Shopping Bags: Paper, Plastic, or Reusable Tote? An Environmental Assessment

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Shopping Bags: Paper, Plastic, or Reusable Tote?

Executive Summary

Shoppers use billions of bags each year to carry purchases home, with a substantial portion distributed by supermarkets and neighborhood grocery stores. In the US, as well as in many other countries, grocery bags are dominantly lightweight thin plastic. But thin plastic bags have come under fire because of their contribution to litter, problems caused by deposition in aquatic environments, and the persistence of plastics and plastic residues in the environment for long periods of time. Opposition is increasingly resulting in plastic bag bans, fees, and other measures designed to reduce plastic bag use and/or use of bags in general.

Opposition to plastic bag use poses a dilemma for policymakers. This is because when various types of bags are analyzed with respect to a wide range of environmental impact measures, results consistently indicate the impacts of thin plastic bags to be much lower than those of available alternatives. So, while single-use thin plastic bags are increasingly viewed as unacceptable from an environmental perspective, policy measures which result in increased consumption of other types of bags can have large adverse environmental consequences.

This report provides background information regarding environmental impacts of bag production, use, and disposal for various types of shopping bags. Measures designed to reduce bag consumption, and their outcomes are also discussed, as are steps that can be taken on an individual level to reduce impacts of bag consumption.

Billions of Bags

The Wall Street Journal estimated in 2013 that 100 billion plastic bags were thrown away in the US every year[1], a number that is undoubtedly larger in 2020. A similar number has been reported for the European Union.[2] Bags made from other materials – paper (about 10 billion per year in the US), fabric (cotton, jute, and hemp), and various types of composite bags – add to the total.

Given the magnitude of bag consumption, and the impact that bag production, use and disposal have on the environment, governmental bodies around the world are looking for ways to reduce the number of bags used and discarded annually. Particular attention is directed toward reduction of lightweight plastic bags commonly used in supermarkets and a number of other retail establishments.

Efforts to curb bag use in recent years have resulted in considerable attention directed toward determination of the environmental impacts linked to various types of grocery bags. The power of cradle to grave life cycle assessments has been employed to examine measurable environmental impacts of a wide array of bag types. At the same time, other investigations have examined consumer behavior regarding bag use and disposal as well as the contribution of various types of bags to litter and landfills.

Results show that no one bag type is universally preferable. Bag reuse following initial use has a large effect on the life cycle impacts of every type of bag, as well as on the relative impacts of different types of bags. Studies also show that certain types of durable bags offer significant potential for reducing impacts if reused a enough times.

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[1] Mahler, K. (2017)
[2] Mudgal et al. (2011)

This report summarizes the findings of life cycle assessments of various types of shopping bags. Also addressed are factors that are more difficult to evaluate and measure.

Bag Alternatives

Bags used by shoppers are of two basic types: *single-use and multiple-use.* Single-use bags are made either of plastic or paper.

Plastic

- Plastic bags are most often made of high-density polyethylene (HDPE), sometimes with additives to promote breakdown following disposal.[3] Recycled content, mostly from pre-consumer scrap, may be as high as 30%. Some single-use plastic bags are made of thick low-density polyethylene (LDPE), often with cut out handles. These contain 2-3 times more plastic than an HDPE bag.
- High- and low-density plastic (HDPE and LDPE) bags are made from ethane, a by-product of natural gas production. Natural gas, though presently abundant, is a non-renewable resource. Plastic bag manufacture in the US requires the equivalent of about 3.1 million barrels of petroleum annually.
- About 3 percent of plastics are made from plant materials such as corn, sugarcane, and soy. Known as bioplastics, these are used in making a wide range of products from bottles and plastic containers, to textiles and bags. Although some of these are designed to be biodegradable, recent research has found that products such as thin bioplastic bags can biodegrade slowly in nature, and particularly in seawater.[4]

Paper

- Paper bags are almost exclusively made of unbleached kraft paper. Recycled content is typically 0-30%, but may be as high as 100%, with reused fiber from both pre- and post-consumer sources.
- Unbleached kraft paper bags are made from wood, which in the US is obtained almost entirely (89%) from privately-owned land.[5] Much of the wood used in making paper comes from dedicated tree plantations.

Multiple-use bags are made from a wide range of fibers, commonly including:

- woven polypropylene
- non-woven polypropylene (NWPP) with LDPE stability insert
- low density polyethylene (LDPE)
- high density polyethylene (HDPE), woven
- cotton
- hemp

Most multiple-use bags sold are made of these materials.

Polypropylene bags are commonly made of 100% recycled materials obtained from discarded carpeting. Polyethylene bags are also commonly composed of 100% recycled fiber, with plastic

[3] Compounds are sometimes added to plastics to promote plastic degradation. Known as PDCs, these additives promote oxidation processes that break plastic down into low-molecular-weight fragments and subsequently, through the work of microorganisms, into carbon dioxide, water, and a form of biomass. However, these additives pose significant risks of contamination of soil, air, water and food, while also risking serious degradation of plastic products made with recycled content (Hahladakis et al. 2018).

[4] Haider et al. (2018)

[5] Oswalt et al. (2019)

resin most often obtained from discarded plastic bottles. Cotton and hemp are both recyclable, and tote bags may contain various levels of recycled fiber.

Environmental Comparisons

Numerous studies have evaluated the environmental performance of various types of bags. Many of these have employed life cycle assessment (LCA) to ascertain impacts across a wide range of specific impact measures – emissions to air, water, and ground; energy consumption; climate change potential; ozone depletion; terrestrial acidification; water and fossil resource depletion; and more. In interpreting findings, it is important to recognize that LCA only considers measures of environmental impact that can be precisely measured. LCA does not consider factors such as tendency to contribute to litter and biodegradability, both of which are major concerns with thin plastics such as HDPE.

Commonality of Findings

The conclusions of virtually all scientific comparisons of various types of shopping bags are very similar (Table 1). When single-use bags are compared on a comprehensive cradle-to- grave basis, and considering a wide range of impact measures, HDPE plastic bags consistently rank as the lowest impact single-use option. Some types of multiple-use bags rank as low impact options, but only if they are used a sufficient number of times (Table 2). Several studies have found that such bags are typically not used enough times to lower their impact below single-use plastic bags.

Six of the assessments referenced in Table 1 included evaluation of bags designed for multiple use. A wide range of bags were included in these assessments, which included calculation of the number of uses required to bring the impacts of various types of bags to rough equivalency to those of single-use HDPE thin plastic bags (Table 2).

Table 1

Lowest Impact Single-use Bags as Determined in Various Studies*

(shading indicates types of bags included in evaluation)

	Study Lead Author, Year of Study, and Country in Which Conducted							
Bag Type	Kimmel et al. (2014) USA	Recyc-Québec (2017) Canada	Ministry of Env. & Fd (2018) Denmark	James and Grant (2004) Australia	Sevitz et al. (2003) S. Africa	Env. Agency (2011) England/ Wales	Ecoblian (2004) France***	Mercado et al. (2016) Sweden
HDPE thin plastic	x, y	x, y			x, y	x, y	x, y	x, y
HDPE thin plastic (degradable)								
Starch-polyester (degradable)				x, y**				
LDPE thick plastic			x, y					
Paper – unbleached Kraft			y					

* x = lowest overall impact across multiple impact measures; y = lowest climate change potential

** This study also examined several types of degradable plastic bags not included in this Table – starch-PBS/A and starch-PBAT, both of which had lower impacts than starch polyester.

*** In this study LDPE thick plastic bags were found to be the lowest impact option across all indicators if used 4 times or more and assuming no reuse of HDPE thin plastic bags.

Table 2

Number of Uses Needed for Various Types of Single and Multiple-use Bags to Have Global Warming Potential (GWP) and Overall Environmental Impact Equal to Single-use HDPE Bag (or LDPE Bag – Denmark)

[first number refers to GWP, second number (in parenthesis) to overall average impact across multiple impact measures; shading indicates types of bags included in evaluation]

	Kimmel et al. (2014) USA	Recyc-Québec (2017) Canada	Ministry of Env. & Fd (2018) Denmark	James and Grant (2004) Australia*	Env. Agency (2011) England/ Wales***	Ecoblian (2004) France
Type of Bag						
Single-use						
HDPE thin plastic	1	1		1	1	1
HDPE thin plastic (degradable)				1 (0.3-1)		
Starch-polyester (degradable)		2 (2-11)	1 (42)	.8 (0.2-2)		2 (2-12)
LDPE thick plastic		4 (4-6)	1			
Paper – unbleached Kraft	6 (4-9)	4 (5-28)	1 (44)	4-5 (9-10)	3	3.3 (2-14)
Multiple-use						
LDPE bag	6 (6-10)			4.5 (4)	4	4 (4)
Nonwoven polypropylene (NWPP)	13 (22-34)	(11-59)	7 (53)	33 (28)	11	
Woven polypropylene (PP)		(16-98)	6 (46)			
Woven HDPE bag				11 (9)		
Recycled polyethylene (PET)		not provided	9 (85)			
Polyester (of virgin PET polymers)			3 (36)			
Starch-complexed biopolymer			1 (43)			
Cotton		(100-2,954)	50** (1,400)	54 (65)	131	
Organic Cotton			150** (3,800)			
Composite (jute, PP, cotton)			1** (740)			

* Number of bags needed calculated using data provided in published report. Very limited number of impact indicators were considered in evaluation of required number of uses for equivalency.

** Calculated number of needed uses without consideration of ozone depletion. When ozone depletion is included, the number of uses as determined across all indicators increases by a factor of 5.

*** Numbers shown are based on no reuse of HDPE bags. If HDPE bags are used one or more times as trashcan liners, and if there is no such reuse of other bags, the number of use estimates increase by a factor of 2-3.

Comparisons of Single-Use Bags

A 2014 study by Clemson University (the Kimmel et al. study referenced in Table 1[6]) compared HDPE bags with 0% and 30% recycled content, paper bags with 40% and 100% recycled content,

[6] Kimmel et al. (2014)

and reusable bags made of LDPE and NWPP. Analysis considered impacts linked to 1, 3.1, 14.6, and 44 shopping trips, with the number of trips based on national average reuse rates for LDPE bags and NWPP reusable bags. Consideration was also given to potential secondary uses of bags such as for trash liners or other uses. This study did not consider potential energy recovery at end of bag life.

Comparison of single-use plastic and paper bags in the Clemson study showed global warming potential of paper bags 3.3 times (100% recycled) to 5.4 times (40% recycled) greater than for use of HDPE bags, and greater impacts as well in every one of eleven other impact categories examined. Analysis also showed that paper bags would have to be reused 4 to 6 times in order to lower their average environmental impacts to those of single-use HDPE bags.

Evaluation of reusable bags revealed that lower impacts can be achieved from their use, but that 22-34 uses of these bags is required to achieve overall impacts comparable to single-use HDPE bags. The greater number of required uses for reusable bags (i.e. 34 uses) results when HDPE bags are assumed to be reused as trash bin liners or in some other way.

Most other studies have had similar outcomes. Among the studies examined as a basis for this report, only the Denmark and Australia assessments yielded different results. In the Denmark study, lightweight HDPE bags were not included in the assessment. Instead, comparisons were between LDPE thick plastic bags, several types of degradable plastic bags, and paper bags of both bleached and unbleached fiber. In this case, global warming potential was found to be roughly equivalent for the bags evaluated, but across all indicators the plastic bag was found to yield substantially lower impacts. The Australia study evaluated six types of degradable plastic bags, none of which were in common use at the time of the study. This assessment identified starch-polyester blend bags as the low impact option across all indicators, whereas paper bags were found to be in general the high impact option.

Although environmental impacts linked to lightweight plastic bags are generally lower than alternatives, as determined through life cycle assessment, there are three major problems with lightweight plastic that are not captured through LCA.

- Degradation upon disposal can require decades or even centuries.
- When degradation does occur, it leaves behind plastic residues in the form of microplastics that appear to persist in the environment for very long periods.
- Light plastic films are prone to windborne transport into water bodies where they can pose significant problems for marine life.

Discussed later in this report, the reality that plastics persist in the environment essentially forever, and that lightweight bags pose serious hazards to aquatic life, has resulted in numerous initiatives to ban or markedly reduce plastic bag use.

Comparisons of Multiple-Use Bags

Multiple-use bags are sturdier than single-use bags and consequently require a greater mass of materials and often greater environmental impacts in their manufacture. Theoretically greater initial impacts are reduced through extended use such that by the end of bag life the per-use impacts of a multiple-use bag are lower than those of single-use bags.

Evaluations, which took into consideration carrying capacity of various types of bags, focused on effectiveness of reusable bags in reducing life cycle environmental impacts in comparison to use of single-use bags for the same purpose. Impact comparisons were generally based on average impact across multiple impact measures, with global warming potential reported separately. What

all of these studies show is that in order for multiple-use bags to be the lowest impact alternative they must be used a considerable number of times – in general 35-50 times simply to yield comparable performance to single-use bags (Table 2), and many more to deliver significantly superior performance. Results also show that cotton bags yield the worst environmental performance of all alternatives and by a very wide margin.

The volume of raw materials needed to produce a thin plastic is less than for any other type of bag of similar capacity. Among single-use bags, paper bags require a greater mass of materials than HDPE thin plastic bags. The average HDPE single-use bag weighs about 6 grams (g) (0.2 ounces), as do various lightweight degradable plastic bags. In comparison, a kraft-handled single-use paper bag weighs about 42g, a non-woven polypropylene bag about 50g, and woven HDPE and cotton bags about 130g. What this means is that changing bag types in order to reduce overall environmental impacts generally requires that a greater mass of materials be used – a result contrary to desired outcomes of most environmental initiatives.

The Bag Reuse Problem

Reusing single-use bags can reduce their impact. Plastic bags, and to a lesser extent paper bags, are often used as waste basket liners. Such use reduces waste bag purchases, and thereby yields environmental benefit. Similarly, if bags are reused in subsequent shopping trips or passed on to non-profit or other organizations for reuse, impacts of all types of bags can be significantly reduced. Assuming no reuse of lightweight single-use plastic bags, 3-6 reuses of paper bags can reduce per-use impacts to that of plastic bags. But studies indicate that this level of reuse almost never occurs.

Likewise, use of multiple use bags a enough times can reduce environmental impacts, including the volume of solid wastes at end of life. However, a 2014 US national survey of multiple bag use[7] found that the average number of uses of such bags is far short of the number needed to achieve environmental benefit over single-use bags.

The survey found that 28% of people own multiple-use bags. Those who own non-woven polypropylene (NWPP) grocery bags use each bag about 15 times. In comparison, the research findings presented in Table 2 indicate that NWPP bags must each be reused as many as 33 times simply to achieve parity in global warming potential, and 59 times to match the overall impact of single-use bags. A much greater number of uses is required to realize substantial benefit. The survey likewise found that shoppers tend to reuse low density polyethylene (LDPE) bags approximately 3.1 times. Average reuse numbers for both NWPP and LDPE bags fall far short of providing environmental advantage.

The cities of San Francisco and Los Angeles have attempted to increase shopping bag reuse through ordinances that require multiple-use NWPP and LDPE bags to be designed for a minimum of 125 uses. However, less than 10% of people nationally reuse their NWPP bags this many times. Only 25-41% of people (depending upon whether secondary uses of single-use plastic bags are included in assessment) reuse NWPP bags enough times that the overall impact of NWPP bags is less than the overall impact of single-use plastic bags. This calculation takes into account the number of thin plastic bags required to make the same number of shopping trips. As noted, LDPE bag reuse nationally is far short (3.1 on average) of 125 trips.

[7] Berland (2014)

Litter and Marine Environmental Pollution

While HDPE and various types of degradable plastic single-use grocery bags would appear to be the lowest environmental impact options based on life cycle assessment, there are, as indicated previously, three major problems with lightweight plastic that are not captured in LCA assessment. First, degradation upon disposal can require decades to centuries. Second, when degradation does occur it leaves behind plastic residues in the form of microplastics that persist in the environment for very long periods. This is a problem with all kinds of plastics, including the various forms of degradable plastics available today. And thirdly, light plastic films are prone to windborne transport; when they find their way into nature, and especially water bodies, they can pose significant problems for marine life.[8] The Australian study referenced in this report[9] indicated that of the 6.9 billion thin plastic bags consumed each year in that country about 30 million (or 0.4 percent) became litter.

Regarding the latter problem, plastic advocates[10] point out that plastic bags comprise less than one percent of litter. But while the combined mass of thin plastics may comprise a small portion of litter overall, these materials, as noted, cause an outsized impact on the environment where they occur.

A Policy Dilemma – Reducing the Use of Thin Plastic Bags

Governmental Actions

Plastic bags cannot be processed in general purpose recycling centers as they clog equipment. Consequently, most municipal curbside recycling programs do not accept plastic bags of any type. These bags can be put in the trash, but unless contained in some way, these bags are highly prone to scatter as litter across the landscape.

Because of the issues with thin plastic bags, despite the many environmental advantages of such bags, numerous government bodies across the US and around the world have taken steps to reduce consumption of single-use plastic bags. A 2018 review by the New York State Plastic Bag Task Force[11] identified initiatives in more than 75 countries, and 20 states and 131 municipalities in the US, aimed at reducing single-use plastic bag consumption. The review found varied approaches to limiting consumption of single-use plastic bags, and bags in general, including:

- Bag bans (on plastic bags, both plastic and paper, or on all types of single-use bags)
- Bag fees (on plastic bags only, on both paper and plastic, on all types of carryout bags available at the retailer including multiple-use bags, or on paper bags in conjunction with plastic bag bans)
- Manufacturer responsibility measures, requiring manufacturer recovery and recycling of plastic bags, with and without added fees to consumers at checkout.
- Voluntary monetary consumer discounts or other incentives at checkout for consumers who bring their own bags.

[8] Andrady (2011), Monterey Bay Aquarium (2019)
[9] James and Grant (2014)
[10] Canadian Plastic Industries Association (2012)
[11] New York State Plastic Bag Task Force (2018)

Effectiveness of Single-Use Plastic Bag Reduction Efforts

Plastic bag bans obviously reduce consumption of plastic bags. To date, this is the approach favored by jurisdictions where bag ordinances have been enacted, with 75% of these ordinances implementing plastic bag bans.

Bag fees are also commonly employed. The New York State Plastic Bag Task Force review found that bag fees of 5¢ to 70¢ have been successful in reducing use of single-use plastic bags by 50%-90%. Such fees are sometimes mandated and in other instances voluntary. The most effective fee programs appear to be those that impose fees on both plastic and paper bags as well as those that combine paper bag fees with plastic bag bans. The nature of fees varies; in some cases, these are retained by the retailer while in other cases bag fees are in reality a tax, with receipts going to the taxing authority. In any event, such initiatives appear to significantly reduce single-use bag consumption and to result in greater use of multiple-use bags.

A number of US states have mandated plastic take-back programs for supermarkets and other retailers. In other states, bag manufacturers have voluntarily partnered with a number of retail grocery chains to establish plastic bag collection sites. Despite these actions, less than 10% of them are recycled in the US.[12] The EU recycling rate for plastic bags was estimated at 6.6% in 2008.[13] Whether different approaches to gathering thin plastic might result in substantially greater recycling is an open question. But success would clearly require different strategies than are currently being pursued.

There have been few studies of landscape and marine plastic bag litter to determine how effective efforts have been in reducing litter. One example that has been widely reported is San Jose, California where dramatic reductions in plastic waste in storm drains, creeks and rivers, and neighborhoods are said to have occurred following implementation of a plastic bag levy.[14]

The retail giant Costco, perhaps with a profit rather than environmental motive, has addressed the bag problem by providing shoppers with no bags of any kind. The result is that customers wheel carts filled with un-bagged groceries and other items to their vehicles, then transfer purchases to multiple-use bags or boxes for the trip home. While this situation is rather unique in the US, it is common in Europe. A coauthor of this report, Dovetail team member Dr. Ed Pepke who resides in France, reports that stores in the area where he lives either no longer provide bags or charge for them, with the result that virtually 100% of shoppers own multiple use bags and use them frequently. These examples perhaps represent the ultimate bag reduction solution.

Unintended Consequences of Plastic Bag Reduction

Single-use plastic bags have lower impact than alternatives by almost every quantitative measure, a fact which poses a dilemma to policymakers concerned about the negative impacts of lightweight plastic bags. Actions taken to reduce use of single-use plastic bags without identification of an environmentally better alternative can lead to unintended consequences. For instance, were 100 billion plastic bags to be simply replaced by an equal number of paper bags the environmental impacts would be enormous.

Several studies have chronicled or estimated unintended consequences of plastic bag reduction initiatives. One examined the consequences of a 2015 British government mandated 5-pence (~6¢) levy on plastic bags, with the goal of encouraging shoppers to adopt multiple-use bags,

[12] USEPA (2019), Skazy (2016)
[13] Mudgal et al. (2011)
[14] Van Leeuwen (2015)

referred to as "bags for life". Under the program shoppers were required to pay for reusable bags only once, with the benefit of returning worn out bags for free replacements, a practice that is also common in several other European countries. On one hand, the legislation appeared to be spectacularly successful, resulting in an estimated 80%+ reduction in use of single-use plastic bags. On the other hand, a reduction of about 16,000 tons of thin plastic bags annually triggered an increase of about 50,000 tons of plastic consumption annually in the form of reusable bags. In the words of one environmentalist observer "Bags for life became bags for a week."[15]

A Scottish study of the likely impacts of a proposed plastic bag levy[16] estimated that the size of levy proposed (10-pence, or about 12¢) would likely reduce annual consumption of lightweight plastic bags by 697 million, but increase annual demand for multiple-use bags by 15 million, plastic trash bin liners by 90 million, and paper bag use by 174 million, while also increasing household solid waste by over 5,000 tons per year. In another scenario, which assumed a levy on both thin plastic and paper bags, a similar reduction in plastic bag use was estimated, as was substantial reduction of paper bag consumption and reduction of overall household solid waste. Both scenarios were estimated to reduce litter in the form of thin plastic bags, but only marginally. None of the scenarios evaluated the probable increase in household solid wastes resulting from discard of multiple-use bags, something that the recent experience in Britain would suggest is likely.

As indicated by results from life cycle assessments, extremely large negative impacts result if shoppers opt to use cotton multiple-use bags. Yet, none of the ordinances that encourage or incentivize use of multiple-use bags discourage or create disincentives for use of bags made of cotton.

What Individuals Can Do

Individuals can influence the impacts of bag manufacture, use, and disposal through simple changes in personal habits and through community engagement.

As a Shopper

As a shopper, there are a number of things you can do:

- Obtain 8-10 reusable bags (not cotton), place in the trunks of all household vehicles, and use again and again, cleaning periodically as needed. The principal author of this report has used the same set of multiple-use shopping bags for grocery shopping for over 10 years. Used with care, these bags last a very long time.
- Don't take a bag if you don't really need it.
- If reusable bags are forgotten, and a bag is needed, choose paper if given a choice between paper or plastic. But make a mental note to bring reusable bags net time.
- If using paper bags, save reusable bags for personal reuse on the next round of grocery shopping, take to area food shelf or other organization for re-use, or use as trash or recycling bin liners. Recycle when no longer usable.

  After bags are unloaded at home, following what is typically a brief trip from the store, kraft paper bags are typically in as good a condition as before they were loaded with groceries. Just as multiple-use NWPP bags or LDPE bags can be carried back to the store for multiple-uses, paper bags could be reused 4-5 or more times beyond that first use.

[15] Peltier, E. (2019), Waste Management (2004)
[16] Cadman et al. (2005)

- When using thin plastic bags, establish two plastic recycling locations (i.e. hang two single-use plastic bags in your broom closet).
    - In one, place reusable bags for personal reuse (trash bin liners or pet waste bags), or for donation to non-profit organizations for reuse.
    - In the other, place damaged bags and bags which will not be reused to be taken to plastic bag recycling centers (often to the nearest supermarket).
- Never place plastic bags in community recycling containers (including home recycling bins).
- Never purchase a cotton bag.

As an Engaged Citizen

Citizens should pay attention to proposals for local and state ordinances, supporting reasonable initiatives to reduce the volume of bag use. When measures are proposed, it is important to examine details and provide input should it appear that consequences of proposed actions are not being adequately considered. Bag bans, when proposed, warrant scrutiny, since if not crafted carefully, can trigger unintended and adverse consequences.

Summary

Thin plastic bags account for about 90% of the billions of shopping bags consumed every year in the US. While popular, such bags contribute to litter, degrade extremely slowly in nature, and present a serious hazard to aquatic life. Consequently, there is a growing public backlash against thin plastic bags. However, by many measures, the impacts of thin plastic bags are quite low as compared to alternatives. Consequently, initiatives to change the mix of shopping bags therefore require utmost care in their development to minimize unintended consequences.

Individuals can reduce impacts of bag consumption through extended use of multiple-use bags, re-use of bags typically used only once prior to disposal, and through care in disposal of bags at end of life. Contributions to community discussions about reduction of impacts linked to bags can help to ensure that public policy decisions are based on thorough examination of potential outcomes.

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