

Plastic Shopping Bags:
An Analysis of Policy Instruments for Plastic Bag Reduction

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I would like to thank my family and friends. You have all been so supportive in helping me follow my path. I knew what I wanted, and you never waivered in your support. You have been my rock.

To D.G.M.,

You always asked for my best, because you knew I could. I felt you helping me along the way.

A deep laugh,

A warm soul,

My Grandpa

Table of Contents

Figures and Tables	3
Abstract.....	4
I. Introduction to Plastic Shopping Bags	5
1.1 Plastic Shopping Bags	6
1.2 The Plastic Bag Issue	9
1.3 Need for Intervention	12
II. Methodology.....	16
2.1 Sustainability	16
2.2 Objective / Aim.....	17
2.3 Research	18
2.4 What are the available Plastic Bag Policy Instruments?	21
2.5 Scenarios	27
2.6 Criteria	29
III. Scenario Results.....	32
3.1 Scenario 1: Outright ban	32
3.2 Scenario 2: Levy	38
3.3 Scenario 3: Voluntary Action	47
IV. Discussion.....	54
4.1 Overview.....	54
V. Conclusion	60
References	61
Appendix	65

Figures and Tables

Table 1	Definition of a Plastic Shopping Bag	6
Table 2	Major PSB Consumers by Country	8
Table 3	Focus of Consumption within the Plastic Bag Cycle	9
Table 4	Overview of National Plastic-Bag Policies Worldwide	13
Table 5	Top 20 GDP countries (2011).....	15
Figure 6	Three Pillars of Sustainability.....	16
Figure 7	Hierarchy of Plastic Bag Management	18
Table 8	Social, Environmental, and Economic Analysis of Policy Performance	19
Figure 9	Performance Scale	20
Figure 10	Methodology for Criteria and Indicators.....	21
Figure 11	Environmental Policy Instruments.....	22
Table 12	Evaluation Criteria and Measurement.....	29
Table 13	Scenario 1: Outright ban.....	32
Table 14	Scenario 2: Levy	38
Figure 15	Consumption of PSB compared to Levy Price.....	40
Chart 16	PSB Reduction from a Levy	40
Graph 17	Ireland’s PSB % of Litter	42
Table 18	Scenario 3: Voluntary Action	47
Table 19	PSB Consumption from Australia’s ‘Voluntary Code of Practice’	49
Table 20	PSB Consumption from United Kingdom’s ‘Voluntary Carrier Bag Agreement’	49
Table 21	Summary of Policy Scenarios.....	54
Table 22	PSB Reduction by Policy Scenario	55

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ABSTRACT

The plastic bag has become synonymous with our culture today. With almost 1 trillion plastic shopping bags consumed every year, their use is widespread, multifaceted, and convenient. However despite popularity, public concern over the current and future impacts of plastic shopping bags have been on the rise. Due to strong public pressure for government action, governments around the world are taking measures to address the issues associated with plastic bag use. To date, a number of countries have implemented plastic bag instruments which have successfully reduced consumption and addressed impacts. On the other hand, a number of countries have also been mediocre or unsuccessful in significantly reducing consumption and impacts.

This research provides an analysis of plastic bag policy instruments that can be used in order to assist policymakers in choosing an effective plastic bag policy. Each of the instruments is evaluated against social, environmental, and economic criteria, and is scored by the impacts and the expected outcomes. Plastic bag bans are stringent, costly to stakeholders, and are less likely to be publicly accepted. A levy on plastic bags are costly, but facilitates consumer choice and generates revenue. Lastly, while voluntary actions by retailers are inexpensive, they are weakly sanctioned and nominally reduce impacts. Analyzed against all criteria, this research suggests that the economic instrument, a plastic bag levy, is the most effective policy instrument for governments to address plastic shopping bags.

Key words: plastic bags, sustainability, policy instrument, policy analysis, bag, levy

I. Introduction to Plastic Shopping Bags

Since it was introduced in 1957 as a sandwich bag, the plastic shopping bag (PSB) has become a part of life today. Alongside cell phones, cars, and fast-food, the PSB is easily recognizable and used by practically everyone in the world. It's hard to find a business that doesn't offer them- grocery stores (the most common place), clothing stores, farmers markets, bookstores, service stations, and take-away food stands.

Although there is no official estimate, it is estimated that 500 billion to 1 trillion plastic bags are consumed worldwide every year (Queensland 2010, Clapp & Swanston 2009, Changshe Norbu 2009)! That equals an average of 2.7 billion every day, or 1.9 million every minute¹!

Even the design promotes its attractiveness to consumers- lightweight, portable, functional, cheap, then easily discarded; it is these features that facilitate the problems and impacts associated with their use. Since PSB are not fundamentally packaging items in themselves, they do not affect the character of the physical product, making them non-essential to the product, but rather acting as a carrying aide (EPHC 2010).

The problem with PSB can be characterized by two factors: (1) environmental impacts, and (2) impacts on society. Environmental impacts range from litter, to a danger to wildlife, to the use of non-renewable resources. Societal use of PSB creates an unnecessary consumption of an unsustainable product, while provided at no visible cost to the consumer.

Consumption of plastic bags are leading to unsustainable development with serious economic, social, and environmental repercussions. As PSB are tangible (compared to climate change, which is intangible), they are visible reminders of our unsustainable consumption and use.

Since the 1990s, the world has witnessed a surge in plastic bag regulations. This report investigates policy strategies using policy instruments to *reduce the use* of PSB consumption. The focus is on policies to reduce use, because a reduction in overall use will result in reduction of environmental and society impacts, as well as future economic impacts (i.e. clean-up costs, fossil fuels). The necessity of plastic shopping bag policies and strategies is evident by the environmental impacts felt from their perpetual use. There are many places around the world with different types of plastic bag policies, including regulatory, non-regulatory, and voluntary options. While all the strategies to reduce use have merit, some have proven more effective than others.

¹ Author's calculations

Despite popularity, momentum has been growing to see a substantial reduction because of the widespread public concern that PSB are becoming more detrimental to the environment and society. While many recognize and understand PSB consumption as a growing issue, they continue to use them (as evident of their perpetual use). We will continue to face resource, waste, and environmental problems so long as PSB continue to remain a single-use option for carrying needs.

**Here within, “plastic bags” and “plastic shopping bags (PSB)” are used interchangeably*

1.1 Plastic Shopping Bags

The Nolan-ITU defines a single-use plastic shopping bag as “a polymer carry bag provided or utilized at the retail point of sale for carrying and transporting retail good”, but excludes bags where the primary purpose is for packaging- not carrying (i.e. garbage bags, dry-cleaning bags) (2007; 1). The FDEP report defines plastic shopping bags as “of any thickness, used by consumers to carry products from establishments... these bags are not necessarily meant to be re-used multiple times” (2010; 3). The AECOM report defines as “any non-reusable bag provided at the retail point-of-sale for carrying and transporting retail goods” (2010; 5), and the EPHC recognizes a PSB as “a carry bag, the body of which comprises polymers in whole or part, provided by the retailer for the carrying or transporting of goods” (2008; 1).

In order to encompass all problematic lightweight PSB, for the purpose of this report, a single-use plastic shopping bag will be defined as “a single-use polymer bag provided to consumers for carrying needs at the retail point of sale”. There are exceptions for what it and is not included in the definition of a plastic bag (see *Table 1* for these examples).

Table 1: Definition of a Plastic Shopping Bag	
Examples of plastic bags that <u>are</u> included in the definition	Examples of plastic bags that <u>are not</u> included in the definition
Take-away food bags	Bin liners
Boutique shopping bags	Laundry/garment bags
Singlet-style bags	Fresh meat & produce bags
Degradable plastic bags	Airport duty-free bags
	Pet waste bags

1.1.1 Plastic Bag Types

There are two main types of single-use PSB: high density polyethylene (HDPE) commonly found in grocery stores, and low density polyethylene (LDPE) identified as ‘boutique’ style bags (Nolan-ITU 2007; 14). Both are produced “from ethylene, a by-product of gas or oil refining” (Hyder Consulting 2007; 1).

High density polyethylene (HDPE) bags HDPE bags are thin and lightweight, and offer convenient means of transporting purchased goods. The structure of HDPE is denser, stronger, and opaque; the major type of HDPE are ‘singlet’ bags, meaning that they are not branded and mainly used in supermarkets, grocery stores, and take-away food stands- grocery stores are the biggest users and accounted for 3.5 billion bags in 2002 (ACG 2006). HDPE bags are FDA approved for food processing and handling, due to their durability (up to 180°F), strength, and stiffness (Connecticut Plastics, 2012).

Low density polyethylene (LDPE) bags LDPE are normally found in boutiques and are generally branded with the store name/logo, commonly used by department stores and clothing stores. They are pliable and tough at a variety of temperatures (Connecticut Plastics, 2012).

1.1.2 Design

The design of these two bag types have remained virtually unchanged and share some common features. Both are made from blown film (a continuous film) that is cut into a ‘singlet’ bag made by fusing two identical rectangular sheets together. Both usually have handles that are either reinforced or integral, and may or may not have a gusset². A study by Verghese et al. (2006) characterized eight different types of HDPE and LDPE bags. The study found that the carrying volume of PSB ranged from 3.5 to 29.5 liters, had a mass from 2.5 to 39 grams, with a thickness that varied from 7 to 97 microns (0.007 to 0.097 millimeters) (p.4).

1.1.3 Plastic Bag Retailers

The purchasing point is an influential element in PSB usage. Purchasing is usually done by the retail sector and then given to consumers to carry goods. While consumers are able to receive a PSB at almost any retailer, some retail areas experience more use in PSBs than others. A report by the Allen Consulting Group (2005; 8) estimated that in 2005, 57% of PSB in Australia are used by supermarkets, 16% of other food/liquor, 11% general merchandise, 7% fast food, convenience, and service outlets, and 9% other retailers (AECOM 2010; 28). A study of PSB consumption in China estimates that supermarkets use 25%

² This is an inset piece that is used to strengthen or reinforce the structure of the bag.

of all PSB, while the remaining 75% is consumed by department stores, service outlets, retailers, and open markets (He 2010; 5).

1.1.4 Plastic Bag Usage

The 500 billion-to-1 trillion can be broken down individually by country. Some of the large consumers include: Americans use 90 billion PSBs annually (FDEP 2010; 1; Clapp & Swanston 2009; 317) while Ireland consumes 72 million (post-levy)⁶ (Convery et al. 2007; 7), and Taiwan consumed 5.8 billion⁷ (pre-ban) (Nolan-ITU 2002; 14). Ayalon et al. (2009) estimates that Israel consumes two billion PSB annually; Clapp & Swanston (2009) estimate that the United Kingdom consumes 8 billion annually, 300 billion in China⁸ (p.317), and 9.8 billion in Hong Kong (Clapp & Swanston 2009; 317; Nolan-ITU 2002;

Table 2: Major PSB Consumers by Country

Country	Consumption / Year ³ (billions)	Population (2012)*	PSB / Capita**	Source for “PSB / Capita”
Hong Kong	9.8	7,153,519	1,370 / 1,095	Author / GHK (2007; 3)
US	90	313,847,465	286.7	Author
Israel	2	7,590,758	263 / 300	Author / Ayalon et al. (2009)
Taiwan	5.8	23,113,901	252.7	Author
Japan	30	127,368,088	235.5 / 230	Author / JFS (2012)
China	300	1,343,239,923	223.3	Author
Norway	1	4,707,270	212	Author
New Zealand	.872	4,327,944	201 / 192	Author / Hyder Consulting (2006)
Australia ⁴	4	22,015,576	181.7 / 187	Author / Hyder Consulting (2006)
South Africa	8	48,810,427	163.9 / 182	Author / Bahri (2005; 53)
United Kingdom	8	63,047,162	126.8	Author
Canada	3	34,300,083	87.5	Author
Brazil	12	205,716,890	58.3	Author
Ireland ⁵	.072	4,722,028	15.2 / 30	Author / He (2010; 5)

*Source: (CIA Factbook, 2012).

** Equation: (Consumption / Year) / Population = PSB / Capital

³ “Consumption / Year” is from the most recent estimates within the literature

⁴ Pre-voluntary action, an estimated 6 billion were consumed annually, with a PSB capita of 365 (GHK 2007; 16; AECOM 2010; 17; Tough 2007; 44)

⁵ Pre-levy, an estimated 1.28 billion were consumed annually, with a PSB capita of 325 (Nolan-ITU 2002; 13)

⁶ Ireland consumed 1.2 billion/year pre-levy= (1,200,000,000 – (1,200,000,000 × .94) = 72,000,000

⁷ Author’s calculation: 16,000,000 × 365 = 5,840,000,000

⁸ This represents the lowest estimation. Some estimates reach up to 1 trillion

12). The United Kingdom⁹ uses 8 billion per year (Nolan-ITU 2002; 14), New Zealand 872 million¹⁰ (Author’s calculation from Tough 2007; 45), South Africa uses 8 billion (Bahri 2005; 53; Hasson 2007; 66), Australia consumes 4 billion (EPHC 2008; 2; AECOM 2010; 7). Norway consumes 1 billion (Nilsen 2010; 48), Canada uses 3 billion every year (Banks 2008; 1), Japanese consume 30 billion (JFS 2012), and Brazil consumes 12 billion (Porta Brasil; 2010).

The PSB per capita within these countries is important to note. *Table 2* highlights that while some countries may not be the top consumers, the PSB per capita can be higher. For example, while Hong Kong consumes only 9.8 billion PSB annually, it has the highest per capita at 1,370 bags per person per year; compared to China whom is the highest consumer of PSB at 300 billion, but only the fourth highest per capita rate.

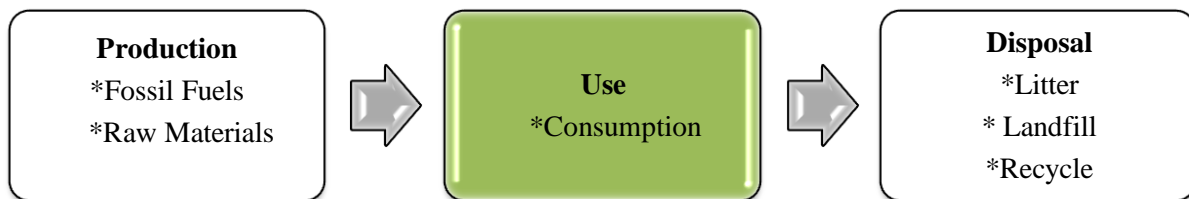
1.2 The Plastic Bag Issue

As PSB are tangible (compared to climate change, which is intangible) the effects are visibly identifiable. This research focuses on the problem of “*Use*” and “*Consumption*” within the PSB cycle structure, not on the production or disposal problem with plastic bags (see *fig. 3*). A problem with PSB is their impacts on the environment and society. Below, two key issues surrounding plastic bag will be discussed: issues created by society’s consumption of PSB, and environmental issues surrounding the consumption.

1.2.1 Consumption Issues

There are two main issues concerning the consumption of plastic shopping bags: (1) the ‘free’ status where bags are provided to customers without a charge, and (2) the single-use purpose.

Figure 3: Focus of Consumption within the Plastic Bag Cycle



⁹ Includes Wales, Northern Ireland, Scotland, and England

¹⁰ This is an estimated average by the Author, it is estimated that New Zealand uses between 245 million and 1.5 billion annually (Tough 2007; 142). Therefore= $(245\text{million} + 1.5\text{billion}) - 2 = 872,500,000$

1.2.1.1 Free Status

PSB are commonly provided at the point of sale with no visible charge. To most consumers, PSB appear to be ‘free of charge’; this is a false impression (Hyder Consulting 2007). The EPHC (2008; 14) and Nolan-ITU (2002; 4) reported that each bag costs around one (\$0.01) to three cents (\$0.03)¹¹, but the cost is spread and absorbed across the price of all items sold by the retailer. An investigation by the EPHC (2008) also reported that retailers spend more than \$173 million each year in supplying PSB to customers (p.14). For customer who chose to forego PSB (i.e. reusable bags, bring their own), they do not see a reduction in their grocery bill. Whether or not customers chose to use PSB, they are still sharing the cost of PSB; the average ‘hidden’ cost per household is \$10-15 per year (UNEP 2005; 23; Nolan-ITU 2002).

The cheapness leads to wasteful consumption and disposal, contributed by market failure (explained later). This hidden cost provides little-to-no monetary incentive to limit consumption. An Australian study noted in stores where single-use PSB were supplied for free, “more than two-thirds of customers chose single-use bags as the method to transport goods” (AECOM 2010; 13)¹². A survey by Zhu et al. (2011; 2518) reported that “71.8% of consumers would use plastic bag each time if only it is free regardless of the (purchase) quantity”, while 23.9% would only use PSB if the purchased quantity necessitated it¹³”.

1.2.1.2 Single-Use Purpose

The main function of PSB is to be used once and then discarded, because “the services that the bag provided are no longer required after the bag’s initial purpose is fulfilled” (ACG 2006; 27). They are good at carrying items only a short distance before they become damaged or weakened, rendering them unusable again. Single-use PSB has implications for raw materials and the environment, which will be discussed later.

1.2.2 *Environmental Issues*

Environmental issues from plastic shopping bags have two dimensions. First, PSB are made from non-renewable and fossil-fuel resources. The second environmental issue comes from contribution to existing problems, such as litter, and waste and emissions. A report on PSB by the Queensland Parliament in Australia describes PSB as “a short term convenience with long term impacts” (Queensland 2010; 5).

¹¹ The costs of the bags include production, transportation, consumption, and disposal costs (UNEP 2005; 24).

¹² The other one-third of customers chose single-use bags in stores that charged per bag (AECOM 2010; 13)

¹³ 3.1% would bring plastic bags with them when shopping (Zhu 2011; 2518).

1.2.3 Sources of Plastic

Plastic bags are manufactured from non-renewable resources, the main raw materials being crude oil and natural gas. The by-products of gas and oil are manufactured and converted into ethylene and propylene (Changshe Norbu 2009; 10); additives are added into the finished product in order to protect the plastic from the negative effects of light and heat (Changshe Norbu 2009; 11). The oil used for bag manufacturing is estimated to be 4% of the world's total oil production (Muthu 2009; 3). Each PSB contains twice its weight in oil products (Nilsen 2010; 13). To put that into perspective, the EPHC (2002 & 2008) estimates that a normal plastic bag at the grocery store contains enough energy to be the equivalent of 13.8 milliliters of crude oil, which is enough petroleum to drive a car one kilometer (p.21)!

1.2.4 Litter

While many used plastic bag end up in landfills, there are many PSB that are littered through both deliberate and inadvertent behavior (EPHC 2008). The Nolan-ITU (2002) report estimates that 0.8% of all PSB are littered (p.9). While this may not seem like much, when compared to the total used worldwide every year, this number is astounding. According to the report by Tweed (2008), during the International Coastal Cleanup in 2006, over 750,000,000 pieces of PSB litter were found in over 60 countries, which accounted for 9% of all the litter found during the cleanup (p.7).

Plastic bags are a prominent source of litter because of their design and single-use purpose, as mentioned previously. Litter is deliberate by consumers either through irresponsibility, laziness, inappropriate disposal, or other reasons. And deliberate littering can be everywhere- in the city, parks, beaches, roads, and open spaces (Ayalon et al. 2009). Inadvertent litter can be produced because their low weight and flimsiness enables them to be carried easily by the wind- this allows them to be blown everywhere- trees, drains, ponds, etc. (EPHC 2008). Even when disposed of properly in bins, plastic bags frequently are taken by the wind and end up as litter despite.

Not only is litter aesthetically displeasing, but it can also cause environmental impacts. Littered PSB can have negative impacts on the social and natural environment (Ritch et al. 2009). The EPHC (2008) report says that the threat to animals is through ingestion and entanglement of PSB, and that both marine, livestock, and wildlife are at risk. Likewise, humans are affected through littered PSB because they can block drainage and sewer systems, leading to health hazards (explained later in section six). The environmental problems can be exacerbated from an accumulation of PSB litter; the length of time that it accumulates depends on the frequency of litter clean-up operations. Most occur infrequently and irregularly, making it more difficult and expensive to clean-up (Ayalon et al. 2009).

1.2.5 Energy, Emissions, and Waste

Waste Most of PSB that are disposed into landfills do not degrade. It is estimated that it takes up to one thousand (1,000) years for a plastic bag to degrade (Queensland 2010; Clapp & Swanston 2009). Even after 1,000 years, these bags do not biodegrade- they photodegrade, meaning that the plastic is broken into smaller and smaller pieces, but ultimately never completely degrading (Clapp & Swanston 2009). This means that every piece of plastic that has ever been manufactured is still in existence, in some form.

Energy & Emissions The production and transportation of plastic bags not only consume energy, but also depletes resources and generates global warming emissions (UNEP 2005). Production of PSB emits toxic chemicals and fumes such as methane, ethane, and ketones. The Nolan-ITU (2002) report assessed some environmental impacts from PSB use. This report calculated that for every 520 single-use HDPE bags, it resulted in 3.12 kg of materials consumed, 210 megajoules (MJ) of energy use, and 6.08 kg of CO² greenhouse gas emitted (ibid, 36). Similarly, the same number of single-use LDPE bags resulted in 11.77 kg of materials consumed, 957 MJ of energy use, and 29.8 kg CO² greenhouse gas emitted (ibid). Put into individual numbers, to supply the US with its annually PSB use (90-100 billion), it takes 12 million barrels of oil to produce (Warner 2009).

A study by Hyder Consulting (2007) rated the environmental impact of plastic bags against the PSB alternatives. In the criteria of global warming, material consumption and energy consumption, LDPE bags scored 5 out of 5, with 5 being the highest impact (ibid, p.14). Its counterpart, HDPE bags, scored three, two, and four respectively. These two bag types had the two top highest cumulative impacts.

1.3 Need for Intervention

Governments around the world are taking actions against the use of plastic bags in an attempt to reduce consumption, protect the environment, and raise consumer awareness. Policies regarding PSB are found on all six populated continents (FDEP 2010); these policies use instruments (tools) that range from regulatory, to environmental taxation, to non-regulatory (voluntary). *Table 4* gives an overview of countries around the world that have enacted a national policy to reduce plastic bag consumption¹⁴.

According to Warner (2009), three barriers stand in the way of reducing PSB consumption and creating PSB policies. First, changing consumer behavior and thinking about PSB is difficult because they have become pervasive within society and are convenient. Secondly, implementing policies to control PSB use

¹⁴ Note: It is possible that not all applicable countries are listed. Table 4 was compiled to the best extent possible of the Author, found within the literature.

Table 4: Overview of National Plastic-Bag Policies Worldwide

Continent	Country	Action
Africa	<i>Eritrea</i>	Complete ban since 2005
	<i>Botswana</i>	Ban less than minimum thickness, and bag tax since 2006- run concurrently
	<i>Rwanda</i>	Complete ban since 2008
	<i>South Africa</i>	Ban less than minimum thickness, and bag tax of \$0.03 Rands since 2004- run concurrently
	<i>Tanzania</i>	Ban since 2006
	<i>Ethiopia</i>	Minimum thickness standard since 2008
	<i>Republic of Congo</i>	Ban since 2011
	<i>Kenya</i>	Ban less than minimum thickness standard since 2007
	<i>Somalia/Somaliland</i>	Complete ban since 2005
	<i>Uganda</i>	Ban less than minimum thickness standard since 2007
	<i>Morocco</i>	Minimum thickness standard
	<i>Zanzibar</i>	Ban since 2008
South America	<i>Uruguay</i>	Bag tax since 2008
	<i>Chile</i>	Ban since 2008
	<i>Brazil</i>	Ban since 2007
Asia	<i>Bangladesh</i>	Complete ban since 2002
	<i>Taiwan</i>	Ban less than minimum thickness since 2001; bag tax HK\$0.23-0.69 since 2003
	<i>China</i>	Ban less than minimum thickness standard since 2008
	<i>India</i>	Minimum thickness standard
	<i>Hong Kong</i>	Bag tax of HK\$0.50 since 2009
	<i>Bhutan</i>	Ban since 2005
	<i>Papua New Guinea</i>	Ban since 2009
Europe	<i>Denmark</i>	Bag tax of 22 DDK/kg <i>paid by retailers</i> since 1994
	<i>Ireland</i>	Bag tax of €0.15 since 2002
	<i>Italy</i>	Bag tax €0.08 since 2007
	<i>Germany</i>	Bag tax between €0.05-€0.25
	<i>Sweden</i>	Voluntary retailer tax between 0.4-0.8 kr
	<i>Switzerland</i>	Bag tax between 0.05-0.10 CHF
	<i>Macedonia</i>	Ban less than minimum thickness standard since 2009
	<i>Spain</i>	Bag tax of €0.10 since 2012
	<i>Bulgaria</i>	Ban less than minimum thickness, and bag tax of BGN 0.15 since 2012- run concurrently
	<i>Finland</i>	Bag tax of €0.10-€0.20 paid by retailers
	<i>Malta</i>	Bag tax of €0.15 since 2009
	<i>Belgium</i>	Bag tax of €3/kg <i>purchased by retailers</i> since 2007
	<i>Netherlands</i>	Bag tax of €0.15-€0.20 since 2008
	<i>France</i>	Voluntary retailer ban since 2009
	<i>Estonia</i>	Bag tax of €0.15-€0.30 since 2011
<i>Iceland</i>	Bag tax of ISK 15 since 1995	
<i>United Kingdom</i>	Voluntary retailer agreement since 2006	
Australia/Oceania	<i>Australia</i>	Voluntary retailer ban or levy since 2002
	<i>New Zealand</i>	Voluntary retailer levy of \$0.05-\$0.10 since 2009
North America		
Middle East	<i>Israel</i>	Bag tax since 2008
	<i>United Arab Emirates</i>	Ban <u>beginning</u> 2013

Note: Unless stated otherwise, all taxes are in national currency

Note: Countries which have a ban and a minimum thickness standard implies that plastic bags below the minimum thickness are banned.

Note: “Minimum thickness standard” means all PSB must have a thickness above an established limit. This standard helps to deal with very thin bags that are vulnerable to littering and single-use character.

can create alternative and secondary problems if not implemented correctly or completely. Lastly, PSB policies face defiance from the plastic industry and retailers.

1.3.1 Market Failure

There has been failure within the world market when it comes to plastic bag consumption. As mentioned earlier, the seemingly ‘free’ charge of plastic bags provides little-to-no incentive (i.e. monetary) to limit consumption, while contributing to blind consumption because customers do not have full information of the impacts associated with PSB use.

Market failure can also be contributed by externalities. The EPA categorizes externalities as when “the market does not compensate for the effect of on party’s activities on another party’s well-being” (EPA 2010; 3-2). Externalities of plastic bags are produced both from production and from consumption; many consumers are unaware of the externalities associated with plastic bags. Each plastic bag creates a negative externality- while individual consumers derive the benefits (i.e. convenience) from PSB, society as a whole is burdened with the collective costs associated thereafter; externalities may not be intentional, but they are typically difficult to avoid. These externalities include impacts to the environment from CO2 emissions, solid waste, loss to biodiversity, future clean-up costs, littering, aesthetics, and costs of non-renewable resources.

1.3.2 Government Involvement

An important role of government is to create and implement policies that seek to correct market failures, correct government failures, address concerns, and provide public goods. Government involvement is often required for issues that regard public concern and safety, significant economic, social, and environmental effects, and international issues (Tough 2007); intervention is warranted with evidence of concern regarding these issues. In the case of PSB, countries that do not have adequate (or lack) policies or systems concerning PSB consumption suffer from governmental failure to address this issue.

The main justification for government intervention with PSB is the market failure caused by environmental externalities associated with PSB; it is unlikely that the market will correct itself without government intervention. Concerning plastic bags, governments have more power, resources, information, and means to address the issues associated with PSB than compared to local or state organizations. Government intervention targeted at reducing PSB will create a more efficient allocation of resources than the individual free market would- as long as the benefits of government intervention outweigh any negative effects and/or costs (EPHC 2008). Governments are able to work with a variety of

stakeholders, can establish regulatory framework to work within, and can provide funding to assist in making necessary changes (EPHC 2007).

While the number of countries with a government-implemented national plastic bag policy has steadily increased since the 1990s, there are still many countries (developed and undeveloped) that have no such policy. Although all six populated continents have countries that have taken *some* action against plastic bag, legislative or otherwise, a large proportion of countries with national plastic bag policies are concentrated in Asia, Africa, and Europe, whilst North and South America lag behind the movement. As seen from *Table 4*, North America has NO countries with a nation-wide policy on PSB, while South America has only a few countries; although both have sporadic regional and/or local policies.

One might expect that the more developed countries would be leading the way in environmental action, considering they have the resources, information, and means to address environmental issues than compared to lesser developed countries. However, concerning PSB that is not the case. Out of the top 20 GDP producing countries, twelve do not have a national plastic bag policy (see *Table 5*). The policy responses from the top GDP countries have not only lagged behind that of developing countries, but have also been concentrated at the state or local level- examples to be shown later (Clapp & Swanston 2009).

Table 5: Top 20 GDP countries (2011)

<i>With a PSB national policy</i>	<i>Without a PSB national policy</i>	
China	United States	Poland
India	Japan	Australia
Germany	Russia	Turkey
Brazil	Mexico	Iran
France	United Kingdom	
Italy	South Korea	
Spain	Canada	
Taiwan	Indonesia	

Source: (CIA Factbook, 2012).

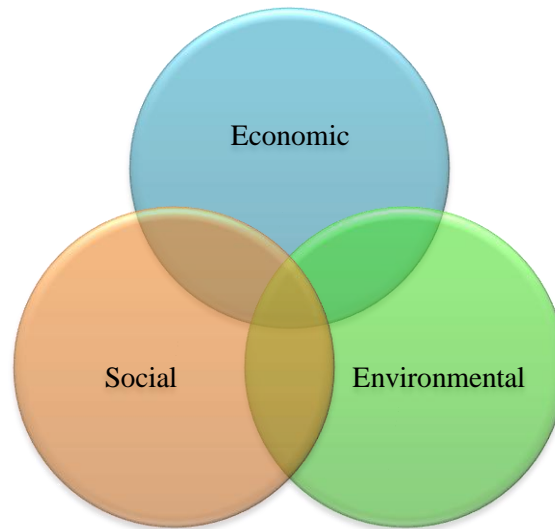
II. Methodology

2.1 Sustainability

The UN report “Our Common Future”¹⁵ (1987) defines “sustainable development” (or “sustainability”¹⁶) as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (p.37; Moldan et al. 2012; 1). Sustainable development rests on three pillars- environmental, economic, and social, and they must be complementary, rather than conflicting (see *fig. 6*).

The aim of this research is to investigate the impacts for PSB policies by evaluating performance based on social, environmental, and economic criteria. Attaining sustainable consumption and production of PSB implies that these three criteria must be addressed. Sustainability can often be misinterpreted to focus primarily on the environmental arena, but social and economic considerations are needed for a broader and holistic context of sustainability. Within this research, social, environmental, and economic sustainability dimensions are defined as:

Figure 6: Three Pillars of Sustainability



Source: Adapted from Comhar SDC (2011)

¹⁵ Also known as the Brundtland Report

¹⁶ “Sustainable Development” and “Sustainability” definition are not identical, although the fundamental underlying is virtually the same (Moldan et al. 20120).

- *Economic Sustainability* concerns the “impacts on the economic conditions of stakeholders and on economic systems at local, national, and global levels“ (GRI 2011; 25). Moldan et al. (2012) believes economic sustainability requires that increasing consumption of resources over time does not reduce future capital (i.e. man-made, human, social, natural) and that there is equal access to the source base for current and future generations.
- *Environmental Sustainability* concerns impacts on the ecosystems, biodiversity resources, land, air, water, etc. The activity must, at the least, do no harm to the surrounding environment. Moldan et al. (2012) summarizes environmental sustainability as “maintaining nature’s services at a suitable level” (p.7).
- *Social Sustainability* concerns impacts on the social system within which the activity is conducted. The activity must be fair and beneficial toward the community, region, etc. Moldan et al. (2012) believes that social sustainability is possibly the most important and critical element needed in order for humans to survive long-term.

2.2 Objective / Aim

2.2.1 Reduction is Key

Two fundamental approaches have been used to deal with issues caused by PSB- the first approach aims at reducing the use of PSB by creating sustainable consumption through policy instruments, and the second focus is on effective recycling of plastic bags. Reduction is a more preferable option to addressing PSB than other options; Bahri (2005) agrees and states that, “the primary target should be reduction of wasteful consumption...” (p.76). This research suggests the objective of policy action concerning PSB is foremost to *reduce* PSB consumption.

In his model of the waste management hierarchy (see *fig. 7*), Bahri (2005; 76) explains “...reduction normally forms the top of the...management hierarchy” (p.11). Bahri continues by separating the hierarchy into two aspects: the pre-consumer and post-consumer (*ibid*). The stages of ‘reduce’ and ‘reuse’ are pre-consumer, while ‘recycle’ and ‘dispose’ (land fill) are post-consumer.

An overwhelming majority of proposed and implemented policies worldwide have addressed strategies for *reducing* PSB, instead of recycling, reusing, or littering (EPHC 2008). There is likely to be a spillover from strategies to reduce plastic bag consumption to the other three. A reduction in PSB will affect virtually all aspects of the PSB consumption flow: accruing less overall waste (litter and sent to landfills), and less waste and emissions created from use and disposal. Also, overall reduction means fewer PSB

Figure 7: Hierarchy of Plastic Bag Management



Source: (ZeroWasteSA, 2011)

will need to be produced and manufactured, resulting in less fossil fuels, energy, raw materials, waste, and emissions needed and created during the production and manufacturing processes

2.3 Research

The necessity of plastic bag regulation is determined by examining the impact of plastic bags on society, the economy, and the environment. This paper will explore the question:

“What are the most employed and recognized policy instruments for reducing the use of plastic bags, and how do they perform in terms of social, economic, and environmental criteria?”

The question aims at providing an analysis of plastic bag policy instruments, in order to assist policymakers in choosing an effective policy. There is international experience on the use of policy instruments to manage the plastic bag problem, which can be used to inform policy makers about plastic bag intervention in other countries.

2.3.1 Methodology

This paper will evaluate the three policy instruments: (1) a ban, (2) a levy, and (3) voluntary retailer action, based on social, environmental, and economic sustainability, and the anticipated outcomes of each. In order to evaluate for social, environmental, and economic sustainability, it is necessary to develop

criteria¹⁷ against which the instruments can be scored (ACG 2006; 30). Each instrument is evaluated based on data received from the available literature.

Although competing policy instruments might produce similar outcomes, they can differ substantially in the way they are regarded and weighted by the affected population. Through considering the social, environmental, and economic impacts, policymakers are more informed to determine the measures that are likely to deliver the best overall outcome.

2.3.1.1 Evaluation

The three policy instruments that are predominately used to manage PSB problems are examined. First, their fundamental structure is explored, i.e. advantages, disadvantages, government role, etc. Then, each is evaluated against a set of criteria to assess the policy. The steps for this are (see *Table 8*):

1. Develop and select criteria and indicators to assess the policy options which relate to the (un)sustainable management of PSB.
2. Describe and score the observed performance of each option against the criteria, based on data found from the available literature. Each will be evaluated on a 5-point scale, 1-‘*weak (poor) performance*’ to 5-‘*high (good) performance*’.

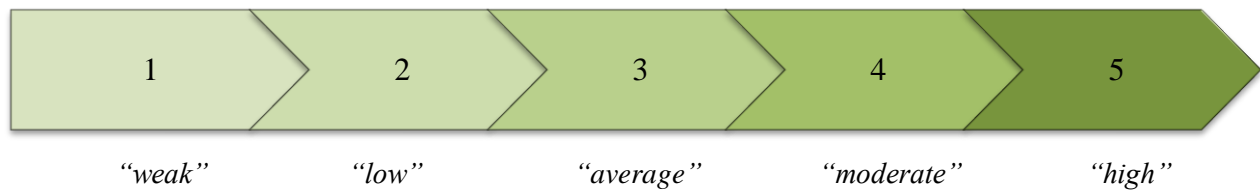
Table 8: Social, Environmental, and Economic Analysis of Policy Performance		
	Criteria	(Policy)
Social Impacts	(a) sub-criteria (b) (c)	e.g. 2
Environmental Impacts	(a) (b) (c)	
Economic Impacts	(a) (b) (c)	
Total (out of 35)		
Scale: 1-5 – 1=weak (poor) performance, 5=high (good) performance		

¹⁷ “Criteria” is defined as: “A standard that a thing is judged by... one that adds meaning and operationality to a principle without itself being a direct measure of performance (Oliveira et al. 2000; 5).

3. Combine the scores for each of the options to derive an overall value.
4. The policy which has the highest accumulated score will be identified as the “most preferred instrument”.

Impact Performance Scale These criteria are then evaluated on a 5-point scale (see *fig. 9*), 1-‘*weak (poor) performance*’ to 5-‘*high (good) performance*’.

Figure 9: Performance Scale



Indicators/Criteria The same set of criteria and indicators will be used for assessing each instrument (see *fig. 10*). As mentioned earlier, the aim of a PSB policy is to reduce consumption, and subsequently create sustainability within the sector.

*A central purpose of these criteria is to identify which policy instrument is most effective in terms of plastic bag reduction.

The report by Oliveira et al. (2000) explains that criteria are “the intermediate point to which the information provided by the indicators can be integrated... and interpret(ed) (p.5)”. The report goes on to say that indicators are “any variable or component... used to infer attributes of the resource and its utilisation” (p.5). Criteria and indicators should be kept to something that monitors a single goal or view point (i.e. efficiency, governmental, etc.).

The methodology framework used has three criteria- social, economic, and environmental- each of which have sub-criteria (the indicators) which can be assessed qualitatively, if not quantitatively, in how each policy is expected to perform against to the applied criteria. Developing and selecting criteria is the first step towards developing an evaluative framework for PSB policies. The three criteria are described as:

- 1) “Social”- The social criteria reflect the social aspects of the policy instrument options under consideration.
- 2) “Economic”- The economic criteria reflect the economic aspect of the policy instrument options under consideration.

- 3) “Environmental”- The environmental criteria reflect the economic aspect of the policy instrument options under consideration.

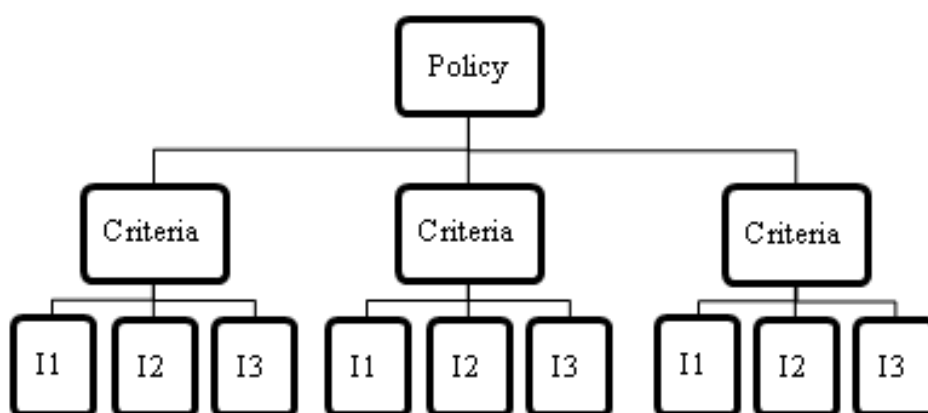
Literature Review Due to time restriction, the evaluation will be based on document analysis from secondary sources to the extent available. These documents include those used for policy discussion, consultancy reports, policies, government research and reports, and academic journals. This evaluation is **not from empirical research**. Also, a literature review was undertaken throughout the phases of this research, i.e. background, problem description, policy instruments, etc. Both electronic and print materials were used.

2.4 What are the available Plastic Bag Policy Instruments?

While there has been a shift within the past few decades in the international norms associated with plastic bags, the way in which it has been interpreted and implemented around the world has differed. Unlike other environmental actions (i.e. Kyoto Protocol, Vienna Convention) the emergence of plastic bag policies was not a simultaneous worldwide movement, but rather a non-network based, uncoordinated, bottom-up initiatives (Clapp & Swanston 2009; 318). Because of these individual initiatives, countries are able to create individually-based plastic bag policies which can be interpreted around individual concerns and problems. Plastic bag policies have occurred on different jurisdictional levels (local, state, national, etc.), different dynamics (binding, non-binding, fixed, changeable), and involvement (individual, collective).

Plastic bags and their applicable policies will be explained in two parts. First, section 2.4.1 explains a typology of three different instruments available that influence collective action concerning

Figure 10: Methodology for Criteria and Indicators



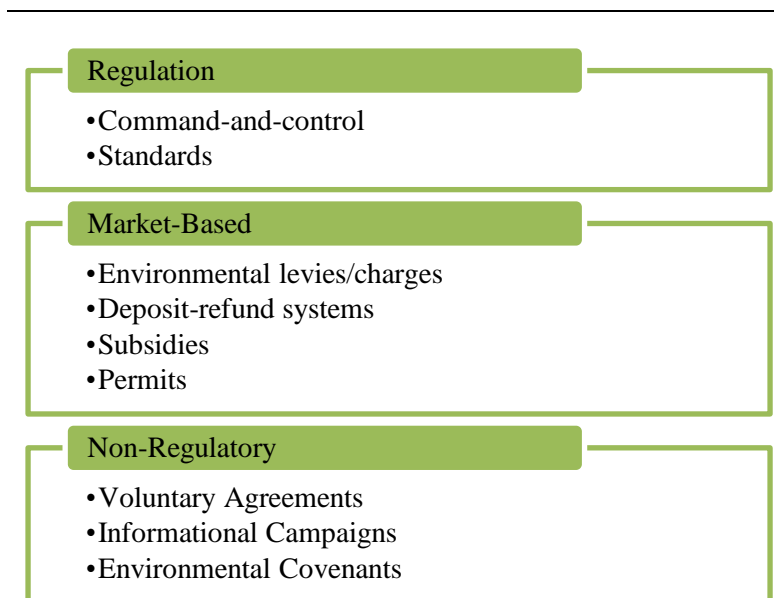
environmental problems. Then in section 2.4.2, these three instruments are broken down into specific plastic bag policy instruments, which are the most employed and leading instruments regarding plastic bags.

2.4.1 A Typology of Instruments to address Plastic Bags

Policy makers must decide which policy instruments to use when choosing and designing the framework for PSB policy. Policy makers need to be able to answer the question “what instruments work, when and with whom, and why?” (Taylor et al. 2012).

A large toolkit of policy instruments has been developed throughout the history of environmental policy. This research recognizes three main types of policy instruments based on the tools they employ in order to influence and create collection action (ACG 2005; 110). These types are (1) regulation, (2) market-based, and (3) non-regulatory (see *fig. 11*).

Figure 11: Environmental Policy Instruments



2.4.1.1 Regulation

Also known as command-and-control (CACs), regulation is “a directive to individual decision-makers requiring them to set one or more output or input quantities at some specified levels or prohibiting them from exceed (or falling short of) some specified levels” (Lindeneg 1992; 282). Regulation sets the standards on “what, how, when, where, and how much to produce, consume, emit, and clean up” (UNEP 2005; 2); this large amount of control is typically targeted at the largest risks and problems (Taylor et al. 2012).

These rules directly control activities of individuals or actors, rather than the outcomes of those activities. The rules are mandatory and present limited options for action, and also have legal sanctions or penalties for non-compliance.

Government Role Regulation requires a large amount of direct government control. The government (or overseeing institution) must be vigilant in monitoring and enforcement¹⁸, as well as have the capacity to do so. It is also important to establish punishment for non-compliance, in order to assert authority. Actors are motivated to comply with the regulations, or else face fines or penalties for non-compliance.

Advantages A main advantage of regulation is that the regulator (i.e. government) has a reasonable degree of knowledge of the expected and predicted outcomes (Lindeneg 1992; 283). Regulation also guarantees equality- the same rules apply to everyone, placing everyone on the same playing field.

Disadvantages Direct monitoring and enforcement of every actor may be time consuming and costly for the overseeing body. Established rules create little or no incentive for compliers to develop means or set goals beyond those required. Also, businesses may be at a disadvantage compared with overseas competitors who aren't required to comply with the regulation.

2.4.1.2 Market-Based

Also known as economic instruments (EIs), market-based instruments create economic incentives for parties to comply and act in accordance with law, and go beyond what is required by laws and regulations. Bahri (2005; 12) states that market-based instruments are appropriate when the impact of the instrument influences the behavior to be influenced as closely and directly as possible.

EIs can have two purposes: (1) to cover the costs of environmental services and expenditures, or (2) incentivize a change in behavior (Killian 2005; 493). Bahri (2005) quotes Panayotou's explanation that EIs "aim to correct (environmental management) these failures, reinstate full-cost pricing, and bring about a realignment of resource allocation with society's objectives and interests- a necessary condition for sustainable development" (p.12). Lindeneg (1992) says that the EIs "give producers and consumers an (economic) incentive to act in accordance with society's ends" (p.283).

¹⁸ Monitoring refers to measuring the performance of the law in comparison to whatever requirements are set out in the applied law.

Government Role This approach requires a smaller amount of direct state control compared to regulation, but some government monitoring is required for maintaining revenue records, enforcement by authorities, and administration of the levy.

Advantages This approach is much more flexible. A charge establishes a 'willingness to pay' for the good or service- consumers can avoid paying the levy by not consuming the priced good.

Disadvantages Some research must be conducted to determine the appropriate charge or fee. It is important to distinguish between a levy (fee) and a charge. A fee is paid for receiving a good or service, while a charge is paid indirectly, like a tax, and may not be clearly displayed. Taylor et al. (2012) argues that taxes can have distributional consequences, such as placing heavier burdens on the poor and distorting goods prices.

2.4.1.3 Non-Regulatory

Also known as voluntary, non-regulatory approaches offer a large degree of flexibility, and takes place either between private actors and/or between the state. Voluntary approaches are based on the idea that participants can decide to commit themselves to go beyond regulation (Crocì 2005; 6); it require parties to create specific rules applicable to the participants who commit to voluntary reduction or environmental improvements.

A popular choice of non-regulatory instruments is voluntary agreements (VAs). Crocì (2005) classified two main types of voluntary agreements: individual (targets are set individually), and collective (targets are unilaterally agreed upon) (p.11). Voluntary does not mean without obligations- there must be realistic targets, mutual trust, communication, and transparent monitoring (ibid).

Participants of VAs also attain costs for involvement. Because there may be no (or little) government intervention in the VA, participants are responsible for any and all transaction, start-up, administrative costs, etc. These costs can include: drafting the agreement, data gathering, data checking, distribution, monitoring, revisions, and sanctioning; these costs grow with the number of participants (Crocì 2005; 26).

Government Role Non-regulatory approaches do not contain much (if any) direct control by the state, but the government will enter into a VA if its determined to be more efficient than other policy alternatives (i.e. regulation) (Crocì 2005; 11).

Advantages Voluntary approaches have benefits for retailers by allowing maximum flexibility in achieving agreed outcomes, avoiding stricter regulation options, cut costs, have self

determined goals, gain a ‘responsible’ reputation, and establish targets beyond the status quo. Governments are subsequently relieved of regulatory overload.

Disadvantages Agreeing on voluntary action would require collaboration between retailers, which can be difficult to achieve and may be seen as interfering with market pricing mechanisms. Also, in absence of legal enforcement and regulation, there is the possibility of free-riders and usually few penalties.

2.4.2 *Plastic Bag Policy Instruments*

Governments around the world have implemented a range of initiatives of policy instruments to modify consumer behavior and consumption of plastic bags. The three policy instruments categorized above can be broken down into specific plastic bag policies: a ban, a levy, and voluntary retailer action. While there is consensus that plastic bag consumption has damaging effects, there are divergent views as to how consumption should be addressed.

2.4.2.1 Plastic Bag Ban (“Regulatory”)

A regulatory approach to addressing the plastic bag problem is an outright ban¹⁹. The UNEP (2005) report states that experience in other countries has shown that bans are the most effective policy instrument in areas with “high vulnerability to litter, single-use character, low (if any) price, and poor recycling feasibility” (p.43).

A ban can substantially reduce the amount of PSB produced and consumed, littered, and disposed into waste. The ban legislation must contain specific and binding guidelines and rules to be followed. In addition to the required legislation, additional factors must be considered. Tough (2007) states these factors are “the phase our period before implementation of the ban, punishments for non-compliance, enforcement, monitoring and administrative responsibilities” (p.133).

A regulation ban on PSB doesn’t allow individuals the option of whether or not to use PSB, therefore taking away the willingness to pay or facilitate consumer choice. There must also be exemptions from the ban for health and safety reasons. These exemptions can include fresh/raw meat and produce products, chemicals, and airport duty-free bags. Issues that may arise from a ban on PSB include an inconvenience to consumers if they forget to take a carrying bag with them, and some consumers may switch to alternatives which also may be unsustainable (i.e. paper bags) (Queensland 2010; 8). Many bans on PSB

¹⁹ Other examples of regulatory PSB policy could be a minimum thickness standard, mandatory recycled content, mandatory participation in a product-or-producer responsibility program, etc.

are accompanied by a minimum thickness standard (see previous *Table 4*), meaning that the ban only applies to plastic bags below an established thickness; bags above the legal thickness are allowed.

Experience Bangladesh implemented a complete ban on PSB in 2002 after littered bags were blamed for contributing to massive floods in 1988 and 1998, which affected $\frac{2}{3}$ of the country. Bangladesh banned the distribution and use of PSB after they were discovered to be blocking the drainage systems, which led to increased damage and casualties (Tough 2007; 41). The ban eliminated the 9 million bags used every day, and today use of PSB can result in a £9,000 fine (Nolan-ITU 2002; 11; Tough 2007; 191).

2.4.2.2 Plastic Bag Levy (“Market-based”)

A market-based approach to addressing the plastic bag issue is in the form of environmental levies and taxes. The purpose of the levy is designed to change the behavior of producers and/or consumers in an effort to reduce consumption; in essence this amounts to a “ban on free plastic bags”.

A mandatory charge on plastic bags gives a visible price for a bag and ensures that consumers pay a fair price for their consumption, while asserting a ‘willingness to pay’ for the good or service- it is important that the levy be set at an appropriate level in order for it to produce behavioral changes and overall reduction. The UNEP (2005; 45) report and Tough (2008; 122) suggest that the appropriate charge is enough to cover the entire cost of PSB production, distribution, consumption, and disposal. The levy should be implemented uniformly across the respective area, and levies are applied more effectively at the national level (ACG 2006; EPHC 2007).

The levy can be prescribed to be collected either from the supplier of PSB or the consumers, but a set charge must be applied for consumers who chose to use PSB. The revenue generated from a PSB tax may then be earmarked for helping to solve problems associated with PSB use, or help fund other environmental issues. Where the generated revenue is allocated can determine the effectiveness of the levy (UNEP 2005; 45).

Experience South Africa enacted a levy in 2003 after initial attempts at a *complete* ban in 2001 became impossible to implement (Killian 2005; 504). Nowadays, the levy and ban are run concurrently and varies with the size and thickness of the PSB- bags less than 30 microns are banned, while those above 30 microns are levied at 3¢/bag. The levy is imposed at the point of purchase (retailers), and failure to comply can result in a fine and/or prison. After closing loopholes within the legislation, the use of new PSB fell by 80-90% within the first three months.

2.4.2.3 Voluntary Plastic Bag Action (“Non-Regulatory”)

Voluntary initiatives could be applied to PSB use; voluntary levies or bans can be structured by a scheme such as a national code of practice for retailers and manufacturers. A voluntary code will commit retailers to reduce the amount of PSB by implementing reduction-based initiatives, such as minimum charge for PSB, increasing PSB produced from recycled materials, reporting total PSB used in a specified period, voluntary labeling, promoting reusable (i.e. cloth) bags, and campaigns and incentives to motivate consumers to bring their own bags.

Voluntary actions used to address PSB can also be integrated concurrently with other PSB policies, such as regulations or economic instruments; they can also be put in place more quickly than other alternatives, allowing for quicker action towards PSB (ACG 2005; 44).

The threat of regulation is an important determinant in VA participation and effectiveness. Signatories will determine if the threat of PSB regulation is more costly and problematic, then (most) will agree to sign the agreement in order to avoid the regulation (Croci 2005; 21; Taylor et al. 2012). For example, if the objectives of the VA are not met (i.e. reduction of 50% within 2 years), then a ban will automatically be imposed. This ‘threat’ of regulation can be a motivator for achieving VA targets.

Experience Australia adopted the Voluntary Code of Practice in 2002 (referred to as Code of Practice here within), which aimed at reducing PSB consumption by 50% by 2005. The Code have a supermarket participation rate of 90% and all participants were given a ‘kit’ with information and tools on how to reduce consumption (Bahri 2005; 59). As a result of wide participation and commitment, Australia reduced its PSB consumption by 34% since 2002 meeting just over half of its initial goal of 50% reduction.

2.5 Scenarios

This analysis will exam three policy instruments that make up the three policy scenarios for dealing with plastic shopping bags. This section describes the scenarios, and their criteria, for action to reduce consumption and the impacts of PSB.

As stated earlier, these three options cover a variety of policy instruments: regulatory, non-regulatory, and voluntary. These three options are then scored against social, environmental, and economic criteria, based on data received from the available literature.

***For the purpose of the analysis- hereafter, these three policy instruments will be referred to as “Scenario...”:**

Scenario 1: Outright ban

Scenario 2: Levy on plastic bags

Scenario 3: Voluntary retailer action

2.5.1 Scenario 1: Outright ban

Under this scenario, an outright ban would be placed on plastic bags. Although it may seem that this should result in 100% reduction in PSB, some exemptions are needed. This scenario would include (EPHC 2008):

- Exemptions from this ban include fresh/raw meat and produce products, chemicals, and airport duty-free bags.
- Monitoring and enforcement by overseeing authority

2.5.2 Scenario 2: Levy on plastic bags

Under this scenario, a mandatory levy would be placed on plastic bags at the point of sale (retailer). The levy would be established by the government or overseeing authority and compliance is mandatory. This scenario would include (EPHC 2008; GHK 2007):

- Retailers have to option to either absorb the levy, or pass the costs onto consumers.
- Exemptions from the levy include fresh/raw meat and produce products, chemicals, and airport duty-free bags.

2.5.3 Scenario 3: Voluntary retailer action

Under this scenario, retailers have the ability to create their own initiatives to reduce PSB consumption. These initiatives can be either independently or through collective agreements.

- Retailers can introduce a ban, a levy, deposit scheme, etc.
- Exemptions from the action include fresh/raw meat and produce products, chemicals, and airport duty-free bags.

2.6 Criteria

The following criteria are used in an evaluation of the impacts of multiple PSB policy scenarios. The evaluation used has three broad criteria, each of which is made up of sub-criteria. These criteria and the measured operation are express in *Table 12*.

Table 12: Evaluation Criteria and Measurement

<i>Criteria</i>	<i>Measurement</i>
1) Social impacts, which contain the following sub-criterion: <ul style="list-style-type: none"> - <i>The policy is fair and equitable to all affected, regardless of income, race, etc.</i> 	Public acceptance & support
2) Environmental impacts, which consist of the following sub-criteria: <ul style="list-style-type: none"> - <i>Reduces consumption of plastic shopping bags</i> - <i>Consumption of non-renewable energy</i> - <i>Reduces litter output</i> 	Change in total bags consumed (%) Change in consumption (%) Change in output (%), Monetary (\$)
3) Economic impacts, which contain the following sub-criteria: <ul style="list-style-type: none"> - <i>Impact to retailers</i> - <i>Impact to governments</i> - <i>Impact to consumers</i> 	Monetary (\$) Monetary (\$) Monetary (\$)

2.6.1 Social

The criterion - *The policy is fair and equitable to all affected, regardless of income, race, etc.* - focuses on the fairness and equality of the policy. Fairness and equality of policies should be compared on how likely they are to be accepted by the key stakeholders and those affected (UNEP 2005). Studies which have used this as a social criterion include UNEP (2005), AP EnvEcon (2008), Bahri (2005), and Wang (2009).

The Comhar SDC (2011) suggests that this is a core criteria in social sustainability; and the criteria should evaluate if there will be appropriate impacts, and if it will lead to inequalities. The impacts- both positive and negative- should be equally distributed among all affected, and not be unequally placed upon a specific income class, race, gender, religion, or other demographics. This is an important aspect to consider since the opinions of these groups may heavily influence the policy outcome. The more fair and equitable the policy is, then the higher likelihood that it will be accepted and supported by stakeholders

and the public as a viable means of improving the PSB situation. Wang et al. (2009) believes that this social criteria is not, and cannot, be measured by numbers- instead, it is a qualitative criteria.

2.6.2 *Environmental*

The first criterion- *Reduces consumption of plastic shopping bags*- focuses on the amount of reduction of PSB that policy will have (if any). All three scenarios target reductions in PSB, so all should have some impact on the amount of PSB consumed. This criterion will measure how effectively each scenario reduces consumer consumption. Studies which have used this as an evaluative criterion include EPHC (2007), ACG (2008), GHK (2007), and Killian (2005).

The second environmental criterion- *Consumption of non-renewable energy*- aims to measure the impact the policy would have on the energy use required for manufacturing PSB (i.e. fossil fuels). The Comhar SDC (2011) recommends “energy” and “resource use” as core environmental sustainability criteria (p.19-20). As discussed earlier, PSB require significant amounts of non-renewable resources; given that most PSB are single-use, the resources required for PSB manufacturing is a continual process. Policies that will reduce PSB consumption and/or production will see a change in the amount of resources used. Studies which have used this as an evaluative criterion include Cadman et al. (2005), Hyder Consulting (2007), and SPA (2009).

The third environmental criterion- *Reduces litter output*- focuses on the reduction of litter each scenario will create; this includes both deliberate and non-deliberate (i.e. windblown) litter output. The amount of litter is considered important because each scenario addresses litter in different ways, with possible varying success (ACG 2008). According to Killian (2005), reductions in litter output can be correlated to total consumption levels- for example, a reduction in consumption would result in a corresponding reduction in PSB litter. Studies which have used this as an evaluative criterion include EPHC (2007), ACG (2008), Killian (2005), Nolan-ITU (2002), and Hyder Consulting (2007).

2.6.3 *Economic*

The economic impacts are quantitative criteria because they can be scored objectively using real costs and benefits. These three sub-criteria reflect the major stakeholders in PSB policies- retailers, governments, and consumers.

The first criterion- *Impact to retailers*- measures the impact that retailers may receive through a PSB policy. Although manufacturers are the start of the PSB process, it is the retail sector that incurs the first costs associated with PSB policies (ACG 2006). A change in PSB policy creates costs for them which can

include initial set-up costs (i.e. employee training, new equipment), administrative costs, education and promotion about changes to its customers, and an increase in theft. However, retailers can also benefit from increase sales of reusable bags and other carrying alternatives. Also, any costs that retailers may incur from a PSB policy can be passed onto consumers in the form of higher prices, so as to reduce costs. Studies which have used this as an evaluative criterion include EPHC (2007), ACG (2008), and GHK (2007).

The second criterion- *Impact to governments*- measures the impact that governments will obtain; governments refer to the federal government, the governments of all the states or provinces, and all local governments. Designing and implementing a PSB policy introduces costs and benefits to the governments responsible. Similar to retailers, governments incur administrative expenses and initially set-up cost, but they also acquire costs for the drafting of the legislature, monitoring and enforcement, and promotion and education about the policy and alternative PSB options (EPHC 2008; GHK 2007). Governments can also receive benefits through increased revenue from the policy (if applicable), and reduced future costs associated with the environment, resources, litter clean-up, etc. Studies which have used this as an evaluative criterion include EPHC (2007), and ACG (2008).

The third and final criterion- *Impact to consumers*- aims to measure the impact that consumers may feel through PSB policies. With almost 1 trillion PSB consumed annually, any of the three policy scenarios will greatly affect the major source of the consumption problem- consumers. Consumers will incur both costs and benefits from a PSB policy. Costs can include additional costs from purchasing alternative carrying methods (i.e. reusable bag, trolley), or they will need to pay to use PSB- both of these will cost significantly more than the current situation. However, the purchasing of alternatives could also save consumers money over the long-run. Additionally, as mentioned previously, any costs that retailers may incur from a PSB policy may be passed onto consumers in the form of higher prices. Studies which have used this as an evaluative criterion include EPHC (2007), ACG (2008), and GHK (2007).

III. Scenario Results

This section provides a social, environmental, and economic analysis of the impacts of the three policy scenarios.

Note: All costs in the analysis will be given in U.S. Dollars (\$), unless otherwise stated.

3.1 Scenario 1: Outright ban

Table 13: Scenario 1: Outright ban

Criteria		Ban
Social Impacts	<i>The policy is fair and equitable to all affected, regardless of income, race, etc.</i>	4
Environmental Impacts	<i>Reduces consumption of plastic shopping bags</i>	5
	<i>Consumption of non-renewable energy</i>	3
	<i>Reduces litter output</i>	3
Economic Impacts	<i>Impact to retailers</i>	2
	<i>Impact to governments</i>	2
	<i>Impact to consumers</i>	2
Total (out of 35)		21

Scale: 1-5 – 1=weak (poor) performance, 5=high (good) performance

3.1.1 *The policy is fair and equitable to all affected, regardless of income, race, etc.*

This criterion was merited a mark of “4- moderate performance” because of the relatively high amount of social equality. A levy is efficient- it does not make anyone more better off at the expense of another. Although there are small pockets where some inequality and unfairness may exist, these are believed to be a consequence of the policing sphere. A ban on PSB guarantees some equality among those affected, regardless of demographics (Lindeneg 1992). The ban will apply to all: rich, poor, white, colored, educated, non-educated, etc. Ayalon et al. (2009) evaluates that “prohibition of use” (a ban) creates an “equality of burden” for the criteria of social equality (p.2030). If it doesn’t apply to everyone equally, the level of success decreases.

Although there is a relatively high performance for fairness and equality, unfairness and inequality do occur. Opponents of a ban have argued that it would discriminate against the elderly, handicapped, and those without private transportation (i.e. a car) (Clover 2007; Ritch et al. 2009). The elderly and handicapped may be unable to carry items individually (without a bag), this can be exacerbated if the items are heavy or bulky. Likewise, those without private transportation may have difficulty when making purchases in large quantities.

3.1.2 *Reduces consumption of plastic shopping bags*

A ban has the highest performance for reducing PSB use; a mark of “5- high performance” was accredited. A ban on PSB *significantly* reduces the consumption of PSB. However, the bags that are exempt from the ban would still be available for use; therefore a 100% reduction in PSB is not possible or likely.

Unfortunately, only data from China and Taiwan could be found that studied the PSB reduction amount in countries with a *national* plastic bag ban; data from Rwanda, Bangladesh, Eritrea, etc. could not be found within the available literature. While this allows for future research, the reduction amounts used for this analysis relied on analyses from other research. Herrera et al. (2008) reported that Taiwan saw up to a 69% decrease in PSB consumption after the ban was implemented in 2001. Some reports estimate that after China implemented a ban of PSB below a certain thickness, total national consumption was reduced by two-thirds (Zhu 2011; Warner 2010; Block 2009). The remaining one-third continues to persist due to bag exemptions and illegal selling. Studied individually, some cities in China saw a higher reduction, for example, Beijing reported a 90% decline of PSB use (Zhu 2011; Warner 2010).

Previous studies have estimated reductions in PSB use from a plastic bag ban. The EPHC (2008) analysis estimates that a ban would result in 80% reduction in PSB use (p.43), while Verghese et al. (2006) estimates that a ban would result in close to a 100% reduction (p.2). Herrera et al. (2008) estimated that Seattle would potentially see a 90% reduction in PSB use *if* a ban was implemented²⁰.

3.1.3 *Consumption of non-renewable energy*

A mark of “3- average performance” was merited, because a ban significantly reduces consumption of non-renewable resources, and reducing consumption of PSB overall has implications for energy use and raw materials (EPHC 2008).

²⁰ Only 10% of consumers would “Continue plastic bag” use after a ban (possibly through illegal or indirect means) (Herrera et al. (2008; 6-10).

Herrera et al. (2008) analyzed the impacts that a ban would have on the environment. He found that a ban on plastic bags would reduce non-renewable energy by 70-73% (measured in *megajoules*), greenhouse gas emissions (*kg CO₂*) by 79-82%, and reduce resource depletion (*kg Sb*)²¹ by 65-70% (p.6-14; 6-16). China saw a drop of petroleum use when the PSB ban was implemented. Pre-ban, China refined “nearly 5 million tons (37 million barrels) of crude oil each year” to produce plastic bags (Liu 2011). After the ban, China reduced PSB-associated crude oil by 32% (1.6 million tons) (Warner 2010).

3.1.4 *Reduces litter output*

A mark of “3- average performance” was credited. This scenario has the ability to greatly reduce litter, similar to the previous criterion ‘*reduces consumption of plastic shopping bags*’. A ban would directly reduce the litter problem associated with PSB (ICF 2010). A near 100% reduction in PSB consumption is expected to lead to almost zero *new* PSB litter (EPHC 2008). However, the bags that are exempt from the ban (mentioned earlier, see section 2.5) would still be available to litter, therefore a complete 100% reduction in litter is not possible or realistic.

The EPHC (2008) analysis estimates that a ban would result in 80% reduction in litter (p.43). However, a study by Herrera et al. (2008) that analyzed a PSB ban scenario for the city of Seattle, estimated that a PSB ban would reduce litter²² output by 28-35% (p.6-14). There is a large discrepancy between the EPHC and Herrera studies. However, a large percentage of the literature has shown that a reduction in overall PSB consumption will directly determine the reduction amount of PSB litter. For example, a ban that results in 80% reduction of PSB consumption will result in 80% reduction in litter (EPHC 2008; 43).

3.1.5 *Impact to retailers*

A mark of “2- low performance” was credited, because although there are moderate costs to retailers for increased transaction times, a percentage of these costs could be recovered through the benefits attained from eliminated PSB costs and alternative bag sales. However, there are not large financial incentives or the opportunity for investment for retailers.

Costs There is expected to be costs for the plastic bag industry and retailers pertaining to promotion, implementation costs, and delayed transaction times. An analysis by EPHC (2008) calculated costs for retailers under a ban scenario in Australia. Costs that were calculated include staff training, equipment

²¹ Measured in kilograms (kg) of material (Sb) (Herrera et al. 2008b; E-1).

²² “Litter Marine Diversity” which is the potential for litter endangering aquatic species, and “Litter Aesthetics” which refers to the amount of material per m² (Herrera et al. 2008; E-2, E-3).

modification, theft, increased transaction times, and in-store promotion for 68,000 retailers (p.62)²³. The total cost to these retailers for the ban-related expenses total \$300-430 million (ACG 2008; 43; EPHC 2008; 62). This amounts to a cost of \$4400-6300 per store²⁴.

One of these costs, increased transaction times, is caused from customers taking a longer time to pack and/or organize their goods when no PSB are available. The ACG (2006) report estimates this cost to retailers to total \$60 million annually (p.56; EPHC 2007)²⁵, however this is expected to gradually decrease over time as consumers become more accustomed to this practice.

Benefits Retailers are able to receive monetary benefits through a ban by saving the costs associated with purchasing PSB for consumers. Though disguised as ‘free’ to consumers, retailers still purchase PSB from manufacturers, store them, and provide for carryout. Although retailers have the option of passing this cost onto the consumers, a ban on PSB would save retailers these capital costs. An investigation by the EPHC (2008) reported that retailers in Australia spend more than \$173 million annually in supplying PSB to customers (p.14). Zhu (2011) believes that Chinese hypermarkets (markets with more than 50 chain branches) could save up to \$100 million dollars every year through the PSB ban (p.2518). Due to these potential reduced costs, some stores in China seriously enforce the ban.

Retailers can also profit from increased sales of reusable bags, especially if reusable bags are one of the few alternatives available to customers. With no PSB available, sales of reusable bags are expected to increase multi-fold. According to the ACG (2006) report, green reusable bags cost retailers an estimated wholesale price of \$0.65, which they can then mark-up for profit (p.9); the average is between \$0.60-\$1.80, depending on the material of the bag (EPHC 2008; 29; AECOM 2001; 13).

3.1.6 *Impact to governments*

Governments will experience an increase in administrative, monitoring, and enforcement costs, while also reducing litter clean-up expenses. A score of “2- low performance” was credited, because of the small impacts from costs and benefits.

Costs The government is expected to incur costs associated with a PSB ban. Administration, monitoring, and enforcement of the ban would be the most expensive component for governments. Also,

²³ See *Appendix 1, Table A1* for breakdown costs

²⁴ $(\$300,000,000 \div 68,000) = \$4,411$ & $(\$430,000,000 \div 68,000) = \$6,323$

²⁵ A survey by KPPM (2006) found that participants observed a delay in check-out times when customers brought their own bags. Some survey participants thought that there was insufficient counter space for packing reusable bags, and a longer time delay when previously purchased goods are in the same bag.

the more exemptions from the ban, then the more complex monitoring will be and more costly enforcement will become (EPHC 2008).

Unfortunately, no data could be found that studied the costs to governments in countries with a *national* plastic bag ban; data from Rwanda, Bangladesh, Eritrea, etc. could not be found. While this allows for future research, the amount of government costs used for this analysis relied on analyses from regional and/or national *scenarios*. Herrera et al. (2008) estimated that the government cost for a PSB ban scenario for the city of Seattle, Washington (United States) would be around \$31,000 annually. This includes costs for administration, inspection, enforcement, education, research, etc. (ibid, 6-14). Similarly, the ACG (2008) report of a ban scenario in Australia estimated that monitoring and enforcement costs would total \$100,000 annually (p.5).

Benefits The government will also see a reduction in expenses associated with litter clean-up. Cleaning up litter caused by improper disposal of PSB can result in substantial costs for governments. The ACG (2006) report estimates that the Australian government could reduce litter clean-up costs by \$4 million (p.57; EPHC 2007). An analysis by OEA (2011) estimates that pre-ban, San Francisco, California, consumed 150 million plastic bags every year; representing 0.6% of municipal litter (p.11, p.15). After implementing the ban, the report estimates that San Francisco reduced litter collection and disposal costs by \$700,000²⁶.

Similarly, a report by ICF (2010) referred to a study by Herrera et al. (2008) that analyzed clean-up costs associated with plastic bag litter in Seattle²⁷. In Seattle, 290 million PSB are consumed annually, which make up less than 1% of municipal waste (Herrera et al. 2008). Despite this small percentage, litter costs the City of Seattle \$2.45 million/year to clean up (ICF 2010; Herrera et al. 2008)²⁸. A ban would *significantly* minimize these litter expenses. Using the estimates from the EPHC (2008) report that a ban would result in 80% reduction in PSB use (previously mentioned), the litter cost savings for Seattle can be estimated. If Seattle were to implement a ban, the estimated annual litter costs would be \$490,000, approximately $\frac{1}{5}$ of the current costs²⁹. These clean-up savings are increased in areas where plastic bag litter is greater than less than one-percent (<1%).

²⁶ \$0.1 million for litter, \$0.6 million for waste (OEA 2011; 11)

²⁷ Because single-use... plastic...bags are more likely than other bag types to persist as litter, it is assumed that they would be responsible for the majority of bag litter cleanup costs” (ICF 2010; 36).

²⁸ These cleanup costs include processing contamination, composing contamination, collection and disposal, and street cleaning (ICF 2010).

²⁹ $(2,452,000 \times 0.8) \equiv X$; $(2,452,000 - X) = 490,400$; $X = 1,961,600$

3.1.7 *Impact to consumers*

A score of “2- low performance” was credited, due to the relatively insignificant benefits that consumers will receive, and the slight costs they will incur from purchasing alternatives (switching costs).

Costs Consumers are expected to incur direct costs associated with alternative carrying methods, specifically reusable bags. These alternative methods will need to be purchased, which means a cost to consumers. The average cost of reusable bags is between \$0.60-\$1.80 (EPHC 2008; 29; AECOM 2001; 13; Nolan-ITU 2006; OEA 2011). Despite these costs, a survey by KPPM (2006) found that participants did not see the cost of reusable bags as an issue, and that they believed costs were insignificant.

Benefits A ban would eliminate the current hidden cost of PSB that retailers absorb into the cost of other products (mentioned previously in “*Impact to retailers*”). According to the AECOM (2010) report, Los Angeles customers who consume 400 to 500 PSB annually will save \$3.25/person/year³⁰ from retailers removing the hidden costs of PSB after implementing a ban. This was calculated by:

$$(post\ ban\ costs = \$6.81) - (pre\ ban\ costs = \$3.25) = \$3.56/capita/year$$

The average estimated cost for consumers from switching from PSB to other alternative methods is expected to be insignificant, but this is on an individual basis. Some consumers may experience higher costs, especially for those buying in large quantity, frequent shopping, etc.

3.1.8 *Summary*

A Ban scenario scored a 22 out of 35 possible points. The ban scored well on the social and environmental impacts, but poorly on the economic. This option provides a significant step towards reducing plastic bag consumption, reducing the energy concern associated with consumption, minimizing litter output, and is a fair and equitable policy; however the impacts on retailers, governments, and consumers are minute or insignificant.

Due to the fact that no economic data could be found on countries with a national ban, the data for economic criteria relied on policy *scenarios* from other studies. These studies concluded that the economic impact to retailers, the government, and consumers is considered minute. Although there are nominal costs for retailers, there are also low benefits for them to comply if there is little-to-no threat of consequences. Therefore, it can be assumed that in the absence of strict monitoring and enforcement, some retailers may choose to continue to supply PSB to consumers in order to gain a competitive edge.

³⁰ The report assumes \$3.25/person/year, based on an average “bags per capita” at 433, and a “cost per bag” at \$0.008 (AECOM 2010; 18).

Studies concluded that a ban would place financial burden on the government due to enforcement and monitoring; these costs would not be recoverable because there is no direct revenue produced to offset the costs³¹. While governments are expected to save costs associated with reduced PSB litter clean-up, up to \$700,000 for some areas, these cost-savings are expected to negate costs. Government costs are determined by the size and scope of the policy, (i.e. those affected- which includes retailers and consumers, as well as the number of ban exemptions); the more complex the size and scope the more costly government responsibilities will be.

Consumers are impacted negatively- they no longer have a cheap method of carrying goods. They must now find alternatives, or purchase reusable bags (priced between \$0.60-\$1.80), both of which cost more than the “PSB hidden cost” of one to three cents (EPHC 2008; Nolan-ITU 2002). As mentioned earlier, retailers can save costs through no longer purchasing PSB for consumers; these cost savings can be passed onto consumers through lower prices of goods, but this decision is solely up to retailers.

3.2 Scenario 2: Levy

Table 14: Scenario 2: Levy

	Criteria	Ban
Social Impacts	<i>The policy is fair and equitable to all affected, regardless of income, race, etc</i>	4
Environmental Impacts	<i>Reduces consumption of plastic shopping bags</i>	4
	<i>Consumption of non-renewable energy</i>	3
	<i>Reduces litter output</i>	4
Economic Impacts	<i>Impact to retailers</i>	4
	<i>Impact to governments</i>	3
	<i>Impact to consumers</i>	4
Total (out of 35)		26

Scale: 1-5 – 1=weak (poor) performance, 5=high (good) performance

³¹ There may be small amounts of revenue from fines and penalties for non-compliers, but these costs are expected to be negligible.

3.2.1 *The policy is fair and equitable to all affected, regardless of income, race, etc.*

A mark of “4- moderate performance” was scored, because a levy offers a considerable amount of fairness and equality among all affected. A levy is efficient because it is set at a level high enough to make consumers think about their willingness to pay for a plastic bag. The levy does not exclude or discriminate- consumers are free to choose whether to purchase or not.

A survey by Convery et al. (2007) polled Irish citizens and questioned their level of satisfaction with the PlasTax. The survey found the majority was satisfied and in favor of the levy, and many believed that the impacts on the environment were positive. This high level of public acceptance contributed to the levy’s success (ibid, p.9).

Similar to *Scenario 1*, although there is relatively high performance for fairness and equality, there does exist the possibility of it occurring. The biggest social obstacle is that not every consumer is able to afford to pay extra money for PSB- low income earners may be unevenly impacted by a levy because they have less disposable income. Low income earners will be more motivated to avoid the levy, compared to other consumers. Low income consumers will have a higher incentive to use alternatives when they shop, rather than pay the levy³².

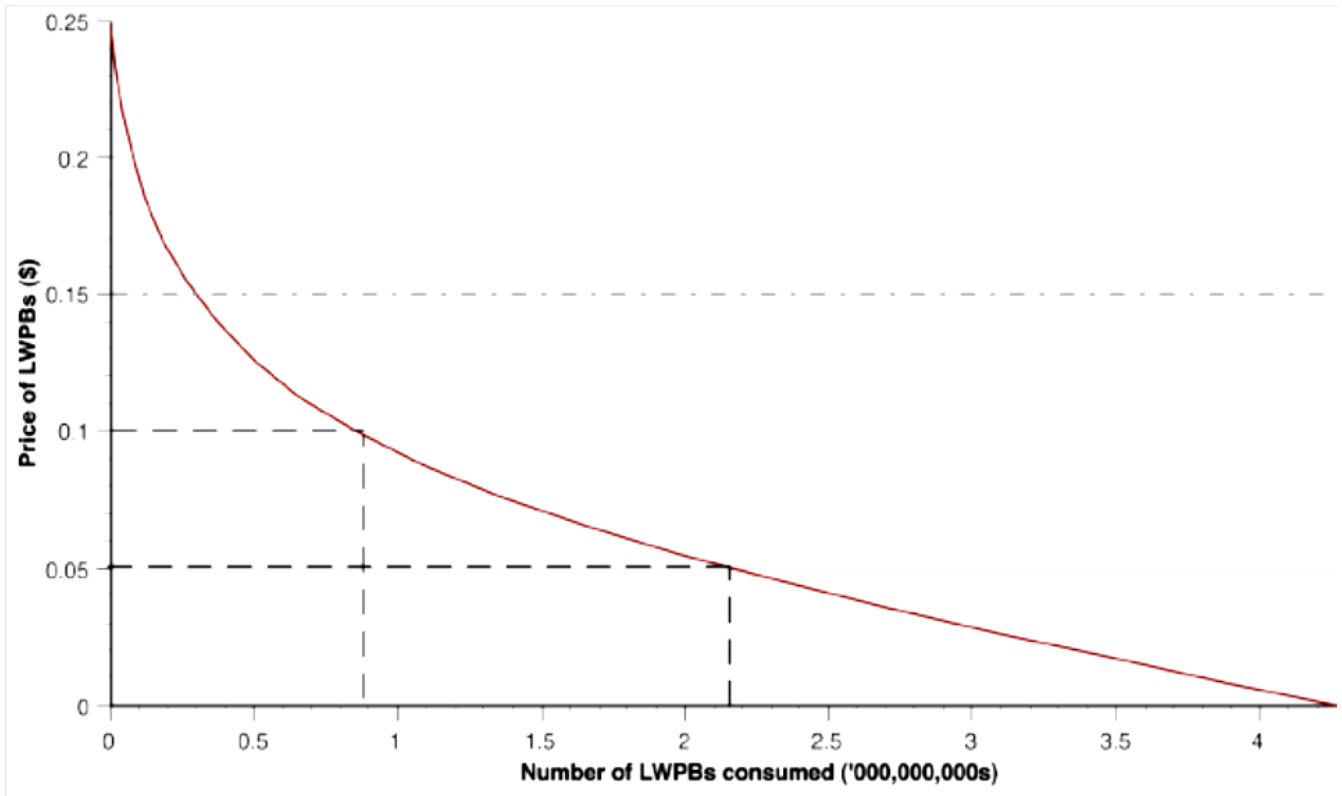
3.2.2 *Reduces consumption of plastic shopping bags*

A mark of “4- moderate performance” was credited, because PSB levies have proven to be successful policies in significantly reducing PSB consumption. Similar to a ban, there are bags that are exempt from the levy; therefore a 100% reduction in PSB is not likely. It has been studied that as the price of the levy increases, so does the reduction. *Figure 15* illustrates how the demand and consumption of PSB can be determined by the price of the levy.

Reductions of PSB through a levy have been successful in a majority of countries where one has been implemented (see *Chart 16*). Ireland’s PSB consumption fell by 90-95% after the PlasTax (McDonnell & Convery 2008; Nolan-ITU 2002; ICF 2002), while South Africa experienced 60-90% reduction with a levy of \$0.17 (Gupta 2011; 10). Botswana has shown a 50% reduction (Gupta 2011; 10), while Denmark’s consumption fell by 60% (GHK 2007; 7). All of these levies have resulted in a 50% or higher reduction in PSB consumption. However, a *scenario* analysis of a levy in Hong Kong estimates a 44% change in PSB consumption (GHK 2007).

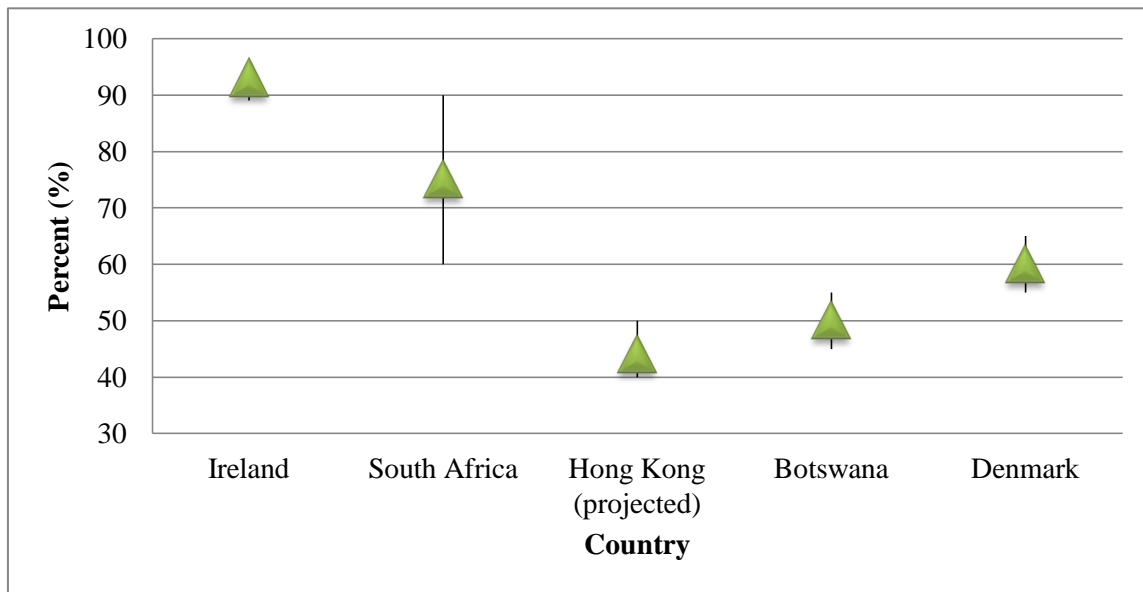
³²To help low-income consumers, some cities that have enacted levies, such as San Francisco and Washington D.C., have created programs where low-income individuals are eligible for free reusable bags, or exempted from paying the fees. This is a similar idea to Food Stamps (Fromer 2009).

Figure 15: Consumption of PSB compared to Levy Price



Source: (EPHC 2008; 33)

Chart 16: PSB Reduction from a Levy



Source: (McDonnell & Convery 2008; Nolan-ITU 2002; ICF 2002; Gupta 2011; GHK 2007).

Other studies have modeled potential PSB reductions for levy scenarios. The Cadman et al. (2005) study investigated the impact of a levy scenario of £0.10 in Scotland and estimated that the levy would reduce PSB consumption by 90%. The EPHC (2008) report estimates that a levy in Australia of \$0.10 would reduce consumption by 80%, while a charge at \$0.20 and \$0.25 will reduce consumption at 90% and 95%, respectively (p.33-36). However, the Nolan-ITU (2002) report projects a slightly smaller reduction of 75-85% for Australia at a tax of \$0.15 and \$0.25 (p.11, 70).

3.2.3 Consumption of non-renewable energy

A mark of “3- average performance” was scored. A decrease in overall PSB consumption can lead to a decrease in non-renewable energy associated with plastic bag production and consumption.

According to Rucker et al. (2008), the Irish PlasTax’s 90% reduction of plastic bags resulted in a savings of 4.8 million gallons of oil, which is the equivalent of 114,240 barrels of oil³³. Using data from the U.S. Energy Information Administration (USAEA), Ireland consumes 52.56 million barrels of oil annually (see *equation #1*); therefore, it can be estimated that the PlasTax reduced national oil consumption by 0.2% (see *equation #2*).

Equation #1:

$$(144,000 \text{ Barrels/Day}) \times 365 \text{ days} = 52,560,000 \text{ Barrels/Year}$$

Equation #2:

$$(114,240 \text{ Barrels of oil saved}) \div (52,560,000 \text{ Barrels/Year}) = 0.002 = 0.2\%$$

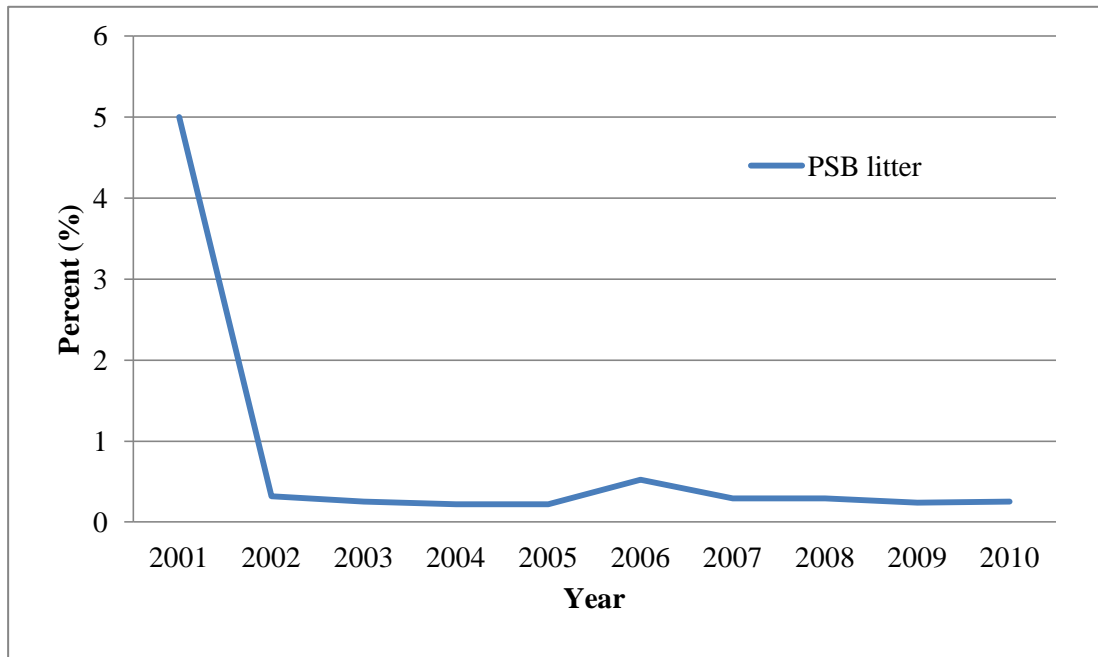
Concerning the proposed levy in Australia, an analysis by Nolan-ITU (2002) analyzed the environmental reductions. The study estimated that a levy of \$0.15-\$0.25 would reduce energy use by 54-63%, respectively (p.11-12). A similar study by Cadman et al. (2005) measured the impact of non-renewable energy from a levy scenario in Scotland. The study calculated a 42%³⁴ decrease in non-renewable energy use associated with plastic bags (p.26, 29).

**Note:* The Australia and Scotland energy figures do NOT represent a reduction in total national oil consumption (as with the Ireland numbers), but rather only in energy associated with plastic bags.

³³ Converted from URL <<http://www.bp.com/conversionfactors.jsp>> (BP, 2012)

³⁴ This calculation does not reflect increase in reusable bags or bin liners. A decrease of 43% equals a savings of 5,580 tonnes of oil, or 40,900 barrels. Converted from URL <<http://www.bp.com/conversionfactors.jsp>> (BP, 2012)

Graph 17: Ireland's PSB % of Litter



Source: (AP EnvEcon 2008; 119)

*Note: for data, see *Appendix I, Table A2*

3.2.4 Reduces litter output

A grade of “4- moderate performance” was graded, because similar to energy use, litter output can be correlated with overall PSB consumption, which is reduced by a levy. The Irish PlasTax indicates a persuasive trend that plastic bag litter is considerably reduced by a levy.

The National Litter Pollution Monitoring System estimates that PSB litter in Ireland fell to 0.3% in three years, from its original level of 5% (see *Graph 17*) (UNEP 2005; McDonnell & Convery 2008; AP EnvEcon 2008); this equals a 60% decrease in litter; the most recent data shows PSB litter was at 0.25% in 2010 (Hogg et al. 2011). The Nolan-ITU (2002) report states that while official data is questionable, it “can be assumed that the dramatic decrease in bag consumption has led to a related decrease in bag litter” (p.35). The Irish Department of Environment, Heritage and Local Government officially states that, “littering of plastic carrier bags is no longer a problem” (Cadman et al. 2005; 7).

The Nolan-ITU (2002) report analyzed that a levy in Australia of \$0.15 and \$0.25 would achieve a significant reduction in litter at 71% and 82% respectively (p.77). The Cadman et al. (2005) study of a levy scenario in Scotland (mentioned previously) calculated that Scotland would see a considerable 50% decrease in ‘risk of litter’ (p.25-26).

3.2.5 Impact to retailers

A mark of “4- moderate performance” was credited, because although retailers’ costs for a levy can be substantial, these costs can be recuperated through cost savings from fewer ‘free’ PSB, and reusable bag sales.

Costs There is expected to be costs for the plastic bag industry and retailers pertaining to implementation and administration. Convery et al. (2007) states that Ireland’s initial retailer set-up costs were €1.2 million (p.6), which included equipment, promotion, and training. An analysis by EPHC (2008) calculated costs for retailers under a levy scenario in Australia. Costs that were calculated included staff training, equipment modification, theft, increased transaction times, and in-store promotion for 68,000 retailers (p.62). Compared to the Irish PlasTax which had relatively low costs, the EPHC (2008) estimates that Australian retailers would need to pay AUD\$245.42 million³⁵ in upfront capital costs in order to comply with a mandatory retailer levy. The report calculated that (ibid; 33-36):

Education and training:	\$ 65.7 M
Theft:	\$ 120.0 M
Increased transaction times/enforcement:	\$ 29.0 M
In-store education & promotion:	\$ 29.01M
Equipment modifications:	\$ 1.71 M
<hr/>	
Total:	\$ 245.42 Million (AUD)

Nolan-ITU (2002) estimates that each transaction would take up to five seconds longer, either because of the purchase of a PSB or the use of reusable bags. The report estimates this cost to the retailers to be \$52 million annually (p.72), although this will decrease over the long-term as consumers adjust.

Benefits Like the retailer benefits in Scenario 1, retailers can generate extra revenue from the sale of reusable shopping bags. Encouraging and promoting the use of reusable bags can lead to retailer cost savings that accumulate, because a reduction in PSB use means that retailers will need to order and store less plastic bags. According to the ACG (2006) report, green reusable bags cost retailers an estimated \$0.65, which they can then mark-up (p.9); the average is between \$0.60-\$1.80, depending on the material of the bag (EPHC 2008; 29; AECOM 2001; 13). Retailers can use reusable bags as a marketing device and increase their sales.

³⁵ The large disparity between these two costs can be accounted for by the difference in annual consumption and the total number of retailers. Pre-levy, Ireland consumed 1.2 billion bags annually, while pre-voluntary agreement Australians consumed 6 billion, almost five times that.

3.2.6 Impact to governments

A mark of “3- average performance” was scored, because the government will incur costs associated with ongoing administration, legislation, collection, monitoring, and auditing. The benefits include the revenue raised from levy, which can be used to offset some of these costs.

Costs There will be legislative start-up costs to governments in order to research, implement, monitor, and enforce the levy. The revenues raised largely depend on which bags are taxed, the amount of the tax, and amount of PSB reduction. A higher reduction in consumption will mean lower revenues, because less people are paying the levy.

In Ireland, government costs were modest- Convery et al. (2007) and Bahri (2005) estimate that set-up costs were €1.2 million, with an annual administration cost for the Irish government at €350,000 (p.6; p.58). A scenario analysis in Hong Kong estimated that a levy would cost the government \$300 million every year for expenses³⁶. Cadman et al. (2005) estimated that for a levy scenario in Scotland, set-up costs would amount to £3-4 million, with an annual cost (i.e. management, enforcement) of £3.5 million.

Benefits The monetary benefits include revenue raised from the levy. At a levy of €0.15, the Irish PlasTax raises an average annual revenue of €12-€14 million (McDonnell & Convery 2008)³⁷, or about €1 million each month. The revenue generated is over thirty times³⁸ the annual costs (noted in *Costs*), or put differently, the costs are only 3% of the revenue³⁹. According to the Nolan-ITU (2002) study, if Australia implemented a levy between \$0.15 and \$0.25, then it could raise revenues for the Australian government in the amount of AUD\$345.5 million annually. The GHK (2007) study estimates that if applied to all retailers, a levy of \$0.06 in Hong Kong would generate as much as \$309.4 million in revenue (p.32)⁴⁰.

The revenue generated from the levy helps governments fund environmentally related projects, such as litter cleanup, recycling, and educational and informational campaigns. Because these environmental projects are funded otherwise, governments are able to redistribute the tax funds that would have otherwise been spent on these projects. For example, within the first seven years, Ireland’s PlasTax had

³⁶ These costs include staffing, inspection and enforcement, legal, education, marketing, research, and administration (GHK 2007; 68).

³⁷ See for data, see *Appendix 1, Table 3*

³⁸ $Revenue (\text{€}12,000,000) \div Costs (\text{€}350,000) = 34.2$

³⁹ $Costs(\text{€}350,000) \div Revenue (\text{€}12,000,000) = 0.029, \neq 3\%$

⁴⁰ HK\$0.50 in Hong Kong would generate as much as HK\$2.4 billion if the levy is applied to all retailers (p.32).

raised more than €85 million for projects such as recycling facilities, return centers, and education and awareness campaigns (McDonnell & Convery 2008).

Governments would also reduce expenditures associated with PSB litter clean-up costs. The AP EnvEcon (2008) study reported that after implementation of the PlasTax in Ireland, PSB litter costs were reduced substantially. Since the PlasTax began in 2001 and until the levy increase in 2007, the levy reduced PSB clean-up by some €0.3 million (AP EnvEcon 2008).

3.2.7 *Impact to consumers*

A mark of “4- moderate performance” was credited, because consumers can control the costs that they pay, and the benefits that they may receive. The impact to consumers will depend on whether or not they choose to avoid the additional cost.

Costs The levy will cost consumers by a few means. Consumers will continue to use PSB and pay the cost, purchase reusable bags, extra cost of replacing bin liners, or a combination of both. The Nolan-ITU (2002) report estimates that a levy of \$0.15-\$0.20 will cost the average consumer \$15-\$21 per year (p.11, 74). A similar study by Cadman et al. (2005) calculated the financial burden to consumers for a levy scenario of £0.10 in Scotland. The study estimated the costs to be £10-£11 per person per year (p.34; AP EnvEcon 2008; 40). These costs include purchasing reusable bags, occasionally paying the levy, and the ‘hidden’ cost of PSB bags. All of these costs can be exacerbated for consumers who frequently purchase PSB *and* pay the levy- these consumers may include those who buy in large quantities, are spur-of-the-moment shoppers, or are simply being forgetful in bringing alternatives carrying methods with them.

Benefits Benefits are received through avoiding paying the levy. Because consumers are able to choose whether or not to pay the costs associated with a PSB levy, it is expected that a large percentage of them will try to avoid this extra cost. This allows consumers to determine the costs that they will pay, by altering their shopping behaviors or remaining the same. Those who alter their behaviors in order to avoid the levy will experience no new or additional costs compared to their pre-levy condition. Those who wish to avoid paying the levy repeatedly will utilize reusable bags, and could be thought of as an ‘investment’ to avoid the levy.

3.2.8 Summary

The Levy scenario scores 26 out of a possible 35, based on its performance against the social, environmental, and economic criteria. It performed consistent “average” or “moderate” scores across all criteria. This economic instrument delivers an effective policy to reduce social, environmental, and economic impacts.

Experience from nations has shown that a PSB levy can dramatically reduce PSB consumption, between 50-90% (i.e. Ireland, South Africa). It is a reasonably fair policy because it allows consumers to place an economic value on PSB use and they have the option of avoiding the levy or not; no one is excluded from participating in their use. A reduction in non-renewable energy and litter output is closely correlated to a reduction in PSB consumption. In Ireland, where PSB consumption was reduced by 90%, litter decreased nearly 60%. Similarly, a levy *scenario* in Australia with an 85% PSB reduction was modeled to result in an 82% decrease in litter and a 63% decrease in PSB-related energy. These figures, both actual and estimated, establish a clear link between a significant reduction in PSB consumption, energy use, and litter.

While there are substantial capital and on-going economic costs for retailers and governments associated with a plastic bag levy, these costs are expected to be recovered through the generated levy revenue and purchasing alternatives. Both will incur set-up and implementation costs, from as low as €1 million (Ireland) to as high as \$300 million (Hong Kong). These costs can be recovered through the levy revenue. Potential revenues generated can surpass capital and on-going costs by the breadth of millions of dollars. As evident, a levy could be a good economic and environmental contributor.

The impact to consumers depends primarily on their choice to avoid or pay the levy. Depending on the amount of the levy, the annual cost to consumers will differ. On average, a low-to-moderate priced levy will cost consumers \$15-\$21 annually- but these costs can be avoided. Consumers can minimize the levy’s impact by purchasing and ‘investing’ in reusable bags or alternative carrying methods.

3.3 Scenario 3: Voluntary Action

Table 18: Scenario 3: Voluntary Action

	Criteria	Voluntary Action
Social Impacts	<i>The policy is fair and equitable to all affected, regardless of income, race, etc.</i>	3
Environmental Impacts	<i>Reduces consumption of plastic shopping bags</i>	3
	<i>Consumption of non-renewable energy</i>	2
	<i>Reduces litter output</i>	1
Economic Impacts	<i>Impact to retailers</i>	3
	<i>Impact to governments</i>	3
	<i>Impact to consumers</i>	2
Total (out of 35)		17

Scale: 1-5 – 1=weak (poor) performance, 5=high (good) performance

3.3.1 *The policy is fair and equitable to all affected, regardless of income, race, etc.*

A mark of “3- moderate performance” was scored, because the impact is felt primarily on retailers and is almost entirely on those participating in voluntary initiatives or agreements.

Public acceptance of voluntary retailer actions and agreements may depend on the level of environmental benefits reaped, public involvement, and accountability and responsibility for participants. If other parties, (i.e. government, the public) are involved in creating goals and guidelines for the agreement, there is more legitimacy because the retail industry would not have complete control of the agreement.

The impact on retailers is almost entirely on those participating in voluntary initiatives or agreements. There may be an unequal distribution of costs that creates greater competition between retailers (Tough 2007). Non-participants will not incur the economic costs associated with the agreement, but they may reap benefits from increased customers; customers may switch retailers if they disagree or are largely impacted by initiatives of their former retailers (i.e. now required to pay for PSB). This can be seen as

non-participating retailers ‘free riding’ off of participating retailers. Those retailers that *are* participating in the initiative will incur the associated costs, and also run the risk of losing customers.

For consumers, similar to *Scenario 1* and 2, although there is relatively high consumer fairness and equality under voluntary action, there exists the chance of unfairness and inequality occurring. If retailers implement a voluntary levy or ban, the biggest social obstacle is that not every consumer is able to afford to pay extra or purchase alternatives- low income earners may be unevenly impacted.

3.3.2 *Reduces consumption of plastic shopping bags*

This criterion scored a mark of “3- average performance” because while it does reduce overall consumption, the difference is not as significant, and over time the change is static.

Because the Australian Code of Practice was agreed until the year 2006, the Nolan-ITU (2002) report modeled a scenario for a continued voluntary levy as part of an extended Code of Practice. The study estimated that a continued voluntary levy would increase reduction to 54% from the current 34%, assuming that 72% of all retailers participated in the levy and administered it (Nolan-ITU 2002). As a result of the Code of Practice in 2002, consumption of PSB in Australia reduced by 34 percent to 2 billion bags by 2006, compared to 2002 levels of 6 billion annually (Hyder Consulting 2006; Tough 2007). Data shows that it took four years to achieve the 34% reduction (see *Table 19*); in the first year of 2002-2003 PSB use was reduced by 800 million, the following year reduced by another 500 million, and the next year (2004-2005) consumption was reduced another 800 million (Tough 2007). This amounts to a total reduction of almost 4 billion, which sets current Australian PSB consumption at 2 billion.

Similar to Australia’s Code of Practice, in Hong Kong in 2006, retailers signed a Voluntary Agreement on Plastic Bag Reduction. This agreement committed retailers to educating consumers through the “No Plastic Bag Please” and “No Plastic Bag Day” campaigns, and aimed for a reduction rate of 15%; however participation was low- only ten major retail chains signed⁴¹ (GHK 2007). According to the GHK (2007) report, participants reduced PSB use by 23-26% (approximately 110-150 million PSB) between April and December 2006, far exceeding the initial goal of 15% reduction (p.3).

⁴¹ The current signatories are: A-1 Bakery, Manning, China Resources Vanguard, Circle K, City Super, DCH Food Marts, PARKnSHOP, Pricerite, Wellcome, Watson’s (GHK 2007; 8-9).

Table 19: PSB Consumption from Australia's 'Voluntary Code of Practice'

<i>Year</i>	<i>PSB consumed (billions)</i>	<i>Change from 2002 (%)</i>
2002	6	-
2003	5.2	-13.3
2004	4.7	-21.6
2005	3.9	-34

**Notes:* Authors calculations using data from sources
Sources: (Tough 2007; 89; Hyder Consulting 2006; 10)

Table 20: PSB Consumption from United Kingdom's 'Voluntary Carrier Bag Agreement'

<i>Year</i>	<i>PSB consumed (billions)</i>	<i>Change from 2002 (%)</i>
2006	12.1	-
2007	11	-7
2008	8.6	-29
2009	7.2	-40
2010	7.5	-38
2011	8	-33

**Notes:* Authors calculations using data from sources
Sources: (WRAP 2012; WRAP 2012b)

The United Kingdom retailers⁴² created and signed the 'UK Supermarket Retailers Voluntary Carrier Bag Agreement' in 2006, which aimed at reducing single-use PSB. Approaches that were undertaken include encouraging customers to use fewer bags through promoting and incentives, training staff to ask customers if they need a bag, increasing the collection of used bags for recycling, and (in some cases) charging for 'single-use' plastic carrier bags. According to WRAP (2012), current reduction estimates from the UK Voluntary Agreement range from 35-48%, while the Author's calculations are around 33% reduction (see *Table 20*).

3.3.3 Consumption of non-renewable energy

A score of '2- low performance' was marked. There has shown to be no significant reduction in non-renewable energy use through voluntary retailer action. Unfortunately, very little data exists on energy savings from current voluntary actions.

The Nolan-ITU (2002) study states that Australia's current Code of Practice has reduced primary energy use by 2,540 gigajoules (GJ) annually (p.66); this is equal to 458.8 barrels of oil (see *Equation 1*). Using data from the Nolan-ITU study and the U.S. Energy Information Administration (USAEA), Australia consumes 356.6 million barrels of oil annually⁴³, therefore it can be estimated that the Code of Practice in

⁴² Agreement between the governments and retailers of Scotland, Defra, Wales, Northern Ireland, and the British Retail Consortium. Participating retailers include Asda, Boots, Budgens, Kwik Save, Marks & Spencer, Morrison's, Sainsbury's Supermarkets, Tesco, and Waitrose, these represent 92% of the UK grocery market.

⁴³ Authors calculations: (977,230 Barrels per day) x (365 days per year) = 356,605,000 barrels per year

Australia reduced *national oil consumption* by $1.28 e^{-6}$ (see *Equation 2*). This is seen as an insignificant amount when compared to the overall national consumption.

Equation 1⁴⁴: $2,540 \text{ GJ} = 19,277.5 \text{ gallons} = 458.8 \text{ Barrels of oil}$

Equation 2: $(458.8 \text{ Barrels of oil saved}) \div (356,605,000 \text{ Barrels/Year}) = 1.28 e^{-6}$

The Nolan-ITU (2002) report also modeled an alternative voluntary scenario; by implementing a voluntary levy in addition to Australia's Code of Practice, it could reduce energy use by 920 GJ to a level of 1,620 GJ every year (Nolan-ITU 2002; 66), approximately 39 tonnes of oil. The voluntary levy reduces *PSB-related* energy consumption by 33%, almost one-third.

3.3.4 Reduces litter output

A score of "1- weak performance" was credited because voluntary action by retailers has not shown to significantly reduce litter output. Unlike the previous two scenarios, research has found no corresponding reduction in PSB litter with a reduction in PSB consumption.

In Australia, while voluntary action saw a noteworthy reduction in PSB consumption, there was not a corresponding reduction in litter levels (EPHC 2008). Before the Code of Practice was signed in 2002, plastic bags made up roughly 2% of all litter in Australia. A few years after the Code of Practice, PSB litter has remained around the same level of 2% (Nolan-ITU 2002; Tough 2007). According to the Nolan-ITU (2002) study, Australia's current Code of Practice has reduced litter output by 188,000 kilograms annually. The ACG (2006) report estimated that a continuation of the Code of Practice in Australia from 2006-2016 would further reduce litter of PSB by 245 million more bags.

3.3.5 Impact to retailers

This criterion earned a mark of "3- moderate performance". The impact on retailers is almost entirely on those participating. Participants are affected by the cost of administering and compliance with the voluntary action, but they can also benefit from reduced costs of providing (free) PSB and a better public image.

Costs According to the ACG (2006) report, extending Australia's Code of Practice from 2006 until 2016 will cost the participating retailers \$330 million dollars; these PSB-associated costs include additional staff training, advertising and promotion, printed materials, theft, and increased transaction

⁴⁴ Converted from <<http://www.bp.com/conversionfactors.jsp>> (BP, 2012) & <http://www.onlineconversion.com/energy.htm>

times. However, the EPHC (2008) report states that the actual amount of investment and capital costs by the Australian retail industry in its voluntary efforts is unknown. Unfortunately, no further data could be found on retailer costs associated with voluntary actions.

Benefits The Nolan-ITU (2002) report calculated the economic benefits to retailers for a voluntary levy under Australia's Code of Practice. According to the report, if the current Code of Practice was extended beyond 2006 it would save retailers \$50-\$65 million by reducing costs associated with purchasing plastic bags for consumers (p.64; GHK 2007). Similarly, in a scenario with a voluntary levy **and** the extended Code of Practice, the report estimated a retailer savings of \$104 million (ibid). Also, signatories of the UK retailer voluntary agreement saw their sales volumes increase by 8.0% between 2006 and 2010, with an average annual increase of 2.0% (WRAP 2011). No scientific data could be found to explain why overall sales increased, but this could be partially explained through increased sales of reusable bags or alternative carrying methods, or increased customers satisfaction and numbers because of a better public persona and environmental responsibility (ACG 2006).

3.3.6 Impact to governments

This criterion scored a "3- moderate performance" because there is minimal government involvement or resources used. In most cases, the government is not a party in the agreement or negotiations, and leaves it up to the participants to manage (Crocì 2005). Minimal involvement leads to minimal associated costs, while obtaining some indirect benefits, such as reduced litter.

Costs Costs to governments are expected to be minor and/or negligible under voluntary action by retailers. Voluntary actions tend to have lower administration and compliance costs because they usually do not require costly monitoring and enforcement. However, some agreements and educational campaigns involve government participation. For example, according to the GHK study (2002) the Hong Kong government actively participates in the voluntary retailer agreement- this costs the government \$374,000⁴⁵ each year; these costs include marketing, staffing, and education and awareness (p.66).

Benefits The reduction in PSB consumed will reduce associated litter, although miniscule. The ACG (2006) report estimates that a continuation of Australia's Code of Practice would save the government \$12.9 million over ten years between 2006 and 2016 in reduced litter clean-up expenses. For this research, the Author projects that a voluntary levy on PSB would be subject to general sales tax (GST); therefore consumers purchasing PSB would also pay a small GST on top of the levy. This revenue from

⁴⁵ HK\$2.9 million (GHK 2007; 66)

the GST would go directly to the government. According to the Nolan-ITU (2002) report, an Australian GST of up to 10% could raise government revenues of tens of millions of dollars, depending on the cost of the levy and the amount of reduction in PSB (p.59).

3.3.7 *Impact to consumers*

This criterion earned a mark of “2- low performance” because while the costs to consumers are minor and insignificant, there are little-to-no benefits. According to the GHK (2007) report, the “direct cost of the Voluntary Scheme to consumers is nil” (p.32). However, the report is of the opinion that consumers may indirectly be effected depending on if retailers pass on changes in costs or savings from the voluntary action onto consumers.

Costs As previously mentioned in *section 1.2.1.1*, consumer PSB costs average \$10 per person per year. However, the Nolan-ITU (2002) report estimates that the Code of Practice in Australia costs consumers an additional \$3-5/year, totaling \$13-15 annually (ibid). This additional cost includes the extra costs of purchasing reusable bags and replacement bin liners in substitution of PSB.

Benefits The benefits to consumers are considered insignificant. Economic benefits are likely to be insensitive to changes through voluntary action. It can be argued that the biggest benefit for consumers is the increase in awareness and education of PSB through voluntary initiatives and campaigns, such as Hong Kong’s “No Plastic Bag Please” and “No Plastic Bag Day”, Australia’s PSB drop-off recycling bins, and overall promotion of reusable bags.

3.3.8 *Summary*

The Voluntary Action scenario scores 17 out of a possible 35, based on its performance against the social, environmental, and economic criteria. It did not score above an ‘average’ in any criteria. It is unlikely that voluntary initiatives would approach near-full compliance across the entire retail sector, due to competition for customers. In addition, it may be more difficult to implement and sustain, therefore resulting in lower PSB reductions.

Lessons from the Australian, United Kingdom, and Hong Kong retailer voluntary agreements resulted in moderate PSB reductions of 34%, 35%, and 25%, respectively. Voluntary action is unlikely to achieve significant or influential reductions in PSB use, due to low retailer participation. Despite these reductions, research has shown that there is little-to-no corresponding reduction in litter levels, contrary to previous *Scenario 1* and *Scenario 2*.

Voluntary actions are weakly sanctioned and generally targeted, but have merits for being simple and inexpensive to implement for retailers and governments, and are low-cost to consumers; voluntary initiatives place more of the burden on retailers than on governments and consumers. Costs to governments and consumers are expected to be minimal. The Australian Voluntary Code of Practice resulted in only a \$3-\$5 annual increase for consumers. The government receives benefits through reduction in litter clean-up expenses, averaging \$1 million annually in Australia, while the Hong Kong government spends \$374,000 annually in marketing, staffing, and education and awareness (p.66). Research and studies have found that voluntary measures result in less participation from retailers and consumers, and must have education and awareness campaigns alongside to build consumer understanding of the measures taking place (GHK 2007; Nolan-ITU 2002; Croci 2005). The Nolan-ITU (2002) report recommends that voluntary initiatives and agreements should be undertaken at a national level, in order to guarantee full coverage and result in lower PSB consumption; this would address issues about competition and compliance.

IV. Discussion

4.1 Overview

A comparison of each policy instrument's scores against the criteria is provided in *Table 21*.

Table 21: Summary of Policy Scenarios

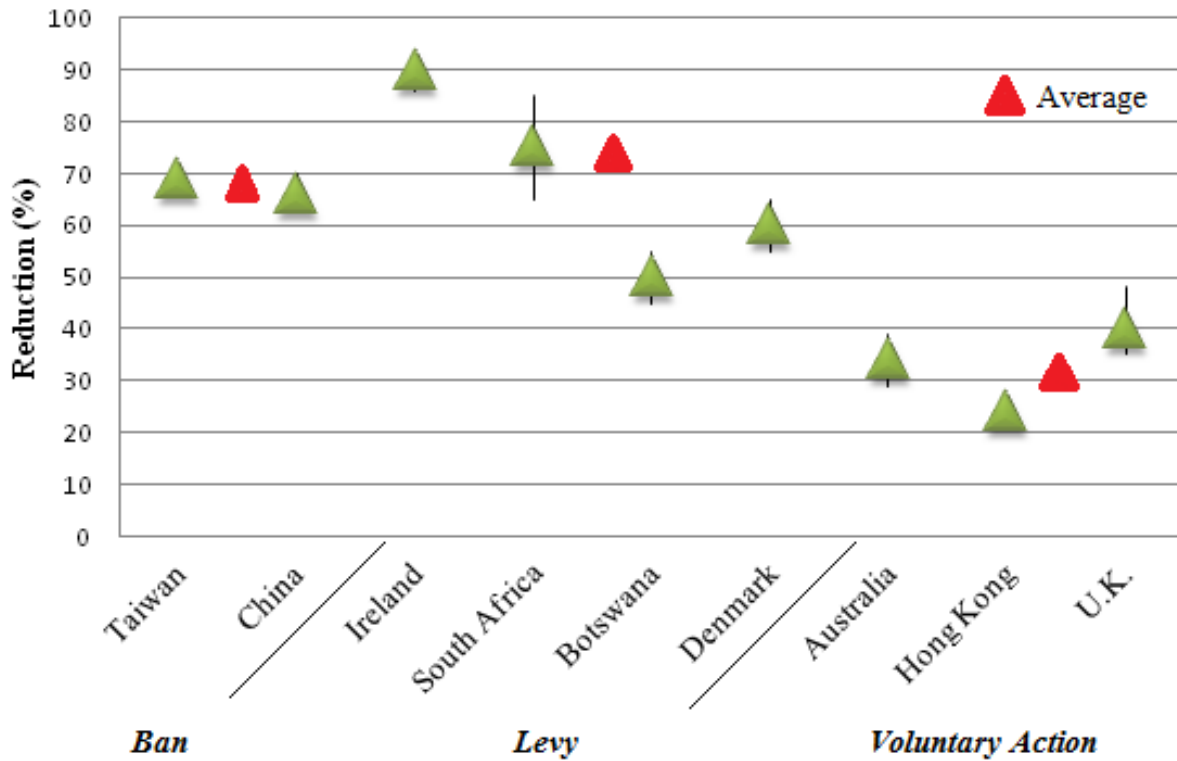
	<i>Criteria</i>	<i>Scenario 1: Ban</i>	<i>Scenario 2: Levy</i>	<i>Scenario 3: Voluntary Action</i>
Social Impacts	<i>The policy is fair and equitable to all affected, regardless of income, race, etc</i>	4	4	3
Environmental Impacts	<i>Reduces consumption of plastic shopping bags</i>	5	4	3
	<i>Consumption of non-renewable energy</i>	3	3	2
	<i>Reduces litter output</i>	3	4	1
Economic Impacts	<i>Impact to retailers</i>	2	4	3
	<i>Impact to governments</i>	2	3	3
	<i>Impact to consumers</i>	2	4	2
TOTAL (out of 35):		21	26	17

Scale: 1-5 – 1=weak (poor) performance, 5=high (good) performance

From *Table 21* it can be seen that there is wide discrepancy between all three policy instruments. Out of a possible top score of 35, *Scenario 1: Ban* scored 21 points (equal to 62.9%), *Scenario 2: Levy* scored 26 points (equal to 74.3%), and *Scenario 3: Voluntary Action* scored 17 points (equal to 48.6%).

This analysis shows that a levy has the highest overall performance when analyzed against social, environmental, and economic criteria. Therefore, this research finds that a levy is the most preferred and effective policy instrument that can best address PSB consumption and PSB impacts. A levy for plastic shopping bags provides a market instrument for reducing consumption, addresses environmental concerns, generates revenue for environmental causes, and stimulates behavioral changes while facilitating consumer choice.

Table 22: PSB Reduction by Policy Scenario



Comparing all scenarios, a levy and ban tie for the highest score in environmental criteria. Against the criterion ‘*Reduces consumption of plastic shopping bags*’, a levy produces the largest average reduction in PSB consumption, followed closely by a ban, while voluntary action lags far behind (see Table 22 for a comparison of all policy instruments). Theoretically, a ban should produce the largest amount of reduction; however a 100% reduction in PSB is not possible or likely. Of the two ban-case studies presented, Taiwan and China, both are relatively new policies (2003 and 2008, respectively) and there still persists numerous bag exemptions and illegal selling. This negatively affects total PSB reduction.

Against the ‘*Consumption of non-renewable energy*’ and ‘*Reduces litter output*’ criteria, there are large discrepancies between impacts. After a PSB ban, China saw its PSB-associated crude oil consumption decrease by 32% (Warner 2010), but no reliable and scientific data on litter reductions could be found. The EPHC (2008) and Herrera et al. (2008) reports offer conflicting estimates on ban litter reductions. The EPHC (2008) report estimates a ban would reduce litter by 80% (p.43), while Herrera et al. (2008) estimates reduction to be only 28-35% (p.6-14). Therefore, it is difficult to reliably ascertain the potential litter reductions from a PSB ban.

A levy performed ‘average’ for reducing ‘*Consumption of non-renewable energy*’, and ‘moderately’ in ‘*Reduces litter output*’; research showed that these two criteria lead to a corresponding reduction in PSB consumption. A PSB levy in Ireland saw litter output dramatically decrease by 60%. *Hypothetical* models from Cadman et al. (2005) and Nolan-ITU (2002) of a levy in Australia and Scotland saw litter output decrease by 82% and 50%, respectively. According to Rucker et al. (2008), Ireland’s PlasTax also decreased PSB oil use by 4.8 million gallons, approximately 0.2% of national oil consumption. Further studies by Nolan-ITU (2002) and Cadman et al. (2005) estimated that under a proposed levy, Australia could reduce PSB energy use by 54-63%, while Scotland could reduce PSB energy use by 42%.

Voluntary action showed weak performance against environmental criteria. Unlike the other two policy instruments, research has not shown strong correlating evidence between reduction in PSB litter, PSB non-renewable energy use, and reduction in PSB consumption. Under Australia’s Voluntary Code of Practice, PSB litter output has remained steady at 2% with no notable change since the code’s implementation (Nolan-ITU 2002; Tough 2007). There has also shown to be an insignificant change in energy consumption for Australia- the Code of Practice eliminated 458.8 barrels of oil, an almost imperceptible amount of $1.28 e^{-6}$ of national oil consumption.

Previous studies have also concluded that a mandatory levy on PSB is the best policy instrument for addressing PSB consumption and impacts. The ACG (2006) report supports the finding that price-based approaches, such as a levy, are considerably more cost-effective than a ban, and more effective than voluntary initiatives (p.xi). The EPHC (2008) report found that a levy produces the most environmental benefits and social impacts, and has strong public support for government intervention; likewise, the Changshe Norbu (2009) study found that PSB levies were the most successful policy instrument in many countries. The study also recommended that a levy may need to be revised over time to accommodate for changes in consumer behavior. A similar study by Nolan-ITU (2002) concluded that a \$0.25 levy would be the best option for PSB management.

Levy Of the three policy instruments evaluated, *Scenario 2: Levy* scored the highest total score, 26 points, against the social, environmental, and economic criteria. It constitutes an effective policy instrument in significantly reducing PSB and its impacts. Against the social criterion, a levy allows consumers the freedom to choose whether to purchase or not, while still being set at a level high enough to make consumers think about their willingness to pay for a plastic bag. Against environmental criteria, a levy significantly reduces PSB consumption and simultaneously reduces litter output and non-renewable energy use.

Countries with a PSB levy have seen considerable reductions in PSB use, litter output, and energy use (i.e. Ireland, South Africa). Studies have estimated that Ireland's PlasTax reduced litter output by 60%, and this study calculated that it reduced overall national oil consumption by 0.2%; both of these figures are the highest confirmed reductions among all three policies. A study by Cadman et al. (2005) estimated that, if implemented, a levy in Scotland would see a 42% decrease in PSB-associated non-renewable energy, with a corresponding 50% litter decrease (p.25-26).

Although there are considerable costs for retailers and governments under a levy, both benefit from funds generated, less-cost of providing free PSB, and reduction in PSB-related environmental expenses (i.e. litter clean-up) (EPHC 2008). From these funds, governments could recover administration and enforcement costs, while retailers could recover compliance costs. The potential revenue is in the million to hundreds of millions of dollars- the Irish PlasTax raises annual revenues of €12-€14 million, while a mandatory levy in Hong Kong could potentially generate as much as \$309 million in revenue (McDonnell & Convery 2008; GHK 2007). Additional revenue can be used to fund activities and projects; Ireland's revenue from the PlasTax is reallocated to fund environmentally related projects, such as litter cleanup, recycling, and educational and informational campaigns.

Consumers can determine the costs that they pay, and the benefits that they may receive. Studies have estimated that the average consumer will pay \$15-\$21 per year; this includes the cost of purchasing reusable bags and occasionally paying the levy (Cadman et al 2005; 34; AP EnvEcon 2008; 40; Nolan-ITU 2002; 11). Consumers can avoid paying the mandatory levy by bringing reusable bags or alternative carrying methods (i.e. back packs, trolleys, etc.).

Recommendations Although this research finds that a levy is the most effective policy instrument, there is still potential for plastic bag levies to improve overall performance. To improve general performance and success, this research suggests:

1. *Stringent monitoring and enforcement.* For optimal impact and success, it's essential to have strict monitoring and enforcement, to ensure the law is being followed and reduce illegal activity. McDonnell & Convery (2008) believe that the successful implementation of a levy might be hindered because of avoidance of the tax and lack of enforceability.
2. *Appropriate levy amount.* The levy must be set at an appropriate amount in order to be publicly acceptable and produce behavioral changes and overall reduction. This amount should be set at a level that reflects consumers' 'willingness to pay' for the good or service.

3. *Establish penalties for non-compliance.* Penalties must be established and enforced for non-compliers. Penalties will help to deter would-be law breakers, and incentivize consumers to follow the law. The less illegal activity, the more behavioral changes and overall reduction.

Ban With a total score of 21, a ban scores well on the social and environmental criteria, but poorly on the economic impacts. Case studies and research have shown that while a ban is effective in reducing PSB consumption, it removes consumer freedom, does not facilitate consumer choice, and is viewed as a ‘blunt instrument’ for achieving its objective. However, a ban has proven to show a corresponding relationship between reductions in PSB consumption and reductions in non-renewable energy use and litter output associated with PSB. The ACG (2006) report is of the opinion that a ban “provides a significant step towards phase out of plastic bags, but is not considered to be as effective.... as the market based mechanisms” (p.43).

Consumers are impacted negatively through a ban, because they are now forced to find alternative carrying methods which can be costly or inconvenient. There are costs for retailers and even more for governments; retailers will be responsible for costs for staff training, equipment modification, theft, increased transaction times, and in-store promotion, while the government has a huge burden for monitoring and enforcement. Unlike in a levy policy, studies concluded that these costs from a ban would be irrecoverable because there is no direct revenue produced to offset the costs⁴⁶.

Recommendations There is potential for plastic bag bans to improve overall performance. To improve general performance and success, this research suggests:

1. *Keep exemptions from a ban to an absolute bare minimum.* The more exemptions, the more complicated and costly monitoring and enforcement will be. More exemptions also allow more room for consumers to take advantage of and use these bags for alternatives purposes. Consumers can also be confused or misunderstand from the complexity, which can create resistance or delay public acceptance.
2. *Establish penalties for non-compliers.* According to Lindeneg (1992), “If society wishes to give individuals an incentive not to break the law” (p.283), then a fine or penalty can deter non-compliers. The penalty must be greater than what the “individual gain received by breaking the law” (ibid).
3. *Stringent monitoring and enforcement by overseeing authority.* Measures should be taken to improve monitoring and enforcement. These are essential in making sure that all participants

⁴⁶ There may be small amounts of revenue from fines and penalties for non-compliers, but these costs are expected to be negligible.

are following the law, there are no free-riders, and carry out rectification and punishment. The less illegal activity, the higher the overall success will be. The Changshe Norbu (2009) study stated that while bans have been successful in some countries, but it requires adequate and regular monitoring and resources to be.

Voluntary With a total score of 17, this research has shown that voluntary actions can only have an impact up to a point; beyond this, further intervention would be required⁴⁷ to achieve more reductions in PSB use and its impacts. While voluntary actions cost less overall compared to the other scenarios analyzed, it also achieves less. According to Tough (2007) and the EPHC (2008) report, government intervention is considered essential during voluntary initiatives, because the initiatives alone are unlikely to change the environmental status, and cannot provide a “level playing field for retailers” (Tough 2007; 86).

Voluntary actions run the risk of free-riding and cheating, which undermines the collective benefits. In absence of enforcement and penalties, non-participants can have a competitive advantage, and result in an unequal distribution of cost impacting on competition.

Recommendations There is potential for plastic bag voluntary actions to improve overall performance. To improve general performance and success, this research suggests:

1. *Establish sanctions for non-compliance by participants.* Sanctions should be agreed upon and applied in cases of non-compliance. Without punishment, participants will “compare the benefits deriving from the non-compliance with the expected costs” (Crocì 2005; 22). These sanctions prevent the likelihood of free-riding, and increase compliance and target success.
2. *Targets must go beyond ‘business as usual’.* Voluntary action can stimulate innovation and performances, but the established targets must be set at a notably high level. According to Crocì (2005), sometimes some voluntary actions set low targets, and in some cases these targets are close or under the ‘business as usual’.
3. *Threat of regulation.* The ACG (2006) report and Crocì (2007) suggests that in order for voluntary actions to be effective, there must be an active, legitimate threat of regulation. If the threat of regulation isn’t legitimate, participants may forgo voluntary action and risk regulation. However if the threat is legitimate, participants may chose voluntary actions because they are deemed less costly and flexible than regulation.

⁴⁷ I.e. the threats of regulation, government involvement, provide incentives for participation, etc.

V. Conclusion

International experience regarding plastic bags has provided policy makers with a variety of policy instruments. While many countries have already taken action to address plastic bags, there are still many countries which need to find and implement a policy instrument in order to alleviate or solve plastic bag use and impacts. This analysis explored the three most common policy instruments available to policymakers for addressing the issue of plastic bags, and analyzed these instruments' performance against social, environmental, and economic criteria.

This analysis has concluded that plastic bags and their impacts are best addressed by implementing a mandatory levy on plastic bag use. In countries or regions where policymakers are trying to reduce plastic bag consumption, this paper finds that a levy is the most effective policy measure. According to case studies and research, the effect of the tax on the use of plastic bags has been dramatic, with consumption falling by more than 90% in some countries, and associated impacts substantially decreasing. While there are risks and costs associated with the levy, it offers the biggest potential positive impacts across social, environmental, and economic considerations.

With almost 1 trillion plastic bags consumed every year, the use, and overuse, of plastic shopping bags is unsustainable for society and the environment. Whichever option policy makers choose, one thing is certain- the negative impacts associated from plastic bag consumption will continue to persist unless actions are undertaken.

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Appendix 1

Table A1: Retailers' Costs under a Ban

	<i>Staff training</i>	<i>Equipment modification</i>	<i>Theft</i>	<i>Increased transaction times</i>	<i>In-store education and promotion</i>	Total
Retailers (small, medium, large)	\$65,702,736	\$1,710,000	\$120,000,000	\$29,452,491	\$29,023,875	\$245,889,102

*Note: Costs for 68,000 retailers

*Note: "Administration" costs for retailers were not included in this analysis, because no monetary values were given

Source: (EPHC 2008; 62)

Table A2: Ireland's Yearly Litter Decline

<i>Year</i>	<i>Percentage of litter (%)</i>
2001	5.0
2002	0.32
2003	0.25
2004	0.22
2005	0.22
2006	0.52
2007	0.29
2008	0.29
2009	0.24
2010	0.25

Source: (AP EnvEcon 2008; 119; Hogg et al. 2011; 98).

Table A3: Revenue from Irish PlasTax Levy 2002-2007

<i>Year</i>	<i>Revenue Returns (€)</i>
2002	7,188,973.48
2003	12,750,954.31
2004	13,536,752.62
2005	17,544,295.77
2006	18,701,367.23
2007	15,565,283.88
Total:	85,287,627.29
2008*	22,600,000

*Note: After 2007, the levy was increased from €0.15 to €0.22

Source: (McDonnell & Convery 2008; 11; AP EnvEcon 2008; 101)