TBT PROGRAMME - REG/FED/022-667

TRADE REGULATORY IMPACT ASSESSMENT - MAURITIUS

INVESTIGATION OF OPTIONS TO REDUCE THE IMPACTS OF POLYETHYLENE TEREPHTHALATE (PET) BOTTLES IN MAURITIUS

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GLOSSARY

GHG	Green house gases
GWh	Giga Watt hour
GWP	Global Warming Potential
HDPE	High Density Polyethylene
LCA	Life Cycle Analysis
LDPE	Low Density Polyethylene
MCCI	Mauritius Chamber of Commerce and Industry
MEA	Ministry of Environmental Affairs (Ministry of Environment, Sustainable Development, and Disaster and Beach Management)
MRA	Mauritius Revenue Authority
MWh	Mega Watt hour
MSW	Municipal Solid Waste
PET	Polyethylene Terephthalate
PP	Polypropylene
RIA	Regulatory Impact Assessment

EXECUTIVE SUMMARY

This regulatory impact assessment (RIA) aims at assessing policy options to reduce the use and especially the litter and landfill of polyethylene terephthalate (PET) bottles in Mauritius, predominantly by increasing recycling of PET bottles.

What is PET?

Polyethylene terephthalate (PET), from which most single-use bottles (and some other containers) are made, has a high strength-to-weight ratio, which makes it a good choice for beverage containers because they can hold a lot yet are light. PET bottles are popular with consumers and retailers because they provide a convenient, highly functional, lightweight, strong, cheap and hygienic way to contain beverages.

How are PET bottles disposed of?

A significant number of PET bottles end in litter, and most PET bottles end in landfill, rather than being recycled. The following economic factors are crucial in determining the optimal recycle rate of PET bottles: (i) costs of plastic recycling by process (collection, transport, etc.); (ii) costs of regulatory compliance and administrative work (licences, fees, paper work etc.); (iii) market price for recycled plastic in comparison to the virgin material they replace; and (iv) recycled plastic price volatility and transport costs estimates. The main benefits of recycling are a reduction of virgin raw materials, energy and GHG emissions and decrease Global Warming Potential (GWP).

How many PET bottles are used in Mauritius? What is their recycling rate?

Government has indicated that at present, Mauritius consumes around 100 million PET beverage bottles per year. With a population of 1.33 million, this would give a figure of 75 beverage bottles per person per year, of which approximately 38 end in landfill or litter. Information shows that at present approximately 9 million PET bottles are sold each month and that approximately 40% of all PET bottles are retrieved and recycled through shredding and subsequent exportation. In Mauritius, approximately 50 million PET bottles end in landfill each year, and this figure is expected to increase significantly unless there is a regulatory intervention.

What is the current legal framework?

In 2006, the Government imposed a levy of Rs1 on all PET bottles at the bottler, i.e. the entity that placed the beverage inside the bottle. In 2010 the levy was increased to Rs2 per PET bottle. This levy is paid over monthly by the bottlers, but is not directly recouped from consumers. The same levy also applies to any beverages imported in PET bottles. The levy is only collected on PET beverage bottles and not on all PET bottles. This means that 27% of all PET bottles are not currently subject to the levy. In 2013 a total of Rs178,654,820 levy were collected; in 2014 a total of Rs194,426,230.

What are the underlying problems?

The use of PET bottles entails negative environmental externalities (littering, greenhouse gas emissions, contamination of air, soil and water, and impacts on ecosystems and human health) that are not reflected in the prices paid by the end-users, who only pay for the final product, i.e. the beverage in the PET bottle. Consumers are neither encouraged to limit their use of PET bottles, nor to recycle them, and are generally not aware of the levy included in the price they pay. Further market failures relate to low consumer awareness of the problem of litter and the overall environmental benefits of recycling PET bottles. A regulatory failure is that the levy is only collected on PET beverage bottles and not on all PET

bottles. Thus, the levy is enforced on 3,500 tons of PET bottles, but not on the other 1,300 tons. This means that 27% of all PET bottles are not currently subject to the levy.

What are the policy objectives?

Regulatory intervention is proposed with regard to PET bottles to increase the rate of recycling of such bottles from around 40% to at least 70% within a period of two years in order to decrease the volume of PET bottle landfill and litter by 50% over the same period.

In essence, the objectives of government regulation are to:

- Reduce the impacts of PET bottles, including the volume of litter and landfill;
- Satisfy community expectations for government intervention; and
- Redress the market failure associated with PET bottle usage.

Who are the most affected stakeholders?

Most affected stakeholders include:

1. Beverage producers and bottlers;
2. Plastic recyclers;
3. Public authorities;
4. Tourism industry and local businesses;
5. Traders and retailers.

What are the policy options considered?

Between government, PET bottlers, pre-formers and an analysis of policy options considered in other jurisdictions, various policy options were placed on the table. These are the following:

- Retain the status quo
- Bottle banks
- Curb-side collection
- Expand levy to include imported bottled products
- Increase the levy to Rs5 per bottle
- Enforce the levy at exit point to the consumer
- Deposit system
- A public awareness programme, including general education on waste, litter and reusable alternatives
- Litter management and enforcement
- Access to waste transit depots
- Incineration of plastics (and other waste)

Options that were considered include:

- Option 1: the current status, i.e., the situation with no new regulatory intervention
- Option 2: Deposit system
- Option 3: Expand levy to include other products
- Option 4.1: Access to waste transfer sites
- Option 4.2: Access to waste transfer sites along with expanded levy
- Option 5: Increase incentive for recycling

What are the impacts of the different policy options?

Multi-criteria analysis

Criteria/Option	1	2	3	4.1	4.2	5
Socio-environmental impacts						
Impact on public spaces	=	+	++	++	+++	+
Support behaviour change in consumers	=	++	=	=	=	=
Environmental impacts						
Litter	--	+	++	++	+++	+
Resource efficiency	--	+	++	++	+++	+
Emissions	--	+	++	++	+++	+
Landfill	--	+	++	++	+++	+
Reduction in GHGs	--	+	++	++	+++	+
Economic impacts						
Impacts on bottlers	=	-	-	-	---	---
Impacts on recyclers	=	+	++	++	+++	+
Impacts on collectors	=	-	++	++	++	+
Impacts on consumers	=	-	--	=	--	=
Impact on major retailers	=	--	=	=	=	=
Impact or small/informal traders	=	--	=	=	=	=
Administrative burden	=	---	--	=	--	=
Impact on job creation	=	+	+	++	+++	=
Trade balance/balance of payments	-	++	++	++	+++	+
Net government levy	=	-	+++	-	+++	-

What is the preferred policy option?

It is clear that Option 1 – current situation – is not sustainable, as the anticipated increase in PET bottle consumption will place a significant strain on landfill options in Mauritius. Likewise, Option 5 – increased incentives – is not viable for the same reasons, as well as the additional costs associated therewith.

Option 2 – deposit system – also appears not to be sustainable, despite the fact that it would have the biggest impact on consumer behaviour. The unsustainability is a result of the market situation in Mauritius, where small traders represent a significant proportion of the overall trade in PET bottles and the impact a deposit system would have on them. The consultation process revealed that small traders represented at least 50% of all PET beverage bottle sales and a significant, albeit smaller, percentage of all other PET bottle sales.

Both Options 3 (extension of the scope of the levy to include non-beverage PET bottles) and Option 4.1 (access to waste transfer stations) are sustainable and would significantly increase the overall recycling rate of PET bottles. However, Option 4.2, which combines Options 3 and 4.1, is preferred, as it would both extend coverage of the levy and the recycling incentive to non-beverage bottles and increase the current recycling rate on PET beverage bottles. This Option would also lead to significantly increased net

levies for government, the most significant impact on the balance of trade, the biggest job creation and the biggest reduction in litter and landfill, although it will also have the same significant impact on non-beverage PET bottlers as Option 3.

1. PROBLEM DEFINITION

1.1 Introduction

"Every piece of litter has a human face behind it."[1]

This regulatory impact assessment (RIA) aims at assessing policy options to reduce the use and especially the litter and landfill of polyethylene terephthalate (PET) bottles in Mauritius, predominantly by increasing recycling of PET bottles. This section provides a note on the scope of the regulatory impact analysis and identifies the parameters for the study as set out by the Ministry of Environmental Affairs (MEA).

1.2 Polyethylene terephthalate (PET)

Polyethylene terephthalate (PET), from which most single-use bottles (and some other containers) are made, has a high strength-to-weight ratio, which makes it a good choice for beverage containers because they can hold a lot yet are light.[2]

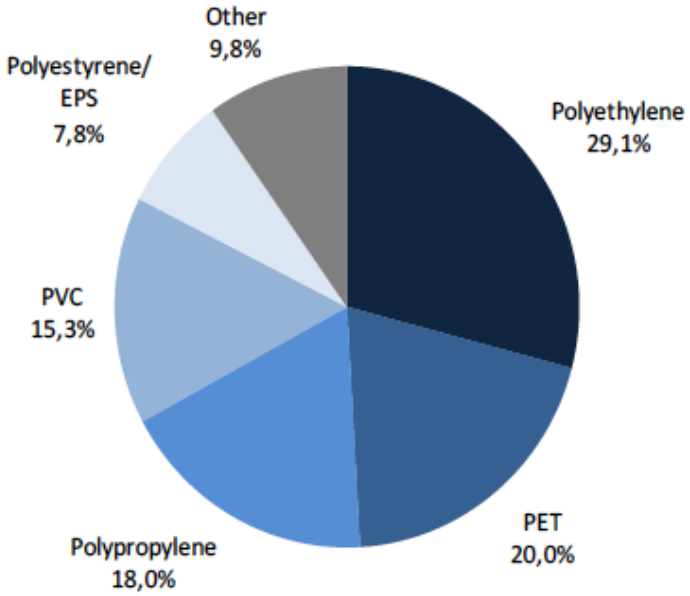
PET bottles are popular with consumers and retailers because they provide a convenient, highly functional, lightweight, strong, cheap and hygienic way to contain beverages. Since the decision of the packaging material (PET bottles, aluminium can or glass) is taken by the bottler, consumers have little choice in the matter, their choice being limited to deciding whether to buy a 250 ml glass bottle of Coke, a 330 ml aluminium can of Coke, or a 500 ml, one litre, 1.5 litre or two litre PET bottle of Coke. This decision is general more influenced by the volume required and the price per volume, than by the choice of container.

Both beverage producers and consumers choose PET bottles far more often than glass bottles. Consumers like the fact that compared to glass, PET bottles are convenient, highly functional, lightweight, strong, flexible, cheap and hygienic. It is also cheaper to recycle PET bottles than to reuse glass bottles. Non-refillable (PET) beverage packaging has the lowest total social cost, mainly due to the lower internal cost.[3] Research has shown that the overall weight of packaging for glass bottles is more than 20 times that of PET bottles, while aluminium cans weigh about 10% less than PET bottle systems.[4] PET bottles also consume less energy; generate less solid waste and generate less greenhouse gases than either glass bottles or cans.[5]

PET is the second most prolific plastic in the world:[6]

[1] Rob Krebs, a spokesman for the American Plastics Council.
[2] Camann (2010).
[3] RDC-Environment (2003) XIII.
[4] Franklin (2009) ES-3.
[5] Franklin (2009) ES-4.
[6] BIO Intelligence Service (2011) 37 shows that although worldwide PET constitutes 20% of all plastics, it only constituted 7% of all plastics in the EU in 2008.

Figure 1. Use of PET and other types of plastics



Source: BIO Intelligence Service (2011) 37

In the EU, PET is the fourth most used plastic packaging product, making up 15% of total plastic packaging products there,[7] with plastic packaging making up 63% of total plastic waste.[8] PET therefore constitutes approximately 9.5% of all plastic waste. PET is generally used for soft drinks, water, oil, vinegar, juices, sauces, medical products and some non-food products, such as toiletries.[9] Approximately 66% of all plastic bottles in the EU are produced from PET, the remainder being produced from HDPE, LDPE or PVC.[10] Bottles constitute 39% of all plastic packaging waste.[11] In the US, PET typically constitutes around 3.1% of the total solid municipal waste collected by weight, but around 9% by volume (or 6.4% if compacted).[12]

It takes more than 3 litres of water to produce 1 litre of bottled water.[13] Worldwide, bottling water (to the exclusion of all other beverages bottled in PET bottles) produced more than 2.5 million tons of CO_2 in 2006.[14] Bottled water costs on average 500 times as much as tap water.[15] The carbon footprint of a single 500ml PET bottle is approximately 83 g of CO_2.[16] In the EU, consumer beverage packaging accounts for around 20 % of total packaging by weight.[17]

[7] BIO Intelligence Service (2011) 41.
[8] BIO Intelligence Service (2011) 65.
[9] BIO Intelligence Service (2011) 42.
[10] BIO Intelligence Service (2011) 43.
[11] BIO Intelligence Service (2011) 43.
[12] Franklin (2010) 2-6 – 2-7.
[13] http://www.pacinst.org/publication/bottled-water-and-energy-a-fact-sheet/.
[14] Oikos Consult (2013) 5.
[15] Oikos Consult (2013) 6.
[16] Oikos Consult (2013) 6.
[17] European Commission (2009) 1.

1.3 Recycling PET

A significant number of PET bottles end in litter, and most PET bottles end in landfill. In order to reduce landfill and litter, it is important to determine the "optimal recycling rate" for PET bottles.

The optimal recycling rate is the share of packaging waste among total packaging waste generation for which:

- under the concrete geographical conditions,
- given the alternative disposal method and
- assuming a realistic participation of the population

recycling is preferable to landfilling and incineration.[18]

The following economic factors are crucial in determining the optimal recycle rate:

- Costs of plastic recycling by process (collection, transport, etc.);
- Costs of regulatory compliance and administrative work (licences, fees, paper work etc.);
- Market price for recycled plastic in comparison to the virgin material they replace;
- Recycled plastic price volatility and transport costs estimates.[19]

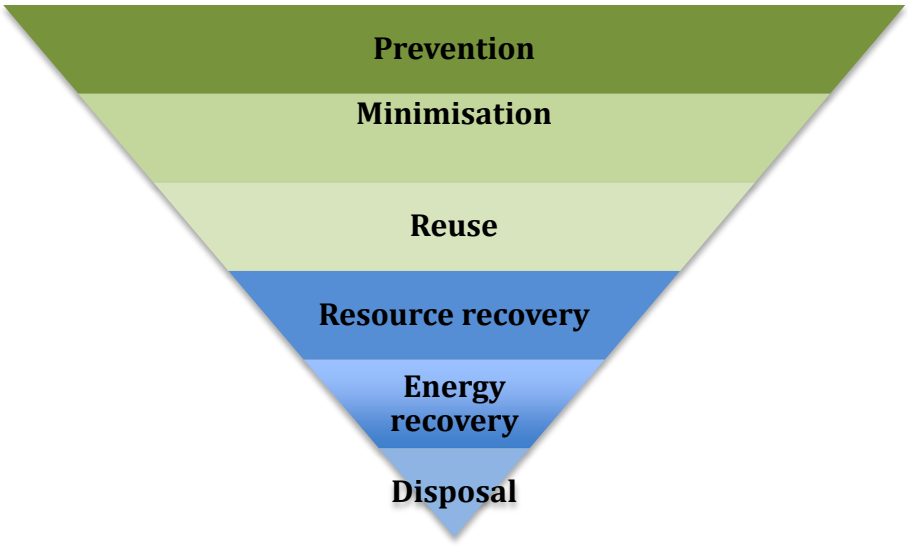
As the recycling of PET bottles in high population density areas with landfilling as alternative treatment results has the lowest total costs, all PET bottles arising in areas with these conditions should go to recycling and are counted for determining the optimal recycling rates.[20] Despite this, research has shown that recycling has the lowest end-of-life impact on human toxicity, followed by incineration with energy recovery, with landfill being the worst option.[21]

The main benefits of recycling are a reduction of virgin raw materials, energy and GHG emissions and decrease Global Warming Potential (GWP). However all types of waste can be recycled and recycling is not always cost-effective. Although landfill is an old concept, it is simple and cost effective, provided sufficient land is available. However, landfill may have negative impacts on human health and environment and should only be an option for waste that cannot be recycled or otherwise used, e.g. through combustion with energy generation.[22]

[18] RDC-Environment (2003) 17.
[19] BIO Intelligence Services (2011) 103.
[20] RDC-Environment (2003) 17.
[21] BIO Intelligence Services (2011) 107.
[22] Mohee (2014) 15.

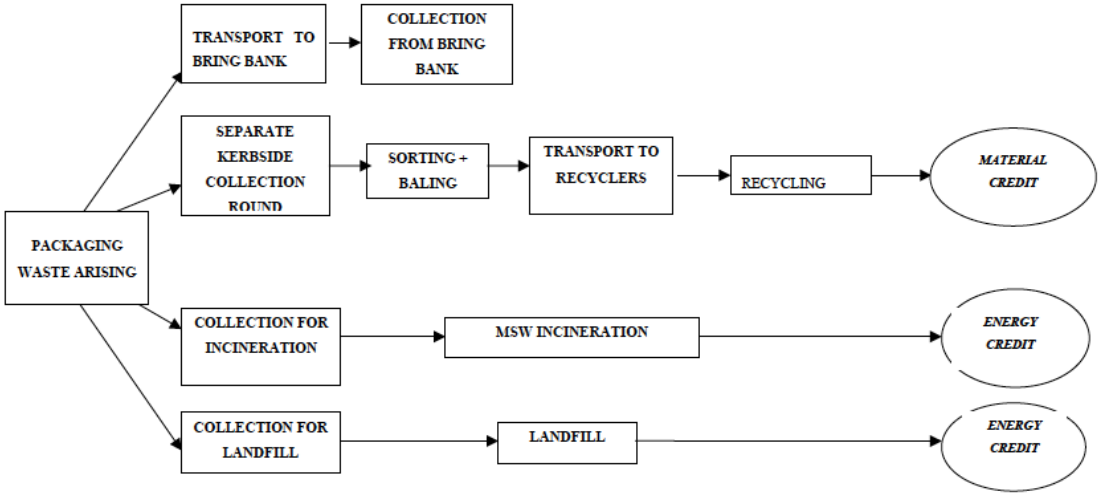
Figure **2** illustrates the waste management hierarchy and shows that recycling is preferable to incineration which, in turn, is preferable to landfill.

Figure 2: Waste management hierarchy



Source: Flanigan (2013) 25.

Figure 3: generic process tree for the recycling case study (household packaging)[23]



Considering the LCA for PET bottles, research shows that the production of one kilogram of PET consumes 84 MJ of energy (83.8MJ in the production process and 0.2MJ in for transport) and produces 45g of solid waste,[24] 2.33kg of CO_2, as well as 103g of other GHG.[25] For recycled PET, the total energy consumption decreases to 27.27MJ/kg (27.07MJ in the production process and 0.2MJ for transport), there is no solid waste in the production process, CO_2 emissions decrease to 163g, and other GHG to 7.25g.[26] Total energy consumption therefore decreases by 67.5%, solid waste by 100% and GHG by 93%. Where PET bottles are incinerated for energy, the LCA values change to 32.7MJ of energy consumed,

[23] RDC-Environment (2003) 32.
[24] Note that this is the solid waste during the production process and not the solid waste as a result of the disposal of the final product after use.
[25] Borodin (2015) 2.
[26] Borodin (2015) 2-3.

2,016g of CO_2, and 3.65g of other GHG.[27] There is thus very strong motivation to increase the recycling rate for PET bottles. The total GHG emissions per kg of PET bottle, expressed as kg-CO_2 equivalent, is 3.33kg for recycled PET, 4.3kg for incinerated PET and 47kg for landfilled PET (i.e. 14.1 times as much as for recycled product).[28]

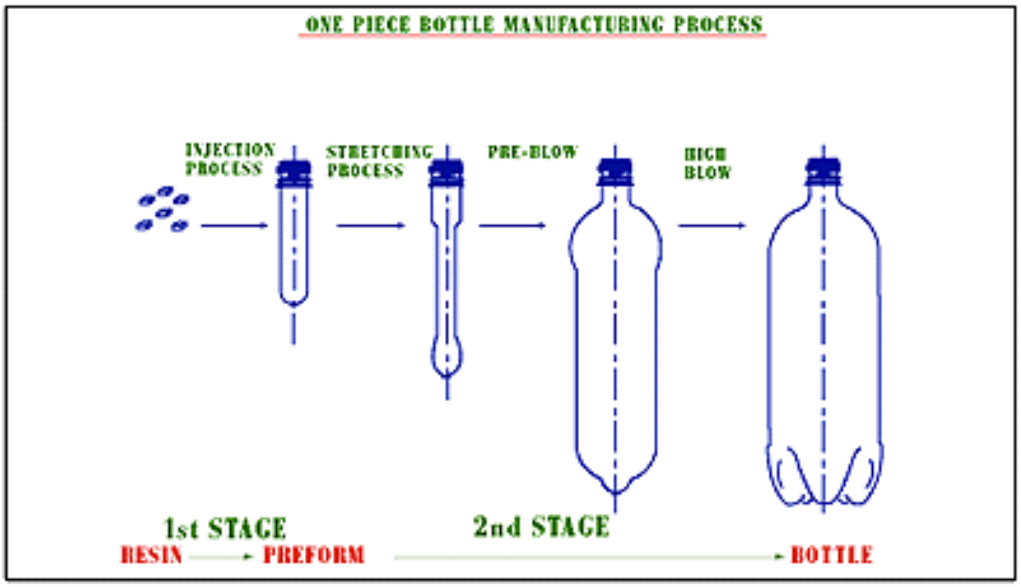
Post-consumer PET is often an attractive material for recycling. Unlike other polymers, recycled PET can be produced that is suitable for contact with food. PET can also be used in applications such as carpet fibres, geo-textiles, packaging and fibre fill. PET can be converted into polybutylene terephthalate (PBT) resin, which can be a valuable material for injection and blow-moulding applications. PBT is created through chemical polymerisation which converts the PET molecular chain into small "repeating units", and through additional catalyst-assisted processes, PBT is produced. The polymerised PBT contains approximately 60% of the original mass of PET, and can reduce solid waste by up to 900 kg for each tonne of PBT produced. Making PBT from recycled PET is often less energy consuming than producing the resin directly from oil stock (at 50 GJ/t to 20 GJ/t respectively).[29]

1.4 Definition of PET bottle

A PET bottle is any bottle made of polyethylene terephthalate, regardless of size. Although the bottles generally vary in size from 200 ml to 5 litres, PET bottles of all sizes are included in the definition for purposes of this RIA.

The PET bottle production process can be viewed as follows:[30]

Figure 4: PET bottle manufacturing process



Videos of the production process of PET bottles can be found through the following links:
https://www.google.mu/webhp?sourceid=chrome-instant&ion=1&espv=2&ie=UTF-8#q=pet+bottle+manufacturing+process (25 August 2015)
https://www.youtube.com/watch?v=ed7XJeXl3b4 (25 August 2015)

[27] Borodin (2015) 3.
[28] Borodin (2015) 4.
[29] BIO Intelligence Services (2011) 59.
[30] http://www.kjvpet.com.my/man_process.htm (accessed 25 August 2015).

1.5 PET bottles in Mauritius: facts and figures

Analysis of domestic wastes in Mauritius shows that the organic fraction was 54% (27% food wastes and 27% yard wastes), thus constituting the major proportion of total domestic waste. Recyclable materials such as metals and glass constituted the lowest percentage of overall domestic waste, because of the high scrap values of waste metal and the active deposit-refund scheme on glass bottles in Mauritius. The high percentage of plastic wastes (15%) in the domestic waste category signified low recycling practices for this waste component. The plastic stream for domestic wastes consisted mainly of PET, HDPE, LDPE and PP. While there are some PET bottles collection points in public places mainly for the commercial and general public, there is no present collection dedicated for PET at household level.[31]

The income and lifestyle of people in Mauritius have changed considerably since 2000. Over the years, with its rapid economic development, Mauritius has moving away from an agricultural to a more technological society and this trend is set to continue over the next decade. This shift has affected the consumption pattern of the population, which, in turn, affected the type and amount of waste being produced to some extent. Thus, the share of plastics in domestic waste has increased from 13% to 14% between 2000 and 2014.[32]

Analysis has shown that the distribution of waste types is closely linked to the economic development in a country, and that the recyclable waste proportion increases as a country develops. Accordingly, if Mauritius experiences strong economic growth over the next 10 years, it is expected that plastics and other recyclables will play an ever-increasing role in total Municipal Solid Waste (MSW).[33]

In Mauritius, effectively all solid municipal waste (SMW) ends up in the Mare Chicose landfill site, after having passed through one of the five transfer stations, being La Laura, La Brasserie, Roche-Bois, La Chaumière, and Poudre d'Or.[34] Waste materials from different regions transit through these transfer stations before final disposal. However, wastes collected from the southern region of Mauritius are routed directly to the Mare Chicose landfill.[35] Bins have been placed at various places on the island for the collection of plastic bottles, paper, cardboard, aluminium cans and glass, following an initiative of a non-governmental organisation namely Mission Verte.[36]

Government has indicated that at present, Mauritius consumes around 100 million PET beverage bottles per year. With a population of 1.33 million, this would give a figure of 75 beverage bottles per person per year, of which approximately 38 end in landfill or litter.

Information shows that at present approximately 9 million PET bottles are sold each month and that approximately 40% of all PET bottles are retrieved and recycled through shredding and subsequent exportation. In Mauritius, approximately 50 million PET bottles end in landfill each year, and this figure is expected to increase significantly unless there is a regulatory intervention. Littered bottles create a negative externality because the impose costs on parties other than the person who disposed thereof, as the cost of littering is not borne by the person doing the littering. These costs can include environmental damage, loss of aesthetic value and damage to recreational equipment. Government intervention

[31] Mohee (2014) 37.
[32] Mohee (2014) 38. The largest change was in food waste, which increased from 25% to 31% of total waste.
[33] Mohee (2014) 39-40.
[34] Mohee (2014) 1.
[35] Mohee (2014) 1.
[36] Mohee (2014) 33.

targeted at reducing littering of PET bottles could produce a more efficient allocation of resources than the market.

In 2006, government imposed the first levy on PET bottles in Mauritius. The levy was set at Rs1 per bottle, on top of which VAT was levied. In 2010 the levy was increased to Rs2 per bottle (plus VAT). This levy is paid over monthly by the bottlers, but is not directly recouped from consumers. The same levy also applies to any beverages imported in PET bottles. The levy is only collected on PET beverage bottles and not on all PET bottles. Thus, the levy is enforced on 3,500 tons of PET bottles, but not on the other 1,300 tons. This means that 27% of all PET bottles are not currently subject to the levy. In 2013 a total of Rs178,654,820 levy were collected; in 2014 a total of Rs194,426,230; and in the first seven months of 2015 Rs125,050,776.[37] Although no historic data are available, producers and retailers both indicated that neither the original imposition or the increase of the levy led to a significant (or any) decrease in PET bottle usage, as PET was found to be a more viable alternative than most other packaging materials and replaced those materials, especially glass.

1.6 Prior actions

In 2006, the Government imposed a levy of Rs1 on all PET bottles at the bottler, i.e. the entity that placed the beverage inside the bottle. Bottlers had to obtain a permit to allow them to bottle beverages and no production could take place without a valid permit, issued by the MEA. Such obligatory permit system allowed the MRA to accurately determine the amount of levies payable by each entity, as the entities are required to file monthly returns of the number of bottles filled. Bottlers are required to assume responsibility, either directly or through a third party, for the collection and recycling of the PET bottles. In 2010 the levy was increased to Rs2 per PET bottle.

There is no proof that the introduction of the original levy and the consequent increase thereof led to any assuage in the number of PET bottles in the market, and recent data show that the growth in demand for PET bottles outstripped both population and economic growth in Mauritius.

1.7 Literature review

Cognisance was taken of several LCAs of beverage containers as well as MSW impact studies conducted in different jurisdictions. These analyses have significantly informed the cost and benefit analyses of this RIA. Significant internet research was also undertaken to obtain additional information. This was done in addition to interviews with affected stakeholders.

European Commission studies related to the promotion of reuse and recycling of beverage packaging showed the following:

- Perchards (2007) describes the availability of reusable and one-way beverage packaging and their return practice in German supermarkets after the introduction of the mandatory deposit on one-way beverage packaging there.
- Perchards (2005) found that the Packaging Directive led to a significant convergence between Member States' recycling rates. It also confirmed that industry opposes using taxation to drive packaging policy.
- Pira & Ecolas (2005) found that a share of the packaging waste recycled was returned due to market incentives, a further share could be related to measures of the Packaging Directive and the final share to pre-directive Member State activities.

[37] For more detail on the exact figures, see section 4 below.

- Golding (no year) describes the situation of the reusable beverage packaging market in the 15 EU Member States of the 1990s. Already back then a trend from reusable packaging towards one-way packaging was to be seen.
- Argus (2001) summarised the European packaging waste management systems in the EU-15 and their compliance with the Packaging Directive. This is complemented by a study of the European Environment Agency (2005), which looks deeper into the effectiveness of the waste management system in 5 Member States.
- RDC-Environment (2003) concluded that separate collection of packaging waste is better than its treatment together with unsorted waste. It found that when total social costs are considered **separate kerbside collection** achieving a recycling rate of 59-69% is the optimal solution of the options considered. This is due to the environmental credit achieved by avoided production of virgin bottle grade PET. The main benefit is associated with avoided emissions of particulates and aerosols.

Mohee conducted a number of studies on waste management in Mauritius. In his 2014 study he found that the waste composition has changed as economic growth took place, with a move away from "yard" waste to "food" waste and, to a smaller extent, to plastic waste. His study also shows that despite the opening of a composting plant that had reduced the overall volume of landfilled waste significantly (by more than 30,000 tons per annum), the overall landfill volume reached a new record high of 420,000 tons in 2014.

1.8 Economic impacts of PET bottles

There are several impacts associated with PET bottles. These can be divided into economic, social and environmental impacts. **Economic impacts** consider the physical production cost and price of the PET bottles to producers, retailers and consumers; and the effect any regulatory intervention would have on them, as well as on direct and indirect employment, administrative and enforcement costs, and the change in public revenue from levies or charge to public funds from incentives. It also considers the actual costs incurred under the environmental impact, including the actual costs of cleaning up the environment, solid waste disposal and landfill costs.

Environmental impacts include the effect on greenhouse gases (GHG), the global warming potential (GWP) of the product and the effect of litter on the marine and agricultural environments. **Social impacts** include the visual impact of litter and the effect this has on citizens, including on their behaviour. Considering all economic, environmental and social aspects is a key issue of this RIA.

Increased PET bottle recycling will save public money by reducing litter and solid waste disposal.

It is not anticipated that there would be any greater impact on small businesses, such a small or informal traders, than on larger retailers or bottlers.

Industry has previously indicated that PET bottle litter is a significantly bigger problem than plastic bag litter and that Government should focus on this problem.[38]

PET bottle littering undermines the "clean" image of countries like Mauritius and the presence of PET bottles littering the environment can be the difference between travellers opting to stop in an appealing village or drive through because it lacks appeal.[39] Litter in scenic places can have negative impacts on

[38] Economisti Associati and BKP Development (2015) 11.
[39] Whitelaw (2014).

tourism. This is particularly the case for PET bottles because of their visibility.[40] Degraded scenic areas are less likely to attract visitors, as confirmed by studies in Ireland.[41]

This RIA did not to take into account the fact that government takes responsibility for provision of public rubbish bins (to prevent litter by providing a more appropriate means for disposal of unwanted items) and clearing up litter in public places, as these activities will continue regardless any regulatory reform on PET bottles and as it would be difficult to determine the cost specifically attributable to PET bottles.

1.9 Social impacts of PET bottles

1.9.1 Introduction

Several aspects of the impacts and consumption of PET bottles relate to community views and aspirations. The social aspect of the problem is important to many in the community, and for some people this can be more important than the direct harm caused by plastic bag litter.

1.9.2 Community participation in increasing PET bottle recycling

There is community concern about PET bottles in the environment, particularly in the form of litter. People are concerned about the impact of the bottles in public places, parks and on beaches and want these areas to be free of such litter.

Community interest does not mean that PET bottles should be placed as a higher priority than other policy issues to be considered by the government, but that the development of policy solutions should consider social impacts as well as environmental and economic impacts.

1.9.3 Loss of aesthetic values and reduced public amenity

It is difficult to place a value on the beauty and integrity of public spaces. Litter makes places look unclean, unattractive and uninviting. This applies equally to urban, rural and more natural landscapes. Communities expect Government to provide safe and clean locations for leisure activities.

Once a public place is littered, perceptions thereof can alter as “litter begets litter”. If action is not taken to reduce litter levels, people perceive that an area is not cared for and that its cleanliness is not valued, thus reducing the social inhibition against littering. Urban public places with continuing high levels of litter can become perceived as being dirty and unsafe to visit, leading to changes in the demographics of people visiting them.

1.9.4 Plastic bottles as a symbol of the throw-away society

In recent years there have been changes in community attitudes about litter. Australia, for instance, has reported a trend in community connecting litter to the wider environmental issues of waste management, illegal dumping and recycling; and growth in people’s concern that litter is damaging to the environment.[42]

Because of their high visibility, people see plastic (PET) bottles bags as a symbol of wasteful consumption.

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[40] Environmental Protection and Heritage Council (2008) 19.

[41] http://www.colby.edu/personal/t/thtieten/litter/htm and http://www.environ.ie/en/Environment/Waste/PlasticBags/

[42] Environmental Protection and Heritage Council (2008) 20.

1.10 Environmental impacts of PET bottles

PET bottles as an environmental issue is an international concern. International studies have shown that PET bottles constitute the third largest waste item (by number of units) worldwide.

Life cycle analysis (LCA) shows that recycled PET has a significantly lower environmental impact than virgin PET, especially as regards the raw materials used.

Visible PET bottle pollution is a major issue in Mauritius and a visual inspection has shown that in most instances of visible litter, there was at least one PET bottle present. A visual inspection has shown that PET bottles represent a very significant proportion of the total litter on Mauritius, despite the relatively high collection and recycling rate.

In Mauritius, approximately 50 million PET bottles end in landfill each year, and this figure is expected to increase significantly unless there is a regulatory intervention. Even with the best engineering and management systems, there is a range of social, environmental, and economic problems associated with landfills. From an environmental perspective, PET bottles have slow decomposition rates, produce trace constituents associated with odour problems, and produce methane and carbon dioxide, the two most important contributors to climate change. In addition to toxic substances from landfills, burning even small quantities of plastics such as PET bottles may release dioxins, a diverse range of chemical compounds known to be extremely to humans.[43]

Many examples of impacts on individual marine animals have been documented, but there is no reliable method for extrapolating this data to the overall impacts of debris in the open ocean. It is also difficult to determine whether debris has originated from ships or from land and how much can be specifically attributed to PET bottles. In a 2014 global study during which more than 5,000 tons of marine debris was collected, it was found that plastic bottles (all types, including PET, PVC and HDPE) constituted the third most prevalent waste item after cigarette butts and food wrappers, followed by bottle caps, plastic straws and plastic bags.[44]

1.11 Underlying drivers

1.11.1 Market failure

Most of the environmental impacts of PET bottles are externalities associated with **littering**. Externalities are the unintended impacts of an activity experienced by persons other than those directly involved in the activity. A littered PET bottle creates a negative externality because it imposes costs on parties other than the person who disposed of it, including environmental damage, loss of aesthetic value, cost of cleaning up the litter and damage to recreational equipment.

The use of PET bottles entails negative environmental externalities (littering, greenhouse gas emissions, contamination of air, soil and water, and impacts on ecosystems and human health) that are not reflected in the prices paid by the end-users, who only pay for the final product, i.e. the beverage in the PET bottle. Consumers are neither encouraged to limit their use of PET bottles, nor to recycle them, and are generally not aware of the levy included in the price they pay.

Government's role in addressing the market failures lies in the externalities associated with littered PET bottles. Government intervention targeted at increasing recycling of PET bottles could produce a more

[43] Whitelaw (2014).
[44] Tullo (2015).

efficient allocation of resources than the market.

Further market failures relate to low consumer awareness of the problem of litter and the overall environmental benefits of recycling PET bottles.[45] In particular, this creates information asymmetries exist for PET bottles, as consumers do not have full information on the goods they are purchasing. The cost of PET bottles is amortised across the cost of the beverage bought, making them appear free of charge. This pricing arrangement provides no monetary incentive for consumers to reduce their PET bottle usage or to recycle the bottles.

1.11.2 Regulatory and implementation failure

The current levy requires bottlers to pay a levy of Rs2/bottle at the end of the month for each bag produced and sold during that month. The same levy also applies to any beverages imported in PET bottles. The levy is not directly charged to consumers, but is only included in the price of the beverage.

A regulatory failure is that the levy is only collected on PET beverage bottles and not on all PET bottles. Thus, the levy is enforced on 3,500 tons of PET bottles, but not on the other 1,300 tons. This means that 27% of all PET bottles are not currently subject to the levy.

1.12 Problem statement

1.12.1 Introduction

Plastics have many properties that make them a popular choice in packaging applications. Their light weight, durability, flexibility, cost and barrier properties make PET bottles bags ideally suited for efficiently containing various types of beverages.

The problem with PET bottles is their impacts on the environment and society. Plastics generally have a negative image in comparison with other materials, in particular with regard to their perceived impact on the environment and use of resources.

PET bottles are designed to be used once and are then discarded. Plastic in general has become a symbol of excessive consumption. Increasing PET bottle recycling is seen as something simple that everyone can do, as well as a way to increase community awareness of other issues affecting the environment.

1.12.2 PET bottle consumption in Mauritius

In 2006, government imposed the first levy on PET bottles in Mauritius. The levy was set at Rs1 per bottle, on top of which VAT was levied. In 2010 the levy was increased to Rs2 per bottle (plus VAT). This levy is paid over monthly by the bottlers, but is not directly recouped from consumers. Based on the levies paid by bottlers with the requisite permit, Government estimates that a total of 97 million PE bottles were used in Mauritius in 2014. Based on the claims for export incentives, Government estimates that 39.7 million bottles (or 40.8% of the total) were recycled.

Interviews with bottlers and retailers have indicated that the use of PET bottles has not decreased as a result of the imposition or increase of the levy, but that this had a significant impact on the volume of recycled product.

[45] BIO Intelligence Service (2011) 54.

1.12.3 PET bottles and litter

1.12.3.1 Introduction

Traders, whether major retailers, small or informal traders, introduce PET bottles into the market. Consumer choices about recycle or disposal determine where PET bottles go after they leave the shop. While most PET bottles end up in landfill, a significant proportion (around 40%) is recycled (mostly through collection by independent collectors), with the rest being littered, both in marine and terrestrial environments. Estimates of PET bottle litter vary in different countries, from 0.6% in the EU to 3% in the US and it has been found to be the third most prevalent form of marine waste internationally. It is estimated that approximately 2% of all PET bottles in Mauritius end up as litter.[46]

On a practical note, visual inspection has shown a high incidence of PET bottles in the Mauritian environment and it appears to be a significant problem at present. Visual inspection by the authors found that the majority of visible waste next to roads and in open fields related to PET bottles.

1.12.3.2 Sources of PET bottle litter

Most PET bottle litter results from inappropriate disposal by consumers. People may leave bottles behind especially where suitable infrastructure (such as bins) is not available. PET bottles taken into outdoor settings generally have greater potential to become litter than PET bottles taken into the home.

Inadvertent litter is usually associated with PET bottles that are blown or thrown[47] from sources such as bins, uncovered loads on moving vehicles, kerbside waste collection, transfer stations, and material recovery facilities.

1.12.3.3 The link between PET bottle consumption and litter

No data are available to indicate which percentage of PET bottle consumption ends up as litter. In Australia, plastic litter items were 19% of the total litter objects, with PET bottles forming the major proportion of all plastic waste, followed by plastic bottle caps. Even if only 1% of all PET bottles end up as litter, this would indicate a total of nearly 1 million bottles (or more than 30 tonnes) each year. Since the bottles take many years to degrade, this litter is piled on top of all previous PET bottle litter, indicating that the litter grows by at least 1 million bottles each year.

1.12.4 Waste and litter management

The costs of cleaning up current levels of PET bottle litter are generally borne by governments, volunteers and the general community, and not by those who litter. This is a market failure.

1.12.4.1 Landfill

Despite the current recycling incentive, the majority of PET bottles used end up in landfill. No data are available as regards the relative volume of PET bottles in landfill, but it is estimated to be between 1% and 2%.

1.12.4.2 Clean up and infrastructure

Plastic litter has direct social and economic impacts on communities. Where litter is allowed to build up, there are often flow-on social and economic effects in the local community. These relate to the aesthetics of public places and how the community perceive them. These factors can play a role in determining how, or even whether, public spaces will be used by various sectors of the community.

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[46] This was based on consultations and visual inspection by the authors, but no hard data exist.

[47] Evidence and inspection show that dogs often tear open rubbish bags and the resultant waste, including PET bottles, is then littered.

Local and central government spend significant amounts each year on litter management in general, including on the maintenance of litter bins and rubbish removal. It has been estimated that storm water gross pollutants are composed of approximately 20% litter (plastic, paper and metal) and 80% organic material (such as leaves and twigs). Any reduction in plastic waste, including PET bottles, would have an effect on storm water volumes.

While litter management costs are significant, it is difficult to determine the percentage attributable to PET bottle litter, or indeed whether costs of clean-up would be reduced if all plastic PET bottles litter were eliminated. However, even though these figures are not restricted to the PET bottles component of litter, PET bottles comprise a highly visible and mobile component of litter and thus help prompt the need for litter prevention and clean-up activity.

1.13 Consultation and expertise

Ministry of Environment, Sustainable Development, and Disaster and Beach Management on 19 August 2015.

QBL on 1 September 2015

Solid Waste Management Division of the Ministry of Environment, Sustainable Development, and Disaster and Beach Management on 3 September 2015.

Boxmore (Mauritius) on 9 September 2015.

1.14 Objectives of PET bottle policy intervention

Regulatory intervention is proposed with regard to PET bottles to increase the rate of recycling of such bottles from around 40% to at least 70% within a period of two years in order to decrease the volume of PET bottle landfill and litter by 50% over the same period.

In essence, the objectives of government regulation are to:

- Reduce the impacts of PET bottles, including the volume of litter and landfill;
- Satisfy community expectations for government intervention; and
- Redress the market failure associated with PET bottle usage.

2. STAKEHOLDER CONSULTATIONS

As part of the RIA requirements and best practice, stakeholder consultations were conducted at the outset of the report research. Due to the short timescale available for completion of the full RIA, very little time could be afforded to stakeholders to provide their responses and to have consultations.

Meetings were held with the Ministry of Environmental Affairs, PET bottle producers, the major recycler, the MRA as well as informally with consumers.

The opinions and issues detailed in this section are representations of the consultation feedback. They are not necessarily the conclusions of the RIA.

2.1 Reaction to wider application of the levy

The bottlers that are currently subject to the levy, that is, the beverage bottlers, welcome the proposed expansion of the levy to non-beverage bottlers on the basis that this will create a level playing field for all PET bottlers. They have also indicated that this would have a major impact on the volume of PET bottles that are collected and recycled, as the same collectors will simply pick up more bottles while doing their collection routes.

The MEA is very positive about the possible extension of the scope of the levy, as it will place the same responsibility for clean-up operations on non-beverage PET bottlers than on beverage bottlers, while also generating significant additional funds for the MRA.

2.2 Reaction to levy increase

An increase in the PET bottle levy was met with general opposition, as it would be inflationary without having any impact either on the level of consumption or the level of recycling. Since the levy is included in the price of the beverage and is not indicated separately, consumers have little awareness thereof. Even if consumers had to separately pay the levy, as is the case on plastic carrier bags, this would not address the problem, as consumers would have little, if any, choice in the container. There is very little overlap between products bottled in PET bottles, glass bottles and foiled-lined cartons. The only possible advantage of either an increased levy or a levy directly payable by consumers might have is to increase awareness of the effects of PET bottles and to increase the number of bottles disposed of in bottle banks. This effect, however, is estimated to be limited.

2.3 Reaction to bottle banks

Several of the larger retailers already have bottle banks on their premises, so this option will not affect them. The MEA has indicated that there had previously been bottle banks in a number of public spaces, but that these were abused as consumers placed different types of rubbish in the bottle banks. This led to increase sorting costs and it became unviable. It is not clear where general rubbish bins (or containers for other products to be recycled, e.g. paper or aluminium cans) were available at the same venues. Had these other bins been available, it may have addressed the problem to some extent.

2.4 Reaction to deposit system

Retailers and traders are strongly opposed to a deposit system, citing the administrative burden, as well as the demand on physical surface space to retain the bottles until they are collected.

2.5 Reaction to increase incentive for recycling

Bottlers are in favour of an increased incentive for recycling and have indicated that an incentive of Rs66/kg of PET (as opposed to the current rate of Rs5/kg) would ensure the removal of all or virtually all PET bottles from Mauritius. The request for Rs66/kg is based on the current levy of Rs2/bottle and the assumption that, on average, 33 bottles make up 1kg.[48]

[48] Winter (2014) 7 shows that a 1 litre PET water bottles weighs 60g, i.e. 16.7 bottles/kg. Accordingly, an assumption of 33 bottles/kg would show a tendency towards 500ml bottles.

3. DATA AND METHODOLOGY

3.1 Introduction

This section of the RIA provides information regarding the data sourced as part of the RIA and identifies some of the associated constraints. With regard to methodology, specific sections for the methodologies employed with regard to analysis are not presented in this section, but rather are detailed within the individual supplementary research section.

Data collection and the development and testing of hypotheses was limited due to time and budget constraints:

- Data have been collected from a limited number of sources
- Assumptions and hypothesis have been necessary
- Data from literature could not always been cross-checked with other sources

3.2 General note on data

Data on the consumption and recycling of PET bottles were obtained from the MEA. In terms of existing regulation, no person or entity may bottle beverages without a permit. Such permit can only be obtained on application from the MEA. Each entity in possession of a permit has to report monthly on the number of bottles used in production. These reports are then used to determine both the bottler's liability for levies and the number of bottles consumed in Mauritius. Since the levy is constant between different bottle sizes, the MEA and industry have determined that on average every kilogram of PET equals 33 PET bottles.[49] On this basis, the MEA was able to determine the total PET bottle consumption by weight. The MEA also pays exporters of PET Rs5/kg for every kilogram of PET exported. PET exporters have to provide proof of exports to qualify for this incentive. On the basis of the requests for incentive payments, the MEA is able to accurately determine the volume of PET exported, which takes the form of PET bottles shredded into smaller pieces. All exports are made to South Africa, where the PET is then recycled and used to produce new products.

On the basis of the information above, Government's estimate of the consumption of PET bottles in Mauritius was 89.7 million in 2013, 92.2 million in 2014 and 62.5 million in the first 7 months of 2015 (compared to 57.2 million in the same period in 2013 and 59.6 million in the same period of 2014). This shows average monthly volumes of 7.44 million; 8.10 million and 8.93 million for 2013, 2014 and 2015, respectively, and growth of 8.8% between 2013 and 2014, and 10.3% between 2014 and 2015. Considering a population of 1.33 million, this indicates per capita use of 69 PET bottles in 2014. The equivalent figure for the EU is approximately 200, which shows significant scope for further growth.[50]

In order to compare this to recycling, these values have to be stated in weight.

[49] Consultations with industry have indicated that a 55ml bottle weighs between 16g (for water) and 18-21g (for carbpnated drinks); a 1l bottle on average 31-32g, but 38-42g for carbonated drinks); and a 1.5l bottle 48-54g. A 2l bottle weighs essentially the same as a 1.5l bottle and is the optimised product. One cannot stretch the neck or foot of a bottle and thus the neck weighs 3-4g, regardless whether a 500ml or 2l bottle. This explains why the weight of the bottle does not increase in line with the volume.

[50] BIO Intelligence Service (2011) 45.

Table **1** below indicates the monthly and total annual consumption in both bottles (units) and by weight.

Table 1: Domestic consumption of PET bottles

	2013		2014		2015	
	Units	**Kg**	**Units**	**Kg**	**Units**	**Kg**
Jan	8,653,071	262,214	12,892,134	390,671	13,168,487	399,045
Feb	5,414,777	164,084	7,766,029	235,334	7,522,818	227,964
Mar	7,354,536	222,865	8,137,307	246,585	8,930,465	270,620
Apr	8,517,596	258,109	8,499,366	257,557	9,210,878	279,118
May	7,961,442	241,256	8,182,555	247,956	8,709,978	263,939
Jun	7,036,372	213,223	7,155,363	216,829	7,760,561	235,169
Jul	5,817,793	176,297	7,006,923	212,331	7,222,201	218,855
Aug	6,455,482	195,621	6,747,766	204,478		
Sep	6,995,120	211,973	7,009,661	212,414		
Oct	6,531,405	197,921	6,651,306	201,555		
Nov	8,971,623	271,867	8,236,322	249,586		
Dec	9,618,193	291,460	8,928,383	270,557		
Total	**89,327,410**	**2,706,891**	**97,213,115**	**2,945,852**	**62,525,388**	**1,894,709**

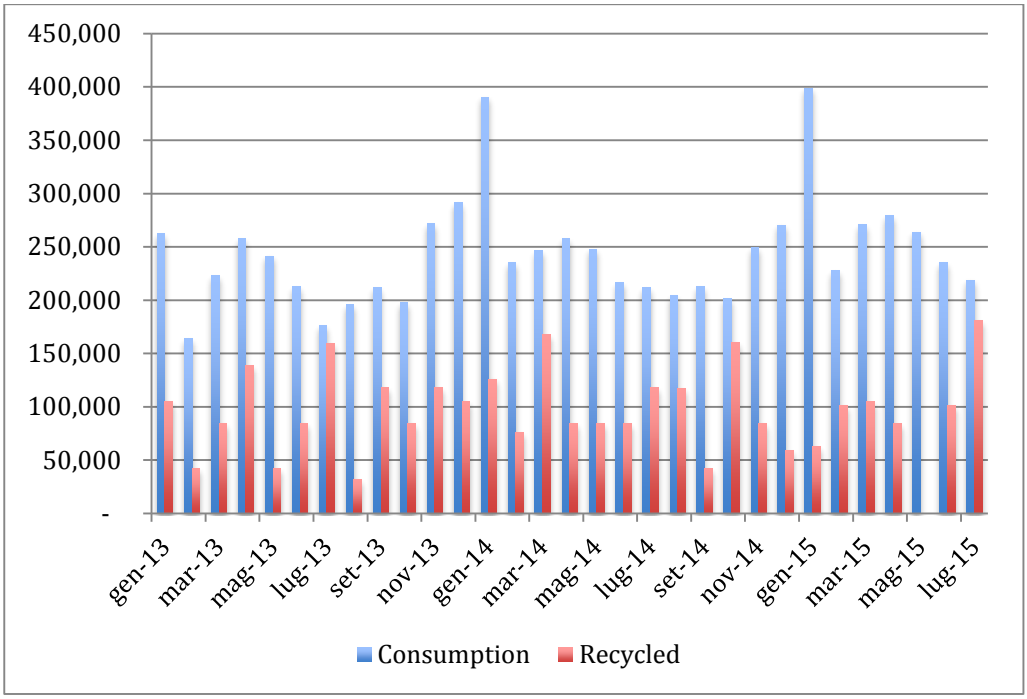
Table 2 below shows the evolution of PET recycling.

Table 2: Recycling of PET bottles

Recycled	**2013**	**2014**	**2015**
Exports	**Kg**	**Kg**	**Kg**
Jan	105,000	126,000	63,000
Feb	42,000	76,000	101,000
Mar	84,000	168,000	105,000
Apr	139,000	84,000	84,000
May	42,000	84,000	-
Jun	84,000	84,000	101,000
Jul	159,450	118,000	181,000
Aug	31,500	117,000	
Sep	118,000	42,000	
Oct	84,000	160,000	
Nov	118,000	84,000	
Dec	105,000	59,000	
Total	**1,111,950**	**1,202,000**	**635,000**

This shows that recycling increased by 8.1% between 2013 and 2014, which, although slightly lower, is in line with the growth in consumption. This means that 41.1% of all PET bottles were recycled in 2013, compared to 40.8% in 2014. However, for the first seven months of 2015, recycling decreased by 14.2% compared to the same period of 2014 (and by 3.1% compared to the same period in 2013), while recycling decreased to 33.5% of total consumption.

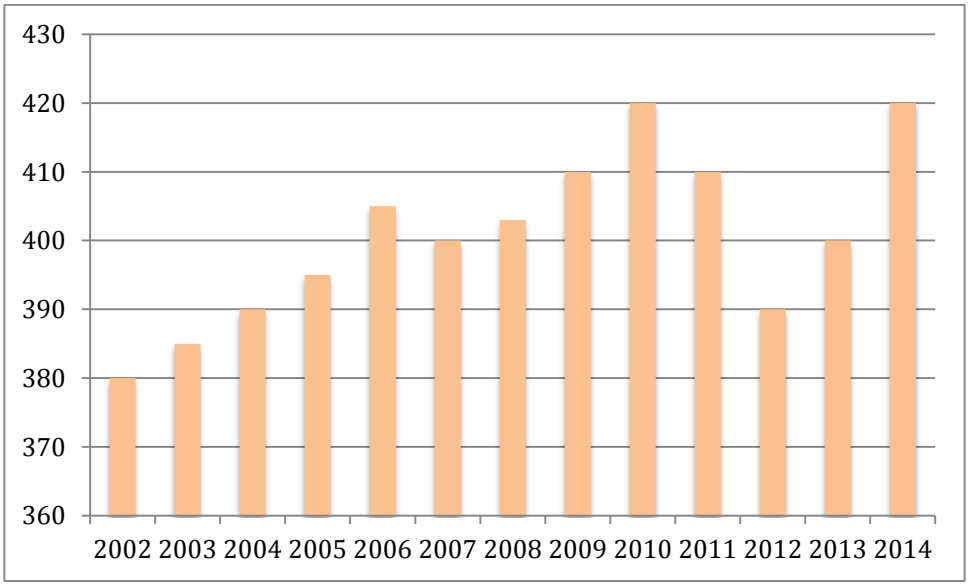
Figure 5: Monthly PET bottle consumption/recycling exports (kg)



It should be noted that the recycling rate is based on the actual volume of shredded PET *exported*, after 18% lost in the cutting and shredding process. The actual collection on PET is therefore significantly higher. The 40.8% *export rate* in 2014 would equate to an actual *collection rate* of 49.8%.

Although recycling rates are anticipated to increase over the outlook period, the proportion of landfill is expected to remain significant. This implies a significant expansion in the overall amount of PET bottles waste in landfill. Total landfill has developed as follows over the past 14 years:

Figure 6: Total MSW in Mauritius (thousand tons)



Source: Mohee (2014) and consultations with MEA.

The decrease in total MSW in 2011 and 2012 followed the opening of a composting plant.[51]

The total MSW budget was Rs896 million in 2014, giving a cost of Rs2,094/ton. By 2014, this had increased to Rs2,500/ton. This includes all costs for collecting, processing, management and operations, but excludes the cost of the land. Estimates are that per capita waste production would increase by approximately 20% between 2014 and 2015.[52] Considering that Mauritius' population is expected to grow by approximately 5% over the same period, this would indicate that total MSW in Mauritius would increase to 529,000 tons by 2025. However, this does not take into consideration that a significant proportion of MSW is already composted and that the recycling rate for PET beverage bottles is already around 40%.

3.3 Impacts

3.3.1 Inefficient use of resources

In general, the production and use of PET bottles contributes to the depletion of natural resources and the increase of waste. Due to their single-use life span, they rapidly enter the waste stream in high numbers. The inappropriate disposal of PET bottles exacerbates this. Although approximately 50% of all PET beverage bottles and 35.7% of all PET bottles are recycled, this means that approximately 65% of all PET bottles end in landfill or as litter. PET bottles are not currently incinerated for power generation.

If it is assumed that 99% of all non-recycled PET bottles end up in landfill (with 1% ending up as litter), and given that the total energy (calorific value) used to produce 1kg of PET bottles (approximately 33 PET bottles) is about 83.8MJ (around 21.5kWh), it is estimated that the equivalent of 245.1 million MJ (62.8 GWh) is landfilled every year in Mauritius, representing an estimated 916,500 tons of greenhouse gas emissions. However, if plastic carrier bags are incinerated for power generation, a portion of this wasted energy can be recouped, along with a significant saving in landfill.

3.3.2 Littering

The same properties that have made plastic bottles commercially successful – low weight and resistance to degradation – have also contributed to their proliferation in the environment. They escape waste management streams and accumulate in natural habitats, especially the marine environment. Because they last so long, the cumulative number of plastic bottles littered increases over time.

Plastics make up most of the marine litter. Some studies have shown that plastics, mostly PET bottles, caps, straws and plastic bags, constitute up to 70% of total marine litter. Worldwide, a large number of different species are known to have suffered from entanglement or ingestion of marine litter. In the North Sea, the stomachs of 94% of all birds contain plastic, and fragments of plastics were found in the stomachs of 35% of fish in the North Pacific, with an average of two pieces of plastic ingested per fish.[53]

Besides impacts on the environment and the fishing industry, littering also has economic and social costs in terms of wider loss of tourism and the need for litter clean-up activities. In Luxembourg, which approximates Mauritius in physical size,[54] annual costs for cleaning litter only along the national roads and highways were estimated to be around €1 million.[55]

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[51] Mohee (2014) 2.
[52] Mohee (2014) 5.
[53] European Commission (2013) 16.
[54] Luxembourg covers 2,586 km^2, while Mauritius covers 2,040 km^2.
[55] European Commission (2013) 17.

3.3.3 Beverage producers (bottlers)

There are two major PET bottlers in Mauritius and an unspecified number of smaller bottlers. The two large bottlers bottle Coke and Pepsi products, respectively, while the smaller producers bottle various different products, such as oil, vinegar and syrups. It is estimated that the two large producers represent more than 90% of the total beverage market, while the smaller producers are responsible for the non-beverage products. All producers have to register with the MEA in order to obtain a permit. No bottling using PET bottles may take place without such permit.

Under the existing regulation, bottlers are also responsible for the recycling of the PET beverage bottles, although they may contract this obligation out to a third party. At present, the bottlers pay a third party R15/kg for retrieving the PET beverage bottles, and an 18% waste-loss for recycling the PET bottles, i.e. for every kg of PET actually exported, an amount of (Rs15+18%) Rs17.70 is paid.

3.3.4 Plastics recyclers:

Although approximately 50% of all PET beverage bottles end in landfill or as litter, there are a number of recycling initiatives taking place. Polypet is by far the biggest and recycles more than 1,000 tons of PET each year. Some smaller recyclers stand to benefit from the latest regulatory intervention which provides that the export incentive will apply to all stakeholders that export at least 1,000 kg (rather than 1,000 tons as per the previous regulation) of PET.

A recent study estimates that recycling creates about ten times as many jobs per ton as sending waste to landfill or incineration, with roughly one job generated for every 200 tons of recycling,[56] while other studies have found 4.896 net jobs created per additional 1,000 tons of recycling.

3.3.5 Public authorities:

Public authorities are affected by the increased costs and administrative burden associated with PET bottle consumption, in terms of increased litter clean-up costs and increased landfill.

3.3.6 Tourism industry and local businesses:

Littering incurs an aesthetic cost to society. This may have a negative impact on local businesses, especially the tourism industry.

3.3.7 Traders:

Some of the larger retailers have PET bottle recycle facilities at (some of) their shops. These recycling depots assist in the recycling of PET bottles. However, since generally only PET recycling facilities are provided, and not facilities for recycling other products such as HDPE, LDPE, PVC, paper and aluminium cans, the recycling depots are sometimes abused by consumers who also want to recycle other products.

While an increase in the levy may not directly affect traders, as there is no direct cost on the consumer, an increase in the incentive to recycle PET may have an impact on the effort traders (whether large retailers or smaller traders) are willing to put in to recycle bottles, as well as the number of bottles actually recycled through the recycle bins.

[56] Friends of the Earth (2010) *More jobs, less waste* 26 indicates that in the EU 563,000 jobs (of which 322,000 direct) would be created for an additional 115 million tons of waste recycled.

4. DESCRIPTION OF POLICY OPTIONS

4.1 Introduction

Between government, PET bottlers, pre-formers and an analysis of policy options considered in other jurisdictions, various policy options were placed on the table. These are the following:

- Retain the status quo
- Bottle banks
- Curb-side collection
- Expand levy to include imported bottled products
- Increase the levy to Rs5 per bottle
- Enforce the levy at exit point to the consumer
- Deposit system
- A public awareness programme, including general education on waste, litter and reusable alternatives
- Litter management and enforcement
- Access to waste transit depots
- Incineration of plastics (and other waste)

4.2 Options used in other countries

The European Economic Area (EEA) – i.e. the 27 EU Member States plus Iceland, Liechtenstein and Norway – has introduced systems for the separate collection of packaging waste as a basis for the reuse of packaging products, the recycling of packaging material and the recovery of energy from packaging material. These systems vary from country to country according to the specific requirements, consumption and distribution patterns of these countries.

In general, national reuse systems work very well for transport packaging, such as crates and pallets, and also for beverage packaging in hotels, restaurants and the catering sector. With consumer beverage packaging, however, public intervention may be needed to encourage the implementation of reuse systems (EC 2009) or to achieve satisfactory recycling rates for one-way beverage packages.[57]

The EU has considered the viability of kerbside collection vis-à-vis requiring consumers to return PET bottles to bottle recycling bins. It found that, depending on population density, PET recycling ranged from 22% to 45% where consumers had to bring PET bottles to bottle banks, and from 59% to 80% where consumers were only required to dispose of PET bottles on their kerb for collection by the city council.[58] A US study has shown that nearly half of all PET recycling took place on the basis of kerbside collection.[59]

Some EU Member States have a mandatory deposit system in place on PET bottles.[60] **Denmark and**

[57] Schneider (2011) 6.
[58] RCB- Environment (2003) 39.
[59] Franklin Associates (2010) 2-2.
[60] European Commission (2009) 4.

Finland have a variable deposit rate, depending on the size of the bottle. The rate is €0.20/bottle for bottles up to 1l and €0.40/bottle for all bottles above 1l, while the rates are €0.10 and €0.20, for the respective sizes in Sweden.[61] **Estonia** also differentiates between bottle sizes, with a €0.04/bottle lax levied on bottles up to 500ml and €0.08/bottle for all sizes above 500ml, but the tax only applies to one-way bottles. **Germany** has a €0.25/bottle (approximately Rs1/bottle) deposit in place.[62] **Norway** has a deposit (or "toll") of approximately €0.13/bottle up to 500ml and €0.33/bottle above that, but there is no deposit on refillable PET bottles, provided a return rate of at least 95%.[63] In **Finland** the return of beverage containers to designated recycling stations increased by 15% between 2008 and 2009 (to 94%) as a result of the introduction of an effective refund scheme.[64] **Belgium** imposed an eco-tax of €0.10/l on both one-way and reusable PET containers, with the intention that the deposit be refunded on return, but the system was never fully implemented.[65] In **the Netherlands** there is a refundable deposit on large PET bottles, which resulted in a return rate of 95% of those bottles with a deposit compared to 66% for bottles without a deposit.[66] **Slovenia** has exempted reusable PET bottles from the waste management levy and the environmental tax, which are both payable on single-use PET bottles.[67]

In Bulgaria, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania and Slovakia, taxes are used as an instrument against non-achievement of recycling targets. The tax is payable on the difference between the recycling targets set for each material for that particular year and the recycling rates actually achieved.[68] Other EU members do not employ a deposit system.

At least 10 states in the US use a deposit refund system for collection of beverage containers, including PET bottles.[69]

4.3 Options discarded at an early stage

The options below were considered but not shortlisted for a detailed assessment:

4.3.1 Kerbside collection

Kerbside collection relates to the situation where each household takes responsibility for sorting its waste and disposing thereof separately. As far as PET bottles are concerned, this would mean that households would have to place PET bottles (and perhaps other plastic) in separate bag or bin for the municipal waste truck to collect on a regular basis. As indicated above, a US study has shown that nearly half of all PET recycling took place on the basis of kerbside collection.

Despite the high proportion of PET recovered in the US via kerbside collection, this option was discarded as it would require government to provide different coloured or coded waste disposal bins to the majority of the population and as government would have to provide additional waste trucks to collect different types of waste, such as plastic, aluminium cans, paper, wood and general waste, on different days. Although the long-term benefits may be significant, as it may lead to significantly lower landfill rates over time, the initial costs may be too high. In addition, this option would have to be accompanied by a very big public awareness programme, which will place a further strain on the available budget.

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[61] Schneider (2011).
[62] Winter (2014) 3.
[63] Bø (2013) 3.
[64] Schneider (2011) 8.
[65] BIO-Intelligence Service (2011).
[66] InfoNU (2011).
[67] Schneider (2011) 15.
[68] Incpen (2011).
[69] Reclay (2014) 1.

4.3.2 Public awareness campaign

Awareness-raising measures by government and non-government agencies (such as the MCCI and the Mauritius Retailers' Association) may contribute to heightened community awareness of and concern about the impact of PET plastic in Mauritius, including the negative impact thereof both on the environment and on tourism.

Increasing consumers' awareness may lead many consumers to recycle PET bottles or even to buy less PET bottles, for instance by not buying bottled water or by using reusable bottles for their water, while it may also have a positive impact on other waste products, such as plastic bags, paper and aluminium cans.

The awareness campaign was discarded as it was found that such awareness campaign would be very costly, while it would be unlikely achieve the objective of increasing PET bottle recycling from 40% to 70%.

This does not mean that it cannot or should not be used in conjunction with any of the other policy options.

4.3.3 Increasing the levy to Rs5/PET bottle

There is currently a levy of Rs2/PET bottle, which is an increase over the Rs1/PET bottle that was originally imposed. However, there is no proof that the introduction or the increase in the levy has decreased the demand for PET bottles. A major reason for this lack of causality may be that the levy is not paid directly by consumers, but is merely included in the price of the bottled beverage they buy. Many consumers may not even be aware of the existence of the levy. Accordingly, an increase in the levy to Rs5/PET bottle will only be inflationary, but will do little to affect consumers' behaviour.

4.3.4 Enforce the levy at exit point to the consumer

At present, the levy of Rs2/PET bottle is paid by the bottler. This cost is passed on to the consumer in the form of a higher price on the beverage, rather than as a separate levy, as is the case for plastic carrier bags. If the levy was imposed direct on the consumer, it would significantly raise awareness of the negative environmental impact of PET bottles. However, whereas the consumer has a choice of packaging material and could decide to rather use a paper bag, a box, a multiple-use PP bag or a cloth bag in lieu of a single-use plastic carrier bag, consumers do not have similar choices as regards beverages. Although some beverages are bottled in glass and others in aluminium, this decision is taken at the bottler or canner and the consumer has little choice in the matter. For plastic carrier bags, the consumer can also bring his own bag to the shop and thereby bypass the levy, but he cannot bring his own PET bottle to be refilled with, for example, a carbonated drink.

Imposing the levy direct on the consumer is therefore unlikely to have a significant impact on the volume of PET bottles that is recycled.

4.3.5 Litter management and bottle banks

This option targets litter reduction through a combination of behaviour change, enforcement and infrastructure improvements. It is designed to deliver a net economic benefit to the community – its cost is lower than the value of the PET bottles it aims to remove from the litter stream. Such programme would include the enhanced enforcement of landfill regulations; supplying adequate numbers of properly designed rubbish or recycling bins in public places; improve education and awareness to change consumer behaviour, through media and public events, promotion of new enforcement requirements, and advisory campaigns on how to minimise inadvertent litter; direct litter clean-up, through grants to community organisations and local groups to clean up sensitive sites, such as coastal areas and near

landfills; improvements to infrastructure, through grants to support better placement and design of public rubbish bins, and grants to local governments to ensure bins are cleared regularly. There is no guarantee that this option would actually increase PET bottle recycling from 40% to 70%, especially as research in the US has shown that bottle banks ("drop-off") only represents 11% of the total volume of recycled PET in the US.[70]

It is assumed that consumers would not make special trips to simply return bottles, but will do this as part of their normal shopping trips, which means there would be no additional costs (travel emissions) related to the bottle banks.

4.3.6 Banning the sale of small water bottles

In the US, several universities and national parks, as well as a limited number of cities, have banned the sale of plastic water bottles with a capacity of less than 1 litre. However, considering the limited effect this has had on PET bottle consumption in those constituencies where the ban was implemented and the attendant costs to consumers and the administration, as well as inconvenience to consumers (including tourists) this was not regarded as a viable option.

Although some studies have recommended the installation of water dispensers to reduce the sale of bottled water,[71] these all related to closed communities such as universities or small towns and it would be impractical on a country-wide basis.

4.3.7 Using Refillable PET bottles

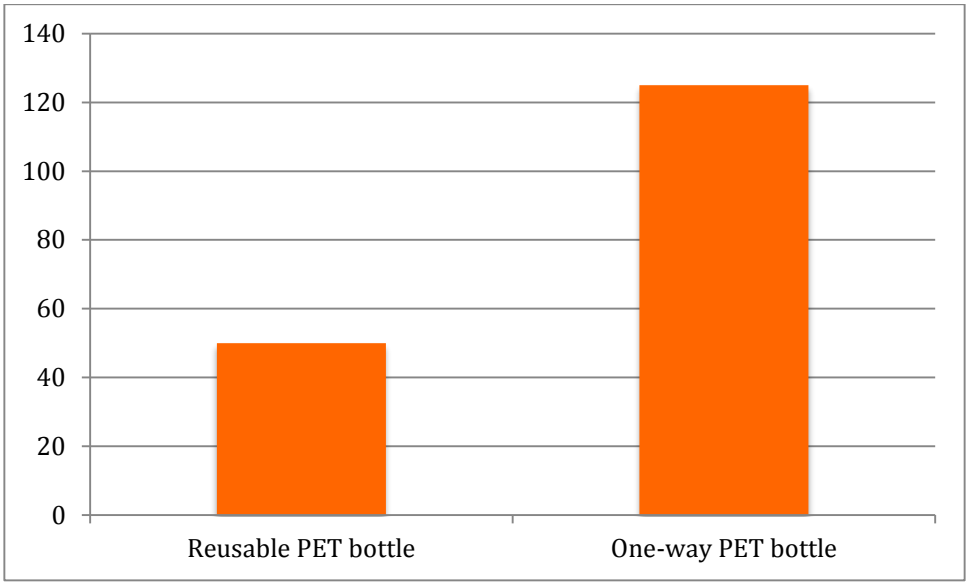
PET bottles can either be recycled or refilled.[72] Reusing bottles is an important way to reduce packaging waste. Reusing means returning, cleaning, and refilling bottles. This method is relevant when the costs of returning, washing, and refilling are less than for using new bottles.[73] Refillable PET bottles are used with success in Germany, the Netherlands, Norway and Switzerland.[74] On average, refillable PET bottles were used 9 times (500 ml bottles) to 12.5 times (1.5 litres bottles).[75]

Sorting and storing of refillable bottles is labour-intensive and therefore more expensive.

Research in Austria has shown that the life-cycle GHG emissions are significantly higher for one-way PET bottles than for reusable PET bottles, as is evident from Figure 7 below.

[70] Franklin (2010) 2-2.
[71] Oikos Consult (2013); Curtis-Murphy and Sessions (2014).
[72] Bø (2013) 3.
[73] Bø (2013) 5. See also Lerche Raadal (2003) and Eidhammer (2005).
[74] Bø (2013) 5. Note that in Norway water is only distributed in non-refillable bottles – Bø (2013) 8.
[75] Bø (2013) 8.

Figure 7: Life-cycle GHG emissions (g CO2 eq./l)



Source: WKO (2008)

However, refillable schemes are mostly used by domestic fillers, given that they require a certain turnover of containers to be returned. This would mean that only the biggest bottlers would be able to make use of this option. In addition, it would mean that over and above collecting the PET bottles, there would have to be additional attempts to sort the bottles by bottler. Owing to the additional costs in separating refillable and non-refillable bottles and the administrative burden on companies to report the number of refillable bottles in order to qualify for the recycling incentive, this option was discarded, although it might be feasible in future with further technological developments.

4.3.8 Incineration of plastic (and other waste)

Research shows that plastic waste as a very high calorific value when compared to other waste types, including food, yard, paper, cardboard and textiles waste. The average calorific value for plastics is 38,762kJ/kg, followed by 21,036kJ/kg for textiles, while paper has a calorific value of only 11,927kJ/kg.[76] This shows that there is high value in incineration of plastic to generate electricity.

Nevertheless, this option was discarded as it would only be viable if sufficient plastic, including PET, was collected. This means that it would not increase the amount of recycling, but could only follow from increased recycling. In addition, preliminary figures show that it would be more economically beneficial to export the recycled PET waste at current prices than to incinerate it for energy.[77]

4.4 Options shortlisted for scenario analysis

The RIA has considered various policy options, including both regulatory and non-regulatory. Options that were reetained include:

- Option 1: the current status, i.e., the situation with no new regulatory intervention
- Option 2: Deposit system
- Option 3: Expand levy to include other products

[76] Mohee (2014) 42.
[77] Note that the Government in 2006 decided against the construction of a 35MW electrical plant at Mare Chicose as the average calorific value of the waste was too low to make it viable – Mohee (2014) 42.

- Option 4.1: Access to waste transfer sites
- Option 4.2: Access to waste transfer sites along with expanded levy
- Option 5: Increase incentive for recycling

4.4.1 Option 1: status quo

In this "do-nothing" option, the current situation would continue and the problem would increase over time as more and more PET bottles are consumed. There would be no additional policies and measures aiming to limit the consumption, or increase the recycling, of PET bottles.

4.4.2 Option 2: Deposit system

The recycling of waste requires from the consumer that he does not simply throw away an empty bottle, but that he takes it to a separate waste collection bin or point of sale. This is an additional effort which is required and which makes the reuse or recycling of waste less convenient. However, if this is connected to an incentive in the form of a returned deposit, this could have a major impact not only on the recycle rate for PET bottles, but for consumers' awareness of the environment in general.

Accordingly, an ideal waste collection system would either be a system where a waste bin/reverse vending machine for PET bottles is conveniently close, or a system which rewards the consumer for taking the trouble (refund of deposit).[78]

A countrywide system should be provided which covers the whole territory affected by the mandatory deposit system. The purpose of a countrywide system is to make available a sufficient number of points of return so that consumers can recover the deposit independently of the initial place of purchase. This increases the acceptance of such a system by consumers and other stakeholders, facilitates the return of PET bottles and increases the amount of bottles returned.[79] Any mandatory deposit and return system must therefore be open to the participation of all economic operators in the sector concerned.

Exemptions for small businesses: Small kiosks may not have the storage space necessary for meeting their take-back obligations. Therefore, it might be considered reasonable to grant them certain exemptions. However, it is advisable to assess whether any such exemption would not affect the overall quality and functioning of the deposit and return system as such, or would lead to discriminatory application of its conditions.[80]

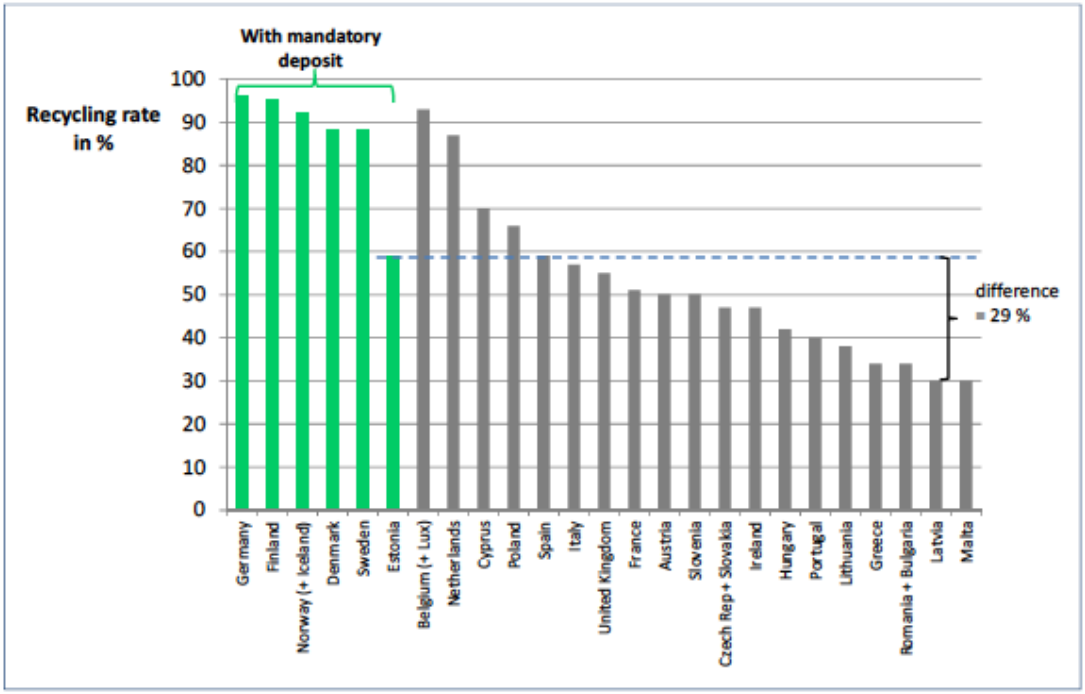
The EU has found the deposit system to be a low-cost system to operate and assumed that consumers would not make special trips to simply return bottles, but will do this as part of their normal shopping trips.[81] Thus, the only additional cost would relate to collecting the bottles from the various depots.

In Sweden, the mandatory deposit system for one-way PET bottles has been successful at achieving high return rates and it is now 73% (and 97% for refillable PET bottles).[82]

In the EU, there is a clear difference in the recycle rate between those countries that have imposed compulsory deposit systems as compared to those countries that have not imposed such a requirement. This is clearly indicated in Figure 8 below.

[78] Schneider (2011) 6.
[79] EC Communication (2009) C107/6.
[80] EC Communication (2009) C107/6.
[81] EC (2015) 212.
[82] EC (2015) 219.

Figure 8: PET bottle recycling rate with an without mandatory deposit



Source: Schneider (2011)

The average recycling rate for countries with a deposit system is around 88%, while it is around 58% for countries without a deposit system.

4.4.2.1 Impacts on employment

Once again the effect that the tax had on employment is difficult to assess given the producer responsibility regulations and the deposit schemes. With a net 4.9 jobs created per extra 1,000 tons of product recycled, an increase from the current 50% of the beverage market (1,625 tons collected) to 70% of the total market (3,180 tons collected) would only increase PET recycling by 1,555 tons, indicating 8 jobs.[83]

Mauritius at present has approximately 14 bottles banks operated by Mission Verte, and some of the major retailers also have bottle banks. In the US, deposit return sites have been set up for every 12,000 to 15,000 people.[84] This would mean that there should be between 89 and 111 return sites. Unless the sites are automatic reverse vending machines, each of these sites would need to be staffed by at least two staff members (considering the hours the site would have to be open, 7 days a week, at least two people would be required).[85]

It is estimated that each deposit centre would employ at least two people and with a required 88-100 deposit system sites spread over Mauritius, this could generate approximately 200 permanent jobs.

4.4.2.2 Impact on consumers

Given the wide number of deposit systems for drinking container packaging in Sweden, the effects that the tax had on consumers are difficult to assess. It has not been possible to identify the extent to which the costs of the tax were passed through to the price of the final product. In relation to the return

[83] Note that Friends of the Earth (2010) indicated only 1 job created per 200 tons recycling, which would indicate the creation of only 8 additional jobs.
[84] Reclay (2014) 15.
[85] Reclay (2014) 15 indicates that urban sites typically remain open 70 hours per week and rural sites 44 hours.

system, the Swedish Brewers' Association considers that the scheme has high public popularity. In addition they see that the system as being low cost to operate, so does not impose higher costs on consumers.

4.4.2.3 Effects on bottlers

Since bottlers have to pay recyclers Rs17.70/kg of PET material exported, and it is anticipated that the deposit system would significantly increase the recycle rate, this would have a significant impact on bottlers.

Direct and indirect benefits provided by recycling refund systems include:[86]

- Decreased litter;
- Energy savings;
- Reduced greenhouse gas emissions;
- Avoided acidification and eutrophication;
- Improvements to human and animal health;
- Decreased waste collection and disposal costs; and
- Net increases in employment, with some economic sectors realizing gains while others experience losses.

4.4.3 Option 3: Expand application of levy and recycling incentive to include other products

The current levy of Rs2/bottle applies only to beverages. When the levy was first imposed in 2006, beverages were virtually the only products bottled in PET bottles. However, with technological advances, more and more products are now bottled using PET. This includes products such as vinegar, concentrated syrups, shampoo and beauty products.

Information at hand shows that the total PET market in Mauritius amounts to approximately 4,700 tons, of which 3,500 tons relates to beverages. The levy therefore applies only to roughly 74% of all PET bottles. It also means that when it is indicated that Mauritius has a current recycling rate of 40%, this only applies to beverages. Accordingly, the recycling of PET *beverage* bottles (if 40% is accepted as the accurate figure) translates into a recycling rate of only approximately 30% of *all* PET bottles.

If the levy and the recycling incentive were expanded to include all PET bottles, this could significantly decrease the overall volume of PET bottles that are recycled, leading to decreased landfill and litter. It could also significantly increase the remuneration received by the PET bottle collectors and create additional employment.

4.4.4 Option 4: Access to waste transfer sites

All waste is moved by local government to five waste transfer sites, being La Laura, La Brasserie, Roche-Bois, La Chaumière, and Poudre d'Or, before everything is moved, generally on the same day, to the Mare Chicose landfill site.

Since PET bottle are light, upon tipping they generally end up at or close to the top of the pile. This would make it relatively easy to remove a significant proportion of all the PET bottles from the transfer sites if access were to be granted to collectors.

All the necessary precautions concerning occupational health and safety should carefully considered and

[86] Reclay (2014) 23.

personal protective equipment like gloves, masks and protective clothes should be made available. The cost of the safety equipment needs to be taken into consideration in the CBA of this option.

4.4.5 Option 5: Increased incentive for recycling

At present, a number of payments affect recycling. First, bottlers pay recyclers an amount of Rs15/kg of PET, plus 18% for material loss, i.e. a total of Rs17.70/kg for every kilogram of PET actually exported.[87] Second, government pays the recyclers an additional Rs5/kg for every kilogram of PET actually exported. Third, recyclers pay collectors Rs9 for every kilogram of PET bottles collected.

If the recyclers were to increase the payment to PET bottle collectors, e.g. to Rs12/kg or to Rs15/kg, this could either persuade the collectors to work harder to collect more bottles, or could persuade more people to start recycling. However, recyclers will only increase this amount if they, in turn, received a larger incentive. This means that either government or the bottlers, or both, would have to increase their incentive to the recyclers.

4.4.6 Summary

Table 3 below provides an overview of the different options.

Table 3: Strengths and weaknesses of the five basic options

Scenario	Social/Community	Environment	Economic
Option 1: No action	Baseline	Baseline	Baseline
Option 2: Deposit system	Less litter Not supported by retailers; high administrative costs, especially on small traders; education required	Significant increased recycling rate None	Increased revenues (retention of non-returned deposits) Increased incentive payments; significant additional administration costs to retailers and government; increased costs to retailers
Option 3: Wider application to all PET bottles	Less litter; supported by industry; little additional administrative burden None	Immediate inclusion of non-beverage bottles in collection leading to significantly increased recycling None	Significantly increased levies Increased incentive payments
Option 4: Access to waste transfer stations	Relatively easy to significantly increase recycle rate Creates "undesirable" jobs; requires proper safety equipment and properly controlled	Significant increased recycling, reducing landfill None	Low-cost recycling Protective clothing; possible health issues for workers; increased incentive payments; increased collecting

[87] This is the amount as of 1 August 2015. Up to 31 July, this amount was Rs11.50/kg plus 10% for material loss, i.e. a total amount of Rs12.65/kg.

	access to transfer stations		costs for bottlers
Option 5: Increased incentive for recycling	Less litter; supported by industry None	Some increase in recycling/decrease in landfill No clear indication of extent of increase in recycling	May attract more collectors Significant additional cost for bottlers and government

In each instance, a community education and a well-advertised phased-in period would be required.

5. ANALYSIS OF IMPACTS

5.1 Introduction

This section analyses the impacts of the different policy options proposed in section 4.4, taking account of the experiences of other countries or regions that have already introduced reduction, reuse or recycle measures on PET bottles.

This section describes the options to increase the recycling of PET bottles. It also provides an economic, social and environmental analysis of the impacts of those options. The data presented here are based on statistics supplied by the MEA, consultations with interested parties, and major retailers, and on studies conducted by other countries.

All costs are indicative only and are presented so that the options can be compared against one another.

In the cost-benefit analysis (CBA), the environmental impacts related to collection, sorting, transport, landfilling, and recycling were translated into monetary values. These monetary values allow the aggregation of and the comparison between internal (financial) and external (environmental and social) costs of the various options considered. The translation into monetary values was done using values from literature based on various valuation techniques, as well as information gathered during consultations.

Any political decision implicitly means attributing a particular value to environmental impacts, simply by deciding whether a measure is taken or not, in other words whether the benefits are perceived to exceed the costs or not. Although the monetary values attributed to environmental impacts remain uncertain, they provide an indication of the relationship between the order of magnitude of the environmental benefits and the costs of a political measure.[88]

To the extent possible, a cost-benefit analysis has been applied, but this has been augmented by a multi criteria analysis (MCA) to assist in assessing the full range of impacts arising from an environmental policy proposal, including a comparison of "apples and oranges" without having to reduce all elements to an economic valuation.

5.2 Underlying assumptions

Many critics of CBA question the underlying ethics of monetary valuation of environmental impacts. They believe that the environment is something sacred upon which it is not acceptable to place a monetary value. It needs to be underlined, though, that every political decision on environmental measures implicitly gives a value to the environment. The question is whether this is done on the basis of transparent information or not.[89]

Considering the significant impact the use of virgin as opposed to recycled PET material has on the environment, it was necessary to attach values to certain environmental effects. In order to value environmental effects, the following values were attached to various environmental impacts:[90]

[88] RCB-Environment (2003) 16-17.
[89] RCB-Environment (2003) 22.
[90] RCB-Environment (2003) 47. The valuation for solid waste was based on the actual present (2015) costs in Mauritius.

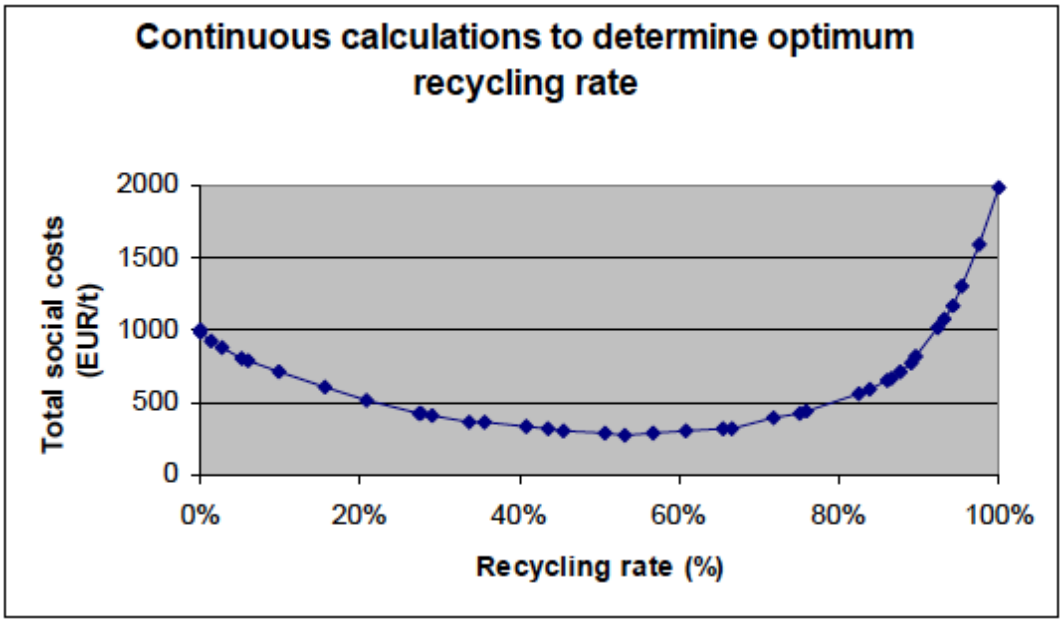
Table 4: Environmental costs

	Unit	Valuation 2003	Valuation 2015[91]	Valuation 2015 (Rs/kg)
GWP (kg CO_2 eq.)	€/kg CO_2	€0.01344	€0.0162	Rs0.633
Other GWG (kg CO_2 eq.)	€/kg CO_2	€0.01344	€0.0162	Rs0.633
Solid waste	kg			Rs2.50

As the exact impact of virgin versus recycled PET was not known for the ozone depletion, acidification, toxicity carcinogens, smog, black smoke, fertilisation and water eutrophication, no values were attached to these effects, although this should still be taken into consideration in the determination of the preferred regulatory option.

The economic valuations applied in this study are principally based on damage cost estimates, derived from hedonic pricing methods or willingness-to-pay studies. Research has also shown that optimal recycling, measured as cost per tonne, occurs at a recycling rate between 45% and 65% and that it becomes incrementally more expensive to improve recycling rates above 80%. Thus, the overall cost per tonne to move from 65% to 80% is an increase of 50%; to move from 80% to 90% the overall cost per tonne is doubled, while it is trebled to move from 80% to 95%, as shown in the graph below:[92]

Figure 9: PET bottle optimal recycling rate



In the EU the overall optimal recycling rate, i.e. for all packaging products combined, was determined to be 53%.[93] For one-way PET bottles specifically, this was determined to be between 59% and 73%.[94] A recycling rate of 70% for Mauritius is therefore feasible, especially as the geographical size of Mauritius should facilitate a higher recycling rate.

[91] The 2003 valuations were updated for the inflation rate in the EU on the basis of http://www.inflation.eu/inflation-rates/europe/historic-inflation/hicp-inflation-europe.aspx.
[92] RCB-Environment (2003) 52.
[93] RCB-Environment (2003) 53.
[94] RCB-Environment (2003) 62.

5.3 Types of impacts

All options to increase the recycling of PET bottles share the same types of impacts. The magnitude of these impacts will differ from one option to another depending on the degree of ambition and effectiveness of each measure.

Recycling difficulties can be classified according to technical, economic and marketing constraints. Marketing constraints can be avoided by specific marketing actions and depend largely on the willingness of the industries.

Technical and economic constraints are more difficult to overcome. Technical constraints require R&D investments or an increase of collecting, sorting and/or treatment capacities. Economic constraints are very difficult to control, e.g. market prices.[95]

The analysis that follows is focused on eight main issues. It looks at two environmental impacts (benefits):

- Littering rates
- Impacts on public spending on waste management and litter collection

The analysis of economic and social costs and benefits will cover six main issues:

- Administrative burden on government
- Impact on Mauritian producers
- Impact on employment
- Impacts on Mauritian retailers/traders
- Impacts on consumers
- Public awareness

5.3.1 Environmental impacts

The primary plastics feedstock will remain fossil fuels, despite the anticipated rapid rise in the production of bioplastics. This implies continued reliance on carbon-intensive production methods, with relatively high levels of embodied carbon and energy in the products. While over time PET bottles became thinner and thus weighed less, the increase in consumption has been such that the total weight of PET bottles has increased significantly over time. More specifically, greenhouse gas emissions associated with the plastics life cycle are anticipated to increase, albeit on a lower trajectory than in the past, due to: expanded use of plastics; continued reliance on largely primary plastic materials; and continued dominance of petrochemical based plastic products. The tailing off in disposal of plastics is not anticipated to dramatically improve the greenhouse gas emissions picture, given that the majority of plastics currently on the market do not biodegrade (at least in the short term) in landfill situations. Negative consequences in terms of littering and plastic pollution in marine waters would also be anticipated to increase in the absence of any additional curbs on the management of plastic wastes and the overall picture of rising levels of waste production/plastic use.[96]

The main environmental benefits of the proposed measures are linked to the reduced use of resources embedded in the production of PET bottles, and corresponding greenhouse gas emissions; a decline in the amount of waste and the number of PET bottles littered. This will decrease litter clean-up expenses,

[95] RCB-Environment (2003) 67.
[96] BIO Intelligence Service (2011) 132.

and expenses incurred in waste management.[97]

In this regard, to the extent possible, the effect on emissions (CO_2, GWP, GHG) will be considered.[98]

All options will increase awareness of the environmental impacts of PET bottles and resource efficiency aspects at large, and could help promote more sustainable consumption patterns. If designed and implemented in an optimal way, measures have the potential to influence consumer behaviour more broadly (e.g. limit use of disposable items, promote re-use or recycling), as well as guide manufacturers' and retailers' business models (e.g. promoting reusable, resource efficient alternatives).

5.3.2 Economic and social impacts

Measures to increase the recycling of PET bottles, especially regulatory measures, are likely to entail some administrative burden, falling on both the public and the private sector, to ensure implementation and enforcement. The extent of the administrative burden will depend on the choice and the exact design of the measures to be implemented.

Economic impacts: expanding recycling sector/job creation, less landfill meaning that the single landfill site will last longer.

Social: health – problems associated with sorting waste. As we continue to expand the use of plastics, there are growing concerns among consumers regarding the associated implications. In many countries there is a desire to recycle materials rather than send these to landfill where there is already public awareness of the issues surrounding biodegradability. There is, however, relatively limited understanding among the public regarding the multiplicity of different plastic types on the market place, the biodegradability of materials and what they should do with such materials or the recyclability of various plastics. Looking ahead to 2015 and given the expansion in plastic use, one might assume that concern regarding the end of life of plastics will continue to rise. However, given limitations in terms of recycling technologies and uncertainty about how best they can help improve environmental performance, this might lead to inappropriate or limited action on the part of the public unless there are further efforts to deliver guidance on how best to deal with plastic waste. [99]

Costs to be considered include the cost for conducting business, especially for small retailers and the informal trade; administrative burden on businesses and government; waste management or recycling costs; employment; and the impact on the MRA.[100]

In Mauritius, the MEA has indicated that the cost for landfilling for PET bottles is Rs2,500/ton. The cost for recycling was significantly higher, as an export incentive of Rs5,000/processed ton (Rs4,100/collected ton) is paid in addition to the costs incurred by the bottlers.

Whilst the costs for transport and processing in Mauritius are not known, bottlers pay the recyclers Rs15.00/kg (of which R9/kg go to the collectors) for collected material. It is not clear whether the amount to the collectors increased in line with the increase bottlers are paying to the recyclers.

It is not proposed that any PET bottles be incinerated, as the costs of incineration are significantly higher than those of recycling.

[97] European Commission (2013) 33.
[98] BIO Intelligence Service (2011).
[99] BIO Intelligence Service (2011) 135.
[100] BIO Intelligence Service (2011).

5.3.2.1 Impacts on bottlers

In terms of the current regulation, bottlers are required to take action to collect the PET bottles they fill, although this function may be subcontracted. All Mauritian producers have subcontracted this to Polypet, whom it paid Rs11.50/kg (plus 10% waste factor = Rs12.65/kg) of PET bottles recycled until 31 July 2015, and Rs15/kg plus 18% waste factor = Rs17.70/kg since 1 August 2015.

The present recycling rate is approximately 40%, or around 1,200 tons. If the recycling rate is increased to 70%, or around 2,275 tons, this would increase the burden on producers from around Rs21.24 million (based on post-July 2015 prices) to Rs40.26 million, an increase of Rs19.02 million. This does not take into consideration the projected growth in the market. If the target of 40% is reached by 2020, bottlers burden will increase to an estimated Rs64.84 million.

5.3.2.2 Impact on retailers/traders

There will be no impact on retailers or traders under Options 1, 3,4 or 5. Under Option 2 (deposit system), this would have a major impact on the retailers/traders. The exact impact will depend on how the system works. However, larger retailers may have to employ additional staff to operate the deposit system, while both retailers and traders would have to dedicate space to keep all the returned bottles. There would also be an added administrative burden on retailers, as they would have to keep record both of the number of PET bottles sold and refunded. At the onset of such product, collectors might also take PET bottles for refunds, rather than the recycling depots, in order to get more money. There could thus be a significant initial cost to this option.

5.3.2.3 Impacts on employment

A European study has also shown on average 6.2 jobs are generated in collecting PET bottles for every 1,000 tons collected, with an additional 0.9 jobs per 1,000 tons for sorting and transport.[101] This is compared to 1.3 jobs created per 1,000 tons of PET bottles landfilled (including collecting and landfill management), for a net positive job creation of 4.9 jobs per 1,000 tons of bottles collected.

5.3.2.4 Impact on consumers

There is no direct levy on the consumer and the price they pay for beverage includes the levy. If the levy is expanded to include non-beverage PET bottles, it is expected that prices for these products would increase by a commensurate amount. However, since the prices of these other products are relatively high, and these products constitute a small percentage of the overall basket of products bought by consumers, the increase would not have a large direct effect on consumers.

A deposit system may, however, have a significant impact on the consumer if the empty bottle is not returned. Such deposit would increase the cost of the beverage and other PET products by the amount of the deposit on every single transaction. However, if consumers return their empty bottles, they will be refunded, which means very little financial impact on them. There may be a small hassle factor in having to take the bottles along to the store, but they would not have to make additional trips specifically for this. The net impact of a deposit system on consumers would therefore be quite small.

There will be no impact on the consumer if access is granted to transfer stations or the recycling incentive amount is increased, as both of these relate to post-consumer options.

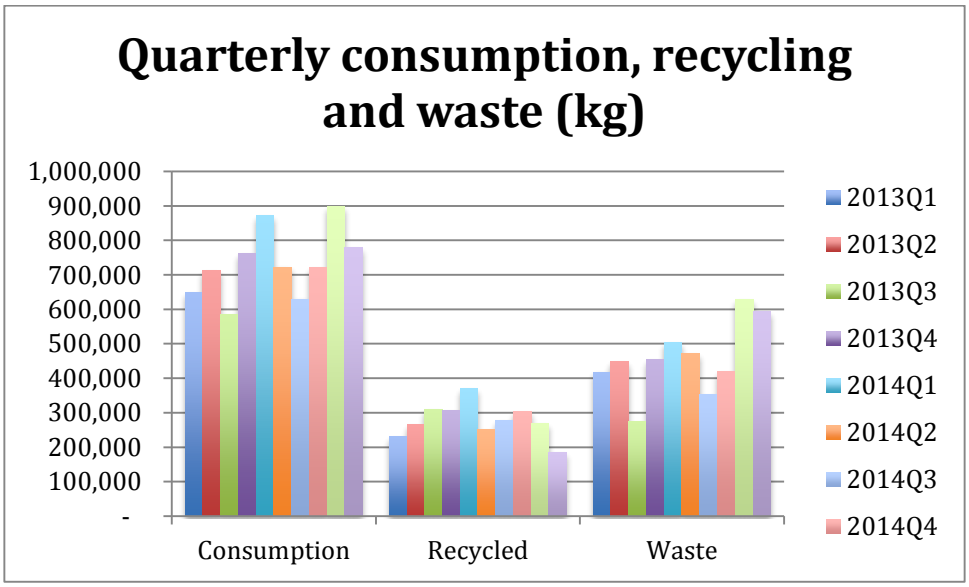
[101] RCB-Environment (2003) 73.

5.3.2.5 *Impact on government*

Total levies collected at present stand at Rs195 million (2014) and are expected to reach Rs214 million in 2015. Considering the significant increase in PET bottles consumption expected over the next 5 years, the levy will increase considerably. If the levy is expanded to include non-beverage PET bottles, this will lead to further increases.

It currently costs Rs2,500/to to process and landfill waste, indicating a cost of approximately Rs8.1 million in 2015, set to increase to Rs14.4 million by 2020 unless the recycle rate is increased. Government in 2014 spent Rs6.01 million on recycling incentives, i.e. Rs5/kg of PET flakes actually exported. This is expected to increase to Rs10.46 million by 2020 if the current recycle rate of PET beverage bottles remains stable. However, if the recycle rate increases, or if the incentive is also paid on non-beverage PET bottles, this cost would increase. Likewise, if under Option 5 the incentive rate is increased, this would also result in a larger cost to government.

Figure 10: PET bottle consumption, recycling and waste



5.4 Specific impacts per type of measure

5.4.1 Option 1: Status quo ("baseline scenario")

Information shows that the number of PET beverage bottles in the market increased by 8.8% between 2013 and 2014, and by 10.3% between 2014 and 2015. It is expected that this increasing trend will continue over the next decade. In addition, more products are switching to PET packaging, which means that the overall PET bottle market is growing stronger than the PET beverage market. It is estimated that this (other) market is growing by 15% per year. Based on these assumptions, the market for PET bottles is expected to grow as follows:

Table 5: Volume of PET bottles in the market (tons)

Tons	PET beverage bottles	Other PET bottles	Total PET bottles
2015	3,249.27	1,300.00	4,549.27
2016	3,574.20	1,495.00	5,069.20
2017	3,931.62	1,719.25	5,650.87
2018	4,324.78	1,977.14	6,301.92
2019	4,757.26	2,273.71	7,030.97
2020	5,232.99	2,614.76	7,847.75

If the recycle rate remains at a level of 50% (before the waste factor during the cutting and shredding process) on PET beverage bottles only, this means that total PET waste will increase as follows:

Table 6: PET bottle waste (tons)

Tons	Recycling	Waste
2015	1,624.64	2,924.64
2016	1,787.10	3,282.10
2017	1,965.81	3,685.06
2018	2,162.39	4,139.53
2019	2,378.63	4,652.34
2020	2,616.49	5,231.26

As for waste processing costs of Rs2,500/ton (at current prices), the total cost of PET waste management will increase from Rs7.3 million in 2015 to nearly Rs13.1 million by 2020, as set out in Table 7.

Table 7: Cost of PET bottles waste processing and landfill

	Waste process costs (Rs)
2015	7,311,593.42
2016	8,205,252.76
2017	9,212,653.04
2018	10,348,824.59
2019	11,630,849.23
2020	13,078,147.67

Maintaining the current recycle rate of 50% (collections) and export rate of 40%, the volume of PET exported will change as follows:

Table 8: Recycled PET exported (tons)

Tons	Exported	Waste
2015	1,299.71	3,249.56
2016	1,429.68	3,639.52
2017	1,572.65	4,078.22
2018	1,729.91	4,572.01
2019	1,902.91	5,128.07
2020	2,093.20	5,754.56

Based on the volume of exports and recycling, the incentives payable by government (Rs5/kg on exports) and by bottlers (R15/kg on exports or Rs17.70/kg on exports) will change as follows:

Table 9: Incentives paid on exported/recycled PET (Rs)

	Gov incentive	Bottlers' incentive
2015	6,498,549.47,	28,756,081.40,
2016	7,148,404.41,	31,631,689.53,
2017	7,863,244.86,	34,794,858.49,
2018	8,649,569.34,	38,274,344.34,
2019	9,514,526.28,	42,101,778.77,
2020	10,465,978.90,	46,311,956.65,

5.4.1.1 Environmental impacts

Increased use of PET bottles will result in more litter and increased landfill, with a bigger impact on environment. Since PET has a very long half-life and therefore degrades very slowly, the additional negative effect on the environment will be cumulative.

In the projected period, the volume of PET bottles consumed rises by 170%. If no action is taken, consumption will keep rising beyond 2020. Unless action is taken to increase recycling, total litter will increase, as will the amount of GHG emitted in the production process. Assessing related impacts in quantitative terms is however difficult.

Table 9: Environmental impact of PET production

	Virgin production	Recycled	Option 1
Solid waste (g/kg)	45	0	131.61kg
CO2 (g/kg)	2,330	163	7,079,220.96kg
Other GHG (g/kg)	103	7.25	313,016.27kg

Table 10 Environmental cost of PET production (Rs)

	Virgin production	Recycled	Option 1
Solid waste (g/kg)	45	0	329,021.70
CO2 (g/kg)	2330	163	4,480,161.44
Other GHG (g/kg)	103	7.25	198,095-73
Total Environmental Cost			**5,007,278.87**

By 2020, these figures would have changed as follows:

Table 11: Environmental impact of PET production

	Virgin production	Recycled	Option 1
Solid waste (g/kg)	45	0	235,406.66kg
CO2 (g/kg)	2,330	163	12 615,322.27kg
Other GHG (g/kg)	103	7.25	557,789.27kg

Table 12: Environmental cost of PET production (Rs)

	Virgin production	Recycled	Option 1
Solid waste (g/kg)	45	0	588,516.65
CO2 (g/kg)	2330	163	7,983,742.95
Other GHG (g/kg)	103	7,25	353,002.96
Total env. Cost			**8,925,262.56**

5.4.1.2 Economic and social impacts

Under option 1, no major change is expected in terms of impacts on administrative burden, producers, retailers, employment, consumers, and public awareness: these remain almost constant. However, the projected increase in PET bottle consumption will both increase the net levies collected (levies collected less export incentives paid) and the cost for landfill (see Table 7 and Table 9 above).

There should be no additional effects on employment, although there might be a small increase in indirect employment as the increased recycle volume might result in a few more collectors entering the market. The increased total stock of PET bottles will increase public spending on clean-up activities.[102]

5.4.1.3 Conclusion

The business-as-usual scenario shows a trend with a significant increase in the amount of PET bottles consumed over the 2015-2020 period.

Table 13: Evaluation of impacts for Option 1

	Environmental impacts	Social impacts	Economic impacts
Strengths	None	None	Significant increase in net levies collected No impact on consumers, or retailers No additional administrative burden for government
Weaknesses	Increased GHG emissions, increased impact on environment, increased landfill	Does not facilitate changed consumer behaviour	Continued and increasing costs for clean-up and landfill; increased costs for bottlers (assuming recycle rate remains constant)

All other policy options are compared to this baseline scenario.

5.4.2 Option 2: Deposit system

Voluntary or manufacturers' own return systems are often applied in the case of reusable containers, because in these situations it is greatly in the producers' interest to collect a large proportion of the packaging used so that the 'refill cycle' can work.[103] In Mauritius, the same would apply to PET bottles, even though the bottles are 'one-way' bottles, as there is a legal duty on producers (bottlers) to ensure that the bottles are removed from the environment and from landfill.

According to the European Court of Justice, a deposit and return system may increase the proportion of

[102] BIO Intelligence Service (2011).
[103] European Commission (2009) 8.

empty packaging returned. Moreover, it may help prevent littering, as it gives consumers an incentive to return empty packaging.[104] However, a changeover from one waste management system to another demands good and thorough preparation by all key players involved, given that this phase is critical for market operators, since uncertainties about the legal and factual position can create instabilities in the market. The changeover to the new system would have to take place without interruption and without jeopardising the ability of businesses concerned to actually participate in the new system as soon as it becomes operational.[105]

This means that features of the system have to be developed and put in place, manufacturing lines and distribution chains have to be adapted and consumers have to be informed. This takes time and effort. Therefore, producers and distributors must be given a sufficiently long transitional period to enable them to adapt to the requirements of the new system before the deposit and return system enters into force. In the case of a complete changeover that requires a new system to be developed at the outset, a period of six months between the legal announcement and the entry into force was considered insufficient.[106] In such circumstances, a period of at least one year seems necessary.

A countrywide system should be provided. The purpose of a countrywide system is to make available a sufficient number of points of return so that consumers can recover the deposit independently of the initial place of purchase. This strengthens the acceptance of any such system by consumers, facilitates the return of empty packaging and undoubtedly increases the amount of collected material.[107]

Theoretical costs for the deposit system in the US have been determined as varying between $0.0324/bottle and $0.0396/bottle, depending on whether rural or urban areas, with a weighted average cost of $0.0391/bottle (Rs1.33/bottle). However, between 82% and 89% of total cost related to "labor and proprietor's profit" (63%-72%) and to "space lease" (17%-22%) costs, both of which would be lower in Mauritius. The average size of a deposit site in the US is between 370m^2 and 650m^2.[108] However, these are dedicated sites, rather than the areas set aside in shops. Considering that beverage bottles take up less than 5% of the space in retailers, and that returned bottles can be stacked more efficiently, it is not anticipated that PET bottles returned for deposit refund would take up more than 1%-2% of the total space at a retailer or other trader. It is therefore not anticipated that "space lease" would add significantly to a retailer's costs. Retailers, however, might have to appoint a dedicated person to receive all bottle returns and process refunds. This additional cost would have to be included in the total cost of the system.

Under this Option, the number of bottles in the market is expected to remain the same as under Option 1, as consumers do not have alternatives and as very few PET bottles can be reused for other purposes. The volume of PET bottles in the market would therefore remain as per

[104] Case C-309/02 Radlberger Spitz (2004) ECR I-11763, para. 77.
[105] European Commission (2009) 5.
[106] Case C-463/01 Commission v Germany (2004) ECR I-11705, para. 81.
[107] European Commission (2009) 5.
[108] Reclay (2014) 22.

Table **5** above.

Deposit systems in other countries such as the EU and the US have significantly increased PET recycling. If the deposit system succeeds in increasing the collection of PET beverage bottles to 70%,[109] the volume of PET material recycled will increase as follows:

Table 14: PET bottle recycling

Tons	Baseline	Option 2
2015	1,624.64	2,274.49
2016	1,787.10	2,501.94
2017	1,965.81	2,752.14
2018	2,162.39	3,027.35
2019	2,378.63	3,330.08
2020	2,616.49	3,663.09

If the deposit system succeeds in increasing the collection of PET beverage bottles to 70%, the volume of PET waste will increase as follows:

Table 15: PET bottle waste

Tons	Baseline	Option 2
2015	2,924.64	2,274.78
2016	3,282.10	2,567.26
2017	3,685.06	2,898.74
2018	4,139.53	3,274.57
2019	4,652,34	3,700.89
2020	5,231.26	4,184.66

Considering waste processing costs of Rs2,500/ton (at 2015 prices), the savings of PET waste management total cost for Option 2 vis-à-vis Option 1 will increase from Rs1.625 million in 2015 to Rs2.617 million by 2020.

Table 16: Cost of PET bottles waste processing and landfill

Waste process costs (Rs)		
	Baseline	Option 2
2015	7,311,593.42	5,686,556.05
2016	8,205,252.76	6,418,151.66
2017	9,212,653.04	7,246,841.82
2018	10,348,824.59	8,186,432.25
2019	11,630,849.23	9,252,217.67
2020	13,078,147.67	10,461,652.95

Considering an increased collection rate of 70% on beverage bottles, along with an 18% waste factor in preparing collected PET bottles for export, the volume of PET exported will change as follows:

[109] Based on the experience in European Union member states that have a deposit system in place on PET bottles, this RIA assumes that a 70% collection rate (which would translate into a 57.4% export rate) would be achievable.

Table 17: Recycled PET exported (tons)

	Baseline	Option 2
2015	1,299.71	1 865,08
2016	1,429.68	2 051,59
2017	1,572.65	2 256,75
2018	1,729.91	2 482,43
2019	1,902.91	2 730,67
2020	2,093.20	3 003,74

Based on the volume of exports and recycling, the incentives payable by government (Rs5/kg on exports) and by bottlers (R15/kg on collections or Rs17.70/kg on exports) will change as follows:

Table 18: Incentives paid on exported/recycled PET

	Gov incentive (Rs)		Bottlers' incentive (Rs)	
	Baseline	Option 2	Baseline	Option 2
2015	6,498,549.47	9,325,418.49	28,756,081.40	40,258,513.95
2016	7,148,404.41	10,257,960.34	31,631,689.53,	44,284,365.35
2017	7,863,244.86	11,283,756.37	34,794,858.49,	48,712,801.88
2018	8,649,569.34	12,412,132.01	38,274,344.34	53,584,082.07
2019	9,514,526.28	13,653,345.21	42,101,778.77	58,942,490.28
2020	10,465,978.90	15,018,679.73	46,311,956.65	64,836,739.31

5.4.2.1 Environmental impacts

Increased use of PET bottles will result in more litter and increased landfill, with a bigger impact on environment. Since PET has a very long half-life and therefore degrades very slowly, the additional negative effect on the environment will be cumulative.

In the projected period, the volume of PET bottles consumed rises by 170%. If a deposit system is implemented and PET beverage bottle collections increase to 70%, this will reduce the overall waste by 1,047 tons per annum by 2020, compared to Option 1. The environmental impact of the deposit system will be to change the amount of energy consumed, solid waste produced in the PET production process and the CO_2 and other GHG emissions, as follows:

Table 19: Environmental impact of PET production (2015)

	Virgin production	Recycled	Baseline	Option 2
Energy (MJ)	83.8	27.27	289,388.47MJ	252,652.17MJ
Solid waste (kg)	45	0	131,608.68kg	102,365.21kg
CO_2 (kg)	2,330	163	7,079,220.96kg	5,670,985.29kg
Other GHG (kg)	103	7.25	313,016.27kg	250,792.66kg

The cost of the environmental impact calculated in **Table 19** above can be calculated as follows:

Table 20: Environmental cost of PET production (2015)

	Baseline (Rs)	Option 2 (Rs)
Energy		

Solid waste	329,021.70	255,913.02
CO_2	4,480,161.44	3,588,944.28
Other GHG	198,095.73	158,716.84
Total env. Cost	**5,007,278.87**	**4,003,574.15**

By 2020, these figures would have changed as follows:

Table 21: Environmental impact of PET production (2020)

	Baseline	Option 2
Energy (MJ)	509,731.32	450,567.14
Solid waste (kg)	235,406.66	188,309.75
CO_2 (kg)	12,615,322.27	10,347,344.64
Other GHG (kg)	557,789.27	457,577.52

Table 22: Environmental cost of PET production (2020)

	Baseline (Rs)	Option 2 (Rs)
Energy (MJ/kg)		
Solid waste (g/kg)	588,516.65	470,774.38
CO_2 (g/kg)	7,983,742.95	6,548,428.81
Other GHG (g/kg)	353,002.96	289,582.88
Total env. Cost	**8,925,262.56**	**7,308,786.07**

5.4.2.2 Economic and social impacts

Any increase in the volume of PET bottles recycled will have a direct effect on bottlers' profitability, as it will increase their direct cost by the amount of additional incentives they have to pay. It was indicated in Table 18 above that the total amount of incentives payable by bottlers would increase from Rs31.6 million to Rs44.3 million in 2016 and from Rs46.3 million to Rs64.8 million by 2020. It is not clear whether this additional cost would be passed on to the consumer, as the full incentive of Rs17.70/kg is already included in the bottlers' prices. This would mean that any additional payments would directly affect the bottlers' bottom line by an equivalent amount. Likewise, the amount of incentives payable by government will increase from Rs7.1 million to Rs10.3 million in 2016, and from Rs10.5 million to Rs15.0 million by 2020. Option 2 will have no impact on the amount of levies collected by Government.

Based on additional job creation of five jobs/1,000 tons of recycling, it is estimated that Option 2 will immediately create an additional 3 jobs, which will grow to 5 jobs by 20120.

Recyclers will benefit from increased scales of economy and by obtaining a gross profit of Rs6.00/kg (the difference between the recycling payment they receive from bottlers and what they pay collectors) plus the Rs5.00/kg export incentive plus the selling price for the exported product.

5.4.2.3 Conclusion

Option 2 shows a significant increase in PET bottle recycling.

Table 23: Evaluation of impacts for Option 2

	Environmental impacts	Social impacts	Economic impacts
Strengths	Decreased GHG emissions, decreased landfill and litter	Significantly facilitates changed consumer behaviour	Some job creation in recycling; additional job creation at retailers; increased profitability for recyclers
Weaknesses	None	None	Significantly increased cost to both bottlers and government (increased incentives); additional

			administrative/enforcement burden for government and retailers

5.4.3 Option 3: Expand application of levy and recycling incentive to include other products

Option 3 considers the extension of the levy and the recycle incentive to all types of PET bottles, rather than the current application that extends only to PET beverage bottles. It is estimated that at present 1,300 tons of non-beverage PET bottles are consumed in the market each year and the expansion of the levy will target these bottles. The projected consumption of PET bottles is shown in

Table 5.

If the recycle rate remains at a level of 50% (before the waste factor during the cutting and shredding process), but the scope of the levy is expanded to include all PET bottles, this means that total PET recycling will increase as follows:

Table 24: PET bottle recycling

Tons	Baseline	Option 3
2015	1,624.64	2,274.64
2016	1,787.10	2,534.60
2017	1,965.81	2,825.44
2018	2,162.39	3,150.96
2019	2,378.63	3,515.49
2020	2,616.49	3,923.88

If the expanded scope of the levy succeeds in extending the collection rate of 50% to all PET bottles, the volume of PET waste will change as follows:

Table 25: PET bottle waste

Tons	Baseline	Option 3
2015	2,924.64	2,274.64
2016	3,282.10	,2,534.60
2017	3,685.06	,2,825.44
2018	4,139.53	,3,150.96
2019	4,652,34	,3,515.49
2020	5,231.26	,3,923.88

Considering waste processing costs of Rs2,500/ton (at current prices), the savings of PET waste management total cost for Option 3 vis-à-vis Option 1 will increase from Rs1.625 million in 2015 to nearly Rs3.269 million by 2020.

Table 26: Cost of PET bottles waste processing and landfill

Waste process costs (Rs)		
	Baseline	**Option 3**
2015	7,311,593.42	5,686,593.42
2016	8,205,252.76	6,336,502.76
2017	9,212,653.04	7,063,590.54
2018	10,348,824.59	7,877,402.71
2019	11,630,849.23	8,788,714.08
2020	13,078,147.67	9,809,692.24

Maintaining the current recycle rate of 50% (collections) and export rate of 40%, but now on all PET bottles, the volume of PET exported will change as follows:

Table 27: Recycled PET exported (tons)

	Baseline	**Option 3**
2015	1,299.71	1,865.20
2016	1,429.68	2,078.37
2017	1,572.65	2,316.86
2018	1,729.91	2,583.79
2019	1,902.91	2,882.70
2020	2,093.20	3,217.58

Based on the volume of exports and recycling, the incentives payable by government (Rs5/kg on exports) and by bottlers (R15/kg on collections or Rs17.70/kg on exports) will change as follows:

Table 28: Incentives paid on exported/recycled PET

	Gov incentive (Rs)	**Bottlers' incentive (Rs)**
2015	9,098,549.47	40,261,081.40
2016	10,138,404.41	44,862,439.53
2017	11,301,744.86	50,010,220.99
2018	12,603,844.34	55,772,011.21
2019	14,061,942.53	62,224,095.68
2020	15,695,507.59	69,452,621.09

5.4.3.1 Environmental impacts

Increased use of PET bottles will result in more litter and increased landfill, with a bigger impact on environment. Since PET has a very long half-life and therefore degrades very slowly, the additional negative effect on the environment will be cumulative.

In the projected period, the volume of PET bottles consumed rises by 170%. If the scope of the levy is expanded to include all types of PET bottles, this will reduce the overall waste by 1,307 tons per annum by 2020, compared to Option 1.

An increase in recycling will have a significant impact on the amount of GHG released into the atmosphere.

Table 29: Environmental impact of PET production (2015)

2015	Virgin production	Recycled	Baseline	Option 3
Energy (MJ/kg)	83.8	27.27	289,388.47MJ	252,643.97MJ
Solid waste (g/kg)	45	0	131.61kg	102.36kg
CO2 (g/kg)	2,330	163	7,079,220.96kg	5,670,670.96kg
Other GHG (g/kg)	103	7.25	313,016.27kg	250,778.77kg

Table 30: Environmental cost of PET production (2015)

2015	Virgin production	Recycled	Baseline (Rs)	Option 3 (Rs)
Energy (MJ/kg)	83,8	27,27		
Solid waste (g/kg)	45	0	329,021.70	255,896.70
CO2 (g/kg)	2330	163	4,480,161.44	3,588,745.36
Other GHG (g/kg)	103	7,25	198,095.73	158.708.05
Total env. Cost			**5,007,278.87**	**4,003,574.15**

By 2020, these figures would have changed as follows:

Table 31: Environmental impact of PET production (2020)

2020	Virgin production	Recycled	Baseline	Option 3
Energy (MJ/kg)	83.8	27.27	509,731.32MJ	435,825.01MJ
Solid waste (g/kg)	45	0	235,406.66kg	176,574.46kg
CO2 (g/kg)	2,330	163	12,615,322.3kg	9,782,225.11kg
Other GHG (g/kg)	103	7.25	557,789.27kg	432,607.43kg

Table 32: Environmental cost of PET production (2020)

2020	Virgin production	Recycled	Baseline (Rs)	Option 3 (Rs)
Energy (MJ/kg)	83,8	27,27		
Solid waste (g/kg)	45	0	588,516.65	441,436.15
CO2 (g/kg)	2330	163	7,983,742.95	6,190,786.81
Other GHG (g/kg)	103	7,25	353,002.96	273,780.28
Total env. Cost			**8,925,262.56**	**6,906,003.24**

5.4.3.2 Economic and social impacts

Any increase in the scope of the levy will have a direct effect on the profitability of bottlers' not currently covered by the levy, as it will not only increase their direct cost, but also their financing costs. This followed from the fact that they will be required to pay third parties for the collection and subsequent recycling of PET bottles that were not previously covered by the levy, and the fact that the levy needs to be paid at the end of the month during which bottling took place, regardless of when the actual sales was paid for.

There would be an additional impact on non-beverage PET bottlers, as they will now be responsible both for paying a levy of Rs2 per bottle and for paying the recycling companies Rs15/kg of PET bottles

collected. Non-beverage PET bottles are general smaller in size than beverage PET bottles, although they may be slightly thicker. For purposes of this RIA it was assumed that the ratio of 33 bottles/kg will remain constant. Considering a total of 1,300 tons of non-beverage PET bottles in 2015, this would equate to 42.9 million bottles, resulting in a levy of Rs85.8 million, plus a collection payment of Rs19.5 million. Accordingly, this would indicate increased costs of R105.3 million on non-beverage PET bottlers. It is assumed that most, if not all, of this cost will be passed on to the consumer, which means that the consumer will have to pay this additional amount in the form of higher prices for products such as syrups, vinegar and shampoo.

Based on additional job creation of five jobs/1,000 tons of recycling, it is estimated that Option 3 will immediately create an additional 3 jobs, which will grow to 7 jobs by 2020.

5.4.3.3 Conclusion

Option 3 shows a significant increase in PET bottle recycling.

Table 33: Evaluation of impacts for Option 3

	Environmental impacts	Social impacts	Economic impacts
Strengths	Significantly decreased GHG emissions, decreased landfill and litter vis-à-vis both Options 1 and 2	Cleaner public spaces enhance quality of life	Significantly increased levies collected; some job creation in recycling; increased profitability for recyclers
Weaknesses	Although it expands the levy and incentive to additional products, it does not do anything to increase the recycling rate on products already subject to the levy (PET beverage bottles)	Very little impact on consumer behaviour	Increased cost to consumers, which can effect especially low-income families; additional administrative/enforcement burden for government and especially for bottlers of non-beverage PET products

There is no reason why Options 2 and 3, which have no overlap, cannot both be implemented at the same time.

5.4.4 Option 4: Access to waste transfer sites

"Separation of waste for recycling" is the number one activity that people think about when they are asked how they can contribute to environmental protection.[110] However, no waste separation takes place at households in Mauritius, leaving post-consumer separation as the only option.

As indicated above, there are five MSW transfer stations in Mauritius, being La Laura, La Brasserie, Roche-Bois, La Chaumière, and Poudre d'Or.[111] The different local authorities all dump there MSW at these five transfer stations on a daily basis. From these stations, the MSW is combined and then transferred to the Mare Chicose landfill, generally on the same day.

PET bottles are lighter than most other MSW and tend to migrate to the top of the waste pile when tipped from a truck. It is therefore relatively easy to extract PET bottles from the MSW at this point. If access can be provided on a regulated basis to a limited number of PET collectors to extract PET bottles

[110] Schneider (2011) 6.
[111] Mohee (2014) 1.

at this point, the recycle rate for PET can be increased significantly. Considering that the weight/volume area for beverage bottles is less than for other PET bottles, e.g. those used for cosmetics, and as the weight/volume plays a major role in which products will end at the top of the waste pile after being tipped, it is assumed for purposes of this RIA that their will be a higher recovery rate for PET beverage bottles than for other PET bottles. For purposes of this RIA it was assumed that access to the waste transfer stations would result in 50% of PET beverage bottles and 40% of other PET bottles retrieved. This relates only to those bottles not already retrieved prior to arriving at the transfer stations. Accordingly, under Option 4.1 it is assumed that access to the transfer stations will extract 50% of all PET beverage bottles that reach the transfer stations. Under Option 4.2, it is assumed that Option 3 has also been applied and that the levy and recycle incentive have been expanded to include all PET bottles. Thus, under Option 4.2, the additional extraction is 50% of all PET beverage bottles and 40% of all other PET bottles that have reached the transfer stations.

Considering that the total MSW amounts to 420,000 tons per year, and assuming that workers will only extract PET from the top 10% of the MSW at each of the transfer stations, it is estimated that six collectors would be required at each of the stations.

Table 34: Collectors required per transfer station

Option 4: Access to waste transfer stations	
Waste/year (tons)	420 000,00
Waste/day (tons)	1,400
Per station/day (tons)	280
Top 10% sorted (tons)	28.00
Tons/worker	5.00
# of workers per station	5.60

Each of these collectors will have to be provided with appropriate safety gear. This includes an overall, mask and rubber gloves. Each collector should be provided with at least two sets of gear, so that one set can be washed while the other is being worn. Considering a cost of around Rs600 per set, the total cost for 60 sets (2 sets per collector; 6 collectors per site; 5 sites) would be Rs36,000. This would be an annual cost.

Assuming a retrieval rate of 50% of PET beverage bottles and a retrieval rate of 40% for non-beverage PET bottles, total PET recycling would increase as follows:

Table 35: PET bottle recycling

Tons	Baseline	Option 4.1	Option 4.2
2015	1,624.64	2,436.96	2,956.96
2016	1,787.10	2,680.65	3,278.65
2017	1,965.81	2,948.72	3,636.42
2018	2,162.39	3,243.59	4,034.44
2019	2,378.63	3,567.95	4,477.43
2020	2,616.49	3,924.74	4,970.65

Assuming a retrieval rate of 50% of PET beverage bottles and a retrieval rate of 40% for non-beverage PET bottles, total PET waste would decrease as follows:

Table 36: PET bottle waste

Tons	Baseline	Option 4.1	Option 4.2
2015	2,924.64	2,112.32	1,592.32
2016	3,282.10	2,388.55	1,790.55
2017	3,685.06	2,702.16	2,014.46
2018	4,139.53	3,058.33	2,267.48
2019	4,652,34	3,463.02	2,553.54
2020	5,231.26	3,923.01	2,877.11

Considering waste processing costs of Rs2,500/ton (at current prices), the savings of PET waste management total cost for Options 4.1 and 4.2 vis-à-vis Option 1 will increase from Rs2.031 million in 2015 to Rs3.269 million by 2020 for Option 4.1, and from Rs3.331 million in 2015 to Rs5.886 million by 2020 for Option 4.2.

Table 37: Cost of PET bottles waste processing and landfill

	Baseline	Option 4.1	Option 4.2
2015	7,311,593.42	5,280,796.71	3,980,796.71
2016	8,205,252.76	5,971,376.38	4,476,376.38
2017	9,212,653.04	6,755,389.02	5,036,139.02
2018	10,348,824.59	7,645,834.17	5,668,696.67
2019	11,630,849.23	8,657,559.77	6,383,851.65
2020	13,078,147.67	9,807,529.27	7,192,764.92

Under Options 4.1 and 4.2, the volume of PET exported will change as follows:

Table 38: Recycled PET exported (tons)

	Baseline	Option 4.1	Option 4.2
2015	1,299.71	1,998.30	2,424.70
2016	1,429.68	2,198.13	2,688.49
2017	1,572.65	2,417.95	2,981.86
2018	1,729.91	2,659.74	3,308.24
2019	1,902.91	2,925.72	3,671.49
2020	2,093.20	3,218.29	4,075.93

Based on the volume of exports and recycling, the incentives payable by government (Rs5/kg on exports) and by bottlers (R15/kg on collections or Rs17.70/kg on exports) will change as follows:

Table 39: Incentives paid on exported/recycled PET

	Option 4.1		Option 4.2	
	Gov incentive (Rs)	Bottlers' incentive (Rs)	Gov incentive (Rs)	Bottlers' incentive (Rs)
2015	9,991,519.81	43,134,122.09	12,123,519.81,	52,338,122.09
2016	10,990,671.79	47,447,534.30	13,442,471.79	58,032,134.30
2017	12,089,738.97	52,192,287.73	14,909,308.97	64,364,577.73
2018	13,298,712.86	57,411,516.51	16,541,218.36	71,409,650.01
2019	14,628,584.15	63,152,668.16	18,357,465.47	79,250,521.68
2020	16,091,442.56	69,467,934.97	20,379,656.09	87,980,466.53

5.4.4.1 Environmental impacts

Increased use of PET bottles will result in more litter and increased landfill, with a bigger impact on environment. Since PET has a very long half-life and therefore degrades very slowly, the additional negative effect on the environment will be cumulative.

In the projected period, the volume of PET bottles consumed rises by 170%. If access is granted to transfer stations, the overall waste will reduce by 1,308 tonnes by 2020, compared to Option 1. However, if the scope of the levy is expanded to include all types of PET bottles, while access is also granted to transfer stations, this will reduce the overall waste by 2,354 tons per annum by 2020, compared to Option 1.

An increase in recycling will have a significant impact on the amount of GHG released into the atmosphere.

Table 40: Environmental impact of PET production (2015)

	Virgin production	Recycled	Baseline	Option 4.1	Option 4.2
Energy (MJ/kg)	83.8	27.27	289,388.47MJ	243,468.10	214,072.50
Solid waste (g/kg)	45	0	131.61kg	95,054.34	71,654.34
CO2 (g/kg)	2,330	163	7,079,220.96kg	5,318,926.37	4,192,086.37
Other GHG (g/kg)	103	7.25	313,016.27kg	235,236.76	185,446.76

Table 41: Environmental cost of PET production (2015)

	Virgin production	Recycled	Baseline (Rs)	Option 4.1	Option 4.2
Energy (MJ/kg)	83,8	27,27			
Solid waste (g/kg)	45	0	329,021.70	237,635.85	179,135.85
CO2 (g/kg)	2330	163	4,480,161.44	3,366,140.00	2,197,323.99
Other GHG (g/kg)	103	7,25	198,095.73	148,872.12	97,203.77
Total env. Cost			**5,007,278.87**	**3,752,647.97**	**2,473,663.61**

By 2020, these figures would have changed as follows:

Table 42: Environmental impact of PET production (2020)

	Virgin production	Recycled	Baseline	Option 4.1	Option 4.2
Energy (MJ/kg)	83.8	27.27	509,731.32MJ	435,776.10MJ	376,651.05MJ
Solid waste (g/kg)	45	0	235,406.66kg	176,535.53kg	129,469.77kg
CO2 (g/kg)	2,330	163	12,615,322.3kg	9,780,350.2kg	7,513,872.5kg
Other GHG (g/kg)	103	7.25	557,789.27kg	432,524.59kg	332,379.11kg

Table 43: Environmental cost of PET production (2020)

	Virgin production	Recycled	Baseline (Rs)	Option 4.1	Option 4.2
Energy (MJ/kg)	83,8	27,27			
Solid waste (g/kg)	45	0	588,516.65	441,338.82	323,674.42
CO2 (g/kg)	2330	163	7,983,742.95	6,189,600.28	3,938,471.41
Other GHG (g/kg)	103	7,25	353,002.96	273,727.86	174,219.84
Total env. Cost			**8,925,262.56**	**6,904,666.95**	**4,436,365.67**

5.4.4.2 Economic and social impacts

Access to the transfer stations will not have any impact on the amount of levy collected. However, it would have a direct impact on bottlers' profitability, as they will be required to pay third parties for the collection and subsequent recycling of additional PET bottles that were not previously recovered. If Option 4.2 is applied, that is, both the increase in the scope of the levy to include non-beverage PET bottles and granting collectors access to transfer sites, the impact will be extended not non-beverage bottlers. All comments provided under Option 3 (extension of the scope of the levy) would be applicable if Option 4.2 was selected. However, the impact would be more significant (other than the amount of levy generated), as the collection rates will be higher under Option 4.2 than under Option 3.

Again, it is assumed that most, if not all, of this cost will be passed on to the consumer, which means that the consumer will have to pay this additional amount in the form of higher prices for products such as syrups, vinegar and shampoo.

Based on additional job creation of five jobs/1,000 tons of recycling, plus 30 additional collectors at the transfer sites, it is estimated that Option 4.1 will immediately create an additional 34 jobs, which will grow to 37 jobs by 2020; and that Option 4.2 would immediately create an additional 37 jobs, which will grow to 42 jobs by 2020.

Table 44: Evaluation of impacts for Option 4.1

	Environmental impacts	Social impacts	Economic impacts
Strengths	Significantly decreased GHG emissions, decreased landfill and litter vis-à-vis both Options 1 and 2 (but equal to Option 3)	Cleaner public spaces enhance quality of life	Relatively significant job creation in recycling; increased profitability for recyclers; no additional administrative burden on bottlers or government
Weaknesses	None	Does not facilitate consumer behavioural change	Increased cost to consumers, which can effect especially low-

			income families; decreased income for government; decreased profit for producers; increased job losses; increased transport costs & road congestion; increased cost for small and informal traders

5.4.4.3 Conclusion

Table 45: Evaluation of impacts for Option 4.2

	Environmental impacts	Social impacts	Economic impacts
Strengths	Significantly decreased GHG emissions, decreased landfill and litter vis-à-vis both Options 1 and 2	Cleaner public spaces enhance quality of life	Significantly increased levies collected; most significant job increases across options; increased profitability for recyclers
Weaknesses	None	Does not facilitate consumer behavioural change	Increased cost to consumers, which can effect especially low-income families; additional administrative/enforcement burden for government and especially for bottlers of non-beverage PET products; increased cost to non-beverage bottlers

5.4.5 Option 5: Increased incentives for recycling

If both government and bottlers were to increase their incentives, and recyclers also increased their incentives to collectors, it is anticipated that there would be a small increase in the volume of PET bottles collected. However, it is not anticipated that the increased collection would be in line with the increase in incentive, as collectors will earn more money by collecting the same volume of products. Unless the incentives increase to such an extent that more collectors enter the market, the anticipated increase in collections will not exceed an estimated 20% and some collectors might even collect less while still receiving the same compensation.

For purposes of this RIA it was assumed that government's and bottlers' incentives to recyclers would increase by 30%, while recyclers would also pay collectors 30% more. If, on the basis of these assumptions, the increased incentives succeed in increasing the collection rate by 20%, that is, from 50% to 60% of PET beverage bottles, total PET recycling will increase as follows:

Table 46: PET bottle recycling

Tons	Baseline	Option 5
2015	1,624.64	1,949.56
2016	1,787.10	2,144.52
2017	1,965.81	2,358.97
2018	2,162.39	2,594.87
2019	2,378.63	2,854.36
2020	2,616.49	3,139.79

Analogously, the volume of PET waste will change as follows:

Table 47: PET bottle waste

Tons	Baseline	Option 5
2015	2,924.64	2,599.71
2016	3,282.10	2,924.68
2017	3,685.06	3,291.90
2018	4,139.53	3,707.05
2019	4,652,34	4,176.61
2020	5,231.26	4,707.96

Considering waste processing costs of Rs2,500/ton (at current prices), the savings of PET waste management total cost for Option 3 vis-à-vis Option 1 will increase from Rs0.812 million in 2015 to nearly Rs1.308 million by 2020.

Table 48: Cost of PET bottles waste processing and landfill

Waste process costs (Rs)		
	Baseline	Option 5
2015	7,311,593.42	6,499,274.73
2016	8,205,252.76	7,311,702.21
2017	9,212,653.04	8,229,747.43
2018	10,348,824.59	9,267,628.42
2019	11,630,849.23	10,441,533.45
2020	13,078,147.67	11,769,900.31

On the basis of the 20% increase in PET beverage bottle collections, the volume of PET exported will change as follows:

Table 49: Recycled PET exported (tons)

	Baseline	Option 5
2015	1,299.71	1,598.64
2016	1,429.68	1,758.51
2017	1,572.65	1,934.36
2018	1,729.91	2,127.79
2019	1,902.91	2,340.57
2020	2,093.20	2,574.63

Based on the volume of exports and recycling, the incentives payable by government (Rs6.50/kg on exports) and by bottlers (R19.50/kg on collections or Rs23.01/kg on exports) will change as follows:

Table 50: Incentives paid on exported/recycled PET

	Gov incentive (Rs)	Bottlers' incentive (Rs)
2015	10,391,180.60	44,859,486.98
2016	11,430,298.66	49,345,435.67
2017	12,573,328.52	54,279,979.24
2018	13,830,661.38	59,707,977.17
2019	15,213,727.52	65,678,774.88
2020	16,735,100.27	72,246,652.37

5.4.5.1 Environmental impacts

Increased use of PET bottles will result in more litter and increased landfill, with a bigger impact on environment. Since PET has a very long half-life and therefore degrades very slowly, the additional negative effect on the environment will be cumulative.

In the projected period, the volume of PET bottles consumed rises by 170%. If the incentives are increased by 30%, this will reduce the overall waste by 523 tons per annum by 2020, compared to Option 1.

An increase in recycling will have an impact on the amount of GHG released into the atmosphere.

Table 51: Environmental impact of PET production (2015)

	Virgin production	Recycled	Baseline	Option 5
Energy (MJ/kg)	83.8	27.27	289,388.47MJ	271,020.32MJ
Solid waste (g/kg)	45	0	131.61kg	116,986.95kg
CO2 (g/kg)	2,330	163	7,079,220.96kg	6,375,103.12kg
Other GHG (g/kg)	103	7.25	313,016.27kg	281,904.46kg

Table 52: Environmental cost of PET production (2015)

	Virgin production	Recycled	Baseline (Rs)	Option 5 (Rs)
Energy (MJ/kg)	83,8	27,27		
Solid waste (g/kg)	45	0	329,021.70	292,467.36
CO2 (g/kg)	2330	163	4,480,161.44	3,341,574.05
Other GHG (g/kg)	103	7,25	198,095.73	147,763.04
Total env. Cost			**5,007,278.87**	**3,781,804.46**

By 2020, these figures would have changed as follows:

Table 53: Environmental impact of PET production (2020)

	Virgin production	Recycled	Baseline	Option 5
Energy (MJ/kg)	83.8	27.27	509,731.32MJ	480,149.23
Solid waste (g/kg)	45	0	235,406.66kg	211,858.21
CO2 (g/kg)	2,330	163	12,615,322.3kg	11,481,333.46
Other GHG (g/kg)	103	7.25	557,789.27kg	507,683.40

Table 54: Environmental cost of PET production (2020)

	Virgin production	Recycled	Baseline (Rs)	Option 5
Energy (MJ/kg)	83,8	27,27		
Solid waste (g/kg)	45	0	588,516.65	529.,645.51
CO2 (g/kg)	2330	163	7,983,742.95	6,018,055.75
Other GHG (g/kg)	103	7,25	353,002.96	266,107.33
Total env. Cost			**8,925,262.56**	**6,813,808.59**

5.4.5.2 Economic and social impacts

An increase in the level of the incentives will have a direct effect on bottlers' profitability, as they will have to pay more for collections, without any guarantees of increased collection volumes. Likewise, it will increase the cost for government, without any guarantees of increased recycling.

Based on additional job creation of five jobs/1,000 tons of recycling, it is estimated that Option 5 will immediately create an additional 2 jobs, which will grow to 3 jobs by 2020.

5.4.5.3 Conclusion

Option 5 shows a small increase in PET bottle recycling.

Table 55: Evaluation of impacts for Option 5

	Environmental impacts	Social impacts	Economic impacts
Strengths	Slightly decreased GHG emissions, decreased landfill and litter vis-à-vis Option 1	Cleaner public spaces enhance quality of life	Small increase in profitability of recyclers
Weaknesses	Lower impact than Options 2, 3 and 4	Very little impact on consumer behaviour	Increased cost to beverage bottlers and government, not specifically linked to increased recycling

6. COMPARING THE POLICY OPTIONS

6.1 Quantitative impacts

This Section compares the different policy options based on a quantitative analysis against Option 1, which is the baseline scnearion. In terms of quantitative impacts, Table 56 to Table 68 show the effect that Options 2 through 5 would have on the volume of PET bottles collected, recycled, PET exported, PET waste, the cost of landfill, the amounts of incentives to be paid by bottlers and government, the incentives received by collectors, the amount of GHG emitted.

Table 56: PET bottle collected (tons)

	Option 2	Option 3	Option 4.1	Option 4.2	Option 5
Tons	Exports	Exports	Exports	Exports	Exports
2015	649.85	650.00	812.32	1,332.32	324.93
2016	714.84	747.50	893.55	1,491.55	357.42
2017	786.32	859.63	982.91	1,670.61	393.16
2018	864.96	988.57	1,081.20	1,872.05	432.48
2019	951.45	1,136.85	1,189.32	2,098.80	475.73
2020	1,046.60	1,307.38	1,308.25	2,354.15	523.30

Table 57: PET exports (tons)

	Option 2	Option 3	Option 4.1	Option 4.2	Option 5
Year	Recycling	Recycling	Recycling	Recycling	Recycling
2015	565.37	565.49	698.59	1,124.99	298.93
2016	621.91	648.69	768.45	1,258.81	328.83
2017	684.10	744.21	845.30	1,409.21	361.71
2018	752.51	853.87	929.83	1,578.33	397.88
2019	827.76	979.79	1,022.81	1,768.59	437.67
2020	910.54	1,124.38	1,125.09	1,982.74	481.44

Table 58: PET bottle waste (tons)

	Option 2	Option 3	Option 4.1	Option 4.2	Option 5
Year	Waste	Waste	Waste	Waste	Waste
2015	-649.85	-650.00	-812.32	-1,332.32	-324.93
2016	-714.84	-747.50	-893.55	-1,491.55	-357.42
2017	-786.32	-859.63	-982.91	-1,670.61	-393.16
2018	-864.96	-988.57	-1,081.20	-1,872.05	-432.48
2019	-951.45	-1,136.85	-1,189.32	-2,098.80	-475.73
2020	-1,046.60	-1,307.38	-1,308.25	-2,354.15	-523.30

Table 59: Cost of PET bottles waste processing and landfill (Rs)

	Option 2	Option 3	Option 4.1	Option 4.2	Option 5
2015	-1,624,637	-1,625,000	-2,030,797	-3,330,797	-812,319
2016	-1,787,101	-1,868,750	-2,233,876	-3,728,876	-893,551
2017	-1,965,811	-2,149,063	-2,457,264	-4,176,514	-982,906
2018	-2,162,392	-2,471,422	-2,702,990	-4,680,128	-1,081,196
2019	-2,378,632	-2,842,135	-2,973,289	-5,246,998	-1,189,316
2020	-2,616,495	-3,268,455	-3,270,618	-5,885,383	-1,308,24

Table 60: Government incentives paid on exported/recycled PET

	Option 2	Option 3	Option 4.1	Option 4.2	Option 5
2015	2,826,869.02	2,827,463.74	3,492,970.34	5,624,970.34	3,892,631.13
2016	3,109,555.92	3,243,460.11	3,842,267.37	6,294,067.37	4,281,894.24
2017	3,420,511.51	3,721,043.62	4,226,494.11	7,046,064.11	4,710,083.67
2018	3,762,562.66	4,269,371.11	4,649,143.52	7,891,649.02	5,181,092.04
2019	4,138,818.93	4,898,964.81	5,114,057.87	8,842,939.20	5,699,201.24
2020	4,552,700.82	5,621,916.38	5,625,463.66	9,913,677.18	6,269,121.36

Table 61: Bottlers' incentives paid on exported/recycled PET

	Option 2	Option 3	Option 4.1	Option 4.2	Option 5
2015	11,502,432.56	11,505,000.00	14,378,040.70	23,582,040.70	16,103,405.58
2016	12,652,675.81	13,230,750.00	15,815,844.77	26,400,444.77	17,713,746.14
2017	13,917,943.40	15,215,362.50	17,397,429.24	29,569,719.24	19,485,120.75
2018	15,309,737.73	17,497,666.88	19,137,172.17	33,135,305.67	21,433,632.83
2019	16,840,711.51	20,122,316.91	21,050,889.39	37,148,742.91	23,576,996.11
2020	18,524,782.66	23,140,664.44	23,155,978.32	41,668,509.88	25,934,695.72

Table 62: Incentives paid to collectors (Rs)

	Option 2	Option 3	Option 4.1	Option 4.2	Option 5
2015	5,848,694.52	5,850,000.00	7,310,868.15	11,990,868.15	8,188,172.33
2016	6,433,563.97	6,727,500.00	8,041,954.97	13,423,954.97	9,006,989.56
2017	7,076,920.37	7,736,625.00	8,846,150.46	15,035,450.46	9,907,688.52
2018	7,784,612.41	8,897,118.75	9,730,765.51	16,848,460.51	10,898,457.37
2019	8,563,073.65	10,231,686.56	10,703,842.06	18,889,191.31	11,988,303.11
2020	9,419,381.01	11,766,439.55	11,774,226.27	21,187,377.90	13,187,133.42

Table 63: Environmental impact (2015)

2015	Option 1	Option 2	Option 3	Option 4.1	Option 4.2	Option 5
Energy (MJ)	-36,736	-36,745	-45,920	-75,316	-18,368	-36,736
Solid waste (kg)	-29,243	-29,250	-36,554	-59,954	-14,622	-29,243
CO2 (kg)	-1,408,236	-1,408,550	-1,760,295	-2,887,135	-704,118	-1,408,236
Other GHG (kg)	-62,224	-62,238	-77,780	-127,570	-31,112	-62,224

Table 64: Environmental impact (2020)

2020	Option 2	Option 3	Option 4.1	Option 4.2	Option 5
Energy (MJ)	-59,164	-73,906	-73,955	-133,080	-29,582
Solid waste (kg)	-47,097	-58,832	-58,871	-105,937	-23,548
CO2 (kg)	-2,267,978	-2,833,097	-2,834,972	-5,101,450	-1,133,989
Other GHG (kg)	-100,212	-125,182	-125,265	-225,410	-50,106

Table 65: Environmental impact of PET production (2015)

2015	Option 2	Option 3	Option 4.1	Option 4.2	Option 5
Solid waste (kg)	-73,109	-73,125	-91,386	-149,886	-36,554
CO2 (kg)	-891,217	-891,416	-1,114,021	-1,513,320	-369,070
Other GHG (kg)	-39,379	-39,388	-49,224	-66,867	-16,308
Total Env. Cost	**-1,003,705**	**-1,003,929**	**-1,254,631**	**-1,730,073**	**-421,932**

Table 66: Environmental impact of PET production (2020)

2020	Option 2	Option 3	Option 4.1	Option 4.2	Option 5
Solid waste (kg)	-117,742	-147,080	-147,178	-264,842	-58,871
CO2 (kg)	-1,435,314	-1,792,956	-1,794,143	-2,673,976	-594,392
Other GHG (kg)	-63,420	-79,223	-79,275	-118,151	-26,263
Total env. Cost	**-1,616,476**	**-2,019,259**	**-2,020,596**	**-3,056,969**	**-679,526**

Note that this excludes the cost of electricity and that **Table 63** and **Table 64** have indicated significant savings in this regard as regards each of the Options.

Table 67: Levies collected (Rs)

	Options 2, 4.1 and 5	Options 3 and 4.2
2015	0	85,800,000
2016	0	98,670,001
2017	0	113,470,500
2018	0	130,491,075
2019	0	150,064,736
2020	0	172,574,447

Table 68: Net levies collected (after government incentives)(Rs)

	Option 2	Option 3	Option 4.1	Option 4.2	Option 5
2015	-2,826,869	82,972,536	-3,492,970	80,175,030	-3,892,631
2016	-3,109,556	95,426,540	-3,842,267	92,375,933	-4,281,894
2017	-3,420,512	109,749,456	-4,226,494	106,424,436	-4,710,084
2018	-3,762,563	126,221,704	-4,649,144	122,599,426	-5,181,092
2019	-4,138,819	145,165,771	-5,114,058	141,221,797	-5,699,201
2020	-4,552,701	166,952,530	-5,625,464	162,660,770	-6,269,121

It is clear that Option 4.2 renders the best savings, that is, it produces the most significant savings in the volume of waste and the highest increase in recycling and exports. At the same time, it also places the highest burden on both government and on bottlers. However, in both instances, there is a significant distribution effect which needs to be considered. With the exception of Option 3, the net levies collected, that is, the difference between the levies collected and the government incentive paid out on exports, is the highest for Option 4.2. Also, while bottlers will have to pay higher incentives under Option 4.2 than under any other option, it will also translate into the highest payments to collectors. This means that a few bottlers will face higher costs, while a broader base of collectors stand to benefit.

It should further be noted that this excludes the impact of increased recycling on the trade balance.

Table 69: Effect on trade balance

	Option 2	Option 3	Option 4.1	Option 4.2	Option 5
2015	10,176,728	10,178,869	12,574,693	20,249,893	5,380,799
2016	11,194,401	11,676,456	13,832,163	22,658,643	5,918,879
2017	12,313,841	13,395,757	15,215,379	25,365,831	6,510,767
2018	13,545,226	15,369,736	16,736,917	28,409,936	7,161,843
2019	14,899,748	17,636,273	18,410,608	31,834,581	7,878,028
2020	16,389,723	20,238,899	20,251,669	35,689,238	8,665,831

It should further be noted that the costs were based on fixed 2015 prices, i.e. no adjustment has been made for increased costs of waste processing, raw materials, GHG impacts, and so forth.

6.2 Multi-criteria decision analysis

Bearing in mind the objective of a policy initiative on PET bottles, namely to increase the recycle rate and to limit, to the extent possible, the volume of PET bottles littered and landfilled, it is important to complement the quantitative assessment above with a qualitative analysis of impacts. Table 70 and Table 71provide an overall assessment of the policy options analysed in this RIA.

Table 70: Advantages and disadvantages of the different options

Policy option	Advantages	Disadvantages
Option 1: Baseline	No additional legal or administrative changes or costs	Increased environmental, economic and social impacts over time
Option 2: Deposit system	Decreased GHG emissions, decreased landfill and litter Significantly facilitates changed consumer behaviour Some job creation in recycling; additional job creation at retailers; increased profitability for recyclers	Significantly increased cost to both bottlers and government (increased incentives); additional administrative/enforcement burden for government and retailers
Option 3: Wider scope of levy to non-beverage bottles	Significantly decreased GHG emissions, decreased landfill and litter vis-à-vis both Options 1 and 2 Cleaner public spaces enhance quality of life Significantly increased levies collected; some job creation in recycling; increased	Although it expands the levy and incentive to additional products, it does not do anything to increase the recycling rate on products already subject to the levy (PET beverage bottles) Very little impact on consumer

	profitability for recyclers	behaviour Increased cost to consumers, which can effect especially low-income families; additional administrative/enforcement burden for government and especially for bottlers of non-beverage PET products
Option 4.1: Access to transfer stations	Significantly decreased GHG emissions, decreased landfill and litter vis-à-vis both Options 1 and 2 (but equal to Option 3) Cleaner public spaces enhance quality of life Relatively significant job creation in recycling; increased profitability for recyclers; no additional administrative burden on bottlers or government	Increased cost to consumers, which can effect especially low-income families; decreased income for government; decreased profit for producers; increased job losses; increased transport costs & road congestion; increased cost for small and informal traders Does not facilitate consumer behavioural change
Option 4.2: Access to transfer stations plus wider scope of levy	Significantly decreased GHG emissions, decreased landfill and litter vis-à-vis all other Options Cleaner public spaces enhance quality of life Significantly increased levies collected; most significant job increases across Options; increased profitability for recyclers	Does not facilitate consumer behavioural change Increased cost to consumers, which can effect especially low-income families; additional administrative/enforcement burden for government and especially for bottlers of non-beverage PET products; increased cost to non-beverage bottlers
Option 5: Increased level of incentives	Slightly decreased GHG emissions, decreased landfill and litter vis-à-vis Option 1 Slightly cleaner public spaces enhance quality of life Small increase in profitability of recyclers Higher income for collectors	Lower impact than Options 2, 3, 4.1 and 4.2 Very little impact on consumer behaviour Increased cost to beverage bottlers and government, not specifically linked to increased recycling

Table 71: Multi-criteria analysis

Criteria/Option	**1**	**2**	**3**	**4.1**	**4.2**	**5**
Socio-environmental impacts						
Impact on public spaces	=	+	++	++	+++	+
Support behaviour change in consumers	=	++	=	=	=	=
Environmental impacts						
Litter	--	+	++	++	+++	+
Resource efficiency	--	+	++	++	+++	+
Emissions	--	+	++	++	+++	+
Landfill	--	+	++	++	+++	+
Reduction in GHGs	--	+	++	++	+++	+
Economic impacts						
Impacts on bottlers	=	-	-	-	---	---

Impacts on recyclers	=	+	++	++	+++	+
Impacts on collectors	=	-	++	++	++	+
Impacts on consumers	=	-	--	=	--	=
Impact on major retailers	=	--	=	=	=	=
Impact or small/informal traders	=	--	=	=	=	=
Administrative burden	=	---	--	=	--	=
Impact on job creation	=	+	+	++	+++	=
Trade balance/balance of payments	-	++	++	++	+++	+
Net government levy	=	-	+++	-	+++	-

Option 4.1 would have the significant advantage of being simple to implement, as it simply means providing access to five waste transfer stations, while Option 5 would also be relatively easy to implement. Option 4.2 would add no additional burden on top of option 3, as the only change would be in the access granted to the waste transfer stations. Options 2, 3 and 42 would require significant additional administrative burden vis-à-vis Option 1.

6.3 Implementation

6.3.1 Introduction

Option 2 will require a completely new implementation system to ensure that traders actually charge consumers the deposit, provide consumers with the possibility of refunds and accurately report both sales and returns. There may also be a requirement to allow traders to retain a portion of the deposit to compensate them for the additional costs incurred in providing storage space for all the bottle returns.

Options 3 and 4.2 would require that the current implementation process be extended to non-beverage bottlers, including that bottlers would have to apply for a permit before they can bottle any product in a PET bottle. Option 4.1 would require some controls to ensure that the workers allowed access to the transfer stations are actually provided with the necessary safety clothing. There are no additional implementation requirements for Options 1 or 5.

6.3.2 Possibility to generate revenues

All Options will increase the revenues currently generated, as it is expected that the use of PET bottles will increase significantly over the next five years. However, under Options 3 and 4.2 there are the possibility of generating significantly additional revenue, and net revenue, through the extension of the scope of the levy to include non-beverage PET bottles.

6.3.3 Supporting the measure

Beverage producers full support the increase of the scope of the levy to include non-beverage producers on the basis that it is unfair that only some PET bottlers pay a levy and be responsible for clean-up costs.

All parties consulted supported the idea of access to waste transfer stations, although some concerns were expressed regarding the safety of the workers to whom access is granted.

There is very little support for Option 2 (deposit system), despite the significant success this has enjoyed in the EU. A major concern is the impact it would have on smaller traders, both as regards their storage space for returned bottles and the administrative burden this Option would place on them.

Although the recyclers would be in favour of an increase in the incentives paid, the bottlers strongly oppose this Option, as there is no guarantee that it would actually improve the recycling rate and would simply cost the bottlers and the government more money.

7. PREFERRED OPTION

It is clear that Option 1 – current situation – is not sustainable, as the anticipated increase in PET bottle consumption will place a significant strain on landfill options in Mauritius. Likewise, Option 5 – increased incentives – is not viable for the same reasons, as well as the additional costs associated therewith.

Option 2 – deposit system – also appears not to be sustainable, despite the fact that it would have the biggest impact on consumer behaviour. The unsustainability is a result of the market situation in Mauritius, where small traders represent a significant proportion of the overall trade in PET bottles and the impact a deposit system would have on them. The consultation process revealed that small traders represented at least 50% of all PET beverage bottle sales and a significant, albeit smaller, percentage of all other PET bottle sales.

Both Options 3 (extension of the scope of the levy to include non-beverage PET bottles) and Option 4.1 (access to waste transfer stations) are sustainable and would significantly increase the overall recycling rate of PET bottles. However, Option 4.2, which combines Options 3 and 4.1, is preferred, as it would both extend coverage of the levy and the recycling incentive to non-beverage bottles and increase the current recycling rate on PET beverage bottles. This Option would also lead to significantly increased net levies for government, the most significant impact on the balance of trade, the biggest job creation and the biggest reduction in litter and landfill, although it will also have the same significant impact on non-beverage PET bottlers as Option 3.

8. MONITORING AND EVALUATION

8.1 Core indicators of progress towards meeting the objectives

The core indicators for progress towards meeting the objectives set for this policy initiative are:

- Increased recycling of PET bottles
- Decreased landfill from PET bottles

Progress towards meeting the objectives can be monitored by monitoring the export volumes of PET chips and flakes.

8.2 Broad outline for possible monitoring and evaluation arrangements

At present, monitoring takes place through a permit system, whereby PET beverage producers have to obtain a permit from the MEA to be able to use PET in their production process. These producers then have to supply the MEA with a detailed monthly report indicating all production that took place and they pay a levy of Rs2 on every PET bottle filled. The exact same administrative process can be used in respect of non-beverage PET bottlers, which will make the whole process easy to administer from a government perspective, as the only additional burden is that there will be more reports to verify reach month. The administrative and cost burden on the non-beverage PET bottlers may be higher, as there will be an initial learning cost regarding the reporting format. In addition, the non-beverage PET bottlers will be liable for paying the Rs/bottle levy at the end of each month, yet may only receive payment for those products some time later, which may, at least initially, have a major impact on their cash flow. There will also be a once-off price increase passed on to their customers and, most likely, to consumers, as the levy will have to be recouped.

There will be no change in the monitoring in respect of the volume recycled, as the PET recyclers will still have to report to the MEA on a monthly basis regarding their volume of exports of PET chips and flakes, to be verified from export documentation approved by the MRA.

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