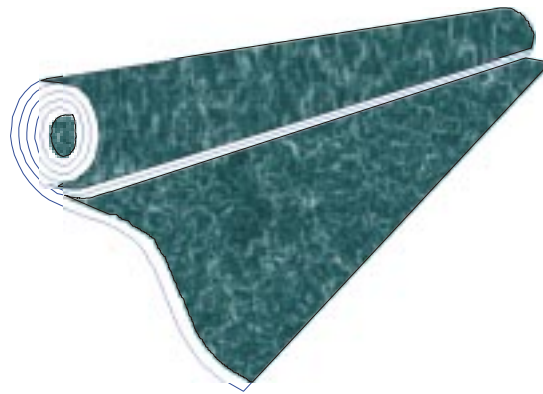


# Textiles: Carpet & Carpet Pad

## COMMODITY PROFILE

North Carolina Department of  
Environment and Natural Resources  
DIVISION OF POLLUTION PREVENTION AND  
ENVIRONMENTAL ASSISTANCE

MARKETS ASSESSMENT 1998



Although closely related in function, carpet and carpet pad are different in material composition. As a result, the recycling processes for these two materials are different as well. This report focuses primarily on carpet recycling and its potential growth in the southeastern United States. It also addresses the more established recycling infrastructure for carpet pad recycling.

### **CARPET OVERVIEW**

The carpet recycling industry is still developing. Carpet fibers and backing material are comprised of a wide variety of materials, making it difficult to develop standard recycling technologies. Also, the material is bulky, resulting in high collection costs. There are currently no carpet recycling facilities in North Carolina, which makes transportation costs for recycling a larger factor. Thus, a majority of waste carpet in North Carolina is being landfilled.

Within the past few years, several carpet manufacturers

and other related material suppliers have begun to invest heavily in carpet recycling processes. These processes include the following: direct re-use, refurbishment, recycling into new carpet face fiber, recycling into other plastic products, recycling carpet backing into new backing, or producing a recycled-content carpet backing derived from melting different types of backing and fiber materials together.

Most recycling programs, which are typically operated by carpet fiber manufacturers, provide recycling services when new product is installed. For the most part, these programs are not free. There will usually be an associated charge equal to at least the local tipping fee.<sup>1</sup> The customer typically has to pay the cost of shipping the material either to a collection facility or to a mill and has to pay more up front for the new carpet to cover the cost of recycling the old carpet. Some programs have proven to be cost-effective, but a majority pass additional costs onto consumers, making it difficult for some carpet recycling businesses to increase the amount of material being recovered.

Data were not available on the total amount of carpet being recycled by the various new recycling operations. A survey of some of the major carpet recyclers nationwide indicates that the capacity exists or soon will exist to recycle a large portion of the waste stream. Provided collection and sorting can be performed cost effectively, the supply of carpet waste from North Carolina will continue to meet demand.

## SUPPLY

### Generation

Annual carpet production for the United States market equals 1.5 billion square yards (3.18 million tons). Carpet typically lasts from 7-10 years (residential) or 5-8 years (commercial). Re-carpeting accounts for approximately 55 percent of all carpet sold, generating annual waste of approximately 1.75 million tons, according to the National Association of Home Builders (NAHB). This tonnage represents nearly one percent by weight, but nearly two percent by volume, of municipal solid waste.<sup>2</sup> Because carpet is a durable good, the supply of the material for recycling is the estimated amount ready for disposal, not the amount of new product sold each year. Figure 1 shows the estimated per capita supply of carpet to be approximately 13 pounds per person per year.

Figure 2 shows the estimated total supply of carpet waste for North Carolina for 1998-2002. The projections are based on the current per capita generation rate of 13.08 pounds per person per year, multiplied by the state's population projections. Carpet production and carpet waste production vary depending on the state of the national economy. An increase or decrease in commercial and resi-

dential construction will affect the future supply of a durable good after its useful lifetime. For the purpose of this study, we assume future supply will remain relatively constant.

Figure 3 presents the different carpet fibers by type and the percentage of the marketplace for each. This information is important, since most of the existing recycling programs handle only certain types of fiber. In particular, a large number of the programs take only nylon 6 or nylon 6,6 materials.

Carpet is available in two forms: tiles and rolls. Carpet tiles are made primarily for business and industrial uses, whereas rolls of carpet are typically applied as household floor covering. Both types of carpet are constructed with face fiber, primary and secondary backing, and an adhesive layer. Residential carpet is 30 to 40 percent fiber by weight, while commercial carpet is only 20-30 percent fiber by weight.<sup>3</sup>

Based on these estimates, the supply of waste carpet fiber and backing materials in North Carolina for 1997 are broken down in Figure 4. For recyclers of face fibers, the total supply of all material is estimated to be 15,707 tons. For recyclers of backing materials, the total supply is estimated to be 32,920 tons. For recyclers of both materials, the estimated supply is 48,627 tons.

### Recovery

No national or state data were available to quantify the amount of material being diverted from the waste stream. Such data is typically provided by industry trade associations. Although the carpet manufacturing industry has an established trade association (The Carpet and Rug Institute),

**Figure 1. Per Capita Carpet Waste Supply**

National Supply*	1,750,000
National Population (1997)**	267,636,061
Per Capita Generation - Tons	0.00654
Per Capita Generation - Pounds	13.08

Sources:

\*NAHB Web site: <http://www.nahbrs.org/homebase/factshee/wstcarpt.htm>

\*\*U.S. Census Bureau Web site:

<http://www.census.gov/population/estimates/nation/popclockest.txt>

**Figure 2. Total Supply of Waste Carpet in North Carolina**

	1997	1998	1999	2000	2001	2002
<b>North Carolina Estimated Population*</b>	7,436,690	7,542,996	7,641,684	7,733,097	7,811,951	7,891,238
<b>Supply of Carpet Waste in North Carolina</b>	48,627	49,322	49,967	50,565	51,080	51,599

\*Source: N.C. Office of State Planning

**Figure 3. Market Share of Different Carpet Face Fibers**

Fiber Type	Percent*	1997 Waste Carpet Supply <sup>2</sup> (Tons)
Nylon 6,6 / Nylon 6	59.3%	28,836
Polypropylene	33.7%	16,387
Polyester	6.6%	3,209
Wool	0.4%	195
<b>Total</b>	<b>100%</b>	<b>48,627</b>

\*Source: Carpet and Rug Institute, "Industry Review," 1998. Figure 2. 1997 Estimated supply of carpet waste in North Carolina

**Figure 4. Estimated Breakdown of North Carolina Waste Carpet Fiber and Backing**

	Carpet Waste (%)*	Total Carpet Waste (Tons)	Face Fiber (%)	Total Face Fiber (Tons)	Backing (%)	Total Backing (Tons)
<b>Commercial</b>	27%	13,129	25%	3,282	75%	9,847
<b>Residential</b>	73%	35,498	35%	12,424	65%	23,074
<b>Total Supply</b>	<b>100%</b>	<b>48,627</b>	<b>100%</b>	<b>15,707</b>	<b>100%</b>	<b>32,920</b>

\*Source: The Carpet & Rug Institute

the carpet recycling industry is still in its infancy and has yet to establish an association specifically geared towards recycling. A description of recovery efforts by some end users of carpet is included in the Demand section of this report.

## DEMAND

The carpet manufacturing industry, which is highly concentrated in the Dalton, Georgia, area, is the center of the national demand for carpet waste. Thus, the strongest demand for the material is in the southeastern states including North Carolina. Several new facilities in this area have come on-line, and several more are expected within the next few years. The facilities not yet on-line are mostly stockpiling materials for anticipated openings.

Carpet recycling efforts include the following: direct re-use, refurbishment, recycling fibers into new carpet face fiber, recycling fiber into other plastic products, recycling carpet backing into new backing, or producing a recycled content carpet backing derived from melting different types of backing and fiber materials together. A brief description of each effort follows, and major end users in each category are listed as well.

### Re-use/Refurbishment

**Carpet re-use** is a recycling option made possible by the durability and relative long life span of carpet materials (five to 10 years). Quality used carpet can be sold directly to businesses or individuals or donated to charities. The capacity for direct re-use is dependent upon the quality of materials being replaced.

**Carpet refurbishment** is another type of re-use where materials are taken back for cleaning, fiber replacement, dyeing, or other types of enhancement. The capacity for re-furbishment will likely increase as this relatively new practice gains popularity. Re-use and re-furbishment should be supported as the best means of carpet waste reduction. Both the fiber and the backing materials are being re-used, producing the least amount of waste material.

### Recycling

**Mixed material recycling** involves the processing of all the different fibers and backings together, to produce a new end product such as carpet backing. In this process, the material is typically shredded or pulverized and sent through an extruder. The new material is made into carpet backing or other recycled content products. According to one manufacturer, the recycled content backing exhibits stronger properties than the virgin material. Similar to re-use, this process produces little waste by using both the fiber and the backing materials. The capacity for this type of processing is not known.

**Recycling carpet face fiber** involves separating the fiber material (typically nylon 6 and nylon 6,6) from the backing. The process includes shaving off the face fiber or pulverizing and screening the combined materials to separate them. The fiber is then made back into face fibers or other plastic products. Type 6 nylon is made from a raw material called Caprolactam. Type 6,6 nylon is made from hexamethylene diamine plus adipic acid. Type 6 nylon is more readily returned to its raw material than is nylon 6,6.<sup>4</sup>

The Caprolactam can be chemically separated from carpet fibers, and re-used to produce any number of plastic products including new carpet fiber. Increasingly, the recycled material is being used in the auto parts industry, as auto manufacturers strive to increase the amount of recycled material present in new vehicles. The capacity for carpet face fiber recovery is expected to increase significantly within the next few years. Unfortunately, with face fiber recovery, only a small portion of the entire carpet is being recovered by weight (30 percent), unless the backing materials are sent to other backing recyclers.

**Recycling carpet backing** also starts with the process of separating the face fiber material. The face fiber is either sold or discarded, depending on its type and value. The resulting backing material is extruded into new backing or other recycled content products such as car stoppers. The capacity of this type of recycling is not known.

### **Major End Users**

This section identifies some of the carpet recovery programs currently in operation. In most cases, the company profiles were developed from information provided directly from the companies. The information provided below does not represent an endorsement by the state.

**Allied Signal, Richmond, Virginia**, has formed a joint venture with DSM Chemicals North America (Augusta, Georgia) to recycle post consumer type 6 nylon carpet waste. The joint venture, Evergreen Nylon Recycling, LLC, was formed to create a carpet waste processing facility with the capacity to recycle approximately 200 million pounds of carpet waste annually. Evergreen will recapture nylon face fiber materials, through a chemical process, and produce various recycled content plastic products including new carpet fiber and automobile parts. Allied Signal is currently in the process of setting up carpet collection points throughout the country, including North Carolina. With these facilities in place, Allied will be able to consolidate volumes of the waste carpet, sort the recyclable type (nylon 6), bale it, and then ship it to the new facility in Augusta, Georgia. The new facility is expected to open in late 1999, and Allied is currently accepting and stockpiling material for the anticipated opening. Allied Signal's facility would have the potential to recycle all of North Carolina's type 6 nylon waste carpet.

**BASF, Dalton, Georgia**, provides an alternative to land-fill disposal of used carpets through two carpet recycling programs: 6ix Again and 6ix Again Expansion. 6ix Again applies to carpets that are made from BASF Zeftron nylon® yarn. 6ix Again Expansion applies to carpets containing yarn systems other than those manufactured by BASF. In order

to participate in the Expansion program, the replacement carpet must be a 6ix Again BASF Performance Certified commercial carpet. The replacement 6ix Again carpet automatically qualifies for the program at the end of its useful life. There is a \$0.40 per square yard fee for used carpets returned through the Expansion program. Each of the programs requires that the participant pay the shipping costs of returning the used carpet to the nearest recycling center.<sup>5</sup>

**Collins & Aikman (C&A), Dalton, Georgia**, recycles polyvinyl backed carpet tiles. C&A's customers pay the cost of shipping, but do not pay a tipping fee for the materials. C&A shreds the carpet with the backing material, and sends it through an extrusion process. The resulting extruded material is made into backing for new carpet products. C&A recycled 200,000 square yards (850,000 pounds) of carpet in 1997 and have recycled the same amount in the first half of 1998. Their recycled content carpets are the same price as those made from virgin material. According to C&A, the quality of the 100 percent recycled content backing material exceeds the quality of virgin materials.<sup>6</sup>

**DuPont Flooring Systems, Dalton, Georgia**, is a division of DuPont, a research and technology-based global chemical, energy, and life sciences company. DuPont Flooring Systems offers a comprehensive carpet recycling system that includes the collection, transportation, and processing of used carpet. The carpets are sorted and evaluated for recycling value and processed into a variety of products, including resins for the auto industry, soundproofing materials, padding, and ground cover. Nylon 6 and nylon 6,6 are primarily used for auto resins, but all types of carpet are collected, including vinyl-backed flooring tiles. The company estimates that it generates about five percent residuals in this process. The company also is investigating carpet to carpet recycling, but is only in the research and demonstration phase. Dupont is currently getting about 180 tons of material from North Carolina annually, and about 9,000 tons of materials nationally. With its current infrastructure, Dupont could easily double the amount of materials it handles.

**Interface Flooring, Atlanta, Georgia**, is a producer of carpet tiles used primarily by business and industry. Through an innovative leasing program, Interface provides maintenance for carpets throughout their useful life and then takes back the material for recycling. Interface also takes back any materials they remove when installing their new carpets, regardless of the type of fiber. Interface donates re-usable carpet tiles and processes the unusable ones. The company separates carpet fibers from the backing and recycles the backing materials into new product. The nylon 6,6 fiber is currently being stockpiled, awaiting future product

development. Interface is currently handling 18,000 square yards of recyclable material per month.<sup>7</sup> The company sells its products in more than 100 countries, with North America accounting for about 70 percent of sales.

**Milliken Carpet, LaGrange, Georgia**, is a division of Milliken & Company, an international textile and chemical manufacturer. Milliken offers a carpet renewal and reuse process, referred to as Earth Square™. Using a patented technology, old carpet tiles are cleaned, re-imprinted with new patterns and colors, and re-installed. Milliken carpets are nylon 6,6; however, well-made nylon 6 carpets from competitors can also withstand the process. The turnaround time for renewing the carpet is usually 4 to 5 weeks. Customers typically re-install the renewed carpet in another location, purchasing new carpet to use in its former location. The process generates between five and 15 percent residuals, and the cost is 40-45 percent less than Milliken's highest volume style. Major customers in North Carolina include Duke Energy and First Union Bank.

**United Recycling, Inc., St Paul, Minnesota**, recycles commercial and residential carpet for carpet retailers, installers, and municipal governments. United is a vertically integrated company that collects, processes, and recycles/remanufactures carpet waste. United manufactures extruded plastic products from the collected carpet.<sup>8</sup>

### **Recycled Content Carpet Manufacturers**

Numerous companies including Image Industries, Shaw Industries, and Talisman Mills produce recycled PET/polyester fiber carpet. As the price of nylon carpet increases, more carpet manufacturers are beginning to use less expensive polyester fibers or blends creating a larger market for competitive recycled-content carpets.<sup>9</sup> However, the processing technology to recycle the fibers back into PET for re-manufacturing has not yet been developed.

**Image Industries, Summerville, Georgia**, manufactures recycled-content carpets using post-consumer plastics. Image produces most of the fiber and yarn needed for its carpet production, and produces its own polyester fiber from materials recycled internally. Image Industries converts polyethylene terephthalate, or PET, containers into clean PET flake, some of which is melted down into pellets. A small portion of this recycled PET is sold in flake and pellet form to other manufacturers for use in molded packages, strapping, sheeting and custom non-food PET bottles. The rest of the recycled PET is extruded into polyester fiber. Most of this fiber is used in the production of Image's carpet, but some of it is sold to other manufacturers as fiberfill for pillows and various other uses in the home furnishing and textile industries. In its recycling plant in

Summerville, Georgia, Image has the capacity to process more than one billion plastic containers every year. For January through September of 1998, Image recycled approximately three million pounds (1,500 tons) of PET from North Carolina.

## **SUPPLY / DEMAND RELATIONSHIP**

Programs for carpet recycling are developing rapidly, and infrastructure will need to be developed to meet this demand. Carpet recycling companies typically require the customers to cover the cost of transporting the materials to processing centers. For large commercial jobs, the economics of recycling are more likely to be favorable when compared to the cost of disposal at local landfills or incinerators. However, for smaller commercial and residential jobs, the financial benefits from recycling the material can be marginal without centralized collection to consolidate larger volumes of materials.

### **Prices**

The variables to consider when deciding whether or not to recycle carpet waste are different for the consumer and the recycler, as indicated below.

#### **Consumer**

- Cost of newly installed carpet
- Quantity of carpet waste
- Material type
- Disposal fees
- Recycling Revenues
- Cost of collection and transportation to market

#### **Recycler**

- Revenues from disposal fees
- Processing costs
- Value of end products
- Disposal costs for residuals

As the infrastructure for carpet recycling grows, some of the costs, such as collection and processing, will likely decrease. Also, as the markets for recycled materials grow, it is likely that the value of the end products will increase as well. However, it is unlikely that disposal fees for residual materials will decrease. Thus, it will be increasingly important to consumers and carpet recyclers to recover as much of the material as possible.

## **CONCLUSION**

The key to increasing carpet recovery lies in establishing the collection infrastructure. Because of its relative bulkiness and the distance to market, carpet can be difficult to cost effectively recycle. Some recycling companies are start-

ing to develop collection facilities to help consolidate volumes of material for more efficient transportation.

## RECOMMENDATIONS

- The state should consider programs to promote the development of recycling infrastructure by working with existing recycling companies, material recovery facilities, private waste haulers, or carpet retailers and installers that are interested in collecting waste carpet. Being strategically located near the center of the national demand for carpet materials in Georgia, North Carolina has the opportunity to cost-effectively transport materials to the newly developing carpet recycling businesses.
- The state also can work with entrepreneurs to develop the following business opportunities:

*Re-use and re-furbishment:* These businesses can range from very simple carpet cleaning and replacement operations to more specialized reconditioning and repair services. This type of service could be an add-on business to existing carpet retailers and installers.

*Material collection:* Recycling/processing businesses are typically capital intensive, and are often started by larger multi-national corporations. The opportunities for small businesses in carpet recycling are mainly with material collection, sorting, and consolidation. The carpet recyclers are working to set up collection/consolidation facilities throughout the nation. This could be a stand-alone business or an add-on service to an existing recycling or carpet installation business.

- The carpet recycling industry is in need of a trade association to help the industry grow and to increase recycling rates. The Carpet and Rug Institute could possibly take on this role, or industry representatives could start a new organization.
- Collaboration needs to be encouraged within the carpet recycling industry. Most of the different recycling processes are highly specialized and capital intensive. Recycling companies need to work together to recycle as many of the different materials as possible. For example, carpet fiber recyclers should work with recyclers of carpet backing material.
- State agencies should make it a priority to recycle carpets that are being replaced. Additionally, in the

bidding process for purchasing new carpeting, agencies should specify recycled content carpets or carpet from manufacturers with take-back programs that ensure re-use or recycling.

## CARPET PAD OVERVIEW

Polyurethane foam, both prime and bonded, makes up approximately 89 percent of all United States carpet pad. Each year, close to 350 thousand tons of post-consumer and post-industrial polyurethane foam trim is compressed, baled and transported to more than 30 United States factories where it is recycled into bonded carpet pad, referred to as re-bond. Post-industrial sources of polyurethane trim include furniture (from sofas, chairs, and mattresses), automotive interiors (from door panels and seat cushions), textiles, and clothing.

Synthetic carpet pad, which is made by needle-punching off-grade carpet fibers, constitutes approximately five percent of the current carpet pad market. Sponge rubber carpet pad totals approximately four percent of the market and is manufactured at three United States plants. Natural fiber underlay, which includes hair underlay and rubberized jute, comprises about two percent of the carpet pad market. Only one United States facility manufactures hair underlay pad. Most of these pads are disposed at the end of their useful life.

NAHB reports that carpet pad recycling is relatively commonplace and attributes this success to the homogeneity and market dominance of polyurethane pad and the well-established collection infrastructure for used pad.<sup>10</sup> Although North Carolina data on carpet pad recycling were not available, most recyclers indicate strong demand for this material. The infrastructure is primarily supported by carpet dealers, and there is almost no local government collection activity.

## SUPPLY

The NAHB estimates that 125,000 tons of carpet pad waste are generated annually in the United States, primarily from residential re-carpeting.<sup>11</sup> Assuming that North Carolina generates waste pad at the same rate, this translates into about 3,470 tons of waste carpet pad in North Carolina, or just under one pound per person in 1997.

The NAHB also quantifies carpet pad recycling and has found that it is relatively commonplace. An estimated 62,500 tons were recycled nationally last year, representing 50 percent of available post-consumer scrap.<sup>12</sup> The market dominance of polyurethane pad and a well-established collection infrastructure for used pad nationally has contributed to this relatively high recovery rate. No data were

available on the amount of pad collected in North Carolina; however, assuming that North Carolina's recovery rate is the same as the national level, about 1,740 tons were recovered in North Carolina last year.

A number of carpet dealers and other installers take back used pad for recycling. Take back programs are typically operated as follows: when new product is installed, dealers collect waste pad, transport it to their facilities, bale it and send it to pad manufacturers. Often the carpet dealer receives a per pound discount on its next order of pad in exchange for the waste pad. At least one carpet dealer in the Triangle formerly accepted pad waste from outside sources and expressed a willingness to consider doing it again, provided it is cost-effective.

Of the four recycling businesses listed as markets for carpet pad in the *Directory of Markets for Recyclable Materials* (Sept. 1997), only two are currently handling pad.

**Motile, Inc., Statesville, North Carolina**, accepts prime and re-bond polyurethane for recycling. The company processed about 350,000 pounds (175 tons) of waste carpet pad in 1997, primarily from carpet dealers. Motile also collects cushion from the furniture, bedding and automotive industries. Currently the company is paying carpet stores a per pound fee and providing dumpsters. Motile then bales the material and sells it to carpet pad manufacturers. The company is also working with the City of Charlotte to collect pad at three of its convenience centers. According to Motile, the City's material is less contaminated than materials received from installers.

Two recycling business listed in *The Directory of Markets for Recyclable Materials* have discontinued handling carpet pad altogether, while another — **Harmony Industries, Inc., High Point, North Carolina** — has not handled it in the past year but is willing to do so and has markets for the material. The barriers to successful pad recycling, as indicated by North Carolina processors, are varied and include: fluctuating prices, material that is difficult to bale, insufficient supply, and low landfill fees.<sup>13</sup>

## DEMAND

The Carpet Cushion Council estimates that 75 percent of all pad is re-bond (i.e., recycled content), made from a

mixture of post-consumer pad, post-industrial trim, and other materials. According to the Council, domestic demand for waste carpet pad exceeds supply, with about 15 percent of United States supply coming from overseas.<sup>14</sup> In North Carolina, most recyclers indicated that demand is strong, especially in the major metropolitan areas of the state.

The cost of post-consumer pad, or pick-up scrap, is tied to the price of process scrap. Currently, process scrap is going for \$0.30 to \$0.40 per pound, and pick-up is worth about \$0.14-0.18 per pound. In this range, carpet dealers have indicated that it is not cost-effective to accept material from outside entities (i.e., other installers, local governments).

## CONCLUSION

National organizations cite a healthy recycling infrastructure for carpet pad initiated by carpet dealers, installers, and remodelers, and this infrastructure is in place in North Carolina. Nevertheless, it is estimated that over 1,700 tons of waste pad goes to landfills in North Carolina. In addition, some recycling businesses, especially those that handle multiple materials, have difficulty handling carpet pad, and most local governments have no outlet for recycling waste carpet pad.

## RECOMMENDATIONS

- The state could work with existing recyclers, either carpet dealers or processors, to encourage residential collections in the major metropolitan areas similar to the limited collection occurring in Charlotte, North Carolina. Both local governments and carpet dealers have expressed interest in working together to collect carpet from residents and small businesses. Any assistance the state should provide in "brokering" such collections, including small grants to help local governments purchase collection containers, could help divert additional materials from landfills.
- In conjunction with this effort, the state should educate installers and remodelers about the opportunity to recycle carpet pad, especially in major metropolitan areas, and link them with local processors or end users who want the material.

- <sup>1</sup> Personal communication with Carroll Turner, Carpet and Rug Institute, November 2, 1998.
- <sup>2</sup> <http://www.nahbrs.org/homebase/factshee/wstcarpt.htm>
- <sup>3</sup> Carpet and Padding: Reuse & Recycling Opportunities, NAHB Research Center, Inc., 1998.
- <sup>4</sup> Personal communication with Carroll Turner, Carpet and Rug Institute, November 2, 1998.
- <sup>5</sup> Personal Communication with Tim Blount, Manager of Recycling Operations, BASF, September 16, 1998.
- <sup>6</sup> Personal Communication with N. Dobbins Callahan, Collins and Aikman, September 22, 1998.
- <sup>7</sup> Personal Communication with David Whitley and Mike Bertolucci, Interface Flooring, September 18, 1998, and September 22, 1998.
- <sup>8</sup> Carpet and Padding: Reuse & Recycling Opportunities, NAHB Research Center, Inc., 1998
- <sup>9</sup> Carpet and Padding: Reuse & Recycling Opportunities, NAHB Research Center, Inc., 1998
- <sup>10</sup> Source: NAHB website. <http://www.nahbrc.org/homebase/facstshee/wstcarpt.htm>
- <sup>11</sup> Ibid.
- <sup>12</sup> Ibid.
- <sup>13</sup> Processor surveys.
- <sup>14</sup> Personal communication, Bill Oler, Executive Director, Carpet Cushion Council, September 28, 1998.