1] BEES Program Description and Software available at: http://www.nist.gov/el/economics/BEESSoftware.cfm

[2] Mahalle, Lal and Jennifer O'Connor. 2009. *Life Cycle Assessment of Western Red Cedar Siding, Decking, and Alternative Products*. FP Innovations

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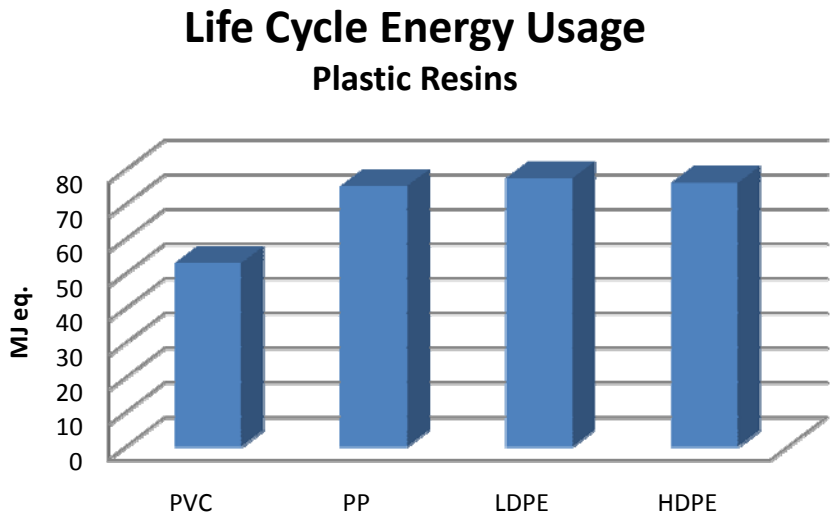
reducing the life cycle impacts of vinyl siding compared to other cladding options that require frequent painting, caulking, pointing, staining, etc.

In the decades since vinyl siding was first developed, significant improvements have been made to the manufacturing process. The move from plastic pellets to a blended, engineered powder in the 1970s resulted in a more consistent and durable product. More recently the move to co-extrusion, now the industry standard, has significantly improved the performance of vinyl siding. Co-extrusion is a process in which the two layers of vinyl siding are extruded simultaneously and are sandwiched together. The outer layer, the topcoat, includes UV-inhibitors, which protect it and the inner layer, the substrate, from UV damage. Co-extrusion also makes it easier to incorporate recycled content into the product, because it can be mixed into the substrate, which does not have to provide the consistent color and UV protection that the topcoat provides.

2. Low quality plastic. I'm sure you're familiar with the Greenpeace pyramid of plastics...vinyl does very poorly... http://archive.greenpeace.org/toxics/pvcdatabase/bad.html I've heard similar things from material scientists. Why not use HDPE or some other more easily recyclable plastic to do the same job?

PVC, like other plastics, is made from a combination of fossil fuels and other compounds. PVC starts with two simple building blocks: 57 percent from common salt, from which chlorine is extracted, and 43 percent from natural gas; both are widely available resources. Vinyl is also the most energy efficient resin to produce, requiring a lower energy investment per kg produced than other plastics, as shown in the graph below. These characteristics, coupled with its physical properties, help to explain the wide use of PVC in a range of applications.

Life Cycle Energy Usage to Produce Plastic Resins[3]



[3] Data for this analysis is from the USLCI database, managed by the Renewable Energy Laboratories, available at: http://www.nrel.gov/lci/

A typical formulation for vinyl siding is included below and is the generic formula used in BEES. Each vinyl siding manufacturer has its own variation, but the proportions are relatively similar.

Typical Vinyl Siding Constituents[4]

	Percent
PVC	82.5 %
Filler	8.5 %
Titanium Dioxide	2.5 %
Impact Modifier	4 %
Stabilizer	1 %
Lubricant	1.5 %

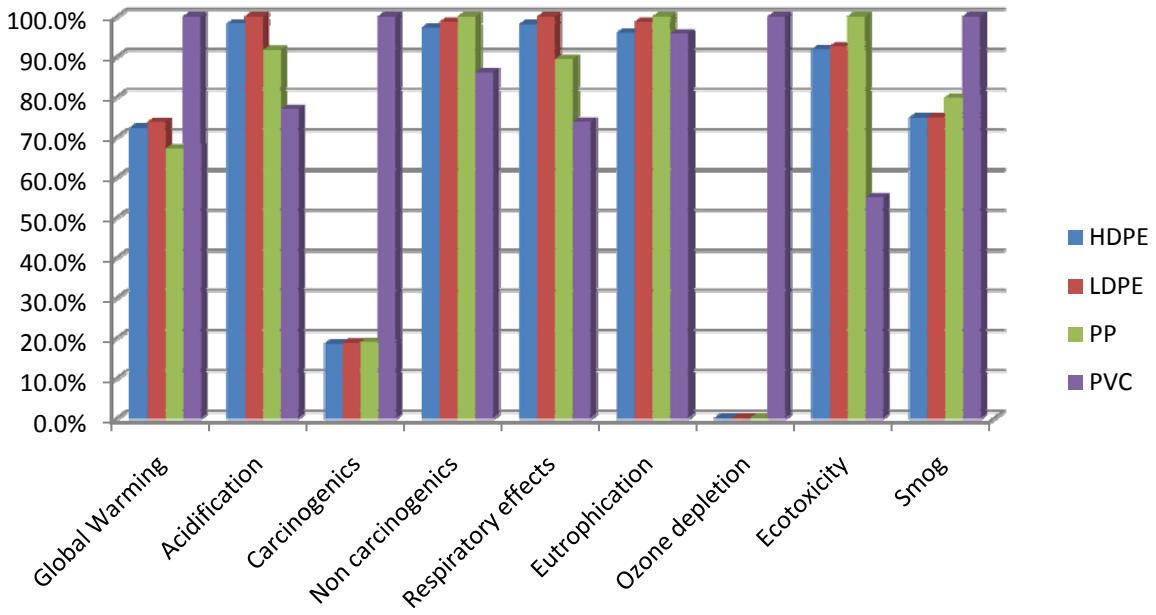
This formula shows that vinyl siding is made up of approximately 82 percent PVC with other materials mixed in to provide additional characteristics needed for the siding to function optimally. The same need to mix plastics and other compounds would exist regardless of the plastic used.

The Greenpeace Pyramid of Plastics provides a qualitative ranking that does not include complete life cycle data for the comparison of the environmental impacts of various plastic resins. The Pyramid only examines "the production, additives, product emissions during use, disposal and recycling." Also, it is not clear if the Greenpeace Pyramid includes any risk-exposure analysis,"[5] All materials cause negative impacts to the environment, and it is important to use the best data at hand to choose materials that are low-impact and appropriate to their use.

As Greenpeace's Pyramid is a qualitative ranking system that does not include raw materials and energy inputs, it is better to use complete LCA data when comparing plastic resins. Such data is available from the National Renewable Energy Laboratory's US LCI database. The result of the comparison of several plastic resins using this US LCI data is provided below. The comparison was made using the TRACI Impact Methodology.

[4] BEES 4.0 Technical Manual and User's Guide. Available at: http://www.nist.gov/el/economics/upload/BEES40manual.pdf
[5] Greenpeace Pyramid of Plastics, Available at: http://archive.greenpeace.org/toxics/pvcdatabase/bad.html

Overall Environmental Impact of Plastic Resins – TRACI Impact Methodology[6]



The graph above demonstrates the various environmental impacts of these plastic resins. All of the plastic resins evaluated above are produced from petrochemicals, and none of them is a clearly superior material from an environmental perspective. PVC performs better in some environmental impact categories and worse in others, and the same is true for the other plastic resins. When selecting a plastic resin for a purpose, one must consider both the environmental impacts associated and the physical properties of that resin to find the right balance of performance and environmental impact.

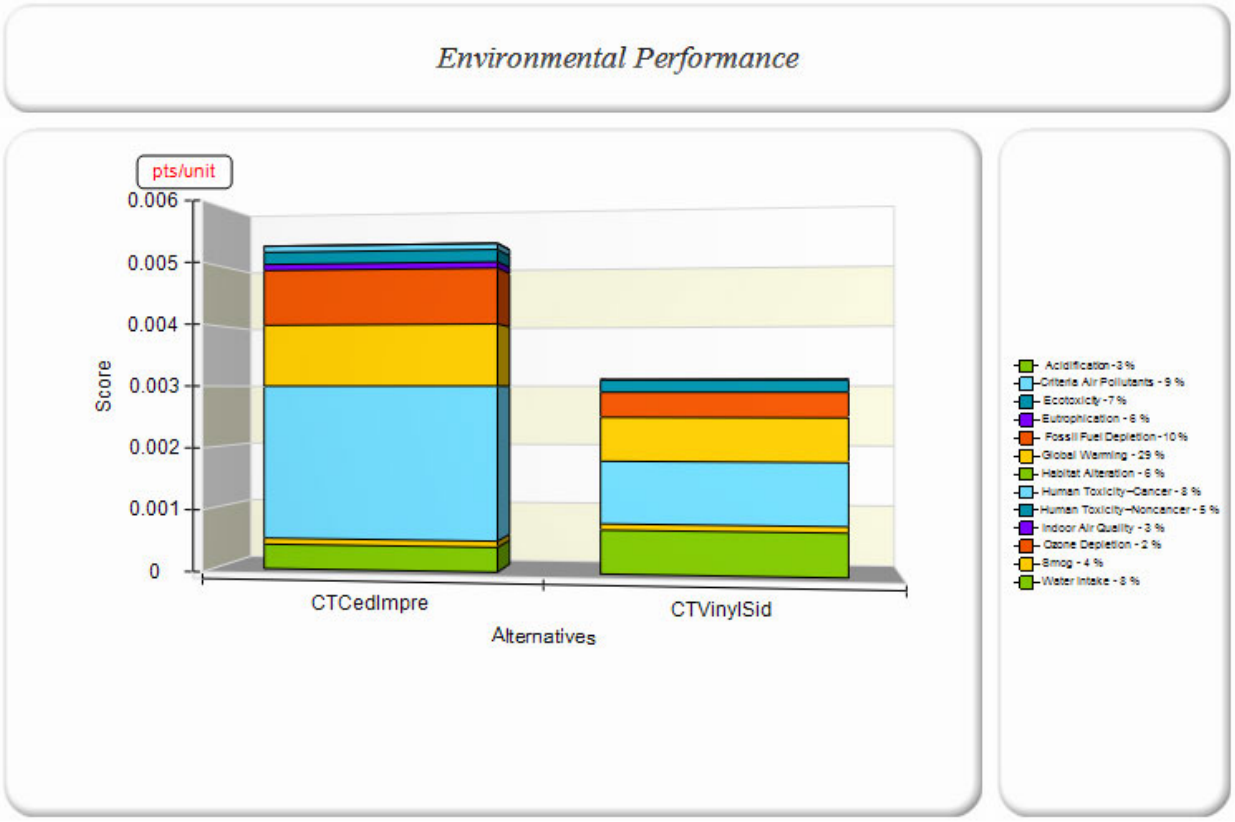
PVC has several characteristics that make it ideal as a building product. It has a higher tensile strength (resistance to stretching forces), flexural strength (resistance to deformation), and hardness (resistance to permanent indentation) than HPDE, LDPE, or PP plastics. This makes it more suitable as a building material under many conditions compared to these other plastics.

Currently, the only other plastic generally used to produce siding is polypropylene (PP). Polypropylene is lower (considered safer) on the Greenpeace Pyramid of Plastics; however, to produce one square foot of siding from PP (and assorted other compounds) requires almost twice as much material as vinyl siding. This greater mass and different mixture of components means that PP siding actually has a higher environmental impact per square foot of wall coverage than standard vinyl siding. CertainTeed Corporation manufactures both standard vinyl siding (CTVinylSid) and Cedar Impressions (CTCedImpre), their PP siding, and have submitted life cycle data for both to BEES. The graph below demonstrates the overall environmental impact of one square foot of both of these siding products. The lower weight per square foot of siding and the proportion of other

[6] Data for this analysis is from the USLCI database, managed by the Renewable Energy Laboratories, available at: http://www.nrel.gov/lci/

components mixed into siding products results in a vinyl siding product that has lower impact than siding made from another plastic resin.

Overall Environmental Impact of Siding Products – BEES Impact Methodology[7]



The US Green Building Council's Technical and Scientific Advisory Committee (TSAC) also investigated alternatives to PVC for siding, flooring, windows, and pipe. The TSAC used a combination of LCA 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 was only advisable in a few cases. Below is a summary of their conclusions in terms of human health and environmental impact:

Human Health Risk: The evidence indicates that a credit rewarding avoidance of PVC could steer decision makers toward using materials that are better for human health in the case of resilient flooring. If buyers switched from PVC to aluminum window frames, to aluminum siding, or to cast iron pipe, it could be worse than using PVC.

Environmental Impact: The evidence indicates that a credit that rewards the avoidance of PVC could steer decision makers toward using materials that are worse on most environment impacts.[8]

[7] This graph was generated using BEES online tool, available at: http://ws680.nist.gov/Bees/
[8] USGBC Memorandum on the TSAC Report on PVC. Available at: https://www.usgbc.org/ShowFile.aspx?DocumentID=2372

3. Why are big companies such as Wal-Mart banning PVC, if the product is problem free? Link here: http://www.planetizen.com/node/19261. I realize many rigid building materials do not contain Phthalates (notably pvc pipes--an error one of our freelancers made recently), but uPVC to my understanding has been banned in Germany and the Netherlands, and California is looking at a partial ban on some pvc products.

In response to the comment about banning rigid PVC, we have been unable to find any large-scale bans. There is some information about Germany refusing to use vinyl siding on public buildings, but that is the only instance we are aware of. While flexible PVC may use phthalates, phthalates are not used in vinyl siding, and therefore, do not contribute to any impacts when analyzing vinyl siding.

There are some companies, such as Wal-Mart, which are making an effort to reduce their usage of PVC. This has proven difficult because, while there are some uses for PVC which have viable replacements, there are other situations in which PVC is the most suitable material. The 2009 Wal-Mart sustainability report states that:

> "While we continue to look for alternatives to PVC, we have been unable to find suitable replacements for PVC used in over-the-counter, tamper-evident bands, metal can sealants and meat wrapping, among others. Until we identify another material of equal performance, we will not eliminate PVC from certain items to ensure the safety of our customers."[9]

The argument is not that PVC should be used for everything, but simply that there are uses for which it is an extremely suitable material; and in those instances, efforts to replace it with other, less suitable, materials may result in higher environmental and human health impacts.

[9] Wal-Mart 2009 Sustainability Report. Available at: http://walmartstores.com/sites/sustainabilityreport/2009/

4. Why is recycling of vinyl siding and windows post consumer so low? Something's not working. The excuse that virgin resin is cheaper than recycled resin is not good enough.

The United States has very low recycling rates for plastics in general. The recycling rates and total amount of each plastic in the municipal solid waste (MSW) stream are listed in the table below. This represents the plastics that are collected from businesses, curbside recycling programs, universities, etc. As you can see, while there is no significant PVC recycling, the contribution of PVC to landfill waste is by far lower than any of the other plastic resins, yet the volume of PVC sold and used in 2009 in the U.S. ranks third among the listed resins (behind PP and HDPE)[10]. This is at least in part due to the durable nature of many PVC products.

Durable goods made from PVC, such as siding, pipe and decking, will last for decades and do not appear in the MSW stream in any significant amount. This can be seen in the fact that the 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. The small potential supply of recycled PVC resin and the lack of a collection and processing network has been a major barrier to the recycling of PVC in the past.

Plastic Resins in MSW and Recycling Rates[11]

Plastic Resin	Total Present in MSW (Thousand Tons)	Amount to Landfill/Incinerator (Thousand Tons)	Recycling Rate
PET	3740	3010	19.5%
HDPE	5350	4780	10.7%
LDPE	5880	5550	5.6%
PP	4190	4120	1.7%
PS	2620	2600	0.8%
PVC	1660	1660	0%

While this EPA data from 2008 doesn't show any PVC recycling occurring, recent conversations with plastics recyclers, including Return Polymers and Bulldog Polymers, suggest that approximately 200 million pounds (100,000 tons) of PVC was recycled in the past year, approximately 40 percent of which is post-consumer. This number is expected to continue to grow as demand for recycled PVC resin continues to grow.

Several building products manufacturers, including CertainTeed, have partnered with PVC recyclers to collect post-consumer vinyl siding, including installation waste and end-of-life vinyl siding, from remodeling. In addition, these recyclers also collect other post-consumer streams including pipe, window frames, and obsolete materials from big box stores and distributors. These materials are being collected, recycled and processed, and are being integrated into new PVC products, including vinyl siding, windows, etc. The collection and recycling of post-consumer vinyl siding and other PVC materials is growing each year as these recyclers expand their collection areas and develop

[10] 2010 Resin Review, the American Chemistry Council

[11] EPA. 2009. *Municipal Solid Waste Generation, Recycling, and Disposal in the United States Detailed Tables and Figures for 2008*. Available at: http://www.epa.gov/epawaste/nonhaz/municipal/pubs/msw2008data.pdf

partnerships with other PVC product manufacturers, waste management companies, builders, and distribution centers. In addition, post-industrial recycling of PVC has been occurring extensively within the industry and approximately one billion pounds of PVC are recycled at the post-industrial level each year.[12]

Economics does, of course, play a major role in the success of these PVC recycling efforts and markets. The national average price of PVC scrap in 2008 varied between 12 and 15 cents per pound. Because the price per pound is relatively low, long distance transportation is generally not feasible, which leads to regional markets. These regional markets function effectively only where there is sufficient, consistent demand (i.e., where there are manufacturers consistently using recycled PVC in their products). This demand is growing as more manufacturers include recycled content in their vinyl siding, and this greater demand should lead to a more extensive system for recycling PVC. This is the same challenge that is faced by other recycled materials, demand for the materials is necessary to support the development of a recycling infrastructure.

[12] Principia Partners. 1999. *Post-Industrial and Post-Consumer Vinyl Reclaim: Material Flow and Uses in North America*. Available at: http://www.vinylinfo.org/Recycling/VinylRecyclingReport.aspx