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Building Long Term Solutions: Retail Shopping Bag Impacts and Options

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About this Report

This report was commissioned by Gap and JCPenney as part of ongoing efforts to better understand and address the environmental impacts of retail shopping bags. Please contact Marshall Chase at mchase@bsr.org or Nandini Hampole at nhampole@bsr.org for questions or clarifications.

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Introduction

Shopping bags are a key part of retail brand identity. However, mounting consumer awareness and government concern about the environmental impacts of these bags—ranging from energy use, inability to decompose, litter, and threats to wildlife—have resulted in a clear need for retail companies to work toward a more sustainable alternative over the long-term. Two recent developments highlight this need.

The first is a new range of options and information that complicate the old "paper or plastic" question. Consumers are increasingly adopting various types of reusable bags, while a range of "environmentally friendly" plastics have emerged, each with different environmental impacts. Competing claims about the benefits, drawbacks and costs of these options make it difficult to choose among them.

The second development is a growing wave of regulations and awareness campaigns around the world. Countries including China and France are banning some plastic bags, Ireland has taxed them, and the British government is working in conjunction with the British Retail Consortium to reduce the environmental impact of plastic bags. These efforts can be both confusing and inconsistent: For example, some cities such as San Francisco have instituted partial bans on non-biodegradable bags, while others like Toronto have banned biodegradable bags because they contaminate the local recycling system. Large retailers rely on standardization to control costs, but a patchwork of city-by-city regulations is likely to drive up costs and may increase overall environmental impact because of misaligned efforts and decreased efficiency.

Objective of the study

The purpose of this study is two-fold:

1. To provide a high-level understanding of the environmental impacts of different kinds of bags, and identify the types and magnitudes of environmental impacts associated with each kind of bag through a literature review of four publicly available life cycle assessment (LCA) studies.
2. To better understand how the environmental impacts of retail shopping bags can be reduced, including through means other than (or in addition to) choice of bag type, such as change in consumer behavior.

Methodology

1. LIFE CYCLE ASSESSMENT OF RETAIL BAGS
The objective of this study is to draw together four existing life cycle assessments (LCA) to compare the environmental impacts of shopping bag alternatives. It aims to help retail brands get a better understanding of bag alternatives by informing them about the life cycle impacts associated with bags. Please note that no new modeling has been undertaken for this project. BSR developed a general overview of life cycle "hot spots" for various types of bags which can support initial prioritization of bags based on their environmental impacts.

2. OPPORTUNITIES FOR DEVELOPING SYSTEMIC SOLUTIONS
Using a combination of stakeholder interviews with companies and environmental organizations and desk-based research, we were able to arrive at a two-pronged strategy for developing systemic solutions: store or business-level process related changes, and broader efforts such as company partnership with relevant stakeholders including supply chain partners, environmental NGOs and governments.

Executive Summary

In this report, BSR will first provide the results and the key findings of the Life Cycle Assessment reports, with a detailed analysis to be found in the Appendix. In the second section, we discuss opportunities and solutions with targeted recommendations for systemic change and consumer behavior change toward retail bags. The solutions we suggest are focused on what we believe companies can do to bring about larger-scale change to reduce environmental impacts from the use of retail shopping bags.

In analyzing and comparing the different LCA studies, we found that there is no clear consensus regarding the environmental impacts of different bags, but kraft paper bags appear to have greater environmental impact across most categories of comparison. We also understand that no single bag type is superior in every environmental impact category, so a shift from one bag to another may improve one or few environmental outcomes but be offset by other negative impacts. We conclude that the focus of the issue should not be on deciding on the best bag alternative, but on convincing consumers to reduce, reuse and recycle bags, in that order.

In the second section of the paper, we highlight select current legislation and voluntary initiatives to bring about change in consumer behavior vis-à-vis retail bags. We also offer targeted micro and macro level options for retailers willing to actively invest in making a cultural shift away from disposable bags possible and bringing about change in consumer attitudes toward retail bag use.

Part I: Life cycle Assessment of Retail Bags

Definition and Methodology

A life cycle assessment provides a systems approach to examining environmental factors. By using this approach, one can examine all aspects of the system used to produce, use and dispose of a product. This is known as examining a product from cradle (the extraction of raw materials necessary for producing a product) to grave (final disposal of the product).

We have used publicly available data (links provided in the 'References' section) from four LCA reports, namely:

1. Sustainability Victoria: "Comparison of existing life cycle analysis of shopping bag alternatives", April 2007;
2. Boustead Consulting & Associates Ltd.: "Life Cycle Assessment for Three Types of Grocery Bags: Recyclable Plastic; Compostable, Biodegradable Plastic; and Recycled, Recyclable Paper
3. LCA study conducted by the retail company Carrefour
4. Karli James and Tim Grant, "LCA of Degradable Plastic Bags".

The comparison of such diverse LCA studies subjects us to certain methodological and practical problems. These include substantial differences in type of bags, electricity sources, travel, production processes, water use and impact on land and soil reviewed in the studies. They also include variations in geography, data quality and choice of technology. The LCA overview table (on pp. 9 and 10) created out of data collected from the above reports provides a rough understanding of environmental impacts across various categories and may not fully reflect the unique production circumstances, use and disposal of a given bag type.
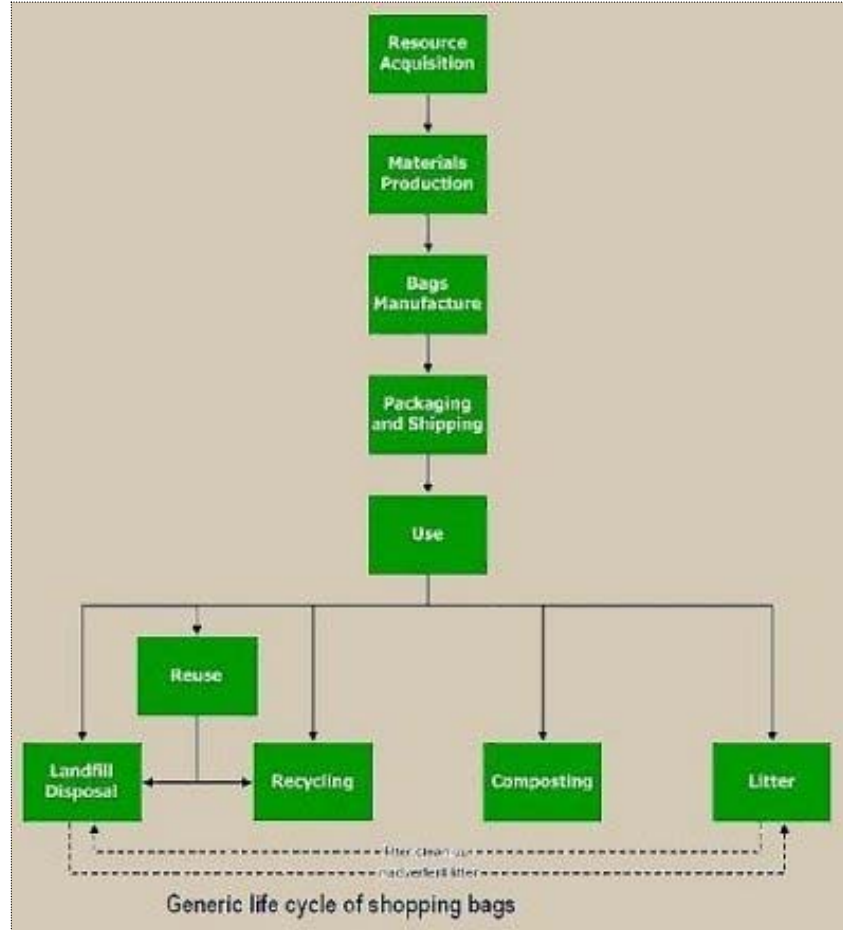
The benefit of such a review is that it illustrates a diverse range of potential bag life cycles, and the variations in impact. Taking the above caveats into account, we have attempted to study and compare impacts across all studies and have succeeded in compiling and comparing data in the LCA overview table (appendix), with a focus on comparing energy use, water use, GHG emissions, litter aesthetics, eutrophication and solid waste across most bags profiled.

Generic life cycle of shopping bags

Source: http://www.seattlebagtax.org/plasticlifecycle

Description of each bag type

For this review, we conducted comparisons across different types of shopping bags and attached these in the appendix. The different bag types are: disposable or 'single use' plastic bags, reusable plastic bags, Kraft paper bags, biodegradable plastic bags and cloth bags. Not all of the above bags were included in each study reviewed. Below is a brief description of each specific type of bag assessed.

1. Single use high density polyethylene (HDPE) bag
HDPE is manufactured from ethylene, a by-product of gas or oil refining. These plastic bags offer a thin, lightweight, high strength, waterproof and reliable means of transporting shopping goods. These bags are mainly used in supermarkets, take-away food and fresh produce outlets.

2. Single use low density polyethylene (LDPE) bag
LDPE is manufactured from ethylene. The LDPE 'boutique' style bags are generally branded and are used by stores selling higher value goods, such as department stores, clothing and shoe outlets.

3. Single use kraft paper bag

Pulping and bleaching processes involved in paper manufacture produce higher air emissions and waterborne wastes than plastics manufacture. One of the major benefits of paper bags is that under proper landfill conditions they are degradable and therefore have less impact on the litter stream.

4. Single use degradable plastic bag

Plastic bags that can be broken down by chemical or biological processes are described as degradable and they are classified differently depending on:

a. The way they degrade (whether they require the actions of microorganisms, heat, ultraviolet light), and

b. The materials they are manufactured from (such as starch polymers, synthetic polymers and so on.)

5. Reusable cloth bag or calico bag

Calico bags are made from woven cotton and can be reused many times. They are strong, durable and flexible. Very few recycling programs exist for damaged calico bags at the end of their life.

6. Reusable non-woven plastic bag or 'Green bag'

Non-woven plastic (polypropylene) or 'Green Bags' are manufactured from polypropylene gas, a by-product of oil refining. They are strong and durable, and can hold more than a conventional single use HDPE shopping bag.

Overview: LCA of different retail bags

We analyzed four comparative LCA reports of different bag types as noted in the definition and methodology section above. We provide report by report analysis in the appendix and here are the overall findings when compared against each other.

Overview of Key Findings	
Findings	**Report**
1. Science regarding the environmental impact of different bag types is not settled, though some bag types clearly have greater impacts in certain areas	Across all reports
2. A shift from one bag to another may improve one or a few environmental outcomes but be offset by another or few other environmental impacts. As a result, no bag produced can have an environmental benefit across all impact categories	Across all reports
3. Kraft bags have the highest impacts across energy use, green house gas emissions and water use because of high consumption of electricity and gas during paper production	3 out of 4 studies
4. Reusable bags have lower air emissions and energy use impacts (based on the assumption that it is used a certain number of times to have a positive environmental impact)	2 out of 4 studies

Overview of Key Findings	
5. Degradable bags have similar greenhouse and eutrophication impacts than conventional HDPE bags	3 out of 4 studies
6. Single use bags are the worst with regards to litter aesthetics.	2 out of 4 reports

Conclusion

Without a clear consensus on the most environmentally friendly bag alternatives, different governments have built disparate policy frameworks to address the issues involved. Governments and other organizations focus on different environmental impacts: some attempt to reduce bag use to control litter impacts such as in San Francisco; while others may be more concerned with the dependence on fossil fuels, the need to reduce solid waste or building efficient recycling systems. However, questions remain about whether larger environmental goals such as reduced natural resource use and efficient recycling systems can be met with the above initiatives. The issue then is not whether to choose paper or plastic bags, but rather finding ways to convince consumers to reduce, reuse and recycle all bag types—in that order.

Part II: Opportunities for finding systemic solutions

Decoupling consumer behavior from bag use is an important challenge in the pursuit of sustainable consumption. In the past decade, two core mechanisms have been used to modify consumer behavior in relation to plastic bag consumption: regulation by cities and countries around the world, and voluntary efforts such as awareness-raising campaigns developed by retail associations, brands, NGOs and others.

In this section we provide brief descriptions of some successes and failures of the two mechanisms. We go on to use the key findings from this to provide high level solutions and recommendations to companies on how they can influence consumer behavior change and move toward sustainable consumption.

Key Findings and Recommendations

1. The solutions currently advocated by governments and companies are disparate and inconsistent, while a systemic approach is essential to having real impact.
2. Companies are generally not reaching past the benchmark set by government actions, as in the case of retailers working on the WRAP-BRC Initiative (discussed below).
3. We propose a two pronged strategy for engaging companies and other relevant stakeholders to drive sustainable change in consumer behavior: store or business-level process related efforts, and company engagement with relevant stakeholders including supply chain partners, environmental NGOs and governments to achieve standardization and long term solutions.

Regulation and Public-Private Partnership

1. BRITISH COLUMBIA PLASTIC BAG REDUCTION CAMPAIGN

In 2008, British Columbia's plastic bag reduction initiative came into being through a voluntary agreement between four leading retail industry associations and the Ministry of Environment. This initiative seeks to reduce the number of single use plastic shopping bags distributed in British Columbia by 50 per cent by 2013 using the reduce, reuse and recycle method.

The changes in in-store bagging practices are having considerable impact on consumer behavior patterns. Key factors contributing to this year's progress toward the 50% reduction target include:

- » In-store incentives encouraging reduction and recycling
- » Improved bagging practices at check-out
- » Increased availability of reusable bags
- » More voluntary in-store collection points for recycling
- » Greater consumer awareness and, most importantly, consumers changing their behavior and reducing their reliance on plastic bags.

2. PLASTIX: IRISH TAX ON PLASTIC BAGS

It is estimated that the introduction of a 15-cent environmental levy on plastic bags has reduced consumption of these bags by about 92%. In addition, it has reduced plastic bags from 5% of total visible litter to 0.3%. Receipts from the levy are ring-fenced into an Environment Fund, and during 2003 these amounted to over € 12.7 million. Levy proceeds are used to support waste management and other environmental initiatives. The levy has been very effective as an awareness raising initiative.

An Attitudes and Actions Survey in 2003 (A National Survey on the Environment) indicated that reusable shopping bags are now being used by 90% of shoppers. However there have been suggestions that this rate has declined somewhat over time.

3. CARRIER BAG AGREEMENT: UK GOVERNMENT AND THE BRITISH RETAIL CONSORTIUM

In December 2008 seven of Britain's leading supermarkets represented by the British Retail Consortium (BRC) signed up to a voluntary agreement with the Government to cut the number of carrier bags distributed by the end of May 2009 by 50% (against 2006 levels). The WRAP (the Waste & Resources Action Program) which has been monitoring the agreement recently reported that retailers achieved a reduction in bag use of 48% across the UK. It has used novel ways to influence consumer behavior to reduce, reuse and recycle plastic bags, such as:

- » Encouraging customers to reduce significantly the number of carrier bags they use;
- » Reducing the impact of each carrier bag (for example, by using less material and/or incorporating recycled content); and
- » Enabling the recycling of more carrier bags.

Marks & Spencer (M&S)and Tesco are leading the way in this effort—the former by imposing a surcharge on plastic bags and the latter by providing incentives to consumers to gain Green ClubCard points as part of its consumer loyalty program without charging consumers for bags. However, both companies have been criticized by environmentalists for not going beyond the BRC reduction

OECD Policy Brief on 'Political Economy of environmentally related taxes'

A tax on plastic bags in Ireland rapidly had the desired environmental effect of sharply reducing plastic bag usage – for one thing, shops stopped giving them away free to customers, and the increased price of the bags encouraged customers to return to re-usable shopping bags.

target and committing to efforts that would cause greater consumer behavior change.

Voluntary Initiatives by Retail Companies

1. ALTERNATIVE SUSTAINABLE BAG SOLUTIONS

Companies like supreme bags (supplying to M&S and Tesco), Trader Joe's, Whole Foods, Gaiam and EcoBags all have a collection of reusable bags. Reusable totes have become very popular across the western world, but their actual reuse is often limited. The perverse effect of reusable bags is that they are very often not used more than a few times, and if they are not used for a minimum number of times then their life cycle impacts outweigh the impacts of paper and single use plastic bags. Some interesting efforts to influence consumer behavior in reusing bags are described briefly below:

» **Tesco's Reusable and Fashionable Bags**

Customers at Tesco grocery stores in the UK were happy to purchase reusable shopping bags when the company began offering at least one Green ClubCard point for each bag used, depending on its size. And customers do not have to use Tesco's bags to rack up points: they get credit for using bags from other retailers, too.

Since the program was launched in August 2006, customers have used two billion fewer disposable bags. Last year, Tesco introduced a line of attractive and affordable reusable shopping bags made from recycled plastic bottles and designed by one of Britain's top designers. The bags became so popular that the company added two more designs to the original six.

» **SmarTote by Innovative Packaging**

This Minnesota-based company produces reusable bags that come with a bar code that allows stores to track whether it is being reused. Companies can use the points collected to offer prizes or other incentives to customers who can prove their bag isn't just collecting dust at home.

2. BAG REBATES BY TARGET

Target stores began a rebate policy in the U.S. in November 2009 whereby they give customers five cents for every reusable bag used, in an effort to reduce the number of paper and plastic bags that get thrown away. Other retailers have implemented similar programs.

3. REDUCE, REUSE AND RECYCLING: A PIONEERING EFFORT BY WAL-MART

Wal-Mart's process-related efforts to reduce, reuse and recycle bags in stores can have a far reaching effect on the way companies can directly work to reduce and change consumer behavior for sustainable bag use. We will leverage the current efforts led by Wal-Mart to provide recommendations to retailers for systemic change, in the next section.

Systemic Solutions and Recommendations to Companies

Currently, there is a jumble of legislation and voluntary initiatives led by governments and companies, while companies are often unwilling to create more ambitious targets to drive consumer behavior change in bag use. Having spoken to various stakeholders in environmental organizations and companies, we believe that there are two broad ways in which systemic solutions can be created:

1. Companies need to create **process related changes** at the store level to bring about consumer behavior change and drive bag reduction and recycling, keeping in mind the business costs and relevance of such changes; and
2. Companies need to work together with peer companies, supply chain partners, interested and willing environmental NGOs and governments in collaborative efforts to define and influence policy and actions **creating similar standards, processes and mechanisms** for reusing, reducing and recycling retail shopping bags.

1. MICRO LEVEL: PROCESS RELATED CHANGES

Reduce, reuse and recycle at the store level, by optimizing bag design, raising awareness, motivating customer and providing incentives to consumers without negatively affecting the retail experience and raising costs to companies.

a. **Training store clerks/cashiers:** Stores and clerks can influence consumer behavior passively and actively:
      i. Passive behavior change can take the form of signs or clerks wearing badges with the question "Do you need a bag?" or "Think of using a reusable bag."
      ii. Active behavior change can involve cashiers asking consumers if they require a bag, instead of automatically giving them out.
   Other methods include improving cashier training on bagging efficiency when using reusable bags.
b. **Redesigning checkout areas:** Stores can create better fixtures for reusable bags and train cashiers on their load capacity, which is different from the standard current set up for 'single use' plastic bags. This area may be more important for high-volume supermarkets than for other types of retail stores.
c. **Phasing out disposable bags:** Wal-Mart has developed a pilot to eliminate disposable bags by making reusable bags affordable to all shoppers in different markets where it operates.
d. **Redesigning reusable bags:** The trendy reusable bags in the market are often not designed to be user friendly. We believe retailers should work together to increase bag 'reusability' and they can be "converged" to suit different shopping experiences, e.g. in supermarkets and in apparel stores.
e. **Increasing consumer incentives:** Retailers can provide incentives in the form of reward points for reusing shopping bags, and provide added incentives through a process that tracks the reuse of bags such as the SmarTote incentive described in the previous section. We recognize that some retailers are providing incentives in the form of club card points, but clothing retailers such as Gap and JCPenney will have real impact by building internal systems to trace the reusability of bags;
f. **Setting up effective recycling areas in stores:** Recycling bins can be placed in prominent locations. Customers can be educated about the positive environmental impact of recycling. Worn out reusable bags can be accepted for recycling and sent to certified recyclers for processing.

2. MACRO LEVEL: PARTNERSHIPS TO ACHIEVE STANDARDIZATION

Companies themselves are effective champions of change when brought together in multi-stakeholder efforts with interested and willing environmental industry, supply chain, government and NGO partners. Here are some ways to engage in a proactive fashion:

a. **Collaboration among companies** through influential retail organizations like the **National Retail Federation**. Such efforts could work along the same lines as the Carrier bag agreement between the British Retail Federation and the UK Government. They could also involve research and education efforts focused on raising understanding and awareness of environmentally preferable bags. We realize that a national level initiative like the British one may be a challenge in the U.S (with different federal legislation) however we believe companies are enthusiastic about exploring this option;

b. **Starting a public service advertising campaign** to encourage better consumer behavior such as the *'Where's Your Bag'* Campaign created by the City of Santa Barbara, the California Grocers Association and environmental groups. The program takes a multi-directional approach to educating store employees, consumers, and the general public about the green benefits of using reusable shopping bags. It includes staff training, advertising, signage, special events and press releases. Signage includes parking lot signs, car window decals and grocery employee buttons. We believe there needs to be an effort for larger collaboration between retailers and governments for sustainable solutions in this sphere.

c. **Bringing together bag manufacturers (suppliers) and disposal companies** to develop more environmentally friendly systems of recycling. Bag manufacturers currently are not being held accountable or asked by retailers to change manufacturing practices to include recycled materials. This has a direct impact on the way recycling companies dispose of bags. Untapped opportunities consist of retailers encouraging disposal companies to sell recycled plastics directly to suppliers (bag manufacturers) for more effective ways of 'closing the loop.'

However, there are challenges to initiating such efforts, including:

a. Different physical interests of retailers: Supermarkets use different bags than clothing retailers, and the two shopping experiences are different. Supermarket shopping is usually a planned, "need" based effort, unlike typically more "spontaneous" shopping associated with apparel stores. As a result, consumer and retailer behavior regarding bags in these stores is different. Consumers are more likely to bring reusable bags to supermarkets, and there is a much stronger style and brand association with bags for clothing retailers, in contrast to more functionally-focused supermarket bags. Thus, collaboration among different types of stores requires thought out and deliberation to set a successful framework for dialogue.

b. Competitive interests of certain retailers: Certain retailers such as Wal-Mart have already begun an internal process and set a target to reduce global plastic shopping bag waste. Some of these companies see their sustainability efforts (including bag reduction efforts) as a differentiator, and getting such retailers on board to discuss a common issue and share their successes and failures will remain a challenge.

Conclusion

Given the uncertainty regarding the relative environmental benefits of different retail bag types, addressing these environmental impacts is ultimately a question of identifying and using "better" bags, and then encouraging consumer behavior change over time focused on reducing bag use, effectively reusing bags, and recycling them at the end of their useful life. The focus should remain on two interconnected issues:

1. **Using bags with lower environmental impacts:** As discussed above, there is little scientific consensus on what the "best" retail bag type might be, but a well-designed reusable bag system (where bags are actually reused) apparently has the least overall impact. Once a bag system is chosen and put in place, bags need to be manufactured, used and disposed of in an environmentally appropriate way.
2. **Encourage behavior change:** Retailers should come together through multi-stakeholder efforts to achieve standardization, drive down costs and ultimately change consumer behavior. Efforts can include:

   a. **Setting up process related changes** at the store level such as training cashiers, redesigning check out areas where necessary, promoting in store recycling centers and tracking the reusability of bags,
   b. **Creating a platform and open dialogue for bag manufacturers, retailers and disposal companies** to come together and discuss opportunities and challenges in finding joint solutions, and
   c. **Actively work together** with other retailers through influential retail associations or other organizations, engage with governments and environmental NGOs to develop public awareness campaigns and continue to improve understanding and action on this issue.

Appendix: Detailed Analysis of LCA Literature

STUDY 1: Life Cycle Assessment for Three Types of Grocery Bags-Recyclable Plastic; Compostable, Biodegradable Plastic; and Recycled, Recyclable Paper by Boustead Consulting & Associates Ltd.

This series was developed by LCA pioneer Boustead Consulting and conforms wherever possible to ISO standards 14040-14043. This is an LCA conducted of Paper bags (unbleached contains 30% post consumer recycled content and water based inks), Compostable bags and Polyethylene bags, calculated to refer to the gross or cumulative totals when all operations are traced back to the extraction of raw materials from the earth and are based on the consumer use and collection of 1000 bags.

STUDY 1 KEY FINDINGS
Overall, the study results confirm that the standard polyethylene grocery bag has significantly lower environmental impacts than a 30% recycled content paper bag across energy use, water use and solid waste generation.
1. <u>ENERGY USE</u>: According to the report, both Kraft paper bag and compostable plastic bags have the highest energy use because of use of fuels in extraction and transport of raw materials for the manufacture of bags as well as in bag manufacturing and greater fuel use in transport of the finished product from the manufacturer to retail establishments.
2. <u>WATER USE</u>: Recyclable plastic bags use the least public water supply;
3. <u>CO_2 EMISSIONS</u>: The data for the 'Kraft Paper bag' below refers to non-sequestered paper in landfills which because of partial decomposition of paper results in high CO_2 emissions.

Bag type/LCA phases	Gross Enegy use by activity (in MJ)	Gross water use by activity (in milligrams)	Total LCA CO_2 emissions (in milligrams) for production, use and disposal	Municipal solid waste by activity
Kraft Paper bag	2,622	3,895,000,000	447,350,000	33,900,00
Recyclable Plastic bag	509	31,150,000	21,350,000	4,690,000
Degradable Plastic bag	1380	2,560,000,000	109,300,000	12,800,000

Source: Boustead Consulting & Associates Ltd, "Life Cycle Assessment for Three Types of Grocery Bags-Recyclable Plastic, Compostable Biodegradable Plastic and Recycled, Recyclable Paper".

STUDY 2: Comparison of existing life cycle analysis of shopping bag alternatives: Sustainability Victoria

This study draws together life cycle assessment data to compare the environmental impacts of shopping bag alternatives for carrying goods in Australia in April 2007. A rating of 1-5 was used to show the diversity of impacts for each criterion, with one being the lowest impact.

STUDY 2 KEY FINDINGS
1. Reusable bags have lowest environmental impacts of all single use bags;
2. A reusable, non-woven (polypropylene bag) or 'Green bag' was found to achieve the greatest environmental benefits;
3. A shift from one single use bag to another single use bag may improve one environmental outcome but be offset by another environmental impact. As a result, no single use bag produced has an overall environmental benefit;
4. Recycled content in bags led to the lowering of the overall environmental impact of bags;
5. Thus the end of life is crucial as there is greater environmental savings achieved from recycling all bags at the end of their useful life.

Bag type/LCA phases	Material Consumption (in Kg)[1]	Global Warming (kg CO_2)	Enegy use by activity (in MJ)[2]	Water use by activity (in kL H_2O)	Litter marine biodiversity	Litter aesthetics
Reusable non-woven plastic (polypropylene) "Green Bag"	♠	♠	♠	♠	♠	♠
Single use Paper bag	♠♠♠♠♠	♠♠♠♠♠	♠♠♠♠♠	♠♠	♠	♠♠
'Single use' HDPE plastic bag	♠♠♠	♠♠	♠♠♠♠	♠	♠♠♠♠♠	♠♠♠♠♠
Bio-degradable plastic bag	♠♠♠♠	♠	♠	♠♠♠♠♠	♠	♠♠
Reusable Cloth bags	♠	♠	♠	♠♠♠♠♠	♠	♠
Boutique single use plastic bags (LDPE)	♠♠♠♠♠	♠♠♠♠♠	♠♠♠♠♠	♠	♠♠♠♠♠	♠♠♠♠♠

Source: Sustainability Victoria: "Comparison of existing life cycle analysis of shopping bag alternatives", April 2007

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[1] Indicator defined as material used in the manufacture of the bag (i.e mass of the bag multiplied by number consumed over one year)
[2] Energy use

Carrefour Group commissioned this LCA study in February 2004 compared the environmental impact of four types of bags: plastic made from high density polyethylene, paper, biodegradable plastic and reusable plastic. The study evaluated environmental impacts from material production, through bag manufacturing and transport, to end of life management. The comparison was based on the number of bags needed to pack 9000 liters (2377 US gallons) which is the typical number of bags needed for a French household in a year's shopping.

STUDY 3 KEY FINDINGS
Overall, the study confirms that the flexible PE reusable bags are better than other bags. This study also makes the observation that paper bags consume more water across their life cycle and produce more GHG emissions than other bag types. Plastic bags (compared to paper bags and degradable bags) are better except on litter aesthetics.

Bag type/LCA phases	Gross Energy use across activities (in MJ)	Gross water use across activities (in liters)	Gross air emissions across activities (in Kg CO_2/9000 liters)	Eutrophication of water by activity (in grams/phosphate/9000 liters)
Disposable Plastic bag	312	54	12.25	-*
Reusable polyethylene bags	275	50	10.3	-*
Recyclable Paper bag	300	169	21	2.2
Bio-degradable Plastic bag	250	55	15.3	2.3

Source: Carrefour-PwC-ECOBILAN

* Negligible impact

STUDY 4 KEY FINDINGS

Study 4 illustrates that Kraft bags do not have the highest impact across all categories (material consumption, greenhouse gas emissions, fossil fuel consumption and eutrophication of water) but a type of biodegradable plastic made from maize represents more fossil fuel use, greenhouse gas emissions and eutrophication than the comparable paper bag.

» Kraft paper is high in material consumption and greenhouse gas emissions because of the consumption of electricity and gas in paper production.

» Kraft paper is high in the resource depletion category due to the consumption of electricity and gas in paper production.

» Degradable bags have similar greenhouse and eutrophication impacts as conventional HDPE bags. By keeping degradable material out of the landfill and managed through composting, the greenhouse impacts will be reduced.

» The single use bags have higher litter values due to the higher possibility of them being littered (risk by abandoning) compared to reusable bags.

Bag type/LCA phases	Material Consumption (kg)	Greenhouse gases (kg CO2)	Fossil fuel consumption (kg Sb eq)	Eutrophication (kg PO4 eq)[3]	Litter Aesthetics (m2.y)
Starch-PE bag	3.12	4.74	0.0694	0.00258	0.078
Single use 'HDPE' plastic bag	3.12	6.13	0.102	0.00246	0.312
Kraft Paper bag (single use)	22.152	30.2	0.285	0.0266	0.078
PLA (type of biodegradable polyester)	4.212	16.7	0.0776	0.00911	0.078
Green bag	0.209	1.95	0.023	0.00126	0.00187
Calico/Cloth bag	1.141	6.42	0.0177	0.00795	0.00164

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[3] Eutrophication refers to the emissions of nitrates and phosphates into waterways.

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