Select Commodities Market Study

Houston-Galveston Area Council

Summer 2008

INTRODUCTION

PURPOSE OF THE STUDY

As efforts increase to reduce waste and conserve natural resources, the development of recycled markets is necessary. Thriving markets will aid the public in managing and reducing waste to protect natural resources. Social, political and regulatory pressure is being placed on communities to increase recovery levels, which in turn applies pressure to the market for recovered materials. Market development promotes long term vitality of recycling programs through increased demand for recovered materials and increased revenue from recycling. There are also secondary benefits realized, such as the creation of new jobs and economic development.

This study explored traditional and non-traditional markets and potential uses for 8 recyclable materials. The information will assist local governments across the region in fostering the development of new markets for these recyclable materials.

METHODOLOGY

The Houston-Galveston Area Council (H-GAC) chose a variety of commodities to explore, some with stronger markets than others. For each commodity, we researched the current and potential markets, practices in the H-GAC region, as well as barriers and strategies to market development.

The eight commodities chosen for this study were:

- Plastic
- Concrete
- Food Waste
- Glass
- Gypsum Board
- Untreated Wood
- Tires
- Carpet

H-GAC staff contacted representatives from local governments and vendors in the region to inquire about current practices. This information was supplemented by internet searches and prior studies of markets. This background paper provides a basis for further exploration into specific markets.

RESPONSIBILITY OF REGIONAL & LOCAL GOVERNMENTS

Government can play a role in market development. At the regional level, organizations like H-GAC can set funding priorities with grant funding for solid waste programs to further recycling goals. At the local level, cities and counties can establish ordinances to further their recycling goals. Efforts must be tailored to fit available resources and abilities of the various levels of government.

PLASTICS

OVERVIEW

Plastics are an essential part to our daily life. For instance, without plastics, 400 percent more material by weight, and 200 percent more material by volume would be needed to make packaging. Plastic is a growing part of the municipal solid waste stream, from less than 1 percent in 1960 to more than 11.7 percent in 2006 (EPA). According to a 2001 report, 80% of post-consumer plastic waste was sent to landfills, 8% was incinerated and only 7% was recycled. Households remain the largest generators of plastic waste.

While offering advantages such as flexibility and light weight, plastic production requires significant use of resources, including fossil fuels used as a raw material and as energy in the manufacturing process. Disposal of plastic products also has a significant environmental impact. Many plastics are non-biodegradable and take a long time to break down. The landfill space required by plastic waste is a growing concern.

POTENTIAL MARKETS AND USES

Plastics can be divided into two major categories: thermoplastics and thermosets. Thermoplastics can be remelted and reformed many times into different shapes. For this reason, they are the most commonly recycled plastics. Thermosets can only be formed once. After that, they may be ground and used as filler for future plastic products.

Markets for recycled plastics 1 and 2 (PETE and HPDE) are stable in most areas of the US. The primary market for recycled PETE is fiber for carpet and textiles, while the primary market for HPDE is bottles. New potential markets for recovered PETE include coating for corrugated paper and other natural fibers to make waterproof products or clothing, such as fleece or jackets. A new potential market for recovered HPDE is recycled-content landscape and garden products. Plastic lumber, a product made from recycled plastic, is ideal for use in landscaping applications. By using plastic lumber, landscapers can create cost-effective, high quality, and environmentally beneficial projects.

Recycled plastics can be used in electronic applications such as computer and printer housings. The plastics used in these applications are polymers such as acrylonitrile-butadiene-styrene (ABS), polycarbonate (PC) and their blends, and these are relatively expensive polymers. This includes polyethylene bin liners and carrier bags; PVC sewer pipes, flooring and window frames; building insulation board; video and compact disc cassette cases; fencing and garden furniture; water butts, garden sheds and composters; seed trays; anoraks and fleeces; fiber filling for sleeping bags and duvets; and a variety of office accessories. Plastics used in agriculture have been reused to generate energy.

Advanced recycling of plastics represents a significant technological advancement that in the case of some polymers is already supplementing existing mechanical recycling processes. These processes signal a significant technical advancement in plastics recycling because the products, after purification, are identical to current feedstocks and monomers used to produce new plastics.

Case Studies:

Plastic-to-Energy

An energy company in Wisconsin, Madison Gas & Electric, owns a 200-megawatt power plant in that burns PDF, or poly-derived fuel. PDF is generated from shredded pre-consumer waste that cannot be recycled, largely wastepaper and plastic. James Garthe, an engineer in the Penn State Agricultural and Biological Engineering Department, invented a product called Plastofuel in the early 90s with the idea that energy recovery through the clean incineration of waste agricultural plastics may be a better alternative. Plastofuel is created by forcing waste plastic through a heated die to produce densified fuel nuggets.

NOVPOL

In 2007, the European Union launched "NOVPOL", a research initiative across several European countries that aimed to create a recycling system to recycle a mixture of at least five different polymers, thus creating new polymeric materials with enhanced properties. This system would enable the recycling of mixed plastic waste into homogenized thermoplastic with enhanced mechanical and processing properties when compared to the average properties of the constituent plastics. If successful, recycling plants will be able to increase the rate at which they process plastics, making plastics recycling more economical and efficient.

CURRENT PRACTICES IN H-GAC REGION

The American Plastics Council estimated that roughly one-half of all US communities collected plastic for recycling (primarily 1 and 2), either through curbside collection or drop-off centers. Currently, plastics number 1 and 2 are collected throughout most of the H-GAC region. Plastics numbers 3-7 are much less commonly recycled. However, collection of a wider variety of plastics is increasing.

In Harris County, the City of Southside Place collects all plastics with their curbside recycling program. Residents are instructed to place plastics along with their other recyclables at the curb every week on pick-up day. City staff takes commingled plastic, metal, aluminum to Vista Fibers. The City of Houston recently expanded plastic collection to include plastics 1-5 and 7 through their curbside recycling program and at recycling drop-off centers.

In Liberty County, the City of Cleveland in conjunction with the nonprofit Operation Refuge, have set up a program to recycle all plastics. One challenge this program has faced is the number of bales required by vendors to come and retrieve the plastics. It requires some time to accrue the number of bales, and therefore the facility has to have adequate storage space.

BARRIERS TO RECYCLING

The recycling of plastic scraps is a straightforward process. The plastic bales are broken apart and ground into small flakes. Depending upon the type of plastic material being recycled, these flakes undergo a process in which the containments are sorted from the actual plastic flakes.

Though the process is relatively straightforward, there are significant barriers to recycling plastics. The sorting, collecting, cleaning and reprocessing can be challenging and expensive. Plastics that can be recycled must be mixed only with that of identical resin identification codes. This is a challenge for the consumer in sorting plastic for recycling and for recyclers, who must sort collected material. In addition to sorting by resin identification codes, sometimes colors also need to be sorted. Dyes are used to color the plastic and if the market demands a certain color, some may not be recyclable. Unclean plastic can damage equipment if not cleaned, and proper cleaning can be cost prohibitive. It is often more inexpensive for manufacturers to use virgin plastic.

In addition to challenges in infrastructure, low market demand is another barrier to recycling plastic. Market demand for some plastics, particularly mixed plastics, are limited. To be economically viable, plastic processors require large quantities of recycled plastics, manufactured to tightly controlled specification at a competitive price in comparison to that of virgin polymer. This is a challenging task, particularly in view of the diversity of sources of waste plastics, the wide range of polymers used and the high potential for contamination of plastics waste. One way to address this problem is to enclose the recycled plastic between layers of virgin plastic to ensure the packaging conforms to hygiene standards. These multi-layered containers are now being used in some drinks bottles, but recycling cannot eliminate the colors from plastics so they cannot be used in transparent or light colored applications.

Industry leaders must consider the environmental impact of manufacturing practices, the use of renewable resources, overall resource minimization and, critically, recycling at the end of the product lifecycle. Consumer interest is limited and government involvement is low.

STRATEGY RECOMMENDATIONS

Select packaging materials that can be recycled or reused. It consumes less energy and fewer resources.

There are many opportunities to reuse plastic. Opportunities include using refillable containers, buying in bulk, buying items that don't need much packaging, and buying items in recyclable and recycled packages**.** Residents can reuse plastic products. Grocery stores can use returnable plastic crates for transportation and display purposes. There may be some challenges to reusing plastic materials due to the recent research on a controversial chemical called bisphenol A (BPA). Opinions differ, but critics claim that plastic products containing BPA may leach hormones from the plastic container into water or food.

Implement a Buy Recycled Policy.

Develop procurement policies that give preference to or require the purchase of products that are recyclable or made from recycled content materials. Local governments can make it the municipality's policy to buy recycled whenever feasible. Challenges may arise if recycled products have a lower quality or higher cost.

Expand recycling collection. Explore new markets.

The American Chemistry Council has created a Recycled Plastic Markets Database. This database is searchable by zip code or state, plastic type and buyer or seller. It is located at the following website:
http://www.americanchemistry.com/s_plastics/sec_rpmd.asp?CID=1591&DID=6053.

UNTREATED WOOD

OVERVIEW

Wood waste consists of sawn lumber, trim, shipping pallets, trees, branches and other wood debris from construction and demolition sites. Wood waste is the largest portion of the waste stream generated from construction and demolition activities.

According to the EPA, nearly 6 million tons of wood waste was generated in 2003. There has traditionally been limited recycling of wood waste. In 1998, only 600,000 tons were recovered for recycling and composting. However, more processing centers developing over the U.S.

POTENTIAL MARKETS AND USES

As with other commodities, markets for wood vary with regional and local supply and demand. The current market is dominated by mulch and fuel applications. The EPA reports that the current market will pay between $12 and $24 per ton for processed wood. Other uses include use as a composting bulk agent, animal bedding or reused wood products.

The deconstruction industry is growing and increasing efforts to recover and reuse wood for flooring, doors, windows and other applications. Salvaged or reused wood typically require the highest costs for sorting and processing. An alternative is to use wood waste as a feedstock for engineered wood, which is a process that binds smaller pieces of wood together with a variety of glues and other chemicals to make a wood-like product, such as particle board or plywood. Collected wood waste generated on a construction site offers great potential for reuse because of the ease of separating and they debris is relatively clean and homogenous. Wood collected on a demolition site is typically less desirable due to the nonuniform nature of the wood waste as well as the commingling of the wood with other materials.

Some less common products made from wood scrap include wood flour, wood-concrete wall forms, fire logs, fingerjointed lumber and animal litter. Wood flour is wood that is ground into a fine dust and dried to desired moisture content. The flour is then used for a variety of applications, including filler for woodfiber-plastic composites for decking and railing materials outdoors. Operating and processing costs to create wood flour can be quite high because it involves the use of a hammermill. Markets for wood-concrete wall forms may increase as green building becomes more mainstream. Fire logs can be made from densified paper or wood residuals, typically with an additive to make it burn more easily. These logs can contain up to five times the energy equivalent of solid wood. Like the process for creating wood flour, creating fire logs requires an investment in equipment, including a hammermill. Creating fingerjointed lumber is becoming more popular and is a process of manufacturing structurally sound lumber from lumber cut-offs. For example, a company in Florida collected clean southern

yellow pine from construction sites and fingerjointed and glued to new, structurally sound 2x4s. The recycled lumber was grade stamped for vertical use in building construction. To increase the cost effectiveness of this process, it may be wise to employ firms that offer certified lumber inspectors to grade lumber for use on site. American Lumber Standards is a licensing body for lumber graders. Creating animal litter wood pellets is a growing market, but the product is typically more expensive than alternatives and the processes requires expensive equipment, such as a hammermill, dryer, pelletizers and other auxiliary equipment.

CURRENT PRACTICES IN H-GAC REGION

Nature's Way Resources in Conroe provides an outlet for organic waste disposal, including untreated wood products like yard trimmings. They develop high quality, cost effective new products, such as compost and mulch, from recycled feedstocks diverted from the waste stream.

Novus Systems, Inc. provides collection and transportation for discarded wood. They have permitted processing sites in the region and recycle material for beneficial reuse.

The City of Houston has wood waste recycling as part of the curbside heavy trash pickup. The wood waste is sorted from the heavy trash and converted into useable products such as compost, soil amendments and boiler fuel.

There are a variety of reuse facilities throughout the region. The City of Houston is in the process of constructing a construction and demolition warehouse. The City of Huntsville also has a construction and demolition warehouse where reusable materials can be dropped off for reuse. There are other alternatives, such as Habitat for Humanity's Restore and Historic Houston's Salvage Warehouse.

BARRIERS TO RECYCLING

One of the major barriers wood recycling lies in the need for standardization of the products. Wood residuals can be partially contaminated, have different forms, shapes and moisture contents and are not all easily recycled. Recovered wood has standards, including grading rules, engineering properties and a grade stamp. There has to be some sort of technical performance testing to determine the structural integrity of the recovered wood. The final use of the wood waste often determines how clean and consistent the feedstock must be.

The end uses of wood recovered from construction and demolition activities are sometimes limited because the wood is commingled with other materials and contaminants or is in such poor condition that the cost of processing and cleaning limits the economic viability of processing and reusing the material. Virgin raw materials are often too inexpensive to make recycled wood an economical choice.

The wood waste processors vary in what they require for a feedstock. Some request only clean wood that is untreated while others will take a mixture of waste woods. Disposal fees vary with each facility and some facilities may pick up loads and supply drop-off boxes. It is important to contact the wood waste processors to determine the most cost effective option for each situation.

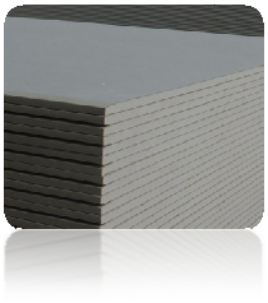
STRATEGY RECOMMENDATIONS

Develop residential yard waste collection.

For communities that do not have residential collection, consider coordinating with the county or other communities to have one day collection events on a seasonal basis.

Coordinate C&D recycling with local programs.

To minimize disposal costs and potentially generate income, contractors should contact local wood waste processors and inquire about setting up drop boxes on site for wood waste scraps. Contractors should also consider collecting pallets and crates that building materials and equipment are shipped in. There are usually several businesses listed in the phone directories, under "pallets" or "skids," that collect and remanufacture pallets.



GYPSUM

OVERVIEW

Gypsum is a naturally occurring mineral composed of calcium sulfate and water. It is mined from deposits formed by ancient seabeds as a raw material. Gypsum board is a family of panel-type products that consist of a noncombustible core, primarily of gypsum, with a paper surfacing on the face, back and long edges. It is often referred to as drywall, wallboard or plasterboard.

The U.S. produces approximately 15 million tons of new drywall annually, and approximately 12 percent of new construction drywall is wasted during installation. Scrap is also generated during demolition, manufacturing and renovation.

When taken to a landfill, hydrogen sulfide gas may be produced, particularly in a wet climate. This gas can be toxic in high concentrations and has an unpleasant odor. In addition, if gypsum gets wet, it dissolves into calcium and sulfate that can leach into the groundwater, causing contamination.

POTENTIAL MARKETS AND USES

To reduce the negative environmental impacts of using raw gypsum, such as habitat disruption, energy use, and emissions in processing and transportation, recycled gypsum can be used. The economic viability of gypsum recycling depends on a number of factors, including landfill tipping fees, cost of transportation, collection and processing and the value secondary markets place on recycled gypsum.

Drywall gypsum can be recycled back into new drywall if most of the paper is removed. The paper affects the fire rating, and limits the amount of recycled gypsum allowed in new drywall. As technologies advance, the paper content in drywall may be decreased, which will further increase the recycled amount.

New construction drywall is the most commonly recycled because it has less contaminant. One current use of recycled new construction drywall is soil amendment. Gypsum drywall is a source of calcium and sulfur similar to agricultural gypsum. Most turf grasses and ornamental plants need these nutrients, and gypsum drywall helps break up the heavy clay. The drywall does not change the pH in the soil like lime because it's pH neutral. The process does not require the paper to be removed. The markets for soil amendment include agriculture, forestry reclamation, nurseries, city parks and recreation areas, residential lawns, golf courses, and compost. Using gypsum as a soil amendment has been shown to improve water penetration and workability of impermeable soils, soften clay soils, neutralize soil acidity and add plant nutrients.

Drywall from demolition sites may be recyclable for non-agricultural markets. There are more potential contaminants that must be considered, making the processing for

demolition drywall more laborious. Those contaminants include nails, tape, asbestos (used as joint compound in some homes built before the mid-1970s), paint (may contain lead in homes built before 1978). Some of these uses include the production of cement and as an ingredient in the manufacture of many types of commercial products.

Less common reuses of gypsum include marking lines on athletic fields, grease absorption on floors and stucco additive. Cut off pieces of new construction drywall can be used as forms to support gunite (concrete sprayed at a high pressure) as it is being sprayed. In addition, Habitat for Humanity and other reuse organizations accept new drywall sheets of a half size or larger.

Case Study:

Legislative Action in British Columbia

In British Columbia, Canada, there are legislative restrictions on the disposal of drywall, prohibiting disposal in a landfill or in the ocean. Increasing environmental pressure acted as a driver to cease disposal and promote recycling. A demolition contractor developed a process that creates cost benefits to manufacturers. Both wet and dry gypsum is accepted. The recycling process removes contaminants and the facing paper to produce a quality product. The recycled gypsum is marketed to drywall manufacturers at a lower price than virgin material. It typically forms up to 22% of the feedstock for new drywall in Canada, while maintaining quality. This study illustrates that placing a landfill ban on a waste product was an effective driver in the development and establishment of drywall recycling.

CURRENT PRACTICES IN H-GAC REGION

Recycling of gypsum board in the H-GAC region is limited. Nature's Way Resources takes in drywall scraps from around the region. The drywall is ground up and small amounts are used in mulch and soil blends as a nutrient resource. The remaining paper is composted.

Some construction and demolition reuse warehouses will take drywall if the sheets are large enough and reusable.

BARRIERS TO RECYCLING

Despite the successful uses of recycled gypsum, most drywall in North America is still disposed of in landfills. The largest challenges to recycling lie in the collection and separation of the gypsum. It can be difficult to obtain a clean source of drywall due to contamination at the job site. There is also a perceived complexity in recycling and the process is unfamiliar to some workers on construction sites. Other issues arise around the storage and scheduling of recycling, as well as the dust involved during grinding the drywall.

Demolition drywall can be challenging to recycle due to the potential contamination from wall coverings and paint, such as arsenic and lead. Another potential problem is creating a nutrient imbalance, when recycled and used as a soil additive, if it is over applied to land.

Typically, due to a relatively large abundance of cheap land and low landfilling fees, construction and demolition debris, including gypsum, is hauled off to a landfill. This method is cost effective, which doesn't encourage an alternative, such as recycling the debris. There is currently no regulatory or market-based demand for builders and contractors in the H-GAC region to recycle gypsum board.

STRATEGY RECOMMENDATIONS

Communicate with political representatives.

An educated public needs to communicate with elected officials and put pressure on them to create legislation dealing with construction and demolition waste issues. If the issue is addressed from a health and safety viewpoint, elected officials may be more likely to respond. Other communities have placed legislative restrictions on landfilling gypsum, which encourages market development.

Reduce the amount of excess drywall on constructions projects.

Drywall comes in standard sizes ranging from 4x8 to 4x16 feet, and in thicknesses from 1/4to 1 inch. Drywall waste can be reduced by constructing standard-sized walls and flat ceilings, ordering custom-sized sheets for nonstandard walls, and finding substitutes that are reusable, such as modular "demountable partitions" for commercial buildings.

Reuse drywall on construction sites.

Consider using drywall as a soil amendment on-site. Contractors, subcontractors and site staff will need to be educated about the process. Identify the location for the collection of the drywall scraps and label the containers clearly and in all applicable languages.

Haul drywall scrap offsite for recycling.

Check local vendors to arrange for reduced tipping fees for drywall scrap.

FOOD WASTE

OVERVIEW

Food waste is any waste derived from food materials, typically consisting of vegetable peelings, meat scraps, excess or spoiled prepared food, and other discards from residences, commercial establishments (grocery stores and restaurants), institutional sources (schools), and industrial sources (factories).

Each year, Americans discard more than 96 billion pounds of useable food. In 2001, the EPA reported that food waste made up 14% of all waste disposed of in the US, but only recovered 2.6% of food waste from the waste stream. The US spends approximately $1 billion every year for food waste disposal.

A recent study indicated that 40-50% of all food ready for harvest never gets eaten. On average, households waste 14% of food that is purchased. That translates to about $590 per year wasted just on meats, fruits, vegetables and grain products for a family of four. Waste studies have shown that over 70% of the waste from restaurants is organic and can be recycled.

In landfills, food waste can cause environmental damage and is the largest contributor to methane gas production. Not only does it cause odor during decomposition, attracts flies and other pests, but it also has the highest potential to add Chemical Oxygen Demand (COD) to the leachate. When food waste is disposed of through garbage disposal units it is treated along with other sewage and contributes to sludge.

POTENTIAL MARKETS AND USES

Reducing food waste and increasing the amount recovered from the waste stream can have a number of environmental, social and economic benefits, including pollution reduction, decreasing consumption of non-renewable material, generating compost for agriculture production, reducing garbage collection and disposal fees, and redistribution of edible food. There are several alternatives to sending food waste to the landfill. In addition to donating to charity, food can also be converted into animal feed, rendered into soap or other products, and composted.

Excess food can be donated to food banks, soup kitchens and shelters. Many restaurants and other food service establishments are not aware that others can benefit from their left over food. Food can be donated to many different non-profit organizations.

Communities can implement composting program at the city or county level. Food waste can be included with yard waste pick up at the curb. This type of program is successful only if there is a central processing facility. Food waste can be composted at home, as an alternative to a city- or county-wide central collection system. However,

the proportion of the population willing to dispose of their food waste in that way is limited.

Case Study:

Anaerobic Digestion

In 2006, the EPA funded a pilot project at the East Bay Municipal Utility District in Oakland, California to investigate anaerobic digestion of food waste. Compared to municipal wastewater solids digestion, anaerobic digestion of food waste provides about three and half more methane per volume of digester. Digesting 100 tons of food waste per day, during a 5 day week, provided enough power for an estimated 800-1,400 homes in one year.

Biogas Power Plant

Also in 2006, a new biogas power plant was opened at UC Davis. Food scraps from around 2,000 restaurants in the San Francisco Bay area is collected and sent to the power plant. The plant receives approximately 8 metric tons per week. The plant has 4 large steel tanks and a 22-kilowatt generator, utilizing a technique called anaerobic phased solids digestion. Each ton of food waste collected provides enough energy to run an average of 10 homes.

A relatively new market for food waste is food-fueled power or food-to-energy projects. Food waste is high in energy potential. The methane produced by food waste and other garbage can be harmful in an open environment, like a landfill, but in a controlled setting, this gas can be harnessed and converted into biogas, that can be used to provide heat, light and fuel.

CURRENT PRACTICES IN H-GAC REGION

In 2003, Rice University expanded a landscape composting project to include food waste at on of the Colleges within the campus. This program utilized an on-site composter known as an Earth Tub, and reduced overall kitchen waste by 75%.

Nature's Way Resources, located in Montgomery County, provides organic waste disposal. They receive pre- and post-consumer food waste from several companies in the region. The Hilton Hotel in downtown Houston has begun recycling food waste that is delivered to Nature's Way by a waste hauler. Nature's Way also collects food waste and biodegradable table ware from several events in Montgomery County. In 2007, they took in 9,243 cubic yards of food waste and 819,000 gallons of liquid.

There are several options for making food donations in the H-GAC region. The End Hunger Network is a nonprofit organization that collects and distributes food to the greater Houston area. In conjunction with America's Second Harvest, these two organizations distribute approximately 7 million pounds of food to the Greater Houston

Area. In addition, there are various food banks and charities around the region that accept food, both from individual donations and commercial/corporate donations.

BARRIERS TO RECYCLING

A common barrier to food waste recycling is the lack of a local processing plant. For composters, there are multiple barriers to food waste recycling, many of which lie in the processing. Those barriers can include odors, residues, leachate collection, impervious surfaces, prevailing winds, plastics, packaging, twist ties, and glass.

There are common perceptions that a separation system will cost more, that it will take time and money to educate the public on food recycling, as well as extra time to work out the logistics of a food waste recovery program.

As with other commodities, tipping fees at landfills are not high enough to make it economically viable to compost the food waste.

STRATEGY RECOMMENDATIONS

Donate to food banks and other charities.

By donating unused food, reusable material is not going into landfills and incinerators, but can also help feed those in need of assistance. Non-perishable and unspoiled perishable food can be donated to local food banks, soup kitchens, and shelters. Local and national programs frequently offer free pick-up and provide reusable containers to donors. Because these donations recycle food and help feed people in need of assistance, this option should be considered before looking at other alternatives.

Reduce food waste.

A recent study suggests that cutting food waste in half could reduce adverse environmental impacts by 25%. These improvements would include reduced landfill use, soil depletion and applications in fertilizers. This waste reduction must come not only from consumers and retailers, but also manufacturers. Source reduction, including reuse, can help reduce waste disposal and handling costs, because it avoids the costs of recycling, municipal composting, landfilling, and combustion. Source reduction also conserves resources and reduces pollution, including greenhouse gases that contribute to global warming.

Conduct community education campaigns.

Conduct community education on the value of food, composting and concerns about food waste recycling. The education should highlight the benefits of food waste recycling, such as avoid disposal fees and improving public image. By letting citizens know that your community is making an effort to recycle and provide for a sustainable future, you will increase satisfaction and confidence in your leadership.

Use food scraps for animal feed.
Food waste for animal feed can help divert reusable food scraps from landfills and provide a nutritious feed, usually at a lower cost than traditional feed. Consider developing relationships with local farmers and others in agriculture.

Promote residential composting.
Educate citizens about the benefits of compost from food scraps, such as soil enrichment and plant health. Encourage a residential composting program or consider teaching citizens classes on backyard composting. Home composting is the most cost-effective and environmentally friendly way to recycle these materials and produce a beneficial product.

CARPET

OVERVIEW

The amount of carpet that is reaching the end of its useful life and entering the waste stream is ever-increasing: In 2002, there was an estimated 4.7 billion pounds. Of those discards, 96% was disposed of in the landfill. In 2007, The Carpet America Recovery Effort reported a total of 296 million pounds of post-consumer carpet was recycled.

On January 8, 2002, in Atlanta, Georgia, members of the carpet industry, representatives of government agencies at the federal, state and local levels, and non-governmental organizations signed a Memorandum of Understanding for Carpet Stewardship (MOU). This important agreement established an ambitious ten-year schedule to increase the amount of recycling and reuse of post-consumer carpet and reduce the amount of waste carpet going to landfills. Through this partnership the Carpet American Recovery Effort (CARE) organization was formed. During the agreement's 10-year span, CARE will work to help enable diversion of post-consumer carpet from landfills by 40 percent by the year 2012.

POTENTIAL MARKETS AND USES

National concerns about disposal capacity, combined with carpet's bulk (which makes it difficult and expensive to handle), have contributed to the search for alternative means for carpet disposal. Carpet manufacturers are voluntarily addressing the problem of waste carpet in landfills by recycling old carpet materials back into carpet production, finding alternative uses such as building materials and auto parts, refurbishing old carpet into new carpet tiles and even reclaiming old carpet so it can be reused or recycled.

Although more efficient manufacturing is reducing excess carpet waste, such as trimmings and shearings, the industry has found creative uses for carpet by-products, such as carpet trim and yarn scraps, to avoid the use of local landfills. Fiber and yarn that cannot be reused in manufacturing is recovered for use in other products. Excess carpet is cut into rugs and mats and sold for other uses. Waste carpet trimmings, backing and yarn often are sold to recycling plants to be processed into such items as carpet cushion, furniture battings and cushions, reinforcing filler for concrete, fence posts, road underlayment, plastic lumber and automotive parts. Polyethylene packaging, used to wrap carpet yarn spools and other raw materials, is recycled into plastic pellets to be sold to extruders of film, plastic wrap or plastic trash bags, or it is used in molded items. Other materials used in the manufacturing process, such as cardboard, paper, aluminum, wooden pallets, yarn cones, roll cores, liquid containers, raw material packaging and scrap metal, are either reused or recycled.

CURRENT PRACTICES IN H-GAC

Carpet recycling is limited in the Houston-Galveston area. For commercial buildings, some carpeting manufacturers (for example, Shaw, Interface) will accept used carpet if new carpet is installed from their mills. Antron, a carpet fiber recycler, has a reclamation program that has reclaimed over 57 million pounds of carpet. There is a small fee associated with recycling that typically ranges from one to three dollars per yard.

The Montgomery County Habitat for Humanity collects carpet that is not shag and has no stains, worn areas, or pet odors. It also accepts carpet padding with no animal stains or odors.

BARRIERS TO RECYCLING

Carpet recycling is an immature recycling market compared to other recycled materials such as paper, aluminum, and electronics. End markets that do exist have not matured sufficiently to use the tools commonly found in other recycled material recovery chains.

The depressed housing market will impact the need for recycled carpet. Fewer new homes result in less demand for carpets and carpets containing recycled content. In addition, the demand for padding, including fiber pad made from 100% post-consumer carpet will decline.

Collecting, sorting and transporting used carpet is a huge challenge not only for individual consumers but industrial ones as well. These processes drive up the cost of recycling carpet, which poses another obstacle. It typically costs between 5 cents to 25 cents per pound to recycle old carpet. Carpet typically weighs about 4-5 pounds per square yard. The cost will depend on the kind of carpet, how it was installed and the geographic location. In addition to these costs there is also the cost to have someone come and pick it up, identify what kind of fiber it is made of, break it down into the components that make it up, convert those components into a form that someone will buy and use to make a new product, and then transport that raw material to the manufacturing location.

STRATEGY RECOMMENDATIONS

Extend the life of carpets.

Carpet is often replaced because it no longer looks appealing; not because it is has worn out. The “Green Label” placed on vacuum cleaners by manufacturers ensures that a particular vacuum cleaner is best suited to keep all carpet surfaces as clean as possible – without putting dust back into the air. This is the first step in helping to preserve the life of carpet. These types of vacuum cleaners remove soil, retain dust within the filtration bag and the machine itself, and leave the carpet damage free as well as maintain its appearance.

Develop an identification system of carpet materials.

An identification system, similar to that of plastics, would make sorting the fiber and backing compounds much easier and more efficient in the future. Many of the Carpet and Rug Institute member companies as well as many entrepreneurs around the country are currently using this identification system, called the Carpet Component Identification Code (CCIC).

CONCRETE

OVERVIEW

In its simplest form, concrete is a mixture of paste and aggregates. The paste, composed of Portland cement and water, coats the surface of the fine and coarse aggregates, which hardens through a chemical reaction called hydration. More concrete is used than any other man-made material in the world. In 2006, approximately seven billion cubic yards of concrete were produced.

Concrete is a large portion of construction and demolition waste, which comprises 22% of the total municipal solid waste stream in the state of Texas and 38% of the total waste stream in the thirteen county H-GAC region. Some estimates put concrete, asphalt, and rubble at about 50% of the C &D waste by weight.

The American Concrete Pavement Association estimates that approximately 322 kilometers of concrete pavement is being recycled each year and approximately 5,440 metric tons of crushed concrete can be reclaimed from 1.6 kilometer of concrete pavement with an average thickness. This shows that 2.6 million metric tons of reclaimed concrete is being recycled annually in the United States.

POTENTIAL MARKETS AND USES

Recycling concrete requires the breaking, removing, and crushing of concrete to a specified size. A contractor can bring the recycling equipment to the on-site, construction location, or use a stationary recycling plant. Recycling plants can produce any desired gradation. After processing, the crushed concrete makes an acceptable aggregate for use in new concrete, road base material, or to protect shorelines, for example in gabion walls or as rip rap.

The Texas Department of Transportation is one of the leading users of recycled concrete aggregate (RCA). Crushed concrete is a component of recycled concrete. Concrete from existing roadways, pavements, airfields, and buildings can be reused. After the material is crushed, magnets remove the steel rebar, and the remaining aggregate is screened to produce the desired consistency, ranging from coarse to fine. In the 1990's, the reconstruction of Houston's Interstate 10 (from Loop 610 to I-45) was the first project in the state in which all recycled aggregate was used for pavement concrete, according to TxDOT. Today, crushed concrete is used extensively in state projects in the Houston area.

Airport projects are examples of a trend in which recovered construction and demolition materials such as concrete are incorporated into new projects, thereby saving money and reducing demands on natural resources and landfills. In 2002, George Bush Intercontinental Airport unveiled a renovated runway. Rather than demolish the old runway and carry the debris to a landfill, crews ground up the pavement, made new

aggregate, and used the recycled blend in both the base and top layers of the runway, which was lengthened from 6,000 to 10,000 feet. Money was saved by reusing materials and doing reclamation on the job site.

Designers use recycled aggregate for sidewalks, curbs, bridge substructures and superstructures, concrete shoulders, median barriers, residential driveways, erosion control, and general and structural fills. Oversized material can be used at entrances of construction sites to help remove mud from truck tires.

Case Study
Dirt Built Cement
Henry Louis Miller, a student from the Rensselaer Polytech Institute in Troy, New York, won the component category of the "Concrete Thinking for a Sustainable World" international competition. His entry, "Clean-Up: Dirt Built/Cement Made," illustrated how cement could be combined with contaminated soil or discarded materials to be reformulated into bricks for new construction. A group of students from Quebec's University Laval – Gisele Fraser, Daphnee Van Lierde, and Mikaelle Rolland-Lamothe – took top honors in the structure category with a proposal for a science center with concrete walls that would seamlessly flow into the natural terrain of the site.

Building products that have a portion of their constituent materials from recycled products reduce the need for virgin materials in new construction. The virgin material aggregates are inert granular materials such as sand, gravel, or crushed stone that, along with water and Portland cement, are an essential ingredient in concrete. Using recycled materials reduces the need to landfill these materials. It also reduces the environmental impacts from extracting and processing virgin materials.

CURRENT PRACTICES IN H-GAC

Today, crushed concrete is used extensively in state government projects in the Houston and Dallas areas. Southern Crushed Concrete is one of the leading suppliers of recycled concrete aggregates. There are several plants in the region, including one in Galveston and eight in the Houston area. Crushed concrete can be dropped of with no disposal fee. Pick up of concrete material is available for a fee if the site has its own machinery. The company's primary customers are governmental agencies, commercial and industrial entities. Its crushed concrete conforms to the specification of the Texas Department of Transportation. When mixed with cement, crushed concrete can be used for projects that call for cement stabilized base. This recycled material is less expensive than the crushed rock alternatives, and it helps preserve the environment.

BARRIERS TO RECYCLING

In addition to low disposal costs at landfills, transportation is a large barrier to recycling concrete. Typically, the concrete is hauled to an off-site recycling plant for processing

before the aggregate can be hauled to the end user. The added cost of transporting and processing may discourage companies from using recycled concrete.

There are significant costs associated with the upstart of recycling program, including the costs of the machinery for crushing and separating, along with its maintenance and space required to store the materials.

While contaminants are usually not a concern for recycled aggregates used as a base course, strict control must be used for recycled aggregates in concrete to ensure that there are no more contaminants than are allowed for virgin coarse aggregate.

STRATEGY RECOMMENDATIONS

Use recycled concrete for public projects.

Recycling concrete is already a smart and environmentally conscious choice that saves resources. The recycling process can be more cost effective by utilizing an in-place system of processing concrete. It will save on wear and tear of highways and roads, saves fuel, and improves air quality by reducing exhaust fumes. The contractor does not have to pay for trucking the materials or finding a location to use as a recycling center. This benefits owners and taxpayers in reduced construction costs.

GLASS

OVERVIEW

Glass is a hard, brittle, transparent solid that is used in many applications. It is an inorganic product of fusion cooled to a rigid condition without crystallizing. Similar to paper, glass comes in many forms and colors such as glass bottles, windows, monitors and mirrors. Soft drink, beer, food, wine and liquor containers represent the largest source of waste glass generated. According to the Environmental Protection Agency's (EPA) 2006 data, 13.2 million tons of glass was generated in the solid was stream, with 22% recovered for recycling.

There are many benefits are derived from recycling glass. It is 100% recyclable – 30 days from recycle bin to store shelf. It also reduces environmental impacts and conserves natural resources by not creating additional waste or by-products. Glass can be recycled indefinitely without losing quality or purity.

POTENTIAL MARKETS AND USES

There are numerous markets that have developed for using recycled glass. The primary end product of recycling glass is new glass bottles and jars. However, other ideas have emerged that are environmentally friendly secondary markets, such as abrasives, aggregate substitute (such as for roadbeds), bead manufacturing, decorative applications (such as tile), and fiberglass.

Case Study:
Terrazzo
Enviroglas, a small recycling plant, located in Plano, TX, converts post-consumer and industrial glass bound for the landfill into elegant, sustainable and ecological hard surfaces and landscaping materials. The concept was created by Tim Whaley, a principal of Enviroglas. In 2002, the City of Plano had an overabundance of crushed recycled glass. Through his creative thinking, Mr. Whaley created and patented the process of making a terrazzo surface out of recycled glass. The end product is formed by mixing epoxy with crushed glass. The company uses this mixture in floors, countertops and numerous decorative surfaces.

In addition to bottles and jars, recycled glass can also be used as mulch in landscaping projects. Glass mulch reduces weeds, and prevents soil from becoming compacted. It does not absorb water like wood mulch, so the water goes where it is intended – into the plants – resulting in less water being used. Glass can be used as a replacement for sand along beaches. Sand along the shores is becoming scarce (erosion and natural disasters) and engineers seek alternatives. One solution is to use waste glass ground to the size of a grain of sand as a replacement.

Glass can also be used in many decorative applications, such as bead manufacturing, landscaping materials, or tiles. It is also used as an aggregate substitute and road base.

CURRENT PRACTICES IN H-GAC

Glass is recycled throughout the region, both at recycling drop centers and curbside. Strategic Materials, is the largest purchaser of scrap glass in North America. The company's headquarters is located in Houston, TX, with several locations across the country. While the Strategic Materials purchases other types of glass scrap, their main supply sources consist of post-industrial window and automotive scrap and post-consumer glass containers. Their bottle supply comes from curbside collections, recycling brokers, buyback redemption centers, post-industrial obsolete scrap, deposit systems, small collectors, and many other sources.

BARRIERS TO RECYCLING

Glass recycling offers many benefits, yet there are obstacles present that can make recycling difficult for some. Contamination of recycled glass can occur at the curb, during collection and processing, or shipping. Because of this, most recycling programs will only accept glass containers. Products such as drinking glasses, light bulbs, mirrors and Pyrex are not accepted by recyclers. The time and effort it takes to separate glass by color is also a barrier that can lessen the recycling effort. Glass comes in four different colors and must be divided as such in order to prevent new glass from being created with a mixture of colors.

Bars and restaurants are large producers of glass; however there are several challenges that can discourage recycling. Most businesses require an economic incentive to participate. In addition, there may not be an appropriate container recycling infrastructure in place to make the program viable if appropriate markets are not located in the area.

STRATEGY RECOMMENDATIONS

Communicate with political representatives to establish a bottle bill.

There are 11 states that have adopted a "bottle bill." Texas, currently has not adopted this bill. This bill allows for consumers to pay an extra charge when purchasing beverage containers, which is then refunded when the container is recycled. The states that have an active bottle bill in place, report higher recycling rates for beverage containers than states without such programs.

Work with bars, restaurants and hotels to establish recycling programs.

While residential curbside recycling remains an important source for container recycling, bars, restaurants, and hotels are next in line as an untapped supply of clean glass containers. Results of a 2005 study conducted by the Beverage Packaging Environmental Council on beverage drinking habits and recycling of beverage packaging found that 18% of beverages are consumed at a bar or restaurant, and another 66% at home.

TIRES

OVERVIEW

Today's tires last for more miles than they did in the past. However, the number of cars on the road is increasing and the average number of miles driven annually is also increasing. According to the Scrap Tire Management Council, the standard assumption is that scrap tires are generated at a rate of one tire per person per year.

According to the EPA, as of 2003 there were more than 290 million scrap tires generated in the United States. Approximately 100 million of those tires were recycled into new products and 130 million were used as tire-derived fuel (TDF).

POTENTIAL MARKETS AND USES

With landfills minimizing their acceptance of whole tires and the health and environmental risks of stockpiling tires, many new markets have been created for scrap tires. In Texas, most scrap rubber is burned in industrial facilities, used as landfill liner or in the construction of septic tank drainage fields.

A viable and innovative use of recycled tires is to transform the scrap tires into fuel. The EPA's 2003 figures estimate that 130 million scrap tires, about 45% of those generated, were reused as TDF in various industrial facilities. The shredded tires are used to supplement traditional fuels (coal, wood). TDF helps to eliminate scrap tires, conserves natural and fossil fuels, and burns cleaner than coal. TDF is commonly used in cement kilns and other industrial facilities (pulp and paper, electric utilities, etc).

Many technologies are developing to minimize any emissions related to tire recycling. Whole tires, grinds them up, removes the wire and fiber contaminants and crushes the remaining rubber bits down to the consistency of household sugar, a product called "crumb rubber." The product can use rubber mats have cushioning features that protect free weight area floors from dings, scuffs, and other damage. Another company, Global Resource Corporation has developed a patent-pending microwave technology that extracts oil and gas from products such as scrap tires.

Case Study:

Green Rubber

One emerging market for scrap tires is utilizing the DeLink technology of "Green Rubber". Petra Group, a Malaysia-based company, has created and patented the waste and emissions free process that converts old tires back to "green rubber." The process de-vulcanizes the rubber by opening the sulfur bonds which causes the chemical characteristics to resemble virgin rubber. The entire process takes about 8 minutes to complete. The company plans to open its first US processing plant in Gallup, New Mexico. The plant is scheduled to open in July, 2008, with six to eight additional plants scheduled to open in the near future. Rick Homas, president of the US subsidiary, Green Rubber Global, states that the plant could end up recycling about six million tires a year.

CURRENT PRACTICES IN H-GAC

The 13-county H-GAC region offers several recycling centers where consumers can bring their recycled items including tires for disposal. For example, in the City of consumers can bring up to 10 tires for disposal at the Westpark Recycling Center. In Fort Bend County, the county environmental center charges a tire disposal fee of $1.00 per tire for automotive tires and $5.00 per tire for truck tires. In addition to municipal drop-off centers, automotive and tire stores, will often take your used tires back with the purchase of a new tire.

Liberty Tire Recycling accepts approximately 25% of the scrap tires in the US through a network of 14 facilities, including one in Houston. They provide door-to-door service to tire and auto dealers, fleet operators, tire manufacturers and retreaders and governmental agencies. The contractor processes and shreds the scrap tires, and the end product is distributed for after- market applications such as fuel, highway materials and other rubber-based products.

BARRIERS TO RECYCLING

Generally, tires need to be reduced in size to fit in most combustion units. Besides size reduction, use of TDF may require additional physical processing, such as de-wiring.

As with any process, there are always concerns about its safety. Whether it is a human safety concern, environmental concern or any number of issues that may cause one to consider the effects of a process, it is safe to say that there are pros and cons to every idea concerning tire recycling. The burning of tires for fuel is a very controversial issue. However, in Texas, burning large amounts of scrap tires for use as fuel in cement kilns, utility boiler, pulp and paper mills and co-generation facilities, is the most common method for disposing scrap tires. Many people and organizations alike, oppose this practice. Organizations such as the Texas Parent Teachers Association (PTA), have pointed out that children's respiratory and immune systems are especially vulnerable to

pollution from tire burning facilities and not much is known about the permanent effects these emissions can have on developing children.

Another concern with the tire burning process is the use of faulty or outdated equipment. Cement kilns, which are the primary machinery used to create tire-derived fuel, were not originally crafted to process scrap tires. Because of the secondary market created by deriving fuel from scrap tires, these kilns have evolved into multi purpose machines. Naturally over time, the kilns will wear down with use which may cause smoke emissions during the burning process. The perception of reduced air quality through the tire burning process is an ever present concern.

For consumers, the ever escalating cost of gas is a barrier in and of itself to recycling. Depending on the distance it is to the nearest recycling center, can deter many from properly disposing of used tires. Instead of using gas to drive to the recycling center, many may opt to just leave it in their yard or illegally leave it in a vacant lot somewhere. If not properly disposed of, the used tires not only create a potential health hazard but also pose a possible fire hazard.

STRATEGY RECOMMENDATIONS

Educate consumers about tire recycling.

Education and public outreach are the keys to a better understanding about the benefits of scrap tire recycling. Educated consumers are one of the most powerful tools a governing body can have. Local municipalities and communities, who are well informed on the benefits of recycling tires, can host recycling events in their neighborhoods. Grants can be awarded that will provide the monetary means to host successful recycling events. With community involvement there are endless opportunities to find unique and resourceful ways to recycle tires.

Utilize tire products in public projects.

Local governments can work with TXDOT to utilize crumb rubber during the roadway construction process. Recycled rubber and tire products can also be used for playground equipment and turf.

Use retreads on City and County vehicle fleets.

Many local governments use retreads in vehicle fleets on non-passenger tires. This reduces the amount of waste tires and extends the life of existing tires.

CONCLUSION

After reviewing the 8 commodities, research revealed that some of the barriers and strategies were consistent throughout all of the materials. Overcoming these barriers and focusing on these strategies to improve the market may provide the most benefit to local governments.

Barriers

The relatively low landfill tipping fees, compared to other parts of the United States, create a challenge and often eliminate financial incentives to find alternative uses for scrap materials.

One of the largest technical barriers to recycling is contamination. Commodities often require sorting by type, color, size and other factors to avoid damage to equipment or the contamination in the final recycled product.

Another common barrier includes adequate space for storage of commodities. Certain vendors and markets require large quantities of a given commodity. Storage can become an issue for some recyclers, particularly on construction and demolition sites.

Strategies

Some strategies have the ability to improve multiple commodities. For example, implementing a Buy Recycled policy can encourage the use of recycled materials by specifying the purchase of recycled content products during procurement.

Green building program, such as the U.S. Green Building Council's Leadership in Energy and Environmental Design encourage and sometimes require the use of recycled building materials, recycling on construction and demolition sites and recycling in the final facility. Many local governments are beginning to mandate green building in new construction or retrofits of existing buildings.

Increasing recycling education and awareness to consumers about existing programs and the benefits of recycling can stimulate an increase in recycling.

Moving Forward

Local and regional governments must continue to work toward development and policy changes that will promote recycling markets over time. Research into recycling market conditions, manufacturing technology, material processors and recyclers can provide information to help guide efforts across the region.