Resource Assessment
Carroll County, Maryland
January 2008 Final Draft

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TABLE OF CONTENTS

1. SUMMARY AND RECOMMENDATIONS

This report provides an assessment of the value of resources wasted in Carroll County and is not a study on the cost of waste management. Commissioned by the Carroll County Department of Public Works, our research addresses the value of materials, number of jobs that could be created, and the global footprint of the 150,000 tons a year of materials currently landfilled by Carroll County residents and businesses. This assessment includes a discussion of potential policies that could be introduced by Carroll County to target zero waste and provides recommendations for implementation.

Richard Anthony Associates (RAA) estimates that the value (based on estimates of reuse, recycling, and composting) of materials landfilled from Carroll County exceeds 12 million dollars annually. This material has the potential to be recovered in a zero waste system implemented in Carroll County. Further, a zero waste program could ultimately create more than 400 new jobs and would be worth over $23 million in pollution reductions.

Key components of zero waste would include: County led upstream green purchasing, countywide required source separation, local “pay-as-you-throw” financing systems, and a resource recovery park that includes reuse, recycling, and food discards and green materials composting programs at the landfill.

The following RAA recommendations are based on recent recommendations from the Environmental Advisory Council:

The County should adopt a goal to reduce wasting by diverting 75% (by weight) of material going to landfill by 2013, and 90% by 2020, using 2005 as a base year.

The County should change the current perspective guiding the handling of solid waste in Carroll County from *Solid Waste* Management to *Resource* Management and require separation of materials for reuse, recycling, and composting at the source of generation.

The priority for the County should be to support existing reuse, recycling and composting businesses and nonprofit organizations through policies and incentive programs. In the event gaps exist in required services that no one else wants to provide, it would be appropriate for the County to offer such services

directly, or by contracting for such services to be provided. Support should be provided to the Department of Public Works with the resources required for development of programs and policies designed to advance this zero waste goal.

Public outreach and education are needed to promote behavioral changes required for the zero waste program to succeed. Resources for staff and media are needed to achieve higher rates of waste reduction, reuse and recycling.

Carroll County should not develop a waste-to-energy facility, but rather commit to funding the planning and implementation of a zero waste plan as an alternative. Further, the County should not try to site another landfill within its jurisdiction in the short term. In addition to Carroll County adopting a linear, "pay-as-you-throw" rate structure, it should use the solid waste ordinance authority to require all licensed haulers to adopt similar variable garbage rates.

The County should develop a countywide composting facility to process source separated organic materials, including a system appropriate for processing food discards and manures at the landfill.

2. BACKGROUND

Carroll County is at a crossroads. According to the Carroll County, Maryland, Ten Year Solid Waste Management Plan, August 2006, page I.1; landfill disposal is "the last resort". The ultimate goal according to the plan is to be flexible to "… react to changes in regulations, technology and market conditions."

According to the Carroll County Times, in an article entitled "Opinions differ on waste disposal strategy" (December 22, 2007), "… the County will need a 250- to 600-acre landfill" by 2018, and the process to develop a new landfill would need to start now, as permitting and site development can take 10 years. The article continues, "…if Carroll County built its own waste-to-energy incinerator and buried the residue in its own landfill, Northern Landfill would last until 2029 and new landfill development would have to begin in 2019."

The County also has the responsibility to "encourage and facilitate the recovery, reuse and recycling of material within the waste stream." Health and safety, as well as economic considerations have led many jurisdictions to require source separation and recovery of traditionally landfilled materials. Current research indicates that emissions created from disposing community discards and the waste of resources represented by these discards is having dramatic, cumulative impacts on the health of the planet.

RAA has categorized and quantified the types of materials discarded from studies done in jurisdictions in the mid-Atlantic region (e.g. State of Delaware and Montgomery County). Information specific to Carroll County was found in Table I-1 in the aforementioned Solid Waste Management Plan ("Projections of Material

Generated in the Municipal Wastestream"), and visited solid waste facilities in the county to obtain a snapshot of what resources are being discarded.

While 150,000 tons of materials are being landfilled, more than 60,000 tons of materials are currently being recovered for recycling and composting in Carroll County. These materials are captured through a comprehensive voluntary program for materials recovery. The materials come from community recycling programs and self-haulers, and include a typical commingled materials recovery facility (MRF), a composting program for yard trimmings, and a material "drop and swap." Hazardous materials are handled as well. Although the ability for local residents to compost and recycle exists on a volunteer basis for most materials in Carroll County, improvement to the infrastructure would be needed if source separation were made a countywide requirement.

Service Opportunity Analysis

In a zero waste system approach, one of the first steps is to inventory the materials generated in the service area and to identify facilities that are available to receive these materials. Discards are identified by standard classifications and sorted into twelve market categories. For each classification, market options are identified, both statewide as well as domestic and export markets outside Maryland. Products or packages that have unacceptable disposal options and/or require new services are also identified through this process. Table 1 indicates material categories where no local markets were found. These materials are currently going to the landfill.

Table 1: Service Opportunities

Service Opportunities	Comments
Food waste	There are no composting or anaerobic digestion programs for food or biosolids in Carroll County, However there are facilities in the Mid Atlantic Region within reasonable shipping distances.
Fish and meat waste	
Sewage sludge	
Gypsum board	There are no programs in Carroll County for recovering gypsum from drywall, although there are regional possibilities.
Fines	
Other glass	No local programs for window glass.
#3-7 & other plastic	No local markets, although there are regional possibilities.
Diapers / Hygiene	Currently landfilled

Stakeholder Meetings

Stakeholder meetings were held in October of 2007 in the County and included Carroll County commissioners, town managers, environmental activists,

government officials, regulatory agents, and material market and service providers.

RAA met with staff on Tuesday October 9, 2007. County staff provided a tour of the landfill and adjacent facilities, and an opportunity to discuss current programs. Copies of the ten-year plan and recycling literature were provided for review by RAA. An opportunity to address the Board of Commissioners occurred that morning, and Richard Anthony explained to the commissioners that new market conditions meant that there was potential revenue and jobs available from making managing resources a priority. That evening Richard Anthony attended the Environmental Advisory Council (EAC) meeting. At this meeting, RAA made a brief presentation in regard to the resource assessment and the need for *resource* management.

On Wednesday, October 10th, there was a meeting with agricultural representatives from government, university and industry sectors concerned with planning and operational issues. The discussion revolved around organic discards and problems specific to Carroll County (such as manure management and direct land application). Later, an evening presentation was made to interested citizens. The presentation equated climate change and world resource availability with the imperative need to better manage resources. About twenty citizens came and engaged in a discussion of what needed to be done in Carroll County.

On Thursday, October 11th, Richard Anthony discussed the resource assessment with four town managers, two county representatives, and two haulers. General consensus from staff was that elected officials make policy but if their town could reduce wasting and stabilize costs, they would be willing to propose “pay-as-you-throw” and required source separation programs. The two haulers stated that they currently recycle and dispose of mixed waste within the County and felt other jurisdictions should do so as well.

On Friday October 12, Cindy Parr recorded interviews for County TV.

3. RESOURCE ASSESSMENT

Using regional data and the ten-year solid waste plan, a rough estimate of materials generated by market commodity categories was done (Fall, 2006) and showed a generation rate of 150,000 tons per year. Materials were divided into twelve market categories. Table 2 shows the value of these resources using current market prices for these commodity categories. Many of the values were reconfirmed through site visits with recycling and composting industry representatives.

Table 2: Resource Commodity Analysis (Fall 2006)

Categories	%	Annual Tons	$/Ton[1]	Annual $s
1. Reuse	3	4,500	550	2,475,000
2. Paper	40	60,000	100	6,000,000
3. Plant Debris	10	15,000	10	150,000
4. Putrescibles	7	10,500	10	100,500
5. Wood	7	10,500	8	84,000
6. Ceramics	2	3,000	4	12,000
7. Soils	1	1,500	10	15,000
8. Metals	5	7,500	40	300,000
9. Glass	6	9,000	10	90,000
10. Polymers	11	16,500	100	1,650,000
11. Textiles	7	10,500	110	1,155,000
12. Chemicals	1	1,500	15	22,500
Total	**100**	**150,000**		**$12,054,000**

The County cannot expect to capture this value alone; as the materials become available, economic incentives will stimulate private entrepreneurs into action. A zero waste recovery system with a countywide source separation requirement and a buy-back and composting center at the landfill will allow the County to capture some of this revenue and help transform the landfill to a revenue generating resource recovery park that will continue after the landfill is closed.

This value is based on the value of commingled materials (e.g. paper, metal, and polymers) net of processing costs. If sorted to the highest and best use, reusable and recyclable materials would be worth many times more than represented here. Achieving this value will depends on setting up the correct legal and technical systems (ordinances and equipment) that are not in place today. These estimates are consistent with the value of materials collected in the current voluntary system.

Reusable's would be sold to thrift stores, dismantlers and recyclers. Fiber products (paper) would be sold to scrap paper dealers to be sorted by grades. The combination of plant debris, putrescibles (food/biosolids), wood, soils and dirty paper is a recipe for compost and could be processed at the landfill, with the end products sold to construction, horticultural and agricultural markets.

[1] Sources for values: www.GRN.com and the Mid Atlantic Market Survey in "Scenario for Resource Management in the State of Delaware." Report to the Secretary Delaware Natural Resource and Environmental Control, Institute for Local Self-Reliance, May 2007. This data was taken from published lists and interviews with local markets.

Ceramics are rocks that could be ground up and used for roads. Metals could be sent to scrap yards for sorting, plastic to plastics recyclers, and other specialty markets exist for textiles and glass. The chemicals can be given away or taken back to manufacturers.

Typically, reuse, recycling buy-back and drop-off centers, and resale businesses make a profit. Composting and aggregate materials break even in today's market. Special materials need to be subsidized but cannot go to the landfill. In each case, quality comes from keeping materials separated. These materials can be stored and collected by a dual or single steam collection program. A zero waste plan is needed to work out the details.

Reuse includes items that can be reused or repaired, but end up at the landfill. RAA has conducted studies with buyers of reusable materials, estimating the value of materials discarded to the landfill that could be reused. Although the value of this material has been documented as high as $1500 per ton, a conservative $550 is used in this evaluation. One scenario would be to allow thrift stores and other resale agents to purchase discarded reusable's before they are sold and/or given to social enterprise charities for repair and resale.

The values listed here are for material sorted into categories. The $100 ton value for paper includes all the cardboard, ledger and news as well as tissue and paperboard. When sorted to grade the total value of all the materials could be greater than ten times the value in Table 2.

New Jobs Created From Recovered Resources

The recovery of materials through a zero waste system in Carroll County promotes economic development as well as environmental conservation. Reuse, recycling, composting, and waste reduction offer direct economic opportunities for communities. Recycling and composting create more jobs than disposal of the same amount of materials. Once materials are separated, they become feedstock for processing and manufacturing plants that require more employees. These jobs are in the private sector. A few indirect workers would be required in the public sector at the city and county level as well, such as program managers and support staff. The workers required for these jobs would be in the unskilled, semi-skilled and skilled categories. A general estimate is that 30% are unskilled ($6-10 per hour), 40% semi-skilled ($11-$15 per hour) and 30% are skilled ($16 hour). Although these jobs *could* all be developed in Carroll County, a more likely scenario would be that these jobs would be created throughout the region.

The Institute for Local Self Reliance (ILSR) report, "Salvaging the Future: Waste-Based Production," looks at how many recycling-based processing and manufacturing workers are required for recycling, composting, manufacturing and disposal. The report is based on interviews with existing processing and manufacturing plants. As noted in Table 3 below, figures represent the number of

jobs required for processing and manufacturing plants, and landfill and incineration disposal facilities, per 10,000 tons of materials generated.

Table 3: Job Creation: Reuse and Recycling vs. Disposal

Categories	Jobs per 10,000 TPY
Product Reuse:	
Computer Reuse	296
Textile Reclamation	85
Misc. Durables Reuse	62
Wooden Pallet Repair	28
Recycling-Based Manufacturers:	25
Paper Mills	18
Glass Product Manufacturers	26
Plastic Product Manufacturers	93
Processing Facilities:	
Conventional Material Recovery Facilities	25
Plastics Processing Facilities	18
Metal Reclaimers	26
C&D Processors	93
Composting	4
Landfill and Incineration	1

TPY = Tons Per Year
C&D = Construction & Demolition
Note: *Figures are based on ILSR interviews with 114 facilities.*
"A Scenario for Resource Management in the State of Delaware" Institute for Local Self Reliance", Washington DC, May 2007 Page 18.

Table 4 below applies the above figures to Carroll County based on 150,000 tons landfilled each year. For processors and manufacturers operating in the Carroll County area, this amount of new jobs would be added to accommodate the corresponding increased flow of material to those facilities. This table provides an estimate of jobs at 100% recovery. A 50% recovery estimate would be based on specific targeted materials and local recovery system design specifications

Table 4: Estimated Potential New Employment from Discards in Carroll County

Categories	Tons/Year Generated	Local "Processing"	Regional Manufacturing	Total Jobs
1. Reuse	4,500	50	---	50
2. Paper	60,000	125	80	205
3. Plant Debris	15,000	6	---	6
4. Putrescibles	10,500	12	---	12
5. Wood	10,500	2	---	2
6. Ceramics	3,000	2	NA	2
7. Soils	1,500	1	---	1
8. Metals	7,500	4	23	27
9. Glass	9,000	2	13	15
10. Polymers	16,500	6	70	76
11. Textiles	10,500	43	---	43
12. Chemicals	1,500	2	2	4
Total	**150,000**	255	188	443

Global Footprint

Dr. Jeffrey Morris[2] analyzed Carroll County discards in terms of their impact on pollution and then compared landfilling and waste-to-energy disposal against zero waste through reuse, recycling, and composting, showing the environmental benefits of required source separations systems. The full report is in Appendix 1, starting on page 19.

[2] For information on similar analyses conducted by Dr. Morris, see www.zerowaste.com

According to Dr. Morris, the average ton of material in Carroll County's discards produces pollution reductions worth $195 when those materials are diverted to recycling or composting, in addition to the value from selling those materials highlighted in Table 1. The total value of pollution reductions attained by recycling and composting resources currently landfilled from Carroll County totals $23.8 million. Much of this value for improved public health and ecosystems sustainability is related to pollution reductions in the manufacturing of new products. These pollution reductions result from replacing virgin raw materials with recyclable materials. Although these pollution reduction values may not be accrued locally for all materials, the more markets are developed locally, the more important these additional values have the potential to be for Carroll County.

Composting the organic materials in Carroll County's discards also adds environmental value.

1) Diversion to composting prevents methane generation in the end-of-life phase when organic materials with high anaerobic decomposition propensities, such as food scraps, are landfilled.
2) Soils fortified with compost need fewer or no applications of synthetic fertilizers and pesticides, thus preventing pollution that would otherwise be released during production and use of synthetic fertilizers and pesticides.

Table 5 estimates the pollution reduction value per ton for materials recycled or composted. Benefits by material type range from $20 per ton from composting untreated wood discards, to $1,458 per ton from aluminum can recycling.

Table 5: Estimated Environmental Value per Ton Diverted From Landfill to Recycling or Composting

Recycled Materials	**Value Per Ton**
Newspaper	$299
Cardboard	$424
Mixed Paper	$152
Glass Containers	$56
PET Containers	$580
HDPE and other Containers and film	$203
Aluminum Cans	$1,458
Tin-plated Steel Cans	$65
Ferrous Scrap	$65
Composted Materials	
Yard Debris	$35
Food Scraps	$65
Untreated Wood	$20

Life cycle analysis and environmental risk assessments connect pollution of various kinds from product manufacturing, use and discards management choices to the public health and ecological impacts that those pollutant emissions cause. For example, in the case of climate change, the United Nations Intergovernmental Panel on Climate Change (IPCC) has conducted and reviewed scientific data to determine the impact of each pollutant relative to carbon dioxide in causing global warming. Over a one hundred year time frame, methane is 23 times and nitrous oxide 296 times more efficient at trapping heat (increasing global warming) than CO2. Based on these global warming factors the emissions of all greenhouse gas pollutants can be aggregated into a single indicator quantity for global warming potential.

Given the estimated pollutant reductions for each type of environmental impact, we can attach a monetary value to those reductions. As an example, the 202,000 metric tons of carbon dioxide emissions reductions achievable by recycling and composting the material resources that Carroll County currently discards has a monetary value of nearly $8 million, given current mid-range estimates of the potential costs of global warming. Thus, reducing the climate change impacts of Carroll County's waste management methods is worth $65 per ton, or 34% of the total environmental value of $195 per ton achievable by recycling and composting materials currently landfilled in Carroll County.

Calculating economic values for environmental impacts allows us to directly compare the value of environmental benefits against the financial costs for implementing expanded recycling and composting systems. At $195 per ton, the environmental value of recycling and composting in Carroll County, along with the financial value from selling recyclables and compost, and the financial value of avoided trash collection and disposal costs, easily outweigh the financial costs of recycling and composting collection and processing systems.

Furthermore, our analysis of the environmental benefits of recycling and composting versus combusting these resources in a waste-to-energy incineration facility shows that recycling and composting have an environmental value of $22.4 million, or $183 per ton, when measured against the waste-to-energy incineration disposal alternative. In other words, diverting recyclables and compostables from disposal in Carroll County's trash has tremendous environmental benefit no matter whether Carroll County's trash is landfilled or incinerated in a waste-to-energy facility. Moreover, the overall environmental impacts of landfilling and incineration are similar enough that the higher financial cost of incineration tips the disposal choice for residuals in favor of landfilling.

Thus the value of a discarded material as a commodity and the resultant impact on the energy and virgin resource use necessitate looking at recovery in a new way. A zero waste systems approach to resource management for Carroll County can extend the life of existing landfills, eliminate the need for a costly

waste-to-energy facility, reduce the County's' global pollution footprint, and provide new revenue and jobs to the community.

Zero Waste Policies and Programs

Gary Liss[3] reviewed Carroll County planning documents and budgets and has provided a report on policies and programs that are available to Carroll County. The full report can be found in Appendix 2, starting on page 37.

As defined by the Zero Waste International Alliance, "Zero Waste is a goal that is both pragmatic and visionary, to guide people to emulate sustainable natural cycles, where all discarded materials are resources for others to use. Zero Waste means designing and managing products and processes to reduce the volume and toxicity of waste and materials, conserve and recover all resources, and not burn or bury them. Implementing Zero Waste will eliminate all discharges to land, water or air that may be a threat to planetary, human, animal or plant health."[4]

A key to implementing Zero Waste is adopting policies, programs, incentives, and new rules that will encourage all stakeholders to shift from wasting to reducing, reusing, recycling and composting their discarded materials. The County has many options to consider for the following policies, programs, incentives and rules:

- Make businesses responsible for products and packages
- Source separation
- Incentives and new rules
- Restore the health of soil with composting
- Support zero waste infrastructure
- Changing the culture
- Green business, green buildings and jobs
- Management of restricted materials and residuals

Based on a review of existing budgets, rates, contracts and ordinances obtained from the County, the report suggests options for policies, programs, incentives, and new rules that possess enormous potential for helping Carroll County overcome resource management challenges and harness the forces of the marketplace through implementation of a zero waste strategy.

The following are suggested options for policies, programs, incentives and new rules that could help Carroll County harness the forces of the marketplace to strive for Zero Waste.

[3] Gary Liss is well known as a pioneer in developing zero waste plans (see www.garyliss.com).
[4] This is a peer-reviewed, internationally accepted definition of Zero Waste from: http://www.zwia.org/standards.html.

a. Make Businesses Responsible for Products and Packages

Carroll County (County) and its service providers could be strong advocates for legislation and Extended Produce Responsibility (EPR) policies and programs regionally, statewide, and nationally that makes business responsible for their packages and products. The County could advocate for systems that enable consumers to ship products back to producers, which in turn would get producers to design their products and packaging more efficiently.

The County could ask or require businesses and institutions to take back designated products and packaging sold in the County and to reuse, recycle or compost those materials. The County could ban products or packages from being sold or require businesses and institutions to take back designated products and packaging sold in the County that are toxic in their manufacture, use, or disposal, and/or are not currently recyclable in the area. The County could adopt local fees and taxes as an alternative way to discourage the use of nonrecyclable materials. The County could ban landfilling of easily recyclable materials to encourage them to be reused, recycled or composted.

b. Source Separation

The County already requires source separation of yard trimmings. The County could require all residents, businesses and institutions to also source separate other designated reusables, recyclables and compostables (including discarded food, and food contaminated paper). The County could require lower rates for clean, source-separated materials deposited at private solid waste facilities in the County. The County could require licensed haulers to offer lower rates or free service for hauling clean, source-separated materials from businesses. The County could place recycling containers wherever there are trash containers in all public locations.

c. Incentives and New Rules

The County could require that licensed waste haulers achieve increasingly higher waste diversion targets over time as a condition of their license, starting with 50% in 2009. The County could require all multi-family dwelling owners to provide recycling services to tenants and require all haulers of waste from multi-family dwellings to collect recyclables as well from those complexes. The County could charge fees on licensed waste hauling services to provide more economic incentives for recycling, and to generate funds for new recycling programs. The County could support local, regional and state landfill surcharges, and bond issues to fund loans and/or grants to develop needed Zero Waste infrastructure.

The County could adopt a linear Pay-As-You-Throw rate structure for the unincorporated areas of the County and require all licensed haulers to adopt a similar program as part of the Solid Waste Ordinance. This could be particularly powerful if coupled with an option to collect rubbish every other week, once licensed haulers offer residents weekly collection of food scraps.

d. Restore the Health of Soil with Composting

Carroll County should implement a County wide composting facility that could process source separated organic materials. The County should support policies for agricultural areas to allow composting on farms, the use of compost products by farmers, and the ability to sell compost made from materials gathered from other agriculture applications as well as source separated material from residents. The County should support legislation to require Maryland (MDOT) to use mulch and compost made from urban organics to landscape freeways.

e. Support Zero Waste Infrastructure

The County could support the development of a Resource Recovery Park at the County's Northern Landfill to accept all reusables, recyclables, compostables and restricted materials from the public. The County could encourage local communities to modify the Zoning Code to support existing and future Zero Waste infrastructure. The County could specify in construction contracts (e.g., roads, parks, public buildings) the use of reused, recycled and compost products.

f. Changing the Culture

The County could create a mass media education campaign on Zero Waste. A community-based social marketing program could be adopted to help. The County could train facilities about Zero Waste systems and resources and highlight how Zero Waste can reduce trash bills. The County could use the latest in mobile media, including video, blogs, advertising, and text messaging. The County should serve as a model in implementing Zero Waste.

g. Green Business, Green Buildings and Jobs

The County could provide preferences in County procurement, funding and permitting for certified Green Businesses in the County and businesses that comprise the Zero Waste infrastructure. The County could purchase Zero Waste products and services and adopt the "Precautionary Principle" for all County purchases. The County could ask businesses to adopt Zero Waste goals and plans that follow Zero Waste Business Principles.

h. Management of Restricted Materials and Residuals

The County should minimize the use of the County landfill to extend its life and convert its main function to be the hosting of a Resource Recovery Park, and management of residuals from Zero Waste programs. Carroll County should not develop a Waste-to-Energy (WTE) facility and commit to the implementation of a Zero Waste Plan instead. If it decides later to send any waste to WTE facilities that have been built, that should be done without any long-term contracts. The County should not accept proposed Waste-to-Energy bids.

The County could continue to contract during the next ten years to dispose of wastes that are not processed in reuse, recycling or composting facilities at out-of-county landfills. In fact, Carroll County could increase the amount of wastes landfilled out of county in the short term and reserve the existing capacity of the Northern Landfill for residue from Zero Waste infrastructure. The County could

negotiate to send more wastes out-of-county in the next couple of years in trade for less waste later. In either case, the County should not try to site another landfill within the County in the short term. This would be a significant distraction from implementing the Zero Waste Plan and take valuable time and resources away from the priority goal of Zero Waste.

RECOMMENDATIONS

The genesis of these recommendations originate from formal recommendations to County commissioners from the Environmental Advisory Council and evaluation of the options proposed in the policy analysis in Appendix 2. The EAC recommendations have been reviewed and in some cases modified by RAA recommendations. Not all EAC recommendations have been included, and some of the recommendations come from the project team.

The County should adopt a goal to reduce solid waste going to landfill by 75% (by weight) by 2013, and 90% by 2020.

The County should change current perspectives guiding the handling of solid waste in Carroll County from *Solid Waste* Management to *Resource* Management, and this paradigm shift should include the following key principle: *Solid waste is an opportunity to be seized rather than a problem to be solved.*

Carroll County's zero waste goals should be guided by an environmental hierarchy for "highest and best use" of materials and pollution prevention in all phases of production, use, and distribution of products and materials. This means designing and managing materials and products to place highest priority on conserving resources and retaining their form and function without burning, burying, or otherwise destroying them. It means eliminating discharges to land, water or air that harm natural systems. The County should work to eliminate as much waste as possible, reuse products and packaging for their highest and best use, transform all remaining materials that are discarded into commodities for market, and dispose within the borders of the county or state only residues from reuse, recycling and composting programs.

The priority for the County should be to support existing businesses and nonprofit organizations that provide reuse, recycling and recovery services with policies and incentives to help them expand. In the event that gaps exist in required services that no one else wants to provide, it would be appropriate for the County to offer such services directly, or to contract for such services. The County's Department of Public Works should be supported with the necessary resources to develop programs and policies to support this zero waste goal, while shifting costs to producers as it pursues extended producer responsibility policies and programs.

The County should work to develop a licensing system that builds on the services currently provided by local businesses and provides opportunities for new businesses to enter the market. The licensing system could include zero waste performance and reporting requirements and could limit the number of licensed haulers operating in a given area.

The County should establish zero waste as the overarching goal for the County's resource management plans, including:

- Adopt policies and ordinances that enable the County to direct reused, recycled and compost products to specific recovery centers

- Increase funding to recycling operations for expanded programs and public education efforts

- Phase in the mandatory recycling of designated materials such as paper, glass, and plastic

Public outreach and education are needed to assist in obtaining the behavioral changes required for zero waste to succeed. Resources for staff and media are also required to achieve higher rates of waste reduction, reuse and recycling.

Carroll County should not develop a waste-to-energy facility, but rather commit to the implementation of a zero waste plan instead. After five years, the County can assess the success of its zero waste efforts and decide how to proceed with other options. The County should not accept any of the bids for a proposed waste-to-energy facility in Carroll County.

The County should not try to site another landfill in the short term.

A linear, "pay-as-you-throw" rate structure for the unincorporated areas of the County should be adopted, and all licensed haulers should be required to adopt similar programs as part of the solid waste ordinance as well.

Carroll County should implement a countywide composting facility for processing source separated organic materials, including appropriate technologies for composting food discards and manure. The County should work with the local agriculture industry to demonstrate the quality of finished products from composting facilities. The County should work with the Agriculture Extension Service to develop a permitting process that allows local farmers to improve soils and diversify revenue streams through accepting yard waste, source separated food scraps, and soiled paper from school cafeterias or restaurants.

Appendix 1, Global Impact, Jeff Morris PhD

Introduction

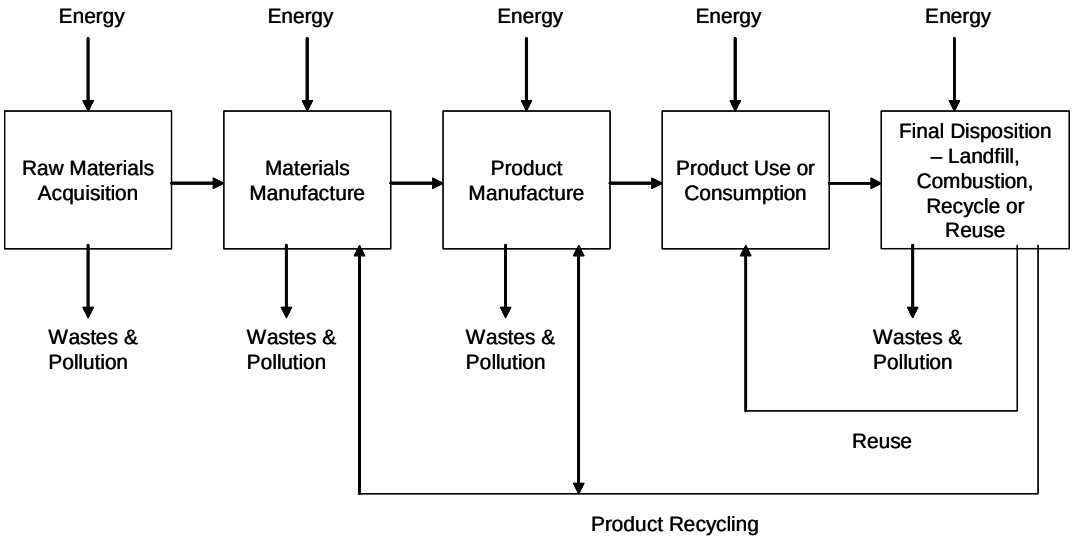
The average ton of material in Carroll County's trash produces pollution reductions worth $195 when those materials are diverted to recycling or composting. The total value of pollution reductions attained by recycling and composting resources currently thrown in Carroll County's trash totals $23.8 million. Much of this value for improved public health and ecosystems sustainability is related to pollution reductions in the manufacture of new products. These pollution reductions result from replacing virgin raw materials with recyclable materials.

Figure 1, Schematic Detail for a Product's Life Cycle Phases, provides a conceptual diagram for the life cycle of a product or service. It depicts the input of energy and output of wastes and pollution that occur over the three phases of a product's life cycle:

- Upstream phase -- resource extraction, materials refining, and product manufacturing,
- Use phase – product use, and
- End-of-life phase – management of product discards.

The Figure 1 schematic indicates how reuse and recycling short circuit the upstream phase, thereby conserving energy and reducing releases of waste and pollutants in the production of goods and services.

Figure 1
Schematic Detail for a Product's Life Cycle Phases



One or limited number of return cycles into product that is then disposed – open-loop recycling. Repeated recycling into same or similar product, keeping material from disposal – closed-loop recycling.

Composting the organic materials in Carroll County's trash also adds environmental value.

3) Diversion to composting prevents methane generation in the end-of-life phase when organic materials with high anaerobic decomposition propensities, such as food scraps, are landfilled.
4) Soils fortified with compost need fewer or no applications of synthetic fertilizers and pesticides, thus preventing pollution that would otherwise be released during production and use of synthetic fertilizers and pesticides.

Table 6, Estimated Environmental Value per Ton Recycled or Composted, shows the value of all these pollution reductions for each type of material currently landfilled. Environmental benefits by material type range between $20 per ton from composting untreated wood discards to $1,458 per ton from aluminum can recycling. These benefits come from reductions in seven different types of damage to public health and ecosystems:[5]

- Climate change,
- Human disease and death from particulates,
- Human disease and death from toxics,
- Human disease and death from carcinogens,
- Eutrophication,
- Acidification, and
- Ecosystems toxicity.

Life cycle analysis and environmental risk assessments provide the methods for connecting pollution of various kinds to these seven environmental damages. For example, releases of carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), chlorofluorocarbons (CFCs), and other pollutants cause global warming which leads to climate change. The United Nations Intergovernmental Panel on Climate Change (IPCC) has conducted and reviewed scientific data to determine the strength of each pollutant relative to carbon dioxide in causing global warming. For example, over a hundred year time frame methane is 23 times and nitrous oxide 296 times more harmful than CO2. Based on these global warming potential factors we can aggregate the emissions of all greenhouse gas pollutants into a single indicator quantity for global warming potential. This quantity is CO2 equivalents (herein denoted eCO2).

Similar scientific efforts enable us to express the quantity of pollutant releases in terms of a single indicator quantity for the other six categories of environmental damage. This methodology greatly simplifies reporting and analysis of different levels of pollution.

[5] See Bare *et al* (2003) and Lippiatt (2007) for a detailed description and discussion of these environmental impact categories

The list of all these indicator quantities is:

- Climate change – carbon dioxide equivalents (eCO2),
- Human health-particulates – particulate matter less than 2.5 microns equivalents (ePM2.5),
- Human health-toxics – toluene equivalents (eToluene),
- Human health-carcinogens – benzene equivalents (eBenzene),
- Eutrophication – nitrogen equivalents (eN),
- Acidification – sulfur dioxide equivalents (eSO2), and,
- Ecosystems toxicity – herbicide 2,4-D equivalents (e2,4-D).

Table 6
Estimated Environmental Value per Ton Diverted from Landfill to Recycling or Composting

Recycled Materials	***Environmental Value Per Ton***
Newspaper	$299
Cardboard	424
Mixed Paper	152
Glass Containers	56
PET Plastic Containers	580
HDPE Plastic Containers	203
Other Plastic Containers	203
Plastic Film & Bags	203
Aluminum Cans	1,458
Tin-plated Steel Cans	65
Ferrous Scrap	65
Composted Materials	
Yard Debris	$35
Food Scraps	65
Untreated Wood	20

Given the estimated pollutant reductions for each type of environmental impact, we can attach a monetary value to those reductions. This is called monetization of the environmental impact reductions. It provides a method for evaluating trade-offs between the seven types of environmental impacts, and is a standard approach within the field of environmental economics. Monetization is discussed in more detail in section 3 below. But as an example, the 202,000 metric tons of carbon dioxide emissions reductions achievable by recycling and composting the material resources that Carroll County currently throws away has a monetary value of nearly $8 million given current mid-range estimates of the potential costs of global warming. Thus, reducing the climate change impacts of Carroll County's waste management methods is worth $65 per ton, or 34% of the total environmental value of $195 per ton achievable by recycling and composting materials currently trashed in Carroll County.

Monetization of environmental impacts allows us to directly compare the value of environmental benefits against the financial costs for recycling and composting. At $195 per ton, the environmental value of recycling and composting in Carroll County, along with the financial value from selling recyclables and composts and

the financial value of avoided trash collection and disposal costs, easily outweigh the financial costs of recycling and composting collection and processing systems.

The next section of this appendix discusses in more detail the estimates of pollution emissions impacts from recycling and composting that we developed for Carroll County. The third section discusses the specific monetization estimates for the pollution impact reductions from recycling and composting. References listed in this appendix provide the interested reader with access to the considerable body of literature that we used for our study.

Finally, in the fourth section of this appendix we provide an analysis of the environmental benefits of recycling and composting versus combusting those resources in a waste-to-energy (WTE) incineration facility. That analysis shows that recycling and composting have an environmental value of $22.4 million, or $183 per ton, when measured against the waste-to-energy incineration disposal alternative. In other words, diverting recyclables and compostables from disposal in Carroll County's trash has tremendous environmental benefit no matter whether Carroll County's trash is landfilled or incinerated. Furthermore, the overall environmental impacts of landfilling and incineration are similar enough that the higher financial cost of incineration tips the disposal choice for residuals in favor of landfilling.

Pollutant Emissions Impacts of Recycling and Composting

This section details the impact of recycling and composting on pollutant emissions. First, we discuss the upstream environmental benefits of recycling. Next we outline the upstream and use phase benefits of composting. Then this section of our appendix covers the greenhouse gas impacts of recycling, composting, and disposal collection, hauling and facility operations. Last, we cover the other pollution impacts besides climate change of recycling, composting and disposal facility operations.

Upstream recycling emissions estimates come from the Decision Support Tool (DST) developed for assessing the cost and environmental burdens of integrated solid waste management strategies by North Carolina State University (NCSU) in conjunction with Research Triangle Institute (RTI) and the US Environmental Protection Agency (US EPA)[6]. The Municipal Solid Waste Life-Cycle Database (Database), prepared by RTI with the support of US EPA during DST model development, provides estimates for environmental emissions from solid waste management practices.[7] Upstream and use phase emissions estimates for composting are based on analyses and data discussed in Morris and Bagby (2007) and Morris *et al* (2007).

[6] (RTI 1999a), (RTI 1999b), (Barlaz 2003a), and (Barlaz 2003b)

[7] Both the DST and its Database are intended to be available for sale to the public by RTI. Contact Keith Weitz at kaw@rti.org for further information on public release dates for the DST and the Database.

Waste material specific greenhouse gas emissions estimates for waste management activities are based on US EPA's latest WARM (Waste Reduction Model) software and report.[8] Estimates of other pollutant emissions are from the RTI/EPA/NCSU DST. The methodology for aggregating numerous emissions into impact categories is discussed in Morris (2005) and Morris and Bagby (2007).

a. The upstream pollution prevention benefits of recycling

Table 7, Estimated Upstream Emissions Reductions per Ton Recycled, shows the upstream emissions reductions that result when recycled materials are used in place of virgin raw materials to produce new products. For example, upstream reductions in greenhouse gases, shown as carbon dioxide equivalents (eCO2), range from 798 pounds per ton of glass recycled into new glass containers to 19,953 pounds per ton of aluminum cans recycled into new aluminum can sheet. As a second example, upstream reductions in emissions toxic to human health, shown as toluene equivalents (eToluene), range from 367 pounds per ton of glass to 11,986 pounds per ton of aluminum cans.[9]

Table 7
Estimated Upstream Emissions Reductions per Ton Recycled
(pounds of emissions reductions per ton recycled)

	Climate Change	Human Health - Particulates	Human Health - Toxics	Human Health - Carcinogens	Eutrophication	Acidification	Ecosystems Toxicity
	(eCO2)	(ePM2.5)	(eToluene)	(eBenzene)	(eN)	(eSO2)	(e2,4-D)
Recycled Materials							
Newspaper	7,630.4	4.5	2,849.8	0.9	-0.3	26.0	7.0
Cardboard	4,770.6	14.5	4,405.4	0.9	0.1	23.0	7.4
Mixed Paper	6,682.9	3.2	466.6	0.0	0.5	16.7	0.6
Glass Containers	797.5	4.2	366.5	0.5	0.1	4.4	1.1
PET Containers	3,574.8	4.7	7,895.1	7.3	1.8	65.3	0.7
HDPE Containers	2,814.0	2.2	2,336.1	2.3	0.7	18.2	0.2
Other Plastic Containers*	2,814.0	2.2	2,336.1	2.3	0.7	18.2	0.2
Plastic Film/Bags*	2,814.0	2.2	2,336.1	2.3	0.7	18.2	0.2
Aluminum Cans	19,953.0	37.9	11,986.4	5.8	2.9	222.0	78.4
Tin Cans	2,098.3	6.1			0.1	4.8	
Other Ferrous	2,098.3	6.1			0.1	4.8	

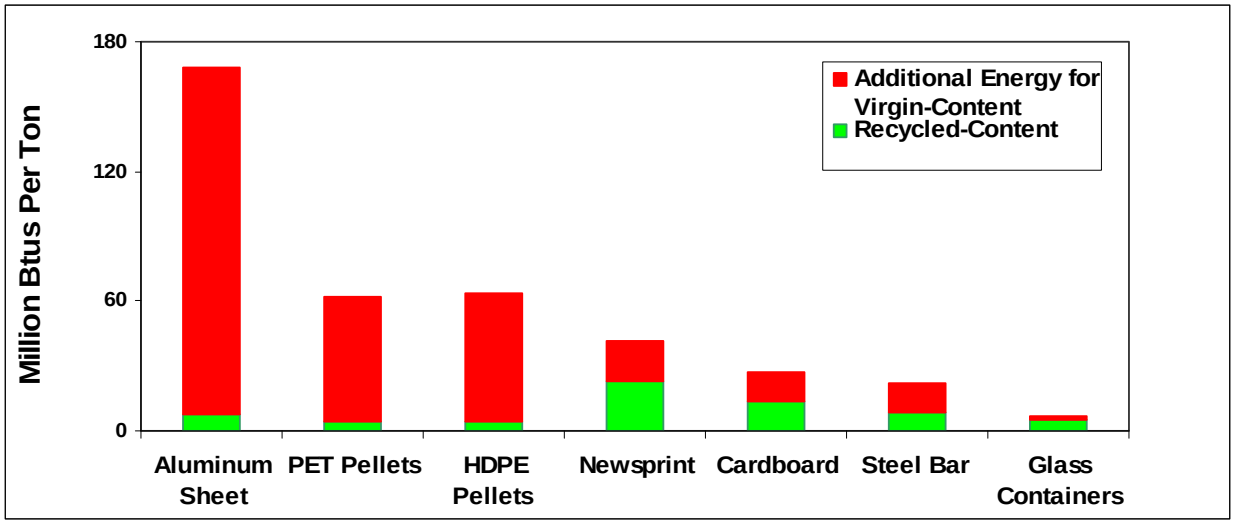
Upstream pollutant emissions reductions tend to be highly correlated with upstream energy savings engendered by recycling. This correlation is due to the pollution intensive nature of most energy sources. Figure 2, Comparative Energy

[8] See EPA (2006) for a detailed description of the data and methods that support the WARM model.

[9] Upstream emissions estimates for human toxics and carcinogens and ecosystems toxics that are available for virgin- and recycled-content steel production are limited to just three specific pollutants. This compares with scores of toxics and carcinogenic pollutant emissions reported for other recycled materials. For this reason, we do not estimate upstream toxic and carcinogenic impacts for tin can and ferrous scrap recycling.

Usage for Virgin- vs. Recycled-Content Products, provides a graphical display of upstream energy savings from closed-loop recycling.[10]

Figure 2
Comparative Energy Usage for Virgin- vs. Recycled-Content Products



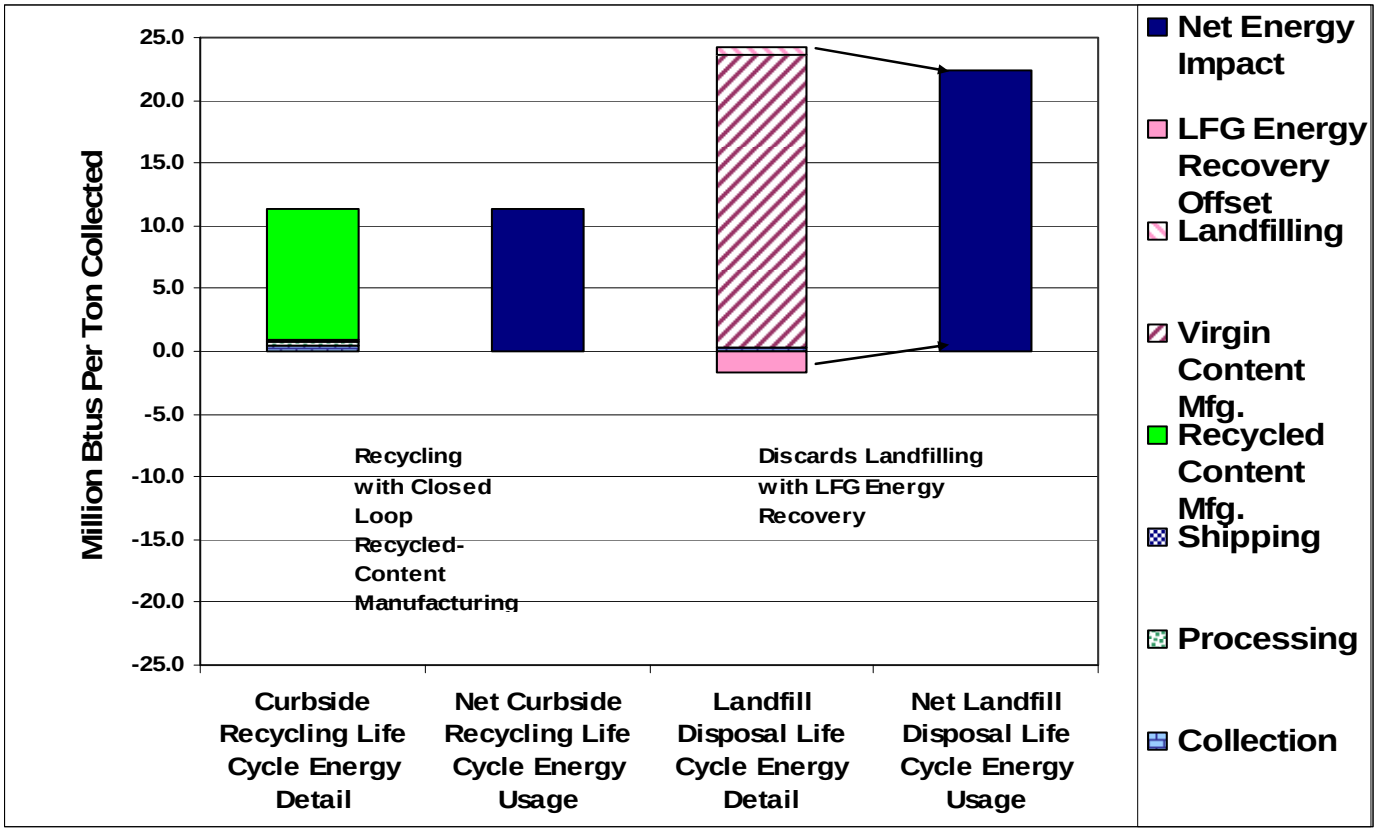
We can use the close correlation between upstream energy usage and upstream environmental impacts to provide perspective on the positive upstream environmental benefits of recycling compared with its collection, processing and hauling impacts.

Figure 3, Total Life Cycle Energy Usage per Ton Collected – Curbside Recycling Versus Landfill Disposal with Landfill Gas Energy Recovery, shows energy usage over the life cycle of the typical ton of materials collected curbside for recycling. The bars in the graph compare energy usage for recycling a ton of curbside materials against energy usage when a ton of curbside recyclables is thrown in the garbage and sent to a landfill where landfill gases are collected and used to generate electricity.

The graph shows that the energy used by recycling collection vehicles and the energy used for processing and hauling of recycled materials is very small relative to the energy conserved by using recycled instead of new virgin materials to manufacture new products. Furthermore Carroll County's landfill does not use collected landfill gas to generate electricity. Thus, there is no energy offset for avoided usage of the electrical grid's power generation facilities as there is when landfill gases are used to generate electricity. This means that the net energy savings from recycling instead of landfilling is even greater than shown in Figure 3.

[10] Figure 2 is based on EPA, NCSU and RTI (2003), Morris (1996), and Morris (2005).

Figure 3
Total Life Cycle Energy Usage per Ton Collected
Curbside Recycling Versus Landfill Disposal with Landfill Gas Energy Recovery



To be specific -- Figure 3 shows that manufacturing products using a ton of curbside recycled materials requires 10.4 million Btus. Collecting, processing and hauling those recycled materials to the manufacturers requires an additional 0.9 million Btus. Total energy used is 11.3 million Btus per ton recycled.

By contrast, manufacturing products using virgin raw materials uses 23.3 million Btus to extract raw materials, refine those resources into manufacturing feedstock's, and use the feedstock's to produce the same basket of goods that the recycled materials produce. Garbage collection, transfer and landfilling uses 0.8 million Btus, while the energy recovered from the landfill gases produced when the ton of recyclables decomposes anaerobically is 1.7 million Btus. This is a net usage of 22.4 million Btus per ton collected for the landfill disposal life cycle, nearly double the energy usage of the recycling life cycle.

Besides the substantial energy conservation from recycling, the other specific conclusion to note from Figure 3 is that the 0.9 million Btus of energy used to collect and process a ton of curbside recycled materials and then haul that ton to market is an order of magnitude smaller than the 12.0 million Btus conserved by

producing products from recycled materials rather than virgin resources. Also, the energy required to handle a ton of curbside recyclables is only about 12% larger than the energy needed to collect and landfill a ton of garbage.

The same sort of relationships between the upstream impacts of recycling versus disposal life cycles, and between upstream versus collection/processing/hauling stages for recycling's life cycle, that hold for energy usage also turn out to be true for climate change, human health, acidification, eutrophication and ecosystems toxicity potential impacts. The exact relationships vary by impact category. However, the two generalizations hold:

1) Recycling beats disposal by a substantial margin for all types of environmental impacts, and,
2) The environmental costs of recycling trucks and processing facilities are small compared with recycling's upstream environmental benefits.

For example, recycled-content manufacturing produces 0.8 tons of carbon dioxide equivalents, while virgin-content manufacturing releases 3.3 tons, over four times as much eCO2. Recycling collection, processing, and hauling operations release 0.2 tons eCO2 per ton collected. In comparison, garbage collection and disposal operations release just over 1.0 ton of greenhouse gases per ton collected.

b. Upstream and use phase pollution prevention benefits for composting

According to Morris and Bagby (2007) and other studies referenced there, compost produced from yard debris, food scraps and compostable paper and cardboard can substantially reduce use of pesticides and synthetic fertilizers on lawns and gardens. Unfortunately, there are as yet no systematic empirical data on the exact amount of pesticide and fertilizer use reductions on average that are associated with home lawn and garden compost applications. However, one can make a reasonable argument that compost use on lawns and gardens may be associated with a 50% or more reduction in pesticides and synthetic fertilizer use. For example, the home owner who purchases compost for application on his lawn or garden presumably makes that purchase as a substitute for synthetic fertilizers and synthetic fertilizer-herbicide products.

Table 8, Estimated Upstream and Use Phase Emissions Reductions per Ton Composted, shows the pollution that is prevented when production and use of pesticides and synthetic fertilizers on lawns and gardens is reduced by 50%. These reductions are engendered by homeowners switching to a more natural lawn and garden maintenance program as a result, in part, of their decision to use compost in place of synthetic fertilizers.[11]

[11] Estimates of emissions from production and use of pesticides and synthetic fertilizers are based on Morris and Bagby (2007), Morris *et al* (2007) and the CEI model, and the Carnegie Mellon Economic Input Output – Life Cycle Analysis model described in Cicas *et al* (2006) and available on the Internet at www.eiolca.net.

Table 8
Estimated Upstream and Use Phase Emissions Reductions per Ton Composted
(pounds of emissions reductions per ton composted)

Environmental Impact	*Indicator Pollutant*	*Emissions Reduction*
Climate Change	eCO2	1,072.3
Human Health – Particulates	ePM2.5	0.5
Human Health – Toxics	eToluene	287.0
Human Health – Carcinogens	eBenzene	0.3
Eutrophication	eN	5.4
Acidification	eSO2	2.3
Ecosystems Toxicity	E2,4-D	4.9

c. Greenhouse gas (GHG) emissions from discards management

Table 9, Estimated Greenhouse Gas Emissions from Discards Management, shows the carbon dioxide equivalent emissions from collection, transfer, and landfill disposal of recyclable and compostable materials, as well as from collection and recycling or composting of those materials. Collection trucks and transfer, disposal, recycling and composting facility operations result in differing amounts of GHG emissions, depending on the type and energy intensity of equipment used for these different components of a solid waste management system. But the handling of different types of waste material on a collection truck or by equipment at a given type of facility tends to yield the same amount of greenhouse gas (GHG) emissions irrespective of material type.[12] This is why the estimates for GHG emissions from recycling systems are the same across all recycled material types shown in Table 9. Also, as shown in Table 9, compostable materials all have the same GHG emissions when composted and their GHG emissions are different than the GHG emissions for materials that are recycled.

However, materials have different decomposition characteristics in the landfill, causing differing amounts of carbon sequestration, methane generation, and energy recovery potential. This accounts for the differences in GHG emissions shown in the Disposal eCO2 Emissions column of Table 9. For example, disposal of yard debris or clean wood in a landfill that collects 75% of generated landfill gases actually decreases GHG emissions.[13] For those materials the carbon sequestered in the landfill outweighs the global warming impact of the methane those materials generate that is not captured by the landfill's gas collection system.

[12] See EPA/NCSU/RTI (2003), EPA (2006), and RW Beck (2007) for data used to calculate the estimates shown in Table 9.

[13] There is some disagreement regarding the efficiency of the typical landfill gas collection system and of the theoretical limit to landfill gas capture possibilities. For example, see Anderson (2007). This analysis assumes a 75% capture efficiency, the default value in EPA's WARM model for calculating GHG emissions from waste management systems.

Food scraps, on the other hand, generate more GHGs in the form of methane than the portion of their carbon sequestered in a landfill. This makes food scraps a net GHG generator, even in landfills that are highly efficient at recovering landfill gases.

The emissions from composting facility operations include a credit for carbon sequestered in soils where the compost is used. The estimate of soil carbon sequestration is from EPA's WARM model, as discussed in EPA (2006). The carbon sequestration credit is larger than the CO2 emissions from collection and compost facility operations. This accounts for the negative values for composting emissions in the Composting eCO2 Emissions column of Table 9.

Table 9
Estimated Greenhouse Gas Emissions from Discards Management
(Pounds of carbon dioxide emissions per ton collected)

	Disposal eCO2 Emissions	***Recycling eCO2 Emissions***	***Composting eCO2 Emissions***
Recycled Materials			
Newspaper	-2,377.3	210.5	
Cardboard	-437.3	210.5	
Mixed Paper	-647.4	210.5	
Glass Containers	88.2	210.5	
PET Plastic Containers	88.2	210.5	
HDPE Plastic Containers	88.2	210.5	
Other Plastic Containers	88.2	210.5	
Plastic Film & Bags	88.2	210.5	
Aluminum Cans	88.2	210.5	
Tin-plated Steel Cans	88.2	210.5	
Ferrous Scrap	88.2	210.5	
Composted Materials			
Yard Debris	-970.8		-440.8
Food Scraps	734.9		-440.8
Clean Wood	-1,771.0		-440.8

d. Emissions other than GHGs from discards management

Table 10, Estimated Emissions Other Than GHGs from Discards Management, shows emissions for the other six environmental impact categories from collection, transfer, and landfill disposal of recyclable and compostable materials, as well as from collection and recycling or composting of those materials. Collection, transfer, and disposal, recycling or composting facility operations result in the same amount of emissions irrespective of material type. At this point in time available research does not distinguish emissions by material type for collection, transfer, or facility operations.[14]

[14] See EPA/NCSU/RTI (2003) for data used to calculate the estimates shown in Table 10.

Table 10
Estimated Emissions Other Than GHGs from Discards Management
(pounds of emissions per ton managed)

Environmental Impact	*Indicator Pollutant*	*Disposal Emissions*	*Recycling Emissions*	*Composting Emissions*
Human Health - Particulates	ePM2.5	0.08	0.4	0.06
Human Health – Toxics	eToluene	3.4	19.6	48.9
Human Health – Carcinogens	eBenzene	0.0002	0.0004	0.0008
Eutrophication	eN	0.13	0.03	0.2
Acidification	eSO2	0.3	1.7	0.4
Ecosystems Toxicity	E2,4-D	0.10	0.05	0.9

e. Summary of pollution prevention estimates for recycling and composting

Table 11 summarizes emissions reductions per ton recycled or composted by material type and impact category. The table indicates that aluminum cans have the highest environmental benefits across all environmental impact categories, except for Human Health – Carcinogens where PET plastic containers provide the top environmental benefits per ton recycled.

Rankings below the top spot vary depending on impact category. For example, mixed paper recycling has the second best climate change benefits, due to the high GHG reductions associated with recycling of the high grade papers included in mixed paper collected from households. Cardboard is in second place for particulate and ecosystem toxics emissions reductions. Plastic PET containers are in second place for human toxics, as well as for eutrophication and acidification emissions reductions.

Among the composted materials shown in Table 11, food scraps provide the greatest climate change emissions reductions benefits. Composting of clean wood actually increases greenhouse gas emissions slightly due to the loss of carbon sequestration when the wood is not landfilled.

Neither the upstream emissions reduction benefits of composting, nor the non-GHG emissions from discards management for the composted materials, vary by material type. Thus, the emissions reductions for environmental impacts other than climate change are the same for all three composted materials.

Table 11

Estimated Emissions Reductions Diverted from Landfill to Recycling or Composting (pounds of emissions reductions per ton recycled or composted)

	Pounds of Emissions Reductions/(Increase) Per Ton Recycled/Composted						
	Climate Change (eCO2)	Human Health - Particulates (ePM2.5)	Human Health - Toxics (eToluene)	Human Health - Carcinogens (eBenzene)	Eutrophication (eN)	Acidification (eSO2)	Ecosystems Toxicity (e2,4-D)
Recycled Materials							
Newspaper	5,042.5	4.1	2,833.7	0.9	-0.2	24.6	7.0
Cardboard	4,122.9	14.2	4,389.3	0.9	0.2	21.6	7.4
Mixed Paper	5,825.0	2.8	450.5	0.0	0.6	15.3	0.6
Glass Containers	675.2	3.8	350.4	0.5	0.2	3.1	1.2
PET Containers	3,452.5	4.4	7,879.0	7.3	1.9	63.9	0.8
HDPE Containers	2,691.6	1.8	2,320.0	2.3	0.8	16.8	0.3
Other Plastic Containers*	2,691.6	1.8	2,320.0	2.3	0.8	16.8	0.3
Plastic Film/Bags*	2,691.6	1.8	2,320.0	2.3	0.8	16.8	0.3
Aluminum Cans	19,830.7	37.6	11,970.3	5.8	3.0	220.6	78.5
Tin Cans	1,975.9	5.7			0.2	3.5	
Other Ferrous	1,975.9	5.7			0.2	3.5	
Composted Materials							
Yard Debris	542.3	0.5	241.5	0.3	5.3	2.2	4.1
Food Scraps	2,248.0	0.5	241.5	0.3	5.3	2.2	4.1
Composted Untreated Wood	-258.0	0.5	241.5	0.3	5.3	2.2	4.1

* Assumed same as HDPE containers.

The Economic Value of Pollution Reductions

The final step in estimating an economic value for the environmental benefits of recycling and composting is to determine a dollar value for the damages to public health and ecosystems from pollution. This section lists an economic cost for each of the seven types of environmental damages that we have included in our analysis of the environmental costs and benefits of recycling and composting. We then provide an explanation for two of these costs – the climate change cost of greenhouse gas emissions and the human health costs of toxics emissions. The references we cite provide explanations for the other five types of pollution costs.

The following list shows the estimated cost for each type of damage to public health or ecosystems. These estimated costs are each in the low to middle part of the range of cost estimates that are found in the literature on damage costs for pollution.

- eCO2 -- $36 per ton based on Morris and Bagby (2007).
- ePM2.5 -- $10,000 per ton based on Eastern Research Group (2006).
- eToluene -- $118 per ton based on Morris and Bagby (2007).
- eBenzene -- $3,030 per ton based on Eastern Research Group (2006).
- eN -- $4 per ton based on Morris and Bagby (2007).
- eSO2 -- $661 per ton based on the average of 2005 ($690), 2006 ($860) and 2007 ($433) spot prices in EPA's annual acid rain sulfur dioxide emissions permit allowances auction under the Clean Air Act.
- e2,4-D -- $3,280 per ton based on Morris and Bagby (2007).

The Value of Greenhouse Gas (i.e., eCO2) Emission Reductions

There is a very wide range of costs for greenhouse gas emissions and valuations for the benefits of reductions in those emissions. The low end for valuations is the trading price for voluntary greenhouse gas emission reductions. Operating much as the markets in sulfur dioxide emissions permits do, several markets are available for trading voluntary greenhouse gas emissions reduction pledges. One of these is the Chicago Climate Exchange (CCX). Trading values on the CCX for CO2 reductions have been between $1 and $4 per ton of carbon dioxide over the past several years. Values on European carbon markets tend to be in range that is ten times higher than those on the CCX due to the mandatory CO2 emissions caps imposed on European greenhouse gas generators.

The upper end of the range for estimated costs of climate change is found in recent studies such as the review of the economics of climate change conducted by Nicholas Stern (2007). That study determined that a reasonable estimate for the cost of current greenhouse gas emissions was $85 per metric ton, based on the risk of catastrophic environmental impacts in the future if substantial reductions in greenhouse gas emissions are not implemented today.

We used $36 per ton for the cost of greenhouse gas emissions in this analysis because it is in the middle of the range between carbon dioxide market values for voluntary emissions reductions and estimated costs of severe climate change impacts if today's emissions levels are not substantially reduced. This also is the estimate used by Seattle City Light to reflect the potential costs of CO2 emissions from electricity production.

The Value of Reductions in Emissions Toxic to Humans (i.e., eToluene)

As with the valuation of the costs of greenhouse gas emissions, there is a wide range in the estimated costs for emissions of pollutants that are toxic to humans. Eastern research Group (2006) found estimates ranging up to $2,700 per ton of eToluene for the human health costs of toxic air pollutant emissions. Our very conservative estimate of monetary costs for toxic air emissions is based on a peer-reviewed study on the health effects of atmospheric emissions of mercury. That study was sponsored by the Northeast States for Coordinated Air Use Management (NESCAUM) and conducted by scientists at the Harvard Center for Risk Analysis (Rice and Hammitt 2005). The study evaluated neurological and possible cardiovascular health impacts from exposure to methyl mercury through fish consumption, where atmospheric releases of mercury result in depositions of mercury in water bodies within and bordering the U.S. These depositions lead to increases in methyl mercury concentrations in fish.

The NESCAUM study evaluated three main health effects from methyl mercury exposure – neurological decrements associated with intrauterine exposure, myocardial effects associated with adult exposure, and elevated childhood blood pressure and cardiac rhythm effects associated with *In Utero* exposure. We used the economic cost estimated in the study for only the first effect. The

decrease in cognitive ability as a result of intrauterine exposure to methyl mercury is well documented and understood, whereas research on the other two health effects is not yet as extensive or thoroughly peer-reviewed.

The NESCAUM study's neurotoxicity health cost estimate for exposure to methyl mercury from consumption of fish that have bioaccumulated that toxin as a result of mercury air pollution is $10.5 million in year 2000 dollars per ton of mercury emitted to the atmosphere. Inflating that estimate to current dollars and converting the cost to toluene emissions, the indicator substance for human toxicity, yields $118 per ton of eToluene for the cost of pollutant emissions that are toxic to human health. This is the value we have attributed to reductions in human toxicity that are caused by diverting material resources from disposal to recycling and composting.

The Environmental Value of Diverting Discards from WTE Incineration to Recycling and Composting

The second section of this appendix developed estimates of pollution reductions attained when material resources discarded in Carroll County trash are diverted from landfilling to recycling and composting. The upstream and use phase pollution prevention benefits of diversion are the same regardless of whether material resources are disposed in a landfill or a WTE incineration facility.

Thus, in order to adjust our estimates for the environmental value of recycling and composting to account for material resources being diverted from incineration rather than landfilling, we only need to account for the differential environmental impacts of incineration. Based on EPA/NCSU/RTI (2003), Dijkgraaf and Vollebergh (2004), EPA (2006), and RW Beck (2007) these differences are not substantial.

Table 12 shows the value of pollution reductions when material resources are recycled or composted rather than incinerated in a waste-to-energy disposal facility. These valuations are quite similar to those shown in Table 6 for the value of pollution reductions when material resources are diverted from landfill disposal.

Some of the bigger differences between the valuations in Table 6 versus Table 12 include the increased value of diverting plastics when residual wastes are incinerated. This is due to the fossil fuel content of plastics. When plastics are incinerated they generate fossil CO2 just as the direct combustion of fossil fuels does. Thus, recycling of plastics and rubber has an even higher environmental urgency and value when these material resources are otherwise destined for incineration.

On the other hand, diversion of ferrous metals from incineration disposal has less environmental value than diversion from landfill disposal. This is because magnetic devices typically separate ferrous metals for recycling from either

incoming waste or outgoing bottom ash at incineration facilities. That means that when residual waste is incinerated ferrous metals are recycled whether or not they are collected separately for recycling.

Table 12
Estimated Environmental Value per Ton Diverted from Incineration to Recycling or Composting

Recycled Materials	***Environmental Value Per Ton***
Newspaper	$308
Cardboard	400
Mixed Paper	132
Glass Containers	35
PET Plastic Containers	622
HDPE Plastic Containers	257
Other Plastic Containers	257
Plastic Film & Bags	257
Aluminum Cans	1,438
Tin-plated Steel Cans	10
Ferrous Scrap	10
Composted Materials	
Yard Debris	$28
Food Scraps	29
Untreated Wood	18

Another material whose environmental value is lower when it is diverted from incineration disposal is food waste. Its valuation drops because diversion from incineration prevents the substantial releases of methane that occur when food waste is landfilled, even when that landfill is able to capture 75% of landfill gases.

Table 13 details the overall emissions reductions (or increases) for each material resource in Carroll County's trash that can be recycled or composted. Comparison of Table 13 with Table 11 shows the material-by-material differences between pollution impacts when diversion is from incineration versus landfilling. For example greenhouse gas emission reductions from recycling plastics are more than doubled when those material resources are being diverted from incineration. On the other hand, greenhouse gas emission reductions for food scraps composting are 37% lower when food scraps are diverted from incineration rather than from landfilling.

In general, total greenhouse gas emissions reductions from diversion are higher when material resources are diverted from incineration than they are from landfilling. This is due to the fossil fuel CO2 releases when discarded materials such as plastics and rubber are incinerated.

On the other hand, particulate and acidifying emissions reductions are lower for diversion from WTE incineration disposal facilities than they are for diversion from landfilling, especially when collected landfill gases are flared instead of

being used to generate electricity. This is due to the electrical power plant fossil fuel offsets when waste materials are incinerated to produce electricity.

Table 13
Estimated Emissions Reductions per Ton Diverted from Incineration to Recycling or Composting
(Pounds of emissions reductions per ton recycled or composted)

	Pounds of Emissions Reductions/(Increase) Per Ton Recycled/Composted						
	Climate Change	Human Health - Particulates	Human Health - Toxics	Human Health - Carcinogens	Eutrophication	Acidification	Ecosystems Toxicity
	(eCO2)	(ePM2.5)	(eToluene)	(eBenzene)	(eN)	(eSO2)	(e2,4-D)
Recycled Materials							
Newspaper	6,728.0	1.2	2,775.1	0.9	-0.4	16.3	6.9
Cardboard	3,963.9	11.2	4,330.7	0.9	0.1	13.3	7.3
Mixed Paper	5,876.7	-0.1	391.9	0.0	0.4	7.0	0.6
Glass Containers	677.9	0.9	291.8	0.5	0.0	-5.3	1.1
PET Containers	6,933.6	1.4	7,820.4	7.3	1.7	55.6	0.7
HDPE Containers	6,841.4	-1.1	2,261.4	2.3	0.6	8.5	0.2
Other Plastic Containers*	6,841.4	-1.1	2,261.4	2.3	0.6	8.5	0.2
Plastic Film/Bags*	6,841.4	-1.1	2,261.4	2.3	0.6	8.5	0.2
Aluminum Cans	19,844.0	34.6	11,911.7	5.8	2.8	212.2	78.4
Tin Cans	-144.4	2.8			0.1	-4.9	
Other Ferrous	-144.4	2.8			0.1	-4.9	
Composted Materials							
Yard Debris	1,364.6	-2.4	183.0	0.3	5.2	-6.2	4.1
Food Scraps	1,410.0	-2.4	183.0	0.3	5.2	-6.2	4.1
Composted Untreated Wood	784.3	-2.4	183.0	0.3	5.2	-6.2	4.1

* Assumed same as HDPE containers.

Given currently available data and the uncertainties and small sample basis thereof, it is very difficult to empirically determine whether emissions reductions of pollutants toxic to human health and ecosystems, as well as of carcinogenic pollutants, are different for diversion from incineration or landfill disposal. One thing that is reasonably certain, however, is that regardless of disposal technology, the upstream and product use toxic and carcinogenic pollution reductions from recycling and composting, as well as the greenhouse gas and other pollutant reductions, are many times larger than disposal facility emissions or pollution offsets due to energy generated from wastes. Thus, the community wanting to minimize the environmental impacts from the choices it makes regarding management of material discards needs to concentrate on investing in systems for recycling and composting material resource discards rather than disposing of them in either a landfill or an incinerator.

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Appendix 2, Policy Options By Gary Liss

Zero Waste is defined by the Zero Waste International Alliance as:

> "Zero Waste is a goal that is both pragmatic and visionary, to guide people to emulate sustainable natural cycles, where all discarded materials are resources for others to use.
>
> Zero Waste means designing and managing products and processes to reduce the volume and toxicity of waste and materials, conserve and recover all resources, and not burn or bury them.
>
> Implementing Zero Waste will eliminate all discharges to land, water or air that may be a threat to planetary, human, animal or plant health."[15]

A key to implementing Zero Waste is adopting policies, programs, incentives and new rules that will encourage all stakeholders to shift from wasting to reducing, reusing, recycling and composting their discarded materials. This section of this Resource Assessment highlights options for the County to consider for the following policies, programs, incentives and new rules:

- Make Businesses Responsible for Products and Packages
- Source Separation
- Incentives and New Rules
- Restore the Health of Soil with Composting
- Support Zero Waste Infrastructure
- Changing the Culture
- Green Business, Green Buildings and Jobs
- Management of Restricted Materials and Residuals

There are many resources already in the county that promote recovery and reuse. The priority for the County should be to support existing businesses and nonprofit organizations with policies and incentives. In the event that there are gaps in services that are needed that no one else wants to provide, it would be appropriate for the County to offer such services directly, or by contracting for such services to be provided. The Department of Public Works should be supported with the necessary resources to develop programs and policies to support this Zero Waste goal, while shifting costs to producers as it pursues Extended Producer Responsibility policies and programs.

[15] This is a peer-reviewed, internationally accepted definition of Zero Waste, from: http://www.zwia.org/standards.html.

Based on a review of existing budgets, rates, contracts and ordinances information obtained from the County, the following suggested policies, programs, incentives and new rules could help Carroll County address these challenges, harnessing the forces of the marketplace to strive for Zero Waste. These are presented as a menu of options for the County to consider.

a. Make Businesses Responsible for Products and Packages

The products and packaging that communities are asked to handle is increasingly complex and toxic. In Carroll County, although electronic discards are accepted at a permanent drop-off site at the Northern Landfill, most household hazardous waste is only collected twice per year. As most household hazardous waste collection programs only recover 2-10% of the materials they target, 90-98% of all those toxics are still being buried in landfills. In addition, for every ton buried in a municipal landfill, 71 tons are buried along the way from mining, manufacturing, and distribution processes. Clearly the system is broken and requires new rules, incentives and policies to address these problems.

As a result, local and state governments are increasingly focusing “upstream” to ask producers and retailers of products and packaging to take physical and/or financial responsibility for their reuse, recycling or composting. By focusing on such “Extended Producer Responsibility (EPR)” policies, local governments are saying to industry that they must stop the “unfunded mandate” placed on local governments to clean up the mess from all these products. Instead, producers should design for reusability, recyclability and compostability, and producers and retailers should use their expertise in supply chain management to set up reverse distribution systems to get those products and packaging back from consumers at the end of their useful life. Instead of paying for some of recycling programs in the future out of garbage rates, EPR programs will shift those costs to producers and retailers which will cover the costs of collecting their products and packaging, and charging for those services in the cost of their products.

Carroll County (County) and its service providers could be strong advocates for legislation and EPR policies and programs regionally, statewide, and nationally that makes business responsible for their packages and products. EPR extends the responsibility of producers for the environmental impacts of their products and packaging to the entire product life cycle. The County could advocate for systems that enable consumers to ship products back to producers, which in turn would get producers to design their products and packaging more efficiently. In advocating for EPR, the County could advocate for a system that sets up efficient repair and reuse programs, not just taking back products and packaging to be crushed or shredded up to be recycled (retaining their form and functions), and ensuring the redesign of products and packaging. The design of programs should be left to brand owners and primary importers.

The Product Stewardship Institute (PSI) was established to address EPR. Local governments cannot afford to properly dispose of an increasing array of complex

and toxic products and packages produced without regard to how they will be handled at the end of their useful life. The County could become an active leader in the PSI, and request the County's lobbyists and affiliated local and state organizations and agencies to make this a priority for legislation and regulations being pursued in Baltimore and Washington, DC. The County could also adopt a generic EPR Resolution to encourage producers to take responsibility for their products and packaging. This would provide support for County staff to play a more active role in the PSI, and other related EPR activities. The County could also work with legislators from the region to promote EPR policies and programs.

The County could require reusability, recyclability and compostability in products it buys and the products that County contractors use. The County could adopt an environmentally preferable products policy with Zero Waste goals and outcomes.

The County could engage industry, make them aware of materials and products that are problems for the County, and establish a process for resolving those problems.

The County has authority in the area of health and sanitation delegated from the State (under Title 12) to make rules as to what can and cannot be placed into the County waste system. If a material has been designated by a State or Federal Agency to be a pollutant or banned it from the landfill, the County could require the seller of the material to be the responsible disposal site for that product.

In the Palo Alto, CA Zero Waste planning process, businesses said that they would like to get a list of products and packaging that are particular problems for the County to properly handle, before the County bans them. This is similar to "notice and cure" processes often provided in performance obligations of contracts, that are to be used prior to the more onerous termination provisions of contracts. Often, these processes lead to better communication among the parties involved, and collaborative resolution of problems so confrontations can be avoided. The exact mechanism of engaging industry may vary by material or product, and may vary depending on whether something can be done locally, or if there needs to be a state or national solution to problems identified. In the latter event, this type of policy might call upon County staff and elected officials to be active participants in state and/or national roundtables and pilot programs to resolve problems identified.

The County could ask or require businesses and institutions to take back designated products and packaging sold in the County and to reuse, recycle or compost those materials. Products that could be designated initially include all products banned from landfills in Maryland and controlled substances (pharmaceuticals). The County could require that all manufacturers and retailers of computers and peripherals take back those products and packaging to be reused or recycled, as New York City is currently considering.

The City of Ottawa, Ontario also developed a voluntary take back program that publicizes businesses that voluntarily accept products they sell from their customers, which engenders customer loyalty and appreciation for their corporate responsibility. The CA Department of Toxic Substances Control initiated a similar program as the Take It Back Partnership. The County could work with industry groups throughout the state and state organizations and agencies to develop a similar Take It Back Partnership. A good target to start might be working with local pharmacies to develop a "take back program" for medications and syringes, which are increasingly being recognized as a problem for water pollution control plants, as well as landfills.

The County could ban products or packages from being sold or require businesses and institutions to take back designated products and packaging sold in the County that are toxic in their manufacture, use, or disposal, and/or are not currently recyclable in the area. The County could adopt local fees and taxes as an alternative way to discourage the use of non-recyclable materials.

Discarded plastic products, packaging and bags that enter the Chesapeake Bay and the Atlantic Ocean from the streams and rivers of the County should be recognized as a source of serious environmental problems. Birds and fish ingest the material and die from choking or starvation as a result.

Ordinances banning polystyrene (e.g., Styrofoam™ takeout containers and cups) are an example of products that have been the targets of local government bans. The Bay Area Zero Waste Communities developed a model "Food Ware" Ordinance that requires all food vendors in the community to use only reusable, recyclable or compostable food ware. Other examples are plastic bag bans or fees on plastic bags (such as the one adopted by Dublin, Ireland) to dramatically reduce the environmental problems associated with plastic bags.

The County could phase in a requirement that all packaging be recyclable by a target date (e.g., by 2015, all packaging will be reusable, recyclable or compostable").

The County could require that all products packaged and sold with a recyclable symbol on it must be able to be recyclable in recycling programs in the County.

The County could ban landfilling of easily recyclable materials as an incentive to encourage them to be reused, recycled or composted (e.g., corrugated paper and yard trimmings). For example, most counties in North Carolina ban corrugated paper from landfills.

The County could take a more active role directly to engage industry, make them aware that all new manufactured products need to be approved as reusable,

recyclable, or compostable to ensure potential problem materials are not introduced into the system.

b. Source Separation

The County already requires source separation of yard trimmings and mulches or composts the material for residents. The County could require all residents, businesses and institutions to also source separate other designated reusable's, recyclables and compostables (including discarded food, and food contaminated paper). By keeping materials separated at the source, the materials retain higher value as resources for reuse, repair, salvage, remanufacturing, recycling and/or composting. That higher value will make County recycling programs more cost effective, and encourage the creation of niche reuse, recycling and composting businesses that could add value to these materials to create more jobs and wealth for the community. San Diego County, CA was one of the first to adopt a Mandatory Recycling Ordinance (MRO) such as this. Other communities around the country that have adopted similar separation requirements are: Portland, Oregon; Seattle, WA; New York, New York; Dane County, Wisconsin; Durham, North Carolina; and Onondaga County, New York.[16] This could be done as an amendment to the Solid Waste Ordinance in Carroll County.

The County could redesign the County landfill and Materials Recovery Facility to provide additional reuse, recycling and composting opportunities to be used by the public, keeping residential traffic separate from commercial traffic to ensure public safety. The County could adopt a rate structure that pays for valuable materials and provides free or low cost tipping for designated clean, source-separated materials deposited at County facilities, such as the current free drop-off of yard trimmings at the County landfill. This would reward those that comply with County policy requiring source separation of reusable, recyclable and compostable materials.

The County could require lower rates for clean, source-separated materials deposited at private solid waste facilities in the County, including the rubble landfill. San Jose included this requirement in the Solid Waste Facility Permit for Zanker Road Landfill. In part due to this and related policies, that landfill has diverted 95% of materials received from landfilling for over 7 years, and extended the life of the landfill by more than 20 years.

The County could include lower rates for clean, source-separated materials as conditions of all permits affecting materials discarded in the County.

The County could include requirements for commingled recyclables and compostable organics collection services to be provided by licensed haulers. Require licensed haulers to offer lower rates or free service for hauling clean, source-separated materials from businesses. This is a companion to the above

[16]Source for some of these: Moore & Associates, *Impact of Mandatory Recycling Ordinances and Disposal Bans on Commercial Fiber Recycling,* **April 21, 2003**

policies for facilities receiving such materials. This would provide businesses that generate waste with an incentive to design waste out of the system.

The County could encourage deconstruction, salvage, and reuse of materials from construction and demolition (C&D) projects in addition to existing recycling requirements. The County could license haulers and demolition contractors to take salvage materials after they deconstruct buildings. The County could require minimum qualifications for businesses to do this type of work, and require insurance certificates and/or performance bonds to assure quality of performance and safety. In Cotati, CA, the County requires contractors to place a notice in the newspaper to advertise when a building will be demolished, and to allow for people to come forward to deconstruct, salvage or reuse products from projects while the projects are obtaining permits for the project. This provides additional lead-time for deconstruction, salvage and reuse of materials, which is needed to accomplish those goals.

The County could place recycling containers wherever there are trash containers in all public locations. One of the major impediments to source separation is the need for reuse, recycling or composting containers wherever garbage containers are located. This is an important facet of "leadership by example" as well. It's difficult to encourage residents and businesses to recycle more, if the County is not making it convenient for all to participate. All bins should be signed with photos of desired material and written in English and the dominant second language of the area.

c. Incentives and New Rules

At the same time, some of the biggest subsidies to wasting come from how local governments structure their garbage systems and rates. Over 7,000 communities around the country have adopted Pay As You Throw rate structures to give the price signal to users to save money the less they throw away. Such programs are fair, economically sound, and environmentally sustainable. The more linear the rate structures, the better the signal to users. Although Carroll County does not contract directly for waste collection services for residents and businesses, it does license the haulers who provide those services. Since 1992, the County's Solid Waste Ordinance requires individual haulers to obtain licenses to operate in the County, and to provide at least weekly curbside pickup of residential recyclables. As conditions of those licenses, or as expanded franchises, the County could add requirements to strive for Zero Waste, as outlined below.

The County could require permitted recyclers and licensed waste haulers to achieve greater waste diversion. The County could require that licensed waste haulers achieve increasingly higher waste diversion targets over time as a condition of their license, starting with 50% in 2009. Similar provisions could be required in permits for recyclers. The licensees would be responsible for collecting and marketing the recovered materials. Hawthorne, CA adopted this approach, with a more regulated franchise system for commingled materials and

a more flexible system of permits for recyclers that collected source-separated materials. The County could also provide waste haulers with access to County long-term contracts for waste disposal as part of a licensing system.

The County could require all multi-family dwelling owners to provide recycling services to tenants and require all haulers of waste from multi-family dwellings to collect recyclables as well from those complexes as a condition of operating in the County. Further, to help the hauler maximize collections, the County should require the generator to separate into blue, green and black bin categories.

The County could require licensed haulers in the County to reuse, recycle or compost at least 50% of all bulky items collected by them in the County. The haulers could partner with thrift stores, repair shops and charity non-profits to take away these materials for repair, reuse and resale. The remaining materials should be dismantled then recycled.

The County could charge fees on licensed waste hauling services to provide more economic incentives for recycling, and to generate funds for new recycling programs. Recycling and composting services provided by the County could be funded in part from revenues from these fees.

The County could support local, regional and state landfill surcharges, and bond issues to fund low-interest loans and/or grants to develop needed Zero Waste infrastructure. In many European nations, they have adopted significant fees on landfills of $20-40/ton to fund recycling programs and decrease greenhouse gases. In San Jose, CA, the combined fees and taxes on landfilling are over $19/ton, and they have one of the highest waste diversion rates in the nation. In Central Vermont Solid Waste Management District, they have adopted a $21/ton surcharge on landfilling in their District to fund their Zero Waste programs. The County could support the state adopting an initial $5/ton Zero Waste for Global Cooling Fee on landfills, and increasing $5/year thereafter until it reaches $20-40/ton. The Zero Waste Fee could be levied on all wastes disposed of in the state or transported for disposal out of the state, to ensure that wastes transferred out of state still pay this fee. Revenues from the fee could fund the implementation of local Zero Waste plans, policies, and programs, including providing initial funding for take back programs for industries committing to ongoing expenses of those programs.

The County could require incentives be provided by licensed waste haulers to residents to reduce waste through a linear Pay As You Throw rate structure, a "Recycling Lottery" program or RecycleBank system.[17] This could be particularly powerful if coupled with an option to collect rubbish every other week, once

[17] Recycling lotteries select households randomly and award prizes if there are no recyclables in the garbage cans, and if all recyclables are placed correctly in recycling bins. The RecycleBank program pioneered in Philadelphia weighs recyclables as they are collected, and residents are provided discount coupons for area businesses based on the amount of materials they recycle.

licensed haulers offer residents weekly collection of food scraps (see below). The Pay As You Throw rates should be set to keep incentives for waste diversion even if fees may need to be instituted to cover reuse, recycling and composting programs run by the County. Charges that may need to be instituted for extra recycling and compostables services should not be more than 50% of the cost of trash service to maintain the necessary incentive for waste diversion.

d. Restore the Health of Soil with Composting

The County could adopt a policy that no compostable organics should go to landfill. The United States has lost half the carbon in its soils and half of what is buried in landfills is organics (yard trimmings, food scraps and food soiled paper). Landfills are the single largest source of human-created methane gas and contribute significantly to climate change. We need to get organics out of landfills and back to the soil. The links between global warming and wasting have also been made by the USEPA, making this a much more urgent issue. With 50% of the current land area of the County being used for agriculture and a market value of almost $70 million annually, the County also has an opportunity to support this major local industry with its organic discards.

The County could help market urban organics to farmers to restore the health of soils and reduce use of fertilizers, pesticides and irrigation water. The County could work with regional and state organizations and agencies to develop a program to demonstrate the value of quality urban compost being used to restore local soils. The County should solicit the support of the County Agricultural Extension Service for the development of such markets for quality compost. The CA Integrated Waste Management Board successfully helped open the agriculture market in California to the use quality urban composts through a series of demonstration projects in the 1990s. Similar efforts could be pursued in Carroll County once programs to compost source separated organics are established.

The County should support policies for agricultural areas to consider composting on a farm or dairy as a right within zoning ordinances. The County should also encourage land use planners to allow composting on farms, the use of compost products by farmers, and the ability to sell compost made from materials gathered from other agriculture applications as well as source separated material from residents.

The County should support legislation to require Maryland (MDOT) to use mulch and compost made from urban organics to landscape freeways, and to use other recycled materials in sub-base and road mixes (e.g., rubberized asphalt). MDOT is one of the biggest potential markets for these materials. The Maryland Department of Transportation (MDOT) procures nearly $2 billion worth of goods and services every year. The County should support requirements for MDOT to achieve targets for organics and recycled materials on an increasing basis over

time. MDOT should also use compost products to help control erosion and to help in re-vegetation after natural disasters.

e. Support Zero Waste Infrastructure

The County could support the development of a Resource Recovery Park at the County's Northern Landfill to accept all reusable's, recyclables, compostables and restricted materials from the public. Resource Recovery Parks colocate reuse, recycling and composting processing, manufacturing and sales businesses. Such Parks are needed to provide locations for reuse, recycling and composting businesses to process materials, manufacture products and sell products to the public.

The County could form partnerships with the private sector for Zero Waste infrastructure development for the multi-family and commercial waste streams. The County could reach out to all existing reuse, recycling, and composting businesses in the region and invite them to expand their operations in the County. The County could also do recruit businesses that use reused, recycled or organic materials to be supported as part of its Zero Waste Plan implementation.

The County could encourage local communities to modify the Zoning Code to allow Zero Waste infrastructure by right in appropriate zones. In order to expand the number and types of reuse, recycling and composting activities, there needs to be more support for the siting of such facilities. By providing an overlay for Zero Waste infrastructure on the existing Land Use and Zoning map of the County, the County could signal its commitment to expanding such businesses in the County. The overlay should recognize the importance of the local use of resources and provision of local services that are needed.

The County could specify in all of its contracts for major construction (e.g., roads, parks, public buildings) the use of reused, recycled and compost products. In addition, the County could agree to purchase certain amounts of these products from private businesses as part of its contribution to creating the demand for new products. The City of San Jose, CA has done that in its yard waste processing agreement since the 1980s.

The County should include Zero Waste goals and infrastructure as part of climate action plans. The US EPA developed a Waste Reduction Model (WARM) to assist solid waste managers determine the greenhouse gas impacts of their waste management practices. WARM compares the greenhouse gas and energy impacts of landfilling, recycling, incineration, composting, and source reduction.

f. Changing the Culture

Zero Waste should become second nature as part of the culture of the family, education system, and community. The County could create a mass media education campaign on Zero Waste, targeting the general population with

specific examples on behavior changes. The County will need to educate residents, businesses and visitors about the new rules and changes over time.

A community-based social marketing program could be adopted to help change the culture and behavior in the County, with different messages targeted to different demographics using a wide assortment of tools that are now available. The County could work closely with electronic and print media to involve their coverage of the County's goals, plans, and implementation of projects, and to challenge them to help engage the public in creative new ways. The County could also work closely with the media to include Zero Waste messages, such as the Trash Challenge and its series on our Consumption Society recently broadcast by National Public Radio. The County could work with to develop an all-encompassing campaign that educates and reinforces desired behavior.

The County could work with local school districts to create a Zero Waste curriculum for the K-12 school system that interweaves environmental education into all aspects of course work. The County could work to integrate a Zero Waste curriculum into existing courses and to implement Zero Waste systems for all schools and administrative offices. The County could also work with the Zero Emissions Research & Initiatives to apply principles in designs of new schools that exceed the efficiency of LEED Platinum and produce healthier schools.

The County could train managers of buildings and facilities about Zero Waste systems and resources and highlight how waste minimization can reduce trash bills so that their bottom line does not go to waste. The County could arrange for training programs for managers of buildings and facilities to understand commodity management and the available markets and services in the County for reuse, recycling and composting. The County could provide trainings for small businesses to encourage warehouse managers and loading dock managers to talk with accounts payable and purchasing departments, and understand details and subtleties of their industry's wastes (e.g., plastic contaminated with food, wax coated cardboard). The County could help link businesses to link their waste-streams with each other and create new businesses. The County could organize an annual Zero Waste awards program to recognize leadership and successful implementation of new programs and policies.

The County could use innovations in communications, including mobile media, online video, blogs, text messaging, online advertising and micro-targeting. The County could use MySpace, YouTube, texting and local celebrities to talk about Zero Waste messages. Websites and list serves are also great communication vehicles that should be used effectively.

The County should serve as a model in implementing Zero Waste. County agencies should lead by example to implement all actions asked or required of residents and businesses and report on progress annually. When the public

comes to any public facility, they should find the best opportunities to reuse, recycle or compost of any place in the County, with lots of signage and information about how to do it, and why. This includes food discards from County facilities and reusable furniture and equipment that are discarded by County surplus property processes. The County should be the example for the public and private sectors on how to properly handle discards.

The County could organize a regular column spotlighting companies in Carroll County that are doing creative, innovative solutions and creative individuals who are making things happen. The County could feature the worst problem's solution each month (e.g., plastic wrap of pallets) and spotlight great reuse operations, recycling centers and compost facilities. The County could clarify what is really recyclable locally and feature different services offered in the County. The County could highlight new language to discard "trash," "garbage" and "waste" from common vernacular to highlight these are resources.

g. Green Business, Green Buildings and Jobs

The County could help retain and expand Green Businesses. Provide preferences in County procurement, funding and permitting for certified Green Businesses in the County and businesses that comprise the Zero Waste infrastructure.

The County could purchase Zero Waste products and services, including: return to vendor any wasteful packaging; reduce packaging and buy in larger units; use reusable shipping containers; purchase reused, recycled and compost products; buy remanufactured equipment; lease, rent and share equipment; buy durables, using life-cycle cost analyses; and buy less toxic products.

The County could adopt the "Precautionary Principle" for all County purchases. The precautionary approach seeks to minimize harm by using the best available science to identify safer, cost-effective alternatives. Adopting the Precautionary Principle for County purchases would not merely ask if a product is safe; it also asks if the product is necessary in the first place. The City and County of San Francisco adopted the precautionary principle to govern all of its purchases.

The County could ask businesses to adopt Zero Waste goals and plans that follow Zero Waste Business Principles.

The County could expand the County's use of Green Buildings and encourage residents and businesses to use more Green Buildings. The County could adopt planning policies to encourage the restoration of functional buildings, rather than demolishing them.

The County could collect and process discarded materials locally to keep jobs within the local community or waste shed.

h. Management of Restricted Materials and Residuals

The County should minimize the use of the County landfill to extend its life and convert its main function to be the hosting of a Resource Recovery Park, and management of restricted materials and residuals from reuse, recycling and composting programs in the County.

The County could require processing of all discarded materials before they are buried in landfills to leach out toxics and digest organics so that only inert materials are buried and greenhouse gases are not released.

Carroll County should not develop a Waste-to-Energy facility and should commit to the implementation of a Zero Waste Plan instead. After five years, the County can assess the success of a Zero Waste Plan and decide how to proceed with other options. As it takes five years to permit and build such a facility, this decision would result in a delay of a minimum of 10 years before a facility could be built for Carroll County, or for Carroll County to participate in a regional effort to build such a facility. However, it is quite possible that other projects may be built during that time and the County could decide in 5 years to participate in such a project. If it decides to send any waste to facilities that have been built, that should be done without any long-term contracts with the rate paid for such service being whatever the "gate rate" is at the time. This would likely mean the per ton costs would be higher for such services than under long-term contracts. But waste reduction, reuse, recycling and composting would be more economically competitive as a result. Furthermore, as a result of the diversion of materials to recycling and composting, the savings in total disposal costs compared with the financial commitments involved in long-term contracts would more than offset the added costs of higher per ton disposal fees. Alternatively, the County could continue to contract during the ten years to dispose of wastes that are not processed in reuse, recycling or composting facilities at out-of-county landfills.

The County should not accept any of the bids for a proposed Waste-to-Energy Facility in Carroll County.

Carroll County could increase the amount of wastes landfilled out of county in the short term and reserve the existing capacity of the Northern Landfill for residue from Zero Waste infrastructure. The County could negotiate with Waste Management for them to develop some of the needed Zero Waste infrastructure (e.g., a composting facility for source separated organics) instead of continuing to "put or pay" to waste in Virginia as tonnages decrease from Zero Waste programs. As an alternative to negotiating with WMI to trade landfill put or pay commitments for composting, the County could negotiate to send them more wastes in the next couple of years in trade for less wastes later. That would be easier to negotiate with WMI and is consistent with the goal of reserving existing County landfill capacity for residues from Zero Waste infrastructure. That would change the local landfill overnight to only receiving pre-processed materials,

which is another major advantage to get all the recyclables out of the discard stream before landfilling.

In either case, the County should not try to site another landfill within the County in the short term. This would be a significant distraction from implementing the Zero Waste Plan and take valuable time and resources away from the priority goal of Zero Waste.

Carroll County should adopt a linear Pay as You Throw rate structure for the unincorporated areas of the County and require all licensed haulers to adopt a similar program as part of the Solid Waste Ordinance.

Carroll County should implement a County wide composting facility that could process source separated organic materials. The County should consider placing an anaerobic digester for putrescibles (food discards and manures) at the landfill. The County should work with the local agriculture industry to demonstrate the quality of compost from source separated composting facilities. The County should work with the Agriculture Extension Service to develop a permitting process that allows local farmers to accept yard waste, separated food scraps, and soiled papers from school cafeterias or restaurants that could be used as a soil amendment while generating tipping fees for farmers.