

# “Green” Carpets

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## Introduction

In choosing “Green” Carpeting, there are many factors to consider. “Shades of green” carpets vary in backing, face (fibers, dyes), type, and form. And, as we will discover, “green” carpet must meet expectations in resource management, toxicity, and performance.

Carpet backing can contribute up to 60% of the carpet material by weight. Though polypropylene is predominantly used, there are other materials, some non-woven. Carpet backing can be made of high-recycled content, which is a common characteristic of “green” carpets.

Synthetic and natural fibers have environmental advantages and drawbacks. Natural fibers like wool rely on renewable resources and require less energy to produce but do not always yield the best environmental results. Wool requires water and energy for washing, thus generating water pollution and solid wastes. However, it is completely biodegradable. Synthetic carpet fibers such as Nylon, Olefins, and Polyester require petroleum, a non-renewable resource, to produce. A common and recyclable fiber, Nylon 6,6, is very durable and can be recycled but production releases toxins and volatile organic compounds (VOCs).<sup>1</sup> Do the benefits of durability and recyclability outweigh the environmental costs?

Sources seem to agree that solution dyeing is preferable for a “green” carpet. The alternatives, such as steam fixing and wet methods dyeing, are energy and water intensive, producing much water waste. In contrast, solution dyeing does not require water solutions or energy intensive processes, which reduces waste.

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<sup>1</sup> Green Seal, “Choose Green Report”, Dec. 2001. No other information is available. This is a PDF file published by Green Seal. The file is saved as “Green Assessment” in L:\2003-2004 Interim\chem.-124\student shared\code green carpets\outline materials.

Carpets basically come in two types: tufted and woven. Most common are tufted carpets, but neither choice seems to have one “green” advantage over the other.

In contrast, commercial carpet *form* choices are important. Carpet tiles are ideal for “green” commercial use because they are cheaper to package and produce less waste. In addition, if one area of carpet is worn, a single tile can be replaced instead of the entire floor. In an age when carpet takes up much landfill space, less waste is best.

### **Four Companies: “Green” Carpet Market**

In this report, four companies that produce carpet lines at different “shades of green” are researched: Milliken, Shaw, Interface, and Collins & Aikman. There is no best company, but these four strive in their own ways to create carpets that are environmentally friendly. The companies are similar in their choices of material, form, and dyeing processes. Approaches to resource management, toxicity, and performance are what really differentiate these companies from one another. “Shades of green” occur in company choices about issues from recycling and waste management to carpet contents and maintenance.

### **Company 1: Milliken Earth Square**

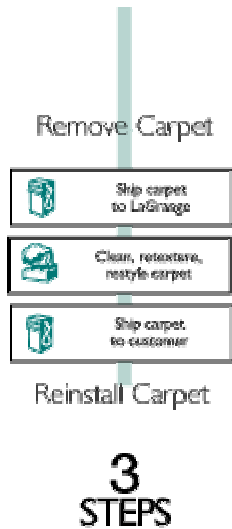
#### **Mission Statement**

Earth Square is a product available through Milliken Carpet Company. What makes this company unique is that it not only shreds and recycles carpet and backing, it reuses the whole carpet. Earth Square takes carpet from the consumer (usually office buildings), and then the carpet is shipped to La Grange, G.A.<sup>2</sup> After the carpet goes through the cleaning process called

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<sup>2</sup> La Grange, G.A. “Milliken Carpet News”, found 28 Jan. 2004 on [www.densonreed.com/milliken^/comerpress](http://www.densonreed.com/milliken^/comerpress). All information unless otherwise stated is taken from this source.

Millicare, it is retextured, dyed with Millitron Imaging, and then shipped backed to the consumer if they want it, or kept in a warehouse to be sold at a later date.<sup>3</sup>

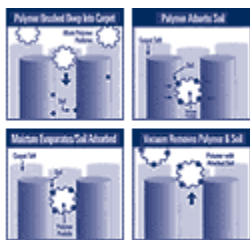


A local distributor of Earth Square is St.Paul Linoleum and Carpet Company. They estimate the sale price to be \$35.00-\$40.00 per square yard.

### Resource Management

The “new” carpet, which contains 100% post-consumer content, has a warranty for seven years and is in modular tile form. This allows for easy and inexpensive replacement to damaged areas. Not only is the carpet, but also its accessories are conscious of the environment. Non-PVC backing reduces CFC’s and water based, solvent-free adhesives contain no hazardous chemicals and have lowest emission rating available.

One way the emissions from the carpet are cut down is through the cleaning process the carpet first undergoes. Millicare<sup>4</sup> is a dry cleaning method that uses polymers to cling to dirt, oil, and stain particles, which are then vacuumed up.



<sup>5</sup>(Polymer product dropped into carpet, polymer absorb soil, maximum evaporates/soil absorbed, vacuum removes polymer and soil)

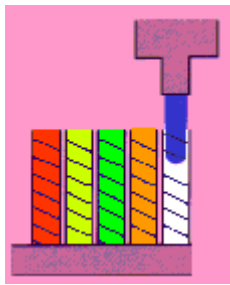
Polymer technology in action - click for full sized graphic

<sup>3</sup> file:///L:/2003-04%20Interim/chem-124/Student%20Shared/Code%20Green%20Carpets/millicare/E2%20The%20Ecological%20Challenge.htm

<sup>4</sup> Millicare “MilliCare Dry Cleaning Method” found, 26 Jan. 2004 on [www.pacificmodular.com/commcare/millicare.html](http://www.pacificmodular.com/commcare/millicare.html).

<sup>5</sup> file:///L:/2003-04%20Interim/chem-124/Student%20Shared/Code%20Green%20Carpets/millicare/Pacific%20Modular%20-%20MilliCare%20Dry%20Carpet%20Cleaning.htm

The process is more environmentally friendly because the polymers are biodegradable. After being cleaned and retextured, the color is added with the Millitron<sup>6</sup> Imaging system.



<sup>7</sup>

Even the method used to ship the product keeps the environment in mind. One of the shipping options is a container that the consumer can ship back to Milliken for reuse. Milliken also works on reducing the amount of shrink-wrap and pallets used during transportation.

## Toxicity

Milliken not only manufactures an environmentally friendly product, they also strive to keep the facilities where it is made in accordance with regulations. 47 out of the 55 domestic locations send no waste to landfills. They have also stopped using chlorinated cleaning solvents. The company has reduced energy use per pound by 16% since 1991 and only 1% of the solid waste created ever sees a landfill. The facilities recycle dye mixes and grind carpet and backing to recycle them into new carpet tiles or backing. Water filtration technologies are also being used to cut down water consumption. VOCs (Volatile Organic Compounds) have been reduced to a non-detectable level. All Modular carpet meets or exceeds the Carpet and Rug Institutes (CRI) criteria for Indoor Air Quality (IAQ). All of these examples are just some of the ways Milliken strives to keep the environment in the workplace and the world as sustainable and healthy as possible.

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<sup>6</sup> Millitron “Milliken Millitron Injection Dye Technology” found, 27 Jan. 2004 on [www.millikencarpet.com/Millitron.html](http://www.millikencarpet.com/Millitron.html)

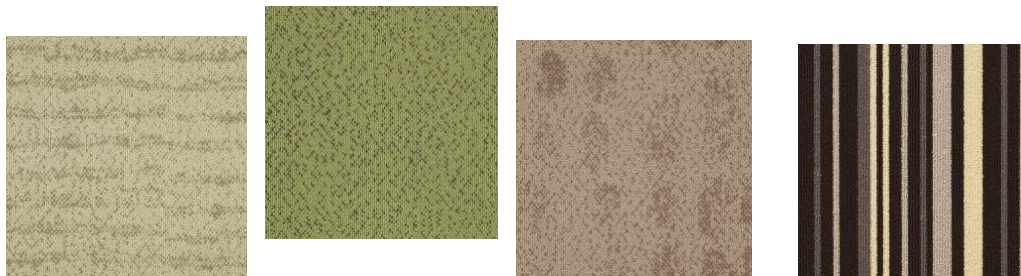
<sup>7</sup> [file:///L:/2003-04%20Interim/chem-124/Student%20Shared/Code%20Green%20Carpets/milliken/Milliken%20and%20Co\\_%20Carpet%20Products.htm](file:///L:/2003-04%20Interim/chem-124/Student%20Shared/Code%20Green%20Carpets/milliken/Milliken%20and%20Co_%20Carpet%20Products.htm)

## Performance

Health plays an important factor, because the Earth Square tiles are designed for commercial areas, such as offices and dormitories. This means many people will come into contact with the product each day. One university used Earth Square in their dorm:



The tile is warranted for such use for up to seven years.<sup>8</sup> When the seven-year life span is reached or when the product no longer meets the demands of the consumer, it can be shipped back and put through the renewal process again. A few life cycles can now be gotten out of the same carpet. Each time the carpet goes through the cycle it must get continually darker. This does not limit the choices available. Many geometric and abstract patterns are available. The options in color and the low price (about half that of a new carpet) are just some of the ways Milliken tries to set itself apart from other environmental carpet companies on the market.



## Company 2: Shaw: Ecoworx and Eco Solution Q

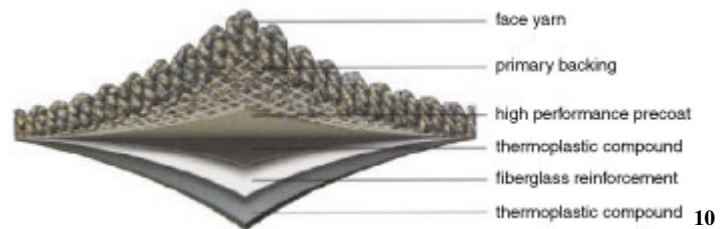
### Mission Statement<sup>9</sup>

Shaw has committed itself to the cradle-to-cradle concept and environmental sustainability. They are committed to continually redesigning their products to make them more

<sup>8</sup> file:///L:/2003-04%20Interim/chem-124/Student%20Shared/Code%20Green%20Carpets/milliken/E2%20Installations.htm

<sup>9</sup> Shaw, "A new way of thinking about materials, energy, and future," Found 27 Jan 2004. on [http://www.shawtile.com/html/html/capabilities/cap\\_sustain1.shtml](http://www.shawtile.com/html/html/capabilities/cap_sustain1.shtml)

eco-effective and to take responsibility for all of their products and return those products to the state of raw materials suitable for further use.



## Resource Management

William McDonough and Michael Braungart, the authors of *Cradle to Cradle*, have specifically designed Shaw's Ecoworx carpet backing and Eco Solution Q fiber, to have exactly what their book title describes, a cradle to cradle life span. The finished product is entirely recyclable back into the original product. However, the original product requires raw materials, so Ecoworx is only 40% recycled material and Eco Solution Q is only 25% recycled material<sup>11</sup>. Eco Solution Q is a nylon 6 product, which is very durable and stands up well under heavy commercial usage. All in-process manufacturing scraps are immediately put back into the processing, eliminating scraps.

The waste from Ecoworx is not zero yet, but it is significantly less than the waste created by traditional backings. Ecoworx and Eco Solution Q are significantly lighter than traditional carpets, especially the Ecoworx backing, which is 40% lighter than traditional carpet backing, thus significantly reducing the CO<sub>2</sub> emissions made by the diesel tractors that pull the trailers from its manufacturing plant in Georgia to consumers. Two-part boxes are also used, as opposed to the traditional cardboard boxes, which significantly reduces air voids in packaging and thus it

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<sup>10</sup> Shaw, "Ecoworx sustainable backing system," Found 28 Jan 2004 on [http://www.shawtile.com/html/html/capabilities/cap\\_sustain2.shtml](http://www.shawtile.com/html/html/capabilities/cap_sustain2.shtml)

<sup>11</sup> Segars, Jeffrey W, et al, "EcoWorx, Green Engineering in Practice," *Environmental Science and Technology* 37 No. 23, 2003: 5269-5277. All information in this section is from this article unless otherwise noted.

takes less space, without damaging the tiles in any way. New packaging methods are being researched that use LDPE shrink-wrap to cut packing waste.

The backbone of the Ecoworx is metallocene polyolefin, which is easily separated from other materials, simplifying recycling. The polyolefin is still made from petroleum products, as is the nylon, but if the plan for continued recycling works, Shaw will only have to use the petroleum products to keep up with the increased demand for the product. As this is a relatively new product, designed in 1999, Shaw has not seen any recycling of it yet, which they provide for free and then reuse the entire waste carpet. When that occurs, the product will be made entirely of recycled product, as opposed to the 40% and 25% recycled content now used.

The use of water and electricity is all that is needed in the manufacture. The water is on a closed loop in the factory, so there is no contaminated wastewater released into the environment. A problem with transport of the materials used is that some of the recycled material comes from Europe because American industry has not invested in recycling nylon yet and Shaw cannot get the materials they need here. The coal fly ash used instead of mined virgin calcium carbonate is from a Macon, Georgia coal plant, which is the closest location that it can be obtained from. Berkshire-Hathaway is also investing in wind power plants, starting with one they have in Iowa and they are continuing to look at solar power also as a resource. Shaw does not know the total energy used to create the product due to some of the processes being under patent protection by Honeywell.

### **Toxicity**

Due to the lack of PVCs and phthalates used in the backing, as is traditional, there are significantly fewer emissions released from the carpet. Also, the base polyolefin has been approved as food safe, so it is obviously very safe for people to inhale. Due to the fact that there

are still plastics and nylons used, as opposed to wool and natural fibers, there is still some off gas, but it has been given the CRI green label for indoor air quality. This carpet has been tested as having low VOC emissions also. The fly ash has been tested at its source for toxicity. It has been certified non-hazardous.

One of the main causes of poor air quality from carpeting has come from flame-retardants. So, in Ecoworx, Shaw decided to use aluminum trihydrate as opposed to antimony trioxide. The aluminum trihydrate is not designated as dangerous to life forms, as the antimony trioxide is. The Ecoworx also produces less smoke than traditional PVC, so it causes less pollution if it were to catch on fire. Most of the products are solution dyed, although they do make a few that combine fiber types and therefore, besides solution dyeing, those carpet types use yarn dyeing also. However, the Eco Solution Q is entirely solution dyed.

### **Performance**

Shaw guarantees that for as long as the original owner has the product that it will not fray and that the binding will not deteriorate. They also guarantee that less than 10% of the original pile weight will be lost during the lifetime of the product. There is also a warranty on the secondary backing against cupping, doming, dishing, and curling, as well as shrinking and stretching for the product's lifetime. They also guarantee colorfastness and stain resistance under "normal" wear conditions. Shaw products are designed to be as durable as any commercial carpeting.

There are currently 31 different available patterns from Shaw with both Ecoworx and Eco Solution Q. Because of the solution dyeing<sup>12</sup>, the carpet is highly mildew resistant and it is also

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<sup>12</sup> Dupont Antron, "Frequently Asked Questions," Found 28 January 2004, [http://www.dupont.com/antron/europe/content/fibre/ant04\\_05.shtml](http://www.dupont.com/antron/europe/content/fibre/ant04_05.shtml)

UV ray resistant, which reduces fading. The carpet is dyed prior to tufting all the way through in this method and does not have just a coating of dye on top.

Maintenance of this product is like that of any other carpet; no additional or special cleaners are required. Also, because of the stain resistance warranty, there is less need for harsh cleaners, because stains can simply be wiped up by a paper towel or dishcloth. Also, you will never need to pay landfill costs, because Shaw will send a truck out to palletize and return your carpet to their plant for complete reuse.

### **Company 3: Interface**



### **Mission Statement**

Interface, Inc. has created a set of 7 goals for increased sustainability practices in the future, including eliminating waste and harmful emissions, using renewable energy, creating closed loop processes, reducing unnecessary travel, and incorporating sustainability into our culture and business world. Within these goals, one can see evidence of the fundamental concerns about Resource Management, Toxicity, and Performance.

### **Resource Management**

InterfaceFLOR, a newly created branch of Interface, Inc., provides a source of several different modular-flooring lines. One of these, the “Spring Planting” brand, is made of Ingeo, a PLA (polylactic acid) fiber from Cargill Dow. Because Ingeo fibers are made through a corn fermentation process, its resources are annually renewable. The carpet tiles are completely

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<sup>13</sup> Interface, Inc., “Interface Corporate”, found 28 Jan 2004 on <http://www.interfaceinc.com>. All information, unless otherwise cited, is from this source.

recyclable. The face fiber, made of the Ingeo PLA, can be composted, and recycling facilities for PLA are in the works. The vinyl in the GlasBac backing can be removed and cycled into the GlasBac RE program that continually reclaims and recycles the vinyl. InterfaceFLOR accepts returns of the whole product. Also, if the consumer so chooses, the carpet can be cleaned and used for charitable purposes.

Some especially significant data is that “PLA plastics use 30-50 percent less fossil fuels used to make the same amount of petroleum-based plastics”<sup>14</sup>. This is in relation to the Cargill Dow plant where the Ingeo Fibers are made, but we also have to take into consideration Interface, which takes the fibers and produces and markets the Spring Planting line. Interface, Inc. is committed to the idea of sustainability, and has outlined the 7 goals mentioned earlier. Their work towards these goals can be seen through its use of teleconferencing as an alternative to travel, for example, and integration of solar power systems. They are striving for zero emissions and have for the year 2005 a goal of reducing nonrenewable energy use by 20%. Furthermore, Spring Planting’s packaging methods reduce difficulty in transportation/delivery. Its shipping methods are especially convenient and efficient, as it travels in “extra large pizza boxes”<sup>15</sup>, thereby eliminating difficult in transportation that is experienced with large rolls of broadloom carpet. The ease in packaging is also helped by the fact that the tiles are very thin, at about a thickness of 0.325 inches, somewhere in between hard flooring and a carpet.

## **Toxicity**

With the Spring Planting line, along with many of Interface’s other carpets, we have to take into consideration the backing and other chemicals added to the carpet. Intersept is an anti-microbial found in the backing of Spring Planting tiles. Intersept, however, does not contain any

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<sup>14</sup> Cargill Dow LLC, “From Corn to Plastics” found 28 Jan 2004 on <http://www.cargilldow.com/ingeo/products.asp>.

<sup>15</sup> InterfaceFLOR, “Top 5 Reasons to Love Flor”, found 28 Jan 2004 on <http://www.interfaceflor.com/cgi-bin/flor/howto.html>.

arsenic, heavy metals, halogens, or formaldehydes, is nonflammable, and meets many certification standards for IAQ testing. The backing itself, GlasBac, meets CRI Green Label, among other standards, for IAQ. GlasBac contains thermoplastic vinyl and fiberglass, but is completely recyclable. Also, in looking at Spring Planting's production, one finds that the carpet is 100% solution-dyed. Solution dyeing does not use vast amounts of water, as it is not a wet process, so it is just one way in which Interface tries to reduce production energy.

### **Performance**

Furthermore, solution dyeing provides better color-fastness, thereby improving performance. Spring Planting currently comes with 2 options in regard to color and/or pattern, but with its versatility as a tile, it can be arranged linearly or parquet-style (turned at 90-degree angles) to give users more options. Another important aspect of its performance level is its easy-care quality. Soiled squares can simply be picked up off the floor and rinsed in the sink. If stains do occur, only one or a few tiles have to be replaced, as opposed to tearing out the whole room of carpet. The only downside to this line of carpet tile is that it cannot handle large volumes of water on its surface. Spring Planting tiles can be used in residential areas, although they were first designed for commercial use.

As far as adhesives, all that is needed for these carpet tiles is FLOR Dots. These small circles of adhesive are only necessary for some of the tiles placed down in one area, as the rest will be held in place by the checkerboard pattern. Furthermore, the adhesives are not too strong, as users may pick up the square in cases of replacement needs, and wipe off any residue with a little rubbing alcohol. Spring Planting is a great example of a simplified, durable, recyclable carpet, and the advantages of this type of carpet tile are numerous.

## **Company 4: Collins and Aikman Floorcoverings (C&A)**

### **ER3 Powerbond Modular Tile Carpet, Style- Habitat**

#### **Mission Statement: Sustainability<sup>16</sup>**

C&A believes it has environmental and social responsibility and is thus committed to developing carpet solutions that are environmentally sustainable. The company achieves its goals through categories of resource management, toxicity, and performance in relation to the ER3 Powerbond Modular Tile Carpet, Style- Habitat.

#### **Resource Management**

Of great importance to “green” categorization is recycling and reuse. C&A’s closed-loop system is the best kind possible. The Habitat ER3 tile contains 100% recycled (from other carpets) vinyl secondary backing. The Nylon face fiber has 82% recycled post-consumer content. Overall recycled content is 45%. Not only does C&A use recycled material, both post-consumer and post-industrial; all of its products are 100% recyclable.

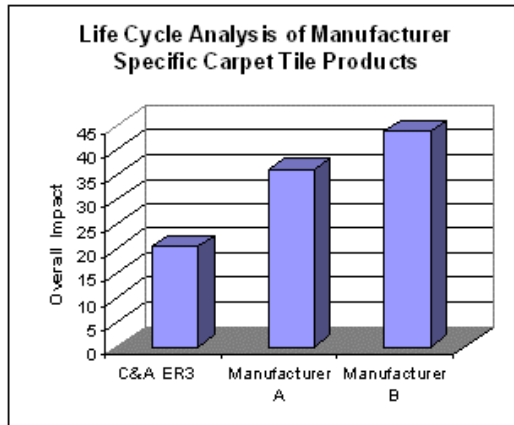
Collins and Aikman supports the high recyclable capabilities of carpet products through a take-back program called “Infinity Initiative” in which all carpets, even from competitors, are gathered and recycled. The company guarantees that no returned carpets see the landfill.

In production of carpets, the company has made commitments toward the environment. An active member of the U.S. Environmental Protection Agency, C&A is working toward goals of reducing water and energy use, waste, and CO<sub>2</sub> emissions by 10%. Between 1993 and 2001, the company saved energy in the amount of 105, 725 mmBTU’s/yd<sup>2</sup>. Water conservation is possible through water-saving equipment and process modifications.

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<sup>16</sup> Collins and Aikman, “Collins and Aikman Floorcoverings”, found 28 Jan 2004 on <http://www.powerbond.com>. All information, unless cited otherwise, is from somewhere on this source.

Additional environmental numbers are available and point to C&A's leadership in sustainability. The Life Cycle Analysis (LCA) analyzes a product based on twelve environmental impact categories: Acidification, Climate Change/Global Warming, Ecological Toxicity, Fossil



Fuel Depletion, Habitat Alteration, Human Toxicity, Particulates, Photochemical, Stratospheric Ozone Depletion, and Water Eutrophication. The LCA of Habitat ER3 tile shows that the overall impact of this product is nearly half that of products by other manufacturers (see graph).

## Toxicity

In each environmental category, the LCA provides specific information for the ER3 Modular Tile, Style- Habitat (see insert in EIQ). For example, Climate Change/Global Warming shows CO<sub>2</sub> emissions to be 2735.15 grams. (However, no cross-reference to grams and amount of product was provided by this source).

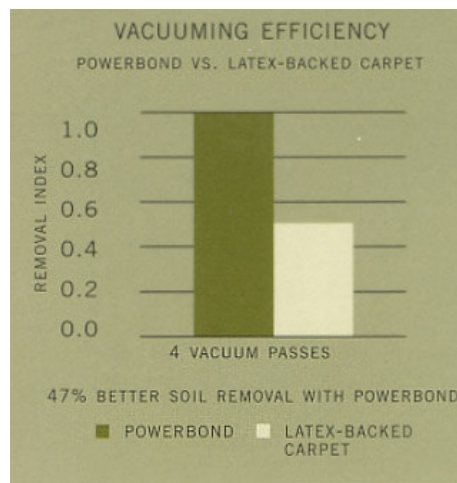
Unfortunately, specific information regarding chemical contents (especially those that are Toxic/Hazardous) of the product was unavailable. MSDS's are hard to come by, as are chemical profiles (besides the content of Nylon 6,6 fiber) and information on CFC's and Electromagnetic Radiation. C&A does comply, however, with the standards of CRI, SCS, FTC, and EPA. The carpet tiles exceed CRI standards in that they release virtually no VOCs.

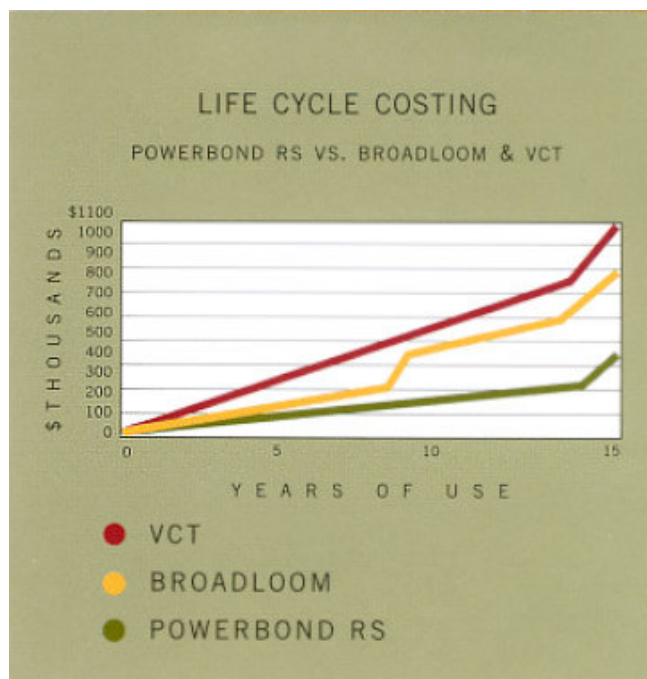
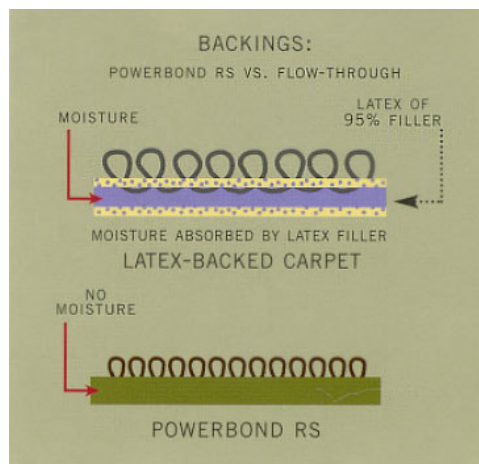
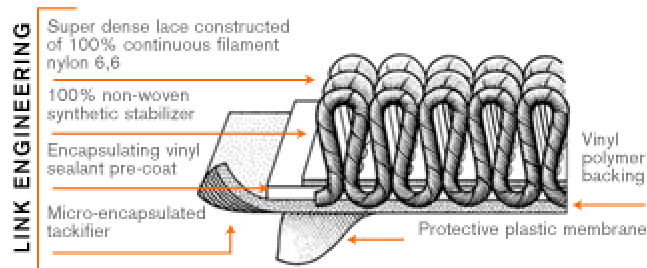
Fortunately, C&A's active steps toward minimizing production wastes shed more light on the issue of toxicity. Since 1998, the manufacturer has reduced solid wastes by 40% by recycling all processed waste and taking other recycling action. Also during that time, closed-loop systems of recycling processed water reduced water use and waste by 29%.

## Performance: Installation, Engineering, and Maintenance

Traditionally, the carpet installation process is burdensome to indoor air quality as adhesives and other materials off-gas toxins. The peel-and-stick adhesive of the ER3 Tiles eliminates the need for wet adhesives, virtually avoiding traceable volatile organic compound emissions. Installation of the tiles in this way is also very easy and energy-efficient, as less carpet needs to be cut and less furniture needs to be moved. C&A claims to have an efficient furniture-lift process (MODU-TEC) but information about the energy use of this process is unavailable.

The “Link Engineering” with Powerbond backing of C&A’s carpet construction makes maintenance easier (see illustration of vacuum effectiveness). Link Engineering, where each component connects with others for a supported structure, makes the carpet strong, lasting five times longer than conventional carpet and allowing for a 15-20 year warranty (see illustration). Powerbond backing contributes to easy, low-cost maintenance (see illustration). For example, vacuums are almost twice as efficient with this backing than with latex backing. This vinyl-polymer backing is also a great moisture barrier, keeping messes on the surface and drying fast when cleaned. As a result, a Powerbond carpet’s maintenance costs over time are considerably less than other carpets (see chart).





Color choice, which affects maintenance, is of course not limited in the C&A line. The Habitat-Style carpet researched is a lighter color, but there is a wide range of color and pattern options available, allowing the carpet to be suitable for any commercial environment or aesthetic need.

## **Conclusion**

No carpet company is perfect and no carpets are totally “green”. Each of the companies (Milliken, Interface, Collins and Aikman, and Shaw) we researched has advantages and disadvantages, and the differences are hard to weigh.

One such difference is in recycling concerns. While Shaw uses low recycled content, the products are entirely recyclable, eliminating down-cycling. C&A believes in closed-loop recycling. All of the companies believe that used carpet is a valuable resource for new carpet.

All four of the companies also strive for minimum waste products, emissions, etc. Milliken, for example, allows only 1% of total solid waste to be landfilled. C&A is striving for continual reduction in CO2 emissions. All featured products of these companies release low levels of VOCs.

Uniquely, Interface makes carpet of PLA face fiber (Cargill and Dow) and 100% recyclable backing. PLA fiber is biodegradable and made from annually renewable resources. Corn is the most common resource, but any form of starch, based on locality, could potentially be used. Ideally, this is much better than the Nylon materials (as found in the other three companies), which require non-renewable fossil fuels to produce. Currently, PLA is not recyclable, but that is a future goal.

The recyclability problem faced by Interface is similar to those faced by other companies. Many products and processes are extremely new. Therefore, we don't know how much of

recyclable material will be recycled, or how different companies will interact to recycle carpets. We also don't know how well carpets will last through the warranty period.

Other deciding factors must be considered when choosing a carpet, as all of these companies make quality products that are relatively environmentally sustainable. Milliken is locally distributed in Eagan, MN. Other companies have to use extra energy to ship carpets to the consumer's location. For example, Interface and Shaw are manufactured in Georgia. Cost of the carpet is variable and dependent on transportation, production costs, etc. Energy use information per company and product is extremely important, though difficult to obtain.

Finally, some companies have more color choices than others. C&A has a wide array of color options but only has select colors for each type of product, thus the specification "style-habitat." Each style has different levels of recycled content. Interface only provides two color options in the environmental line. Milliken's carpets get darker and darker each time they are reused. Shaw has 31 different styles and patterns.

In conclusion, we believe that to make the best carpet choice, one must assess specific commercial carpet needs in addition to budget, company locality, and aesthetics.