Closed Loop Cycle Production in the Americas Program

Sustainable alternative packaging

to replace the expanded polystyrene foam containers produced within the printing and packaging industry of

Trinidad and Tobago

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Government of the Republic of Trinidad and Tobago
Ministry of Planning and Development

2016

OAS Cataloging-in-Publication Data

Organization of American States. Department of Sustainable Development.

Sustainable alternative packaging to replace the expanded polystyrene foam containers produced within the printing and packaging industry of Trinidad and Tobago.

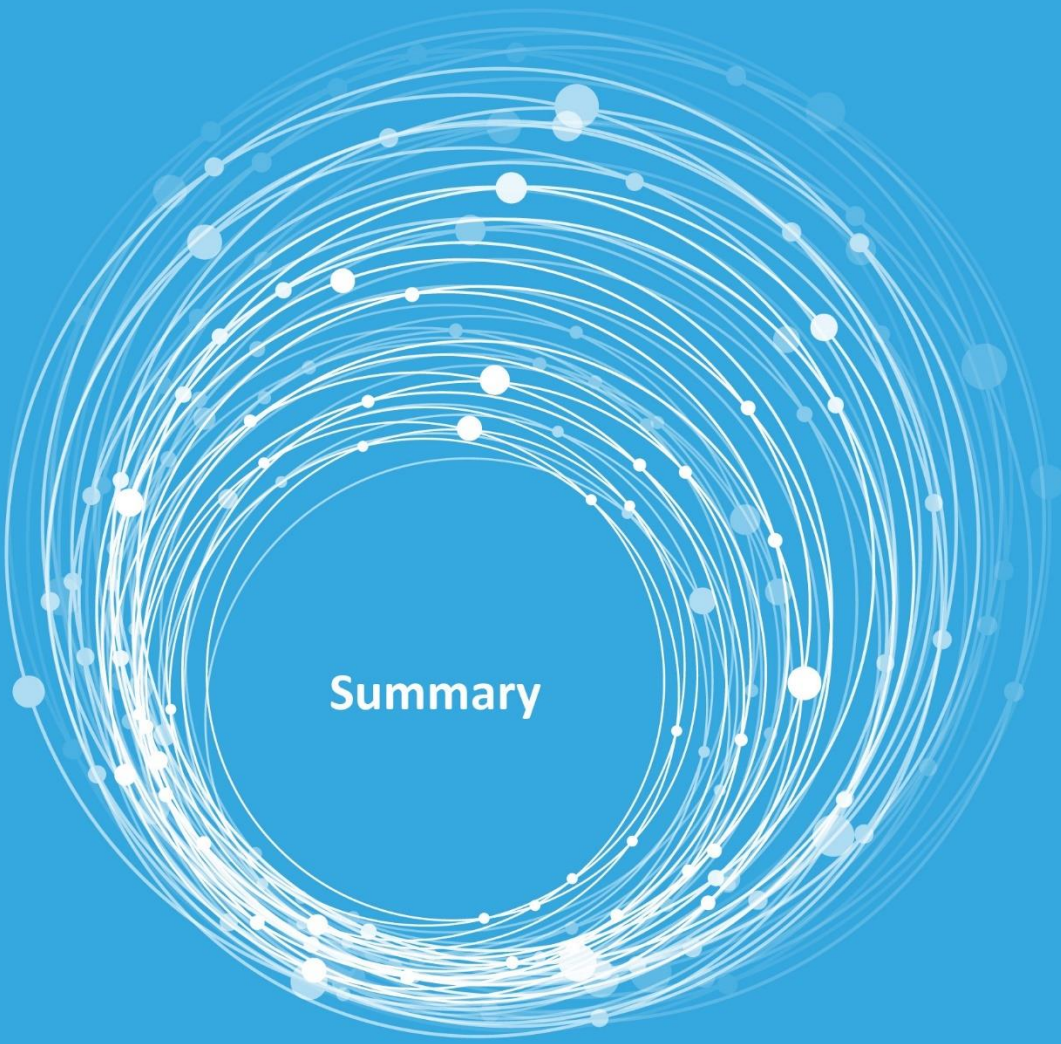
p. : ill. ; cm. (OAS. Official records ; OEA/Ser.D/XXIII.17.1)

ISBN 978-0-8270-6601-4

1. Food--packaging--Trinidad and Tobago. 2. Polystyrene--Environmental aspects--Trinidad and Tobago. 3. Recycling (Waste, etc.)--Trinidad and Tobago. 4. Sustainable development--Trinidad and Tobago. I. Title. II. Title: Closed Loop Cycle Production in the Americas Program. III. Title: Closed Loop Cycle Production. IV. Organization of American States. Executive Secretariat for Integral Development. V. Series.

OEA/Ser.D/XXIII.17.1

Closed Loop Cycle Production in the Americas



Summary

This document presents a proposal to implement sustainable food containers in the printing and packaging industry of Trinidad and Tobago. Its purpose is initiating a discussion among key ministries and decision makers regarding the potential for the development of an alternative sustainable packaging. It addresses the current scenario of the Expanded Polystyrene (EPS) foam, analyzing its production and consumption in the country.

In close collaboration with the Ministry of Planning and Development of Trinidad and Tobago, two sub-sectors were identified as having strategic development growth and diversification potential for the country. Printing and Packaging, and Food and Beverage subsectors showed the greatest potential for the introduction of new innovative business models to further sustainable growth and on which the Government has decided to place attention and assistance through the Closed Loop Cycle Production in the Americas Program of the Department of Sustainable Development of the Organization of American States.

The Closed Loop Cycle Production in the Americas Program innovative approach and objective is to look into how to close material streams in an economy, and start showcasing practical approaches to help nations transition toward Circular Economies. By adequately selecting primary materials or feedstock, using eco-intelligent design processes and sustainable manufacturing techniques; a new sustainable product can be produced. This new high-quality product can be introduced into the market and could compete with conventional products. This is because of the product automatically becomes a clean and sustainable source for another productive process after satisfying its main use or function (thus waste = resource).

This document covers a diagnostic of the production sector of Trinidad and Tobago, describes the current scenario of food and beverage Expanded Polystyrene containers and explores a sustainable alternative based on the concept of Cradle to Cradle® (C2C). It is recommended to continue this study with a pilot project or implementation phase where first the market is tested with sustainable packaging and second the prototypes are produced with local technology and resources.

Contents

Chapter 1
Background

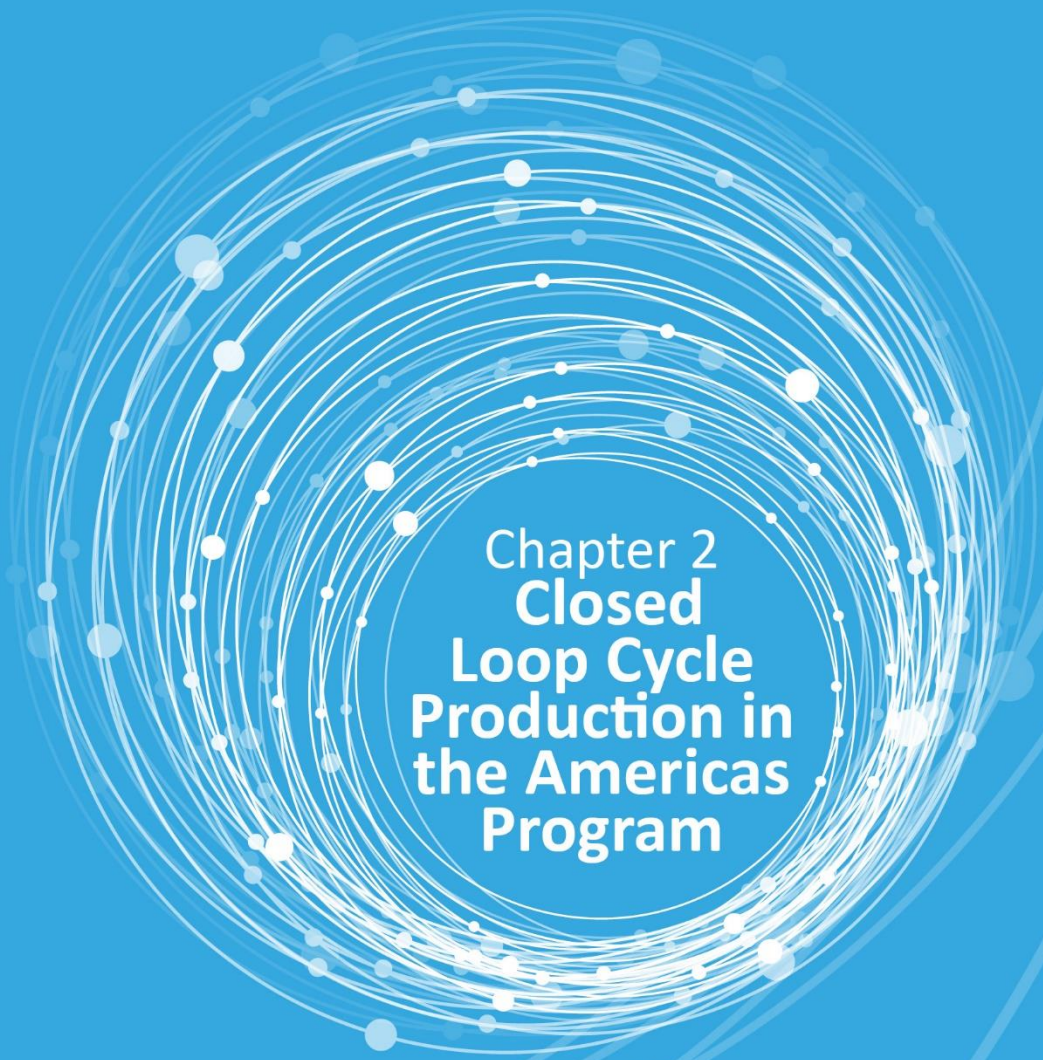
The Closed Loop Cycle Production in the Americas (CLCPA) Program is an initiative of the Department of Sustainable Development (DSD) of the Executive Secretariat for Integral Development of the Organization of American States (OAS), which aims to introduce and showcase the viability and applicability of Closed Loop Cycle Production (CLCP) design and manufacturing methodologies in the industrial sector while increasing the productivity, competitiveness and sustainability of business.

The CLCPA Program was launched in 2009 and has focused on increasing awareness in participating countries (Ecuador, Colombia, Panama and Trinidad and Tobago), of the relevance and viability of innovative closed-loop cycle design and manufacturing methods as means for sustainable production practices in small and medium-sized enterprises (SME) to increase their productivity, competitiveness and sustainability. The program aims to promote and facilitate the transition towards a sustainable and circular economy that employs renewable energy, eliminates the use of toxic chemicals and materials, and eradicates waste.

On August 30th 2013 the Ministry of Planning and Development of Trinidad and Tobago accepted the invitation to participate in the CLCPA Program. The ministry expressed its support for the program and put forward the possibility of a Project in the *Printing & Packaging Industry*. This industry is one of the largest export sectors next to the oil and gas industry and it fits strategically within the food sustainability cluster for long-term socio-economic development.

The non-energy related sectors have been prioritized by the Government of Trinidad and Tobago for further economic diversification and strategic development. Within the manufacturing sector the *Printing and Packaging*, and the *Food and Beverages* are identified as the sub-sectors with the greatest potential for further growth and that warrant the Government's attention and assistance from the CLCPA Program for their sustainable development.

When assessing the general performance indicators of the sectors of the economy, the waste production indicator, as one of the environmental indicators of the industrial sector, shows that more than 1,300 tons of waste reaches the landfill sites of Trinidad and Tobago every day. The Expanded Polystyrene (EPS) foam among other materials is the most common type of material disposed by the Domestic and Industrial sectors. Therefore, the petition of the Ministry of Planning and Development to focus the project of the CLCP in Trinidad and Tobago, and the pressing needs of finding a sustainable material to replace the Expanded Polystyrene foam and overcome the negative environmental impact of the high usage of these materials on food containers.



Chapter 2
Closed Loop Cycle Production in the Americas Program

The Closed Loop Cycle Production in the Americas (CLCPA) Program is inspired by the innovative and increasingly evolving Cradle-to-Cradle® (C2C®)[1] design and manufacturing paradigm. This new paradigm implies the development of industrial processes or manufacturing in which materials utilized for creating a product become valuable nutrients upon reaching the end of their useful life. Closed Looped Cycle Production (CLCP) does not only seek to rationalize the use of materials and resources, but involves a fundamental focus on the sustainable design of products and services to leap frog towards a closed-cycle sustainable manufacturing industry that will be able to deliver high-quality environmentally-friendly products to its customers and incentivize nations to achieve circular economies.

The proper design of a product increases its eco-effectiveness. In other words, the potential for the basic ingredients and/or materials contained in the product to be utilized again and re-enter the production cycle (technical or ecological cycle) and serve to devise a new product whose value is greater or comparable to the original one. In this manner, in line with the principles of Sustainable Materials Management, the continuous extraction of commodities and resources (being generally energy intensive processes) is minimized, while also improving the environmental performance of processes of manufacture and throughout the lifecycle of the product.

The CLCP approach distinguishes itself from the traditional methods of recycling or cleaning production in which the residues are used for the creation of materials or products of lower aggregate value and/or for a secondary use; or in the latter case, where attempts are made to make a production process “less bad” or cleaner.

The program is focused on promoting, introducing and applying the concept of 'Closed Looped Cycle Production' to the productive sector of nations in the Americas as a key solution to help mitigate climate change, increase productivity and promote innovation through sustainable and eco-effective production. The goal of the program is introduce and showcase the viability and applicability of Closed Looped Cycle Production design and manufacturing methodologies in the production sector of nations in the Americas as an innovative business development tool to mainly improve energy efficiency and environmental performance in the industrial sector and to increase the productivity, competitiveness and sustainability of businesses, in particular Small and Mediums size Enterprises (SMEs).

Between 2011-2013, a pilot project was implemented in Ecuador and it resulted in (1) the creation and approval of a National Closed Looped Cycle Production Program; (2) the first Cradle to Cradle Certified™[2] product in Latin America and the Caribbean for the packaging of a cereal bar produced by the company Batery Alimentos S.A.; (3) incentivizing the establishment of a new Cleaner Production Center for Ecuador; and (4) the inclusion of dedicated text in the National Development Plan “Plan para el Buen Vivir 2013-2017” regarding Closed Looped Cycle Production.

Colombia, Panama, and Trinidad and Tobago are the participating countries of the current phase of the CLCPA Program 2013-2016. The CLCPA Program has strategic alliances with partners that contribute to the program development within the participating countries. These partnerships have allowed contextualizing the program according to the needs of each country and providing the technical assistance for the development of the projects. The following are the consortium partners of the Program:

[1] Cradle to Cradle® and C2C® are registered trademarks of MBDC, LLC
[2] Cradle to Cradle Certified™ is a trademark licensed by the Cradle to Cradle Products Innovation institute

Department of Sustainable Development of the Organization of American States (DDS/OAS): The Department of Sustainable Development (DSD) supports OAS member States in the design and implementation of policies, programs and projects oriented to integrate environmental priorities with poverty alleviation, and socio-economic development goals. Translating sustainable development and environmental protection goals into concrete actions, DSD supports the execution of multiple country projects in such diverse areas as Integrated Water Management, Energy and Climate Change Mitigation, Risk Management and Climate Change Adaptation, Biodiversity and Sustainable Land Management and Environmental Law, Policy and Good Governance. The Department also supports transparency and Public Participation, as practical ingredients of good governance (OAS, 2013).

McDonough Braungart Design Chemistry (MBDC): MBDC is a firm founded in 1995 by world-renowned architect William McDonough and chemist Dr. Michael Braungart. They are co-authors of Cradle to Cradle: Remaking the Way We Make Things (2002) widely recognized as one of the most consequential ecological manifestos of our time. MBDC originated the Cradle to Cradle® design framework that helps companies go beyond minimizing harm and move towards creating a wholly positive impact on the planet. MBDC leads companies beyond sustainability toward positive growth by integrating the Cradle to Cradle® framework into corporate strategy, communications, operations, supply chains, and product designs. Using the process of inventory, assessment, and optimization, MBDC provides the technical expertise to help companies develop solutions around material health, material reutilization, renewable energy use, water stewardship, and social fairness (MBDC, 2014).

C2C ExpoLAB: The C2C ExpoLAB is home to Cradle to Cradle specialty consultants who enable and accelerate innovation through the vision of Cradle to Cradle. Its services include Cradle to Cradle inspiration sessions, presentations, workshops, project support and specialist consulting for the following key focus areas: Built environment and Government (C2C Lab, 2014).

National Cleaner Production Center of Colombia (CNPML): The CNPML works to strengthen a technical service, promote sustainable business development and showcase study cases that allow companies learning from the environmental and economic benefits of incorporating an environmental policy to strengthen its competitiveness in the public and private sector on the field of sustainability (CNPMLTA, 2015).

Environmental Protection Agency of United States (EPA): The mission of EPA is to protect human health and the environment. EPA was established on December 2, 1970 to consolidate in one agency a variety of federal research, monitoring, standard-setting and enforcement activities to ensure environmental protection. Since its inception, EPA has been working for a cleaner, healthier environment for the American people. EPA specializes in the development and enforcement of environmental regulations, financial aid, environmental research, sponsors voluntary partnerships and programs, and supports educational efforts to develop a public awareness and responsibility about the environment (EPA, 2013).

Chapter 3

Production sector of Trinidad and Tobago

The Production sector of Trinidad and Tobago is characterized by seven sub-sectors namely: *Food, Beverages and Tobacco*; *Textiles, Garments and Footwear*; *Printing and Publishing*; *Wood and Related Products*; *Chemicals and Non-Metallic Minerals*; *Assembly type and Related Industries*; and *Miscellaneous Manufacturing*.

The Production sector diagnostic of this country includes economic indicators per subsectors, such as: GDP in constant Market Prices, Productivity levels, Number of business establishment, Number of establishments by size workforce, and Percentage of employees. These indicators allowed analyzing the economic environment of the industry sector and its sub-sectors. However environmental data of industrial sub-sectors in Trinidad and Tobago is minimal to non-existing. Therefore recommendations are given in order to complete the environmental indicators.

3.1 Economic and Production Growth

- Context

The republic of Trinidad and Tobago (T&T) is a two-island country located on the northern edge of South America. The country shares maritime boundaries with Barbados, Grenada, Guyana and Venezuela. T&T has a population of 1.3 million people and an area of 5,128 square kilometers. It is considered part of the Caribbean Community (CARICOM), a regional co-operative Trade and Common Market Agreement.

The Trinidad and Tobacco economy has been primarily driven by the energy sector, with large exports of oil, gas and downstream energy products which in 2007 represented 66% of the country's export revenue. The country is currently the number one exporter of methanol and ammonia in the world. In 2007 60% of LNG imports to United States were originated from Trinidad and Tobago.

The major exports of the country are Petroleum gases (34%), Petroleum oils, refined (17%), Ammonia (14%), acyclic alcohols (10%), petroleum oils, and crude (9%). These products account for 84% of the total exports of the Trinidad and Tobago. The Major imports are Iron ores and concentrates (15%), Petroleum oils, crude (7%), cars (5%), Petroleum oils, refines (4%) and Parts for use with hoists excavation machinery (3%). Regarding the manufacturing Industry, T&T's exports are weaker (e.g. waters flavored or sweetened 0.46%, Cereal foods 0.18%, baked goods 0.18%, beer 0.13%, Packing containers 0.10%. The major export trade partners of Trinidad and Tobago are United States (48%, Spain (7%), Jamaica (5%), Argentina (4%) and Dominican Republic (3%) (OEC, 2014). Trinidad and Tobago's economic growth has been the result of oil and gas extraction. (See figure 1.0) This figure shows a clear trend in periods of growth and recession, which means that the country's GDP is highly dependent on oil prices.

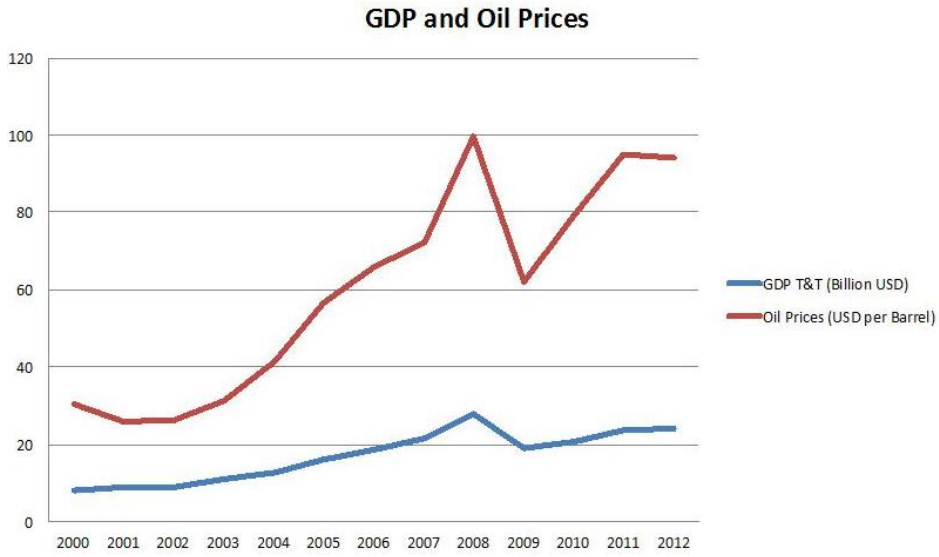


Figure 1.0: GDP and Oil Prices
Source: U.S Energy Information Administration and World Bank

Despite being an energy-based economy, Trinidad and Tobago is trying to develop other industries. In 2003 Trinidad and Tobago established a Standing Committee on Business Development (SCBD) to facilitate growth and diversification of their economy. The SCBD identified the following seven sectors for future development: Film, Music and Entertainment, Seafood, Merchant Marines, Printing and Packaging, Food and Beverages, and Yachting. T&T is focusing on these sectors because they already contribute to a small percent of the GDP and have a great potential for further growth.

- Gross Domestic Product

The Gross Domestic Product in Trinidad and Tobago was worth 88,934 million of T&T dollars in 2012. The share of the petroleum industry of the total GDP was 39%; while the non-petroleum industry was 61%. Within the petroleum industry, the most significant sector is exploration, with a share of 22%. In the non-petroleum industry, the service sector has a major role, as it is 51.4% of the total GDP - with the finance subsector having the largest part. Following the Service sector, the manufacturing sector is 8.7% - an important contribution to the GDP. (See figure 1.1)

As can be seen in figure 1.1 the contribution of the manufacturing industry to the national GDP has remained between 7-9%. Although the manufacturing industry has benefited from the availability of cheap fuel, the sector did not experience any outstanding growth in the 12 years represented by Figure 1.1.

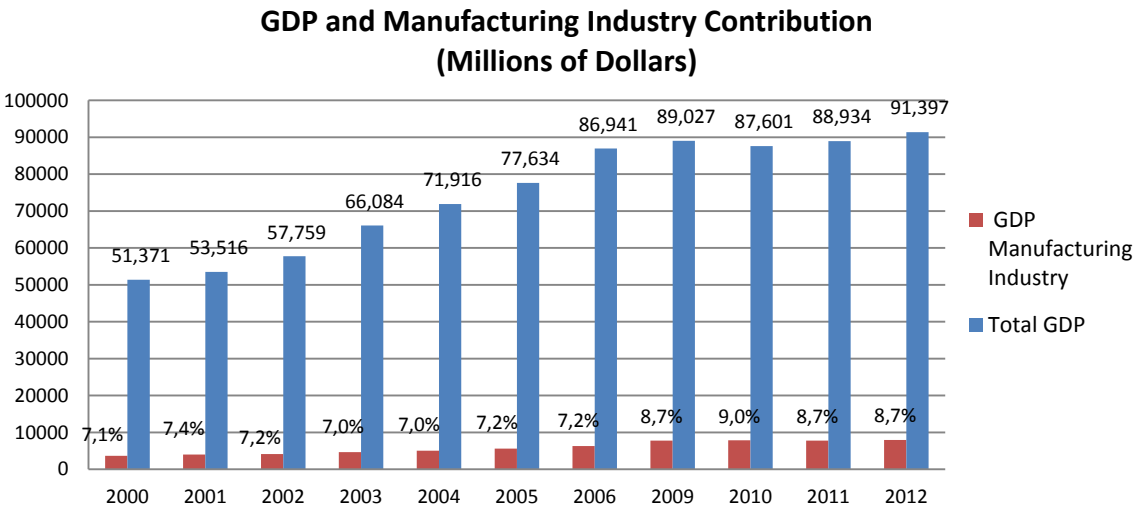


Figure 1.1: Contribution of Manufacturing Industry to GDP
Source: Central Statistical Office- Trinidad and Tobago

Analyzing the GDP by the sub-sectors of the manufacturing industry, the food, beverages and tobacco industry is the main sub-sector as seen in figure 1.2 (see below).

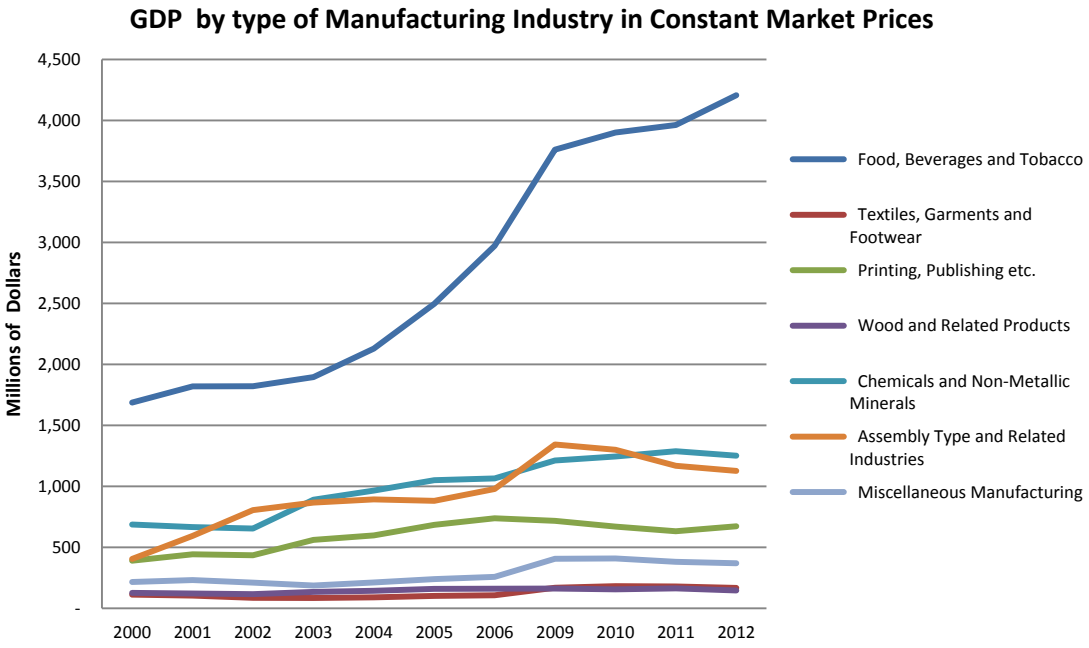


Figure 1.2: GDP of Manufacturing Industry Sectors
Source: Central Statistical Office- Trinidad and Tobago

The food, beverage and tobacco sub-sector represented 53% of the manufacturing GDP in 2012 after experiencing a steady growth since 2003 when the percentage contribution was 41%. Table 1.0 below shows the percentage of contribution of each sub-sector from 2000 to 2012. Other important sub-sectors within T&T manufacturing industry are the Assembly Type and related industries, Chemicals and Non-Metallic Minerals, Printing and Publishing.

Gross Domestic Product by type of Manufacturing Industry in Constant 2000 Market Prices

Percentage Distribution											
Sector	2000	2001	2002	2003	2004	2005	2006	2009	2010	2011	2012
Food, Beverages and Tobacco	46,5%	45,7%	44,1%	41,0%	42,3%	44,5%	47,3%	48,4%	49,6%	51,0%	53,0%
Textiles, Garments and Footwear	3,1%	2,6%	2,1%	1,8%	1,8%	1,8%	1,7%	2,2%	2,3%	2,3%	2,1%
Printing, Publishing etc.	10,8%	11,1%	10,5%	12,1%	11,9%	12,2%	11,8%	9,2%	8,5%	8,1%	8,5%
Wood and Related Products	3,5%	3,1%	2,8%	2,9%	2,9%	2,8%	2,6%	2,1%	2,0%	2,1%	1,9%
Chemicals and Non-Metallic Minerals	18,9%	16,7%	15,8%	19,3%	19,2%	18,7%	16,9%	15,6%	15,8%	16,6%	15,8%
Assembly Type and Related Industries	11,2%	14,9%	19,5%	18,8%	17,7%	15,7%	15,6%	17,3%	16,5%	15,0%	14,2%
Miscellaneous Manufacturing	6,0%	5,8%	5,1%	4,1%	4,2%	4,3%	4,1%	5,2%	5,2%	4,9%	4,7%

Table 1.0: GDP Manufacturing Industry Percent of Contribution
Source: Central Statistical Office- Trinidad and Tobago

In order to see which sub-sectors are growing or decreasing in the T&T economy, it is important to analyze the GDP growth per year. Figure 1.3 (see below) shows the performance of all manufacturing sub-sectors since 2001.

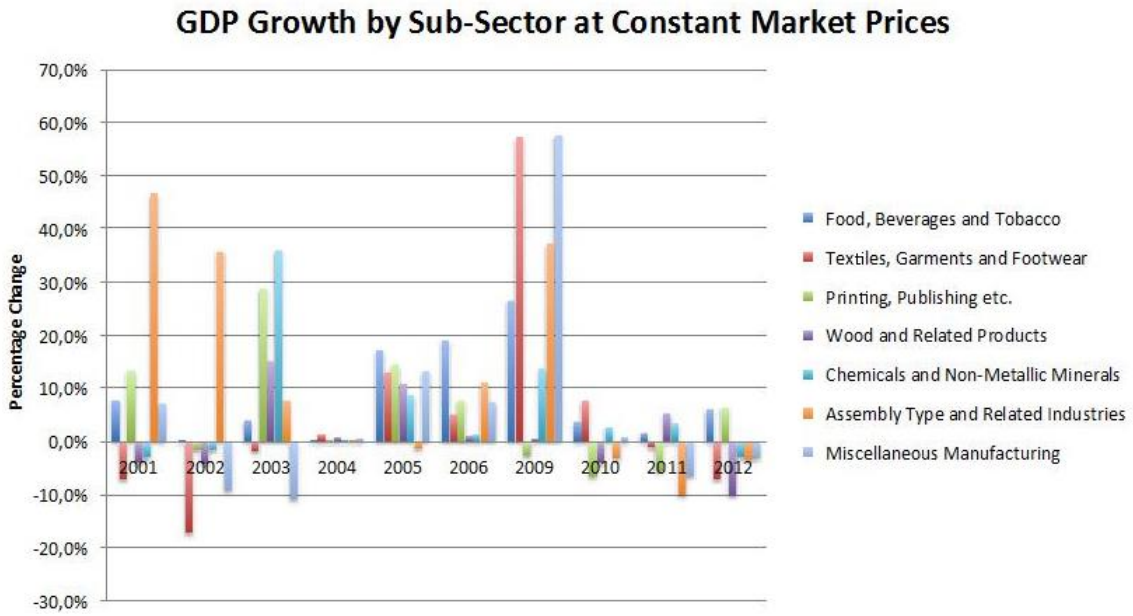


Figure 1.3: GDP by type of Manufacturing Industry
Source: Central Statistical Office- Trinidad and Tobago

Looking at figure 1.3, it can be concluded that even though the Food, Beverage and Tobacco industry has had some years of slower growth (e.g. years 2002, 2004, 2011), the sector still maintained positive growth for 12 years in row. The only two sub-sectors that by the end of the year 2012 had positive growth were Food, Beverages, Tobacco and Printing and Publishing. Textile Garments and Footwear sub-sector was more volatile. It had a period of negative growth between 2001 and 2004, then a very fast growth from 2005 to 2010, but ended up 2011 and 2012 decreasing again. The Assembly Type and Related Industries sub-sector has experienced mainly years of very fast growth, but it has been showing negative growth since 2011.

There are certain industrial sectors that drive productivity levels in T&T. These are shown in Figure 1.4 (see below), with Textiles, Garments and Footwear industrial sub-sector having the highest productivity levels of the sub-sectors shown during the 2000-2011 period. Despite being a very important sub-sector and perhaps one of the most developed in the T&T's manufacturing industry, the food sub-sector has not had high productivity levels. Printing, Publishing and Paper converters sub-sector has a low productivity performance as well. It is important to recognize that this sub-sector has been already prioritized to enhance development. Food, Beverage and Tobacco sub-sector presents better productivity levels.

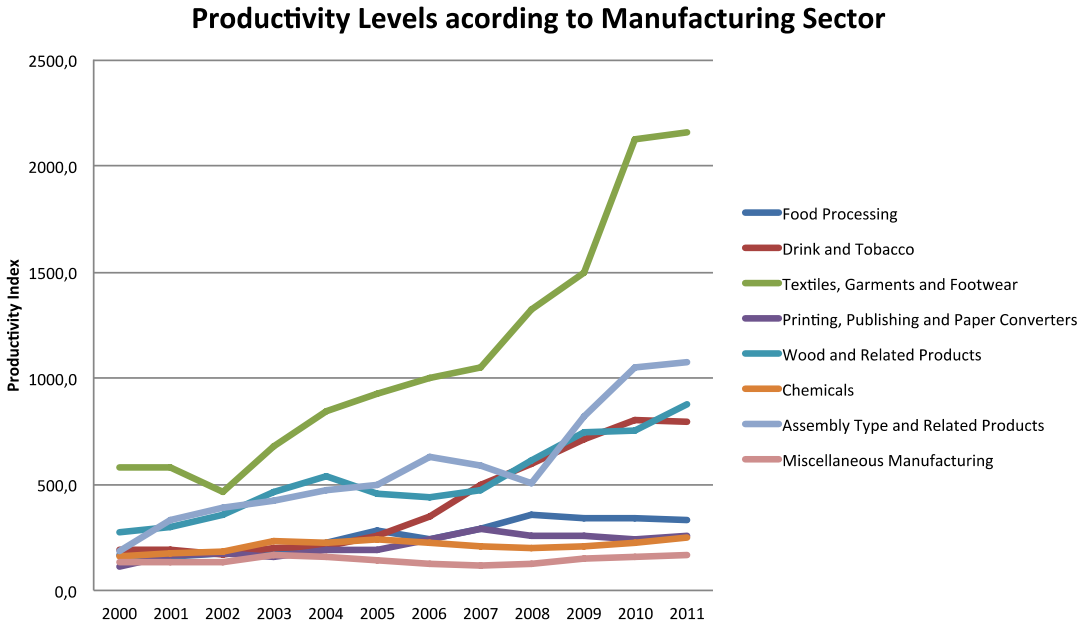


Figure 1.4: Productivity Levels

Source: Central Statistical Office- Trinidad and Tobago

- Number of Business Establishments

Food processors and Drinks sector has had the highest amount of establishments since 2001, followed by the Assembly Type and related Industries. See figure 1.5. Other sub-sectors that represent an important number of establishments are Printing, Publishing and Paper converters, and Wood and related products. Each sub-sector represents approximately 15% of the total establishments.

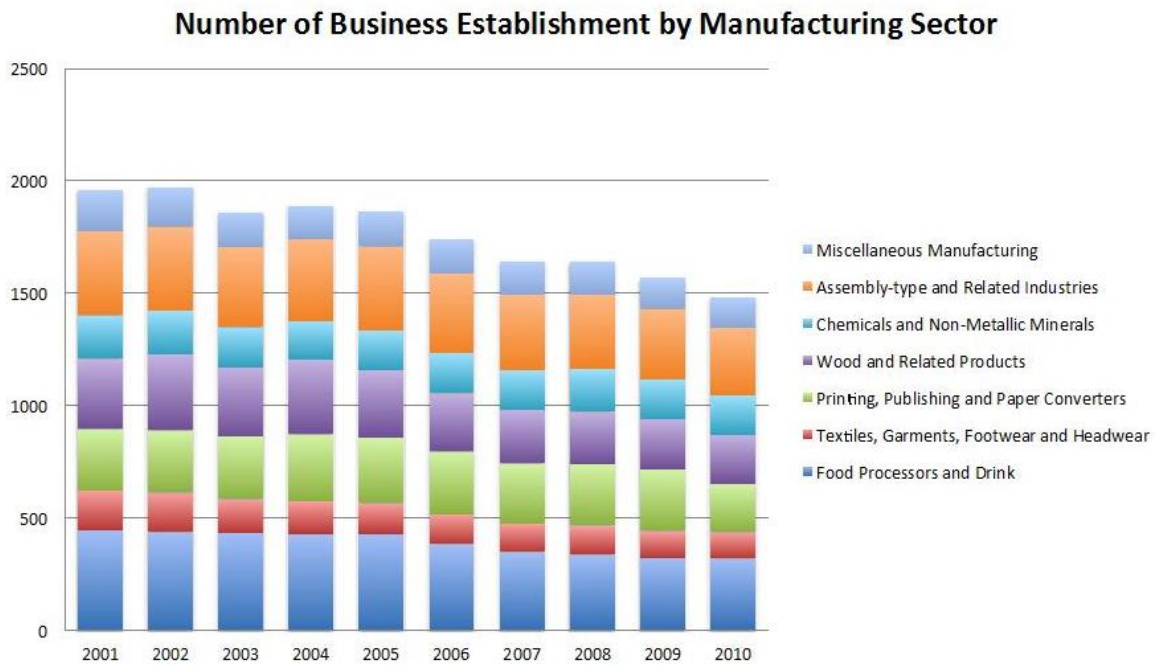


Figure 1.5: Number of Establishments
Source: Central Statistical Office- Trinidad and Tobago

Table 1.1 (see below) shows the percentage of establishments by sub-sector and their evolution from 2001 to 2010.

Percentage distribution of Business Establishments in Trinidad and Tobago by type of Manufacturing

Manufacturing Industry	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Food Processors and Drink	22,7%	22,1%	23,3%	22,7%	22,9%	21,9%	21,1%	20,5%	20,4%	21,4%
Textiles, Garments, Footwear and Headwear	9,1%	9,0%	8,1%	7,8%	7,5%	7,7%	7,9%	7,8%	7,7%	8,0%
Printing, Publishing and Paper Converters	13,9%	14,0%	14,9%	15,6%	15,6%	16,0%	16,3%	16,8%	17,5%	14,4%
Wood and Related Products	15,9%	17,0%	16,6%	17,6%	16,1%	14,8%	14,5%	14,2%	14,1%	14,7%
Chemicals and Non-Metallic Minerals	9,9%	9,9%	9,6%	9,2%	9,6%	10,3%	10,7%	11,6%	11,4%	11,8%
Assembly-type and Related Industries	19,1%	18,9%	19,1%	19,2%	20,0%	20,2%	20,4%	20,2%	20,0%	20,4%
Miscellaneous Manufacturing	9,5%	9,0%	8,4%	8,0%	8,4%	9,0%	9,1%	9,0%	8,7%	9,2%

Table 1.1: Number of Business Establishments
Source: Central Statistical Office- Trinidad and Tobago

Figure 1.6 (next page), shows the number of establishments by size of their work force; from 0 to 4 workers, 5 to 24 workers and so on. Observing Figure 1.6, it can be concluded that within Food and Drink sub-sector the majority of establishments have more than 50 employees. This could mean that this sub-sector is mainly composed of larger companies. In general for all sub-sectors, companies with a work force size of 25 to 49 people (green color) have fewer establishments.

The Printing, Publishing and Paper converters sub-sector, which seem to have a relevant importance in the T&T economy, judging by all of the above analysis, has approximately the same number of

establishments with a work force size of 0 to 4 (very small companies), 5 to 24 (small companies) and more than 50 workers (big companies). This could mean that this sector has an almost equal distribution of very small, small, and bigger companies. The definition of micro, small, medium and big enterprises encompass various criteria that are not analyzed in this document, however we have taken one criteria "size of work force" to have an idea of the composition of companies by size.

In T&T local context small enterprise is defined as having 6-25 employees, assets of TT$250,000 – TT$1.5 million and annual sales ,between TT $250,0000-$5 million. A medium enterprise is one with 26-50 employees, assets of TT $1.5–$5 million and annual sales of TT $5-$10 million.

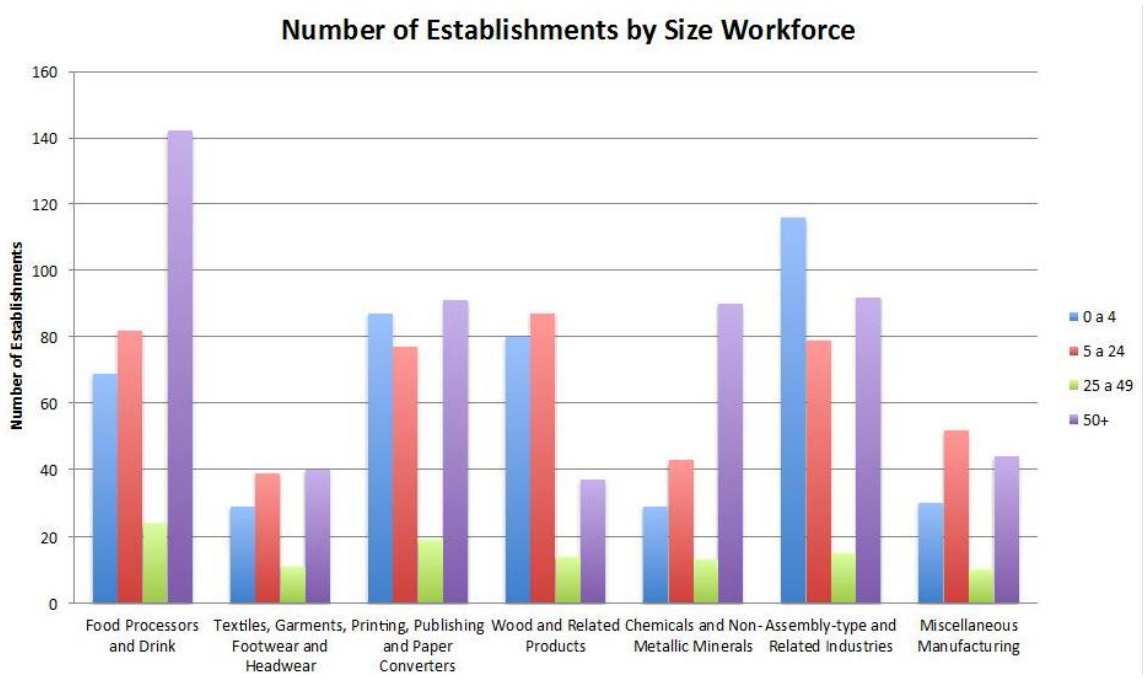


Figure 1.6: Number of Establishments by Work Force Size
Source: Central Statistical Office- Trinidad and Tobago

According to a survey conducted in 2009 by the National Training Agency and with collaboration of Trinidad and Tobago Manufacturers' Association (TTMA) the Food, Beverage and Tobacco sub-sector employment rate accounted 53% of all employment generated by the manufacturing industry. (See figure 1.7). This confirms that this sub-sector is very representative in T&T's economy and any initiative to improve its development will have major impacts.

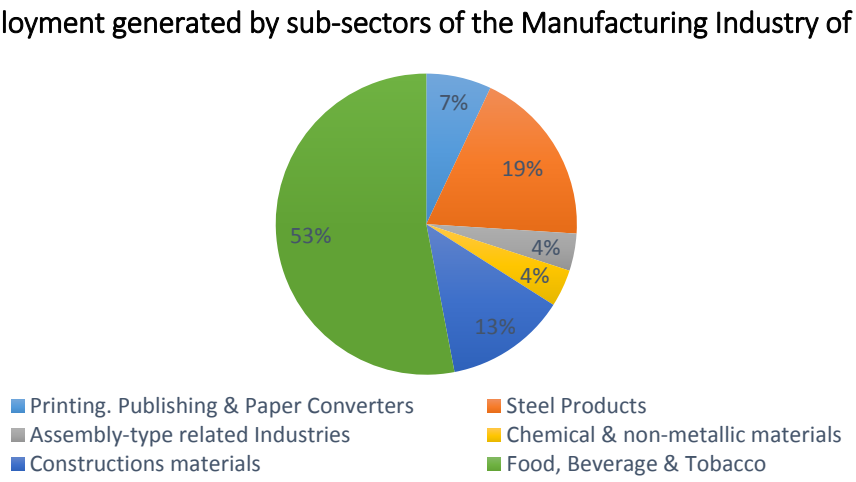


Figure 1.7: Percentage of Employment per Sub-sector
Source: National Training Agent and Trinidad and Tobago Manufacturers' Association (TTMA)

3.2 Environmental Indicators of Trinidad and Tobago

Research has been performed on Government Ministries, private companies and international environmental organizations websites to analyze the environmental performance of Trinidad and Tobago. This section uses the available environmental information of the country. Due to a lack of data within the productive, some assumptions and allocations are suggested.

- Waste Production

The Trinidad and Tobago Solid Waste Management Company Limited (SWMCOL) is in charge of managing three major disposal sites in Trinidad. SWMCOL had estimated the annual tons of waste that enters the sites namely Beetham Landfill site, Forres Park Landfill site and Guanapo Landfill site, see table 1.2. It is assumed that these amounts of waste come from industrial and residential disposals. Information about waste generated by specific productive sub-sectors is not available on public databases.

Tons of waste per Landfill per year between 1995 and 2004

SITE DATA, 1995-2004										
BEETHAM LANDFILL SITE	YEARS									
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Total Estimated Annual Tons	143.101	133.722	177.434	176.949	172.263	195.967	200.527	238.540	269.440	283.456
Monthly Average Tons	11.925	11.144	14.786	14.746	14.355	16.331	16.711	19.878	22.453	23.621
Daily Average Tons	392	366	486	485	472	537	549	654	738	777
FORRES PARK LANDFILL SITE	YEARS									
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Total Estimated Annual Tons	70.747	77.869	79.378	98.285	113.858	178.957	104.809	103.051	131.449	149.600
Monthly Average Tons	5.896	6.489	6.615	8.190	9.488	14.913	8.734	8.588	10.954	12.467
Daily Average Tons	194	213	217	269	312	490	287	282	360	410
GUANAPO LANDFILL SITE	YEARS									
	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Total Estimated Annual Tons	33.322	47.838	39.069	47.984	49.863	48.818	73.448	83.393	85.307	97.034
Monthly Average Tons	2.777	3.987	3.256	3.999	4.155	4.068	6.121	6.949	7.109	8.086
Daily Average Tons	91	131	107	131	137	134	201	228	234	266

Table 1.2. Disposal of waste on site, 1995-2004.
Source: SWMCOL

Based on table 1.2 more than 1300 tons of waste is reaching the sites every day. Beetham landfill site represents the largest site of the country managing around the 50% of the waste generated in Trinidad. Table 1.3 illustrates the type of waste collected at the three different landfill sites. Organics, Plastics and Paper are the materials with the highest percentages at the disposal sites followed by Glass, Metals, Textiles, Rubber and Leather respectively. Organic matter, in the form of waste, emits large quantities of greenhouse gasses, primarily methane (CH4), if not disposed properly. Some waste recovery processes have been implemented in Trinidad and Tobago during recent years. Beetham Landfill site accommodates a bottle recovery facility and a fecal waste stabilization pond system. It is not known to what extent they intend to keep materials in continuous cycles.

Tons of waste per Landfill per year between 1995 and 2004

TYPE OF WASTE	BEETHAM	FORRES PARK	GUANAPO
Organics	26,7%	45%	28,4%
Paper	19,7%	18%	20,3%
Glass	10,5%	8%	6,3%
Metals	10,4%	8%	9,5%
Plastics	19,9%	13%	19,6%
Textile	7,3%	4%	9,2%
Rubber & Leather	5,3%	2%	6,6%
Other	0,2%	2%	0,1%

Table 1.3. Type of Waste on site.
Source: SWMCOL

Due to a lack of information related to the waste generated by the productive sector, the information showed on tables 1.2 and 1.3 is used to allocate the values by sub-sector. It is considered the type of waste and the material that is highly used in every sub-sector. As a result the following assumptions are made: the percentage of Organics belongs to the sub-sector of Food, Beverage and Tobacco. Textiles, Rubber and Leather are allocated to the sub-sector of Textiles, Garments and Footwear. Paper is assigned to Printing and Publishing. Metals are set to Assembly type and related industries. Plastics are assigned to Chemicals and Non-Metallic Minerals. And Glass is allocated among several sub-sectors. None amount of waste is identified for Wood and related products (see table 1.4).

Tons estimated by subsector of waste in 2004

SUBSECTOR	Total Estimated Annual Tons 2004						
	Organics	Paper	Glass	Metals	Plastic	Textiles	Rubber & Leather
Food, beverages and Tobacco	102.446		11.961				
Textiles, Garments and Footwear						35.603	24.410
Printing and Publishing		102.467					
Wood and Related Products							
Chemicals and Non-Metallic Minerals			11.961		94.874		
Assembly Type and Related Industries			11.961	50.666			
Miscellaneous manufacturing			11.961				

Table 1.4. Allocation of waste type material by sub-sector

Source: SWMCOL

The estimated waste values of the year 2004 (latest year information available of table 1.8) were used to allocated the percentage of each Landfill site and obtain an estimated annual tons by subsector. Thus, figure 1.8 presents the total assumed values of estimated annual tons for the year 2004 by the different sub-sectors.

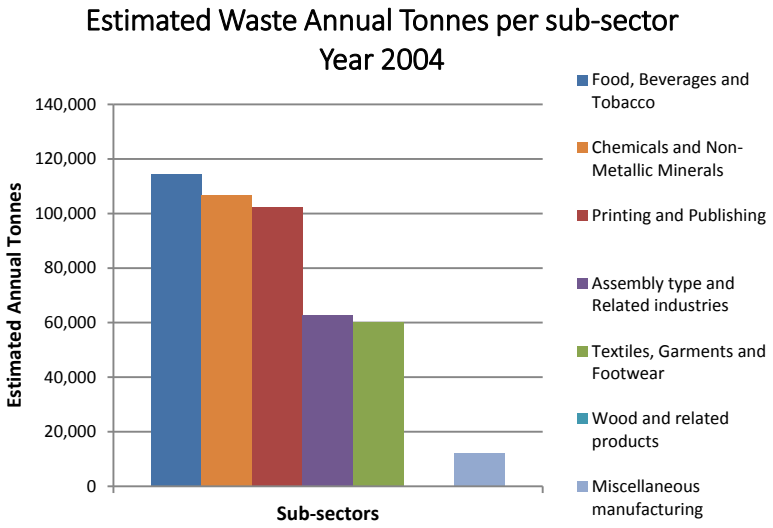


Figure 1.8: Allocated values of waste annual tons per sub-sector
Source: SWMCOL

Food, Beverages and Tobacco; Chemicals and Non-Metallic Minerals; Printing and Publishing are estimated to have highest amount of waste production followed by Assembly type; and Miscellaneous manufacturing.

- Greenhouse gas emissions

Most of Trinidad and Tobago greenhouse gas emissions are attributable to the operations of its petroleum and petrochemical industries. The country's CO_2 emissions per capita are among the highest in the world with about 30 tCO_2e per year. Around 40 million tons of CO_2 are emitted per year in Trinidad and Tobago (IEA, 2013).

According to the National Climate Change Policy 2011 of Trinidad and Tobago (Goverment of the Republic of Trindad & Tobago, 2011) carbon dioxide emissions from the energy sector (petrochemical and heavy industry) increased from 16,806 gigagrams (Gg) to 63,456 Gg, thus an increase of **278 %** over the period 1990 – 2011. Carbon dioxide emissions from the industrial processes sector had increased by 86.7% from 1990 to 2006. Figure 1.9 illustrates the CO_2 emissions by sector for the year 2007 (Ministry of Energy and Energy Industries, 2013).

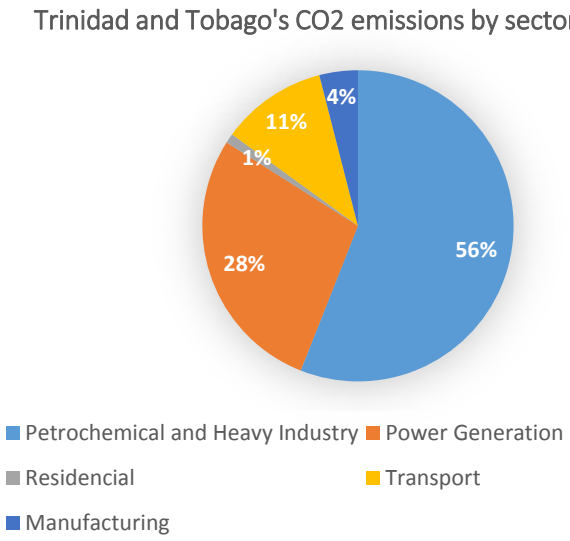


Figure 1.9. Trinidad and Tobago´s CO2 emissions by sector 2007
Source: Ministry of Energy and Energy affairs

Considering the 40 million tons of CO_2 emitted per year in Trinidad and Tobago and the percentage of emissions allocated by sector in 2007, the manufacturing sector generates around 1.6 million tCO_2e per year. Data about the emissions by different industries of the manufacturing sector is minimal to non-existing.

- Water consumption

The Water Resources Agency had calculated the Trinidad and Tobago's combined Public Water Supply Demand for the year 1997 and made a prognosis for the years 2000 and 2025 (see table 1.5 below). There is no available information on the Agency website to verify the data for more recent years. The highest category demanding is *Domestic*. The agency has forecast an increment of 211% in water demand for *Major industries* from 1997-2025. *Minor industries* are estimated to present an increase of 66% for the same period. Unaccounted demand belongs to those areas where there is an absence of a metered system. Owing to the fact that there is not a clear distinction between the industrial sub-sectors that belong to major or minor industries, the categories considered in this analysis are related to the following sub-sectors: *Food, Beverages and Tobacco*; *Textiles, Garments and Footwear*; *Printing and Publishing*; *Wood and related products*; *Chemicals and Non-metallic Minerals*; *Assembly type and related industries*; and *Miscellaneous Manufacturing*.

Total Public Water Supply Demand (MCM/year)

YEAR	DOMESTIC	MAJOR INDUSTRIAL	MINOR INDUSTRIAL	UNACCOUNTED FOR/NEGATIVE	TOTAL
1997	118	36	9	124	287
2000	120	51	10	126	307
2025	203	112	15	141	471

Table 1.5. Total Public Water Supply Demand (MCM/year)
Source: Environmental Management Authority

Public Water Supply Demand is reflected in this study as the water consumption for the different categories. This relation is assumed because there is no reliable information about the consumption of water by the different sectors. For instance the water consumption in the *Domestic* category is difficult to provide since only 1% of the population is metered and about 22% of customers have a 24-hour (continuous) supply. The scenario for Major and Minor industries is unknown.

Accurate data for recent years must be validated with the Water Resources Agency and if possible obtain the data by the sub-sectors of our interest. If the required information does not exist, it is recommended using the Water Supply Demand for Major and Minor industries of the year 2000 or the latest available and allocated it equally as water consumption of each of the sub-sectors.

- Energy Consumption

The Energy Division of the Infrastructure and Environment Department of the Vice President of the Research Department at the Inter-American Development Bank (IDB) published in 2012 a report of Energy Sector in Latin American and Caribbean countries. According to this study Trinidad and Tobago's energy sector is dominated by gas production and the island state is among the five largest exporter of liquefied natural gas (LNG). The total production of primary energy in the island was 903 thousand barrels of oil equivalent per day (kboe/day) where 752 kboe/day corresponds to Natural Gas and 151kboe/day to Crude oil. Around 357kboe/day of LNG and 79kboe/day of Crude oil were exported in 2012. The total supply of primary energy was 544kboe/day from which 73% was Natural Gas.

The final consumption by sectors was 318kboe/day, where 14kboe/day had been transformed as electricity, 278 kboe/day entered as LNG, and 26 kboe/day as oil products. Around 110 kboe/day of oil products were exported. The *Industry sector* consumed 81kboe/day, *Transport sector* 21kboe/day, *Residential sector* 8kboe/day, *Commercial sector* 2kboe/day, and *Others* 207kboe/day. The highest consumption of energy went to the category *Others* where its activities had not been clearly identified (see figure 2.0). The values´ unit *kboe* (thousand barrels of oil equivalent) have been converted into MJ (Mega Joules) using the conversion rate of 1kboe equals to 5861520MJ. According to this information, the primary energy consumption by the Industrial sector is 1,733E+11MJ/year.

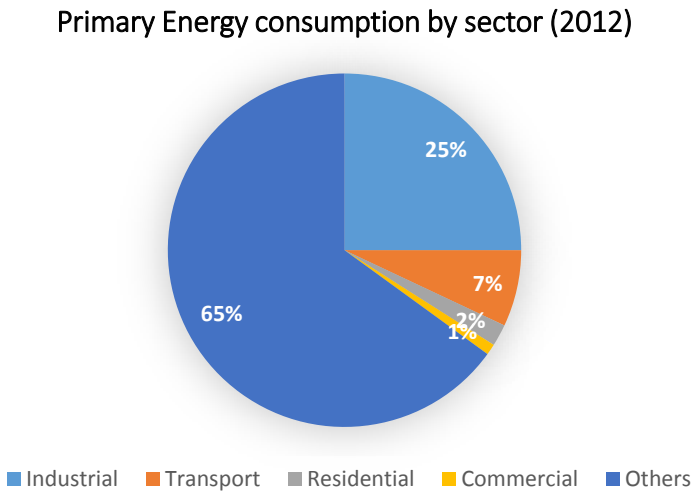


Figure 2.0. Primary Energy consumption by sector (MJ/year)
Source: Inter-American Development Bank

Electricity is supplied by the Trinidad and Tobago Electricity Commission (T&TEC), which is responsible for power supply on both islands via a single interconnected grid. Electricity generation in 2012 stood at 8,485 GWh of which 98 percent was produced from gas turbines and the remaining two percent from medium speed diesel plants. The majority of electricity is consumed by the industrial sector (60 percent), followed by the residential sector (29 percent), and the commercial sector (10 percent). The remaining one percent is consumed by street lighting (see figure 2.1). The values´ unit *GWh* (Gigawatt hour) have been converted into MJ (Mega Joules) using the conversion rate of 1GWh equals to 3600.000MJ. Therefore the secondary energy consumption by the Industrial sector during 2012 was 1,83E+10MJ.

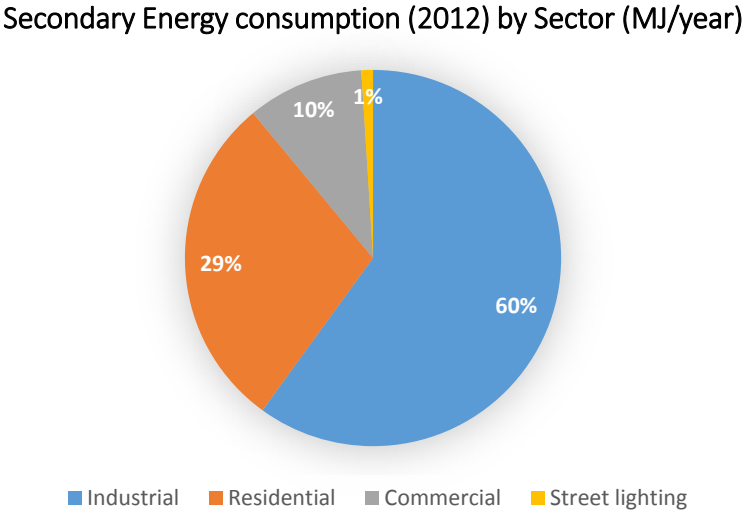
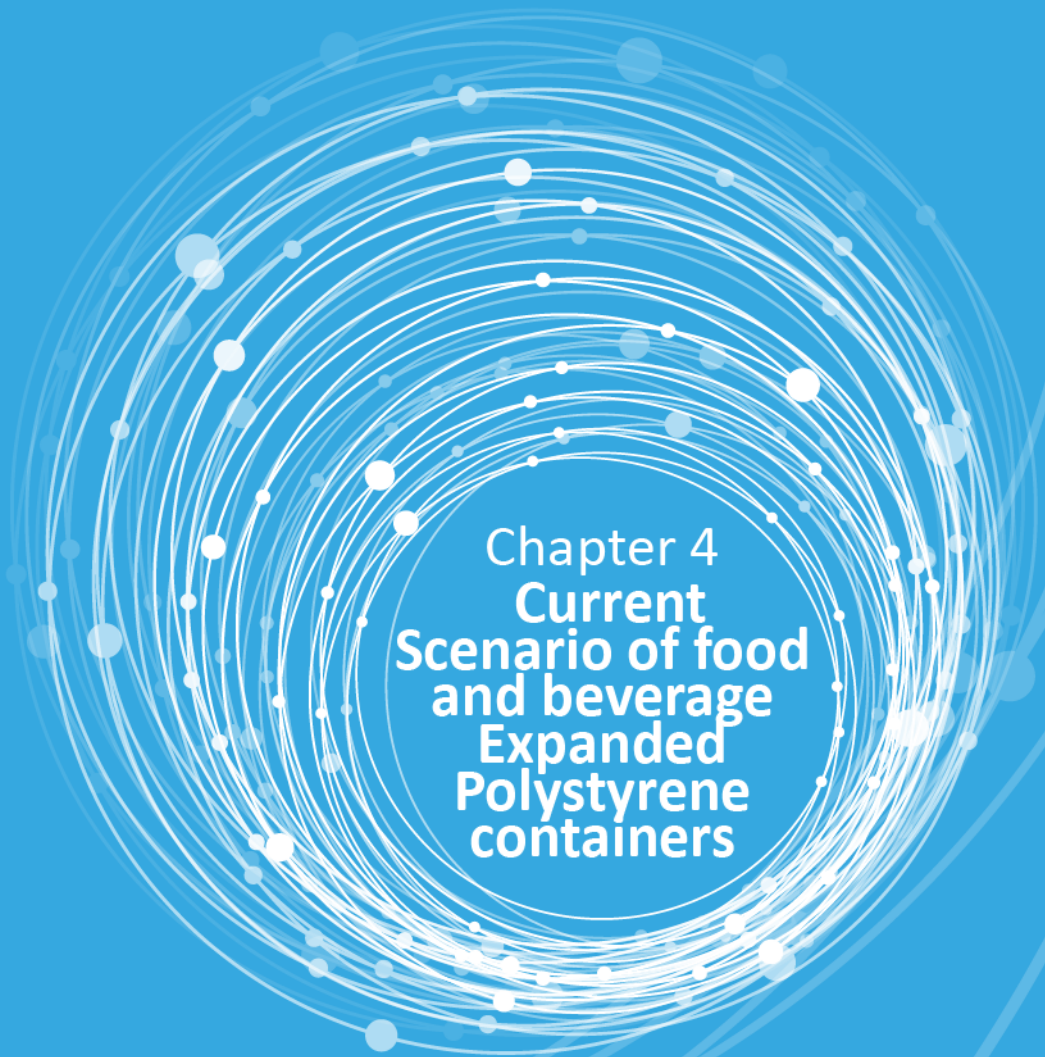


Figure 2.1. Secondary Energy consumption by sector (MJ/year)
Source: Trinidad and Tobago Electricity Commission (T&TEC)



Chapter 4

Current Scenario of food and beverage Expanded Polystyrene containers

This section aims to illustrate the impacts of continuing with the same situation of consuming disposable beverage and food containers made of polystyrene, in Trinidad and Tobago (T&T).

It is organized as follows: the first section gives a description of the current situation; all the available information about the production and distribution of these products is analyzed. Moreover, a study of the imports and exports of different products of this sector is carried out to ensure proper understanding of the dynamics of this market in T&T; the second section provides an analysis of the international policies regarding disposable beverage and food containers. Some examples are given to indicate what other countries have done when confronted with this problem; the following section anticipates the repercussions of moving forward in the same manner in the development of the country. It is included here all the research from the literature and from the missions carried out by the Closed Looped Cycled Production of the Americas Team (CLCPA); the economic, social and environmental impacts are also covered in this section; the final section consists of conclusions and some recommendations.

The next chapter outlines a different way to face the problematic through the implementation of new ideas. It is important to note that the data sources used were the Government of Trinidad and Tobago, NGOs, companies and strategies, contouring a clear idea about the current situation in the island.

4.1 Waste and consumption of food and beverage Expanded Polystyrene foam containers

The Government of T&T has expressed concern about the waste resulted from disposable food and beverage containers. Supported by data gathered in missions on the island and based on information provided by public and private entities of the country, CLCPA had an opportunity to analyze the situation. With the aim of finding the quantities and impact of disposable products, the focus fell on the tons of waste produced in the country. According to the waste characterization survey data of 2010, the overall waste generation in the island of Trinidad was 700,000 tons in that year, giving a generation of 1.50 kg per person per day. This study considered that 390,742 tons of this waste could be recycled (CBCL, 2010).

EPS is, among other materials, a common type of material disposed of by the residential and industrial sector on the island of Trinidad. This material leaches the toxin Styrene when it comes into contact with warm food or drink, alcohol, oils and acid foods causing human contamination and posing a health risk to people. Additionally it is widely known to be a complicated material to properly and responsibly dispose of. When not properly collected, handled, and disposed, it may end up in water ways, coastal zones, urban residential areas, and other ecologically sensitive areas leading to contamination, environmental impacts, nuisance, and eventually health issues. There is currently no suitable waste management infrastructure and management in place to convert EPS containers into a secondary productive use or purpose. EPS is a light and voluminous material, and as part of the Municipal Solid Waste (MSW) stream, it takes a lot of space while having a low mass density resulting in costly waste collection, hauling, and disposal and contribution to accelerating the reduction of landfill capacity in Trinidad and Tobago.

Figure 1.2 classifies the different kinds of waste and the contribution each has in the total amount produced on the island.

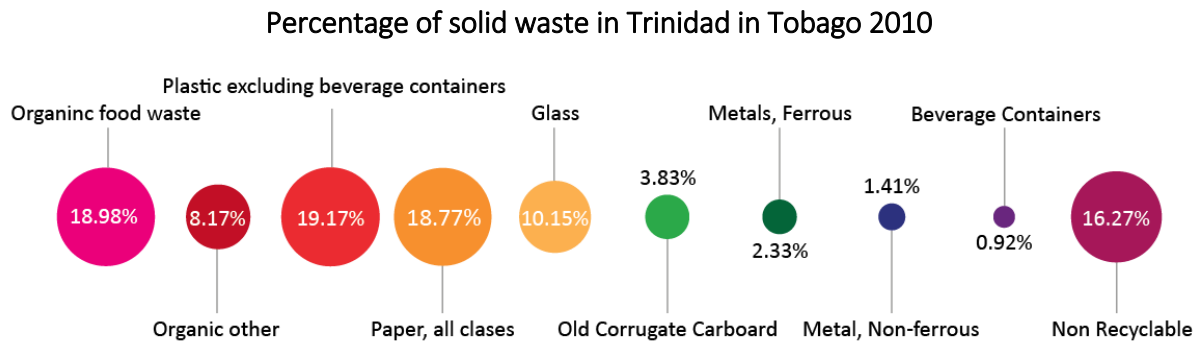


Figure 2.2: Trinidad Solid Waste Management Program
Source: CBCL, 2010.

This study reveals that plastic products represent 19.16% of the total waste of the country. That percentage signifies 134,120 tons of plastic. Figure 2.3 shows the different products that are part of this category and their percentages.

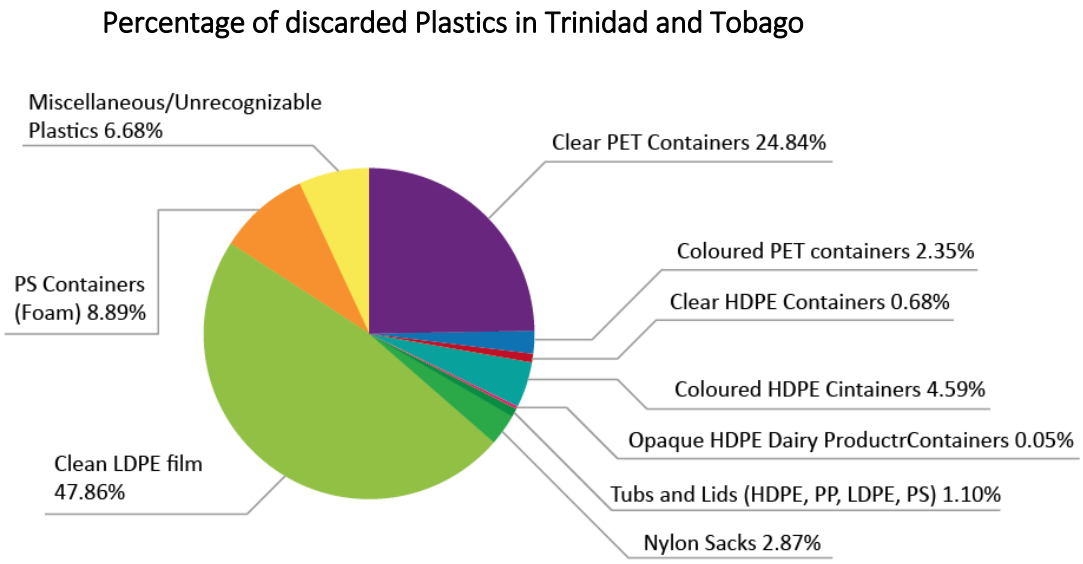
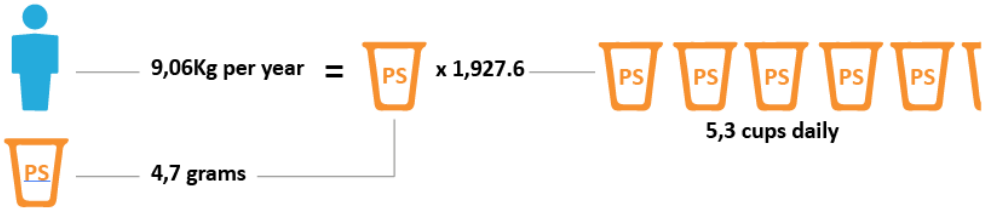


Figure 2.3. Trinidad Solid Waste Management Program
Source: CBCL, 2010.

According to the pie chart above, 8.98% of the total plastic waste is PS containers, signifying that 12,040 tons of PS containers are discarded on the island. To analyze the PS containers consumed per capita, it is necessary to note that this study was conducted in 2010, so the study population is that of 2010.

In accordance with the study of Plastic Foodservices Packaging Group (PFPG), a cup of 16oz made of Polystyrene weighs 4.7 grams (PFPG, 2011). When the value of 12,040 tons of PS containers is divided by the 2010´s T&T population of 1,328,095 (Wolrd Bank, 2014), the result is that the PS containers waste per capita in the Island is 9.06Kg. This is equivalent to 1,927.6 cups consumed per year by each citizen of the country. It would mean that each person in Trinidad uses approximately 5.3 cups made of Polystyrene daily. Figure 2.4 illustrates this.



Consumption per capita of food and beverage Expanded Polystyrene foam container

Figure 2.4. Calculate consumption according to the weight of PS waste in T&T.
Source: own resource.

The high amount of waste resulted from the consumption of polystyrene products is directly correlated to the amount of financial investment the government needs to direct to managing this kind of refuse. After quantifying the use of Polystyrene products in the island, it is necessary to analyze the economic costs involved in handling this problematic for Trinidad and Tobago.

Administration of the waste in Trinidad entails very high costs in economical and spatial terms (Phillips & Elizabeth, 2012). Table 1.6 shows the total cost of waste handling in 2010, the cost per ton and the cost of handling and disposing of the 12,040 tons of disposable polystyrene containers.

Cost of handling waste in Trinidad and Tobago

Amount in Tons	Cost
700,000	US$ 35.9 million
1	US$ 51.2
12,040	US$ 617,050

Table 1.6. Trinidad Solid Waste Management Program
Source: CBCL, 2010.

According to Phillips and Thorne the total cost of waste handling in Trinidad during 2010 was US$ 35.9 million (Phillips & Elizabeth, 2012). The table shows the cost of handling the PS containers discarded in the island in 2010. The total annual amount of US$ 617,050 represents the government's spending for managing this kind of packaging waste. The cost to manage each ton was US$ 51.2 and daily 32.95 Tons of Expanded Polystyrene foam containers were thrown away, which is approximately 6,555,611 polystyrene cups. The GDP of T&T in 2010 was US$ 20,578,437,536 (Wolrd Bank, 2014). This means that 0.17% of de GDP was spent on managing all waste. This percentage proves the significant cut of the National budget that is attributed to garbage collection.

Furthermore, it is necessary to note that in the cost of managing waste must be included the landfill cost. According to a study carried out by Plastikeep, there are four landfills dedicated to depositing solid residues in Trinidad and Tobago. Three of them are located in Trinidad and are operated by SWMCOL and one by THA (Plastikeep, 2007). In Trinidad, 76 hectares are used for waste management, each of them with different capacities and located in different areas of the island. Figure 2.5 shows the main aspects of the landfills in Trinidad.

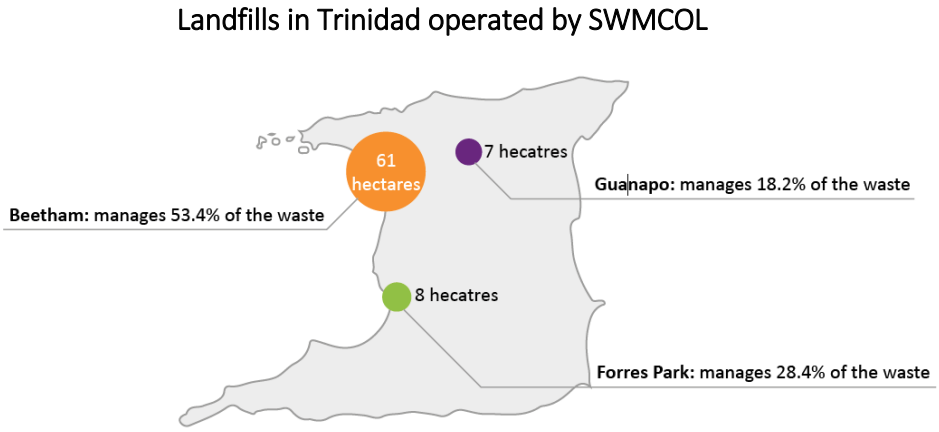


Figure 2.4. Trinidad Solid Waste Management Program
Source: CBCL, 2010.

According to Willard Phillips and Thorne, there are two main challenges related to the landfills in Caribbean countries. One is the limited space for disposing residues, and the other the lack of technology available for processing waste (Phillips & Elizabeth, 2012). Partly, these problems are visible when analyzing the waste that ends up in the sea in T&T. Greenpeace states that 80% of the waste floating on the seas consists of plastics, which means 13,000 pieces of plastic waste per kilometer of water (Allsopp et al., 2006). Out of these 13,000 pieces; 1,155 can be considered polystyrene containers since this represents 8.89% of the plastic category in the solid waste study (CBCL, 2010).

Clearly, there are many other impacts correlated to polystyrene food and beverage containers that have not been quantified, in economic terms - factors as land pollution, water pollution, wildlife damage, diseases and so on. It is necessary to start implementing the minimal corrective measures to achieve the collection of all PS containers. This should be the short-term goal set, but it should be only the beginning of new modalities of usage, discarding and reprocessing PS containers.

This section provided an overview of the current situation of food and beverage polystyrene containers in T&T. The next segment will analyze the market, the imports and exports of disposable products and compare the corresponding taxes.

4.2 Market of food and beverage polystyrene containers

The consumption of disposable food and beverage containers in Trinidad and Tobago is part of the daily dynamics of the inhabitants. According to Peters and Badrie, from the Faculty of Science and Agriculture of the University of the West Indies, packaging is used to transport and protect the food as part of the consumption culture of this nation (Peters & Badrie, 2005). The same study shows the aspects people in Trinidad take into account when buying packaged food. Figure 2.5 shows the factors that influence purchasing.

Factors that influence purchasing of food and beverage containers in Trinidad and Tobago

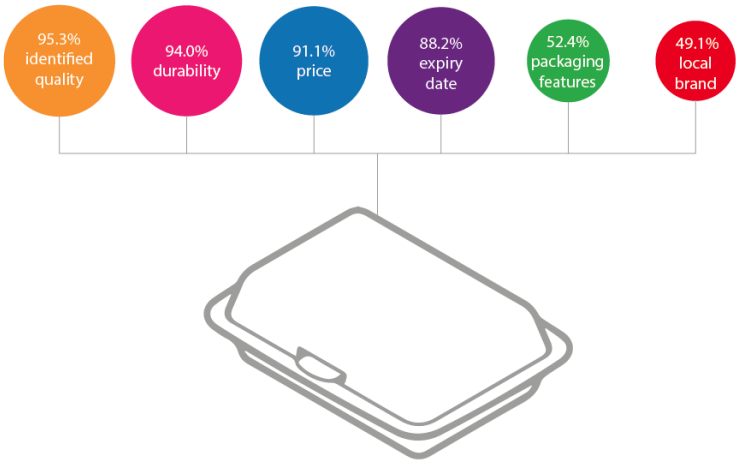


Figure 2.5. Consumers' perception of food packaging in Trinidad, West Indies and its related impact on food choices
Source: Own resource.

The aspects that influence purchasing of food and beverage containers in Trinidad and Tobago are about general packaging. Furthermore, they illustrate the order of importance people in Trinidad consider when they choose to buy food or beverages in polystyrene containers. The production of Expanded Polystyrene foam containers is cheap and price is a significant factor in selecting a product. While the most important factors people consider when they buy packaged food are identified quality and durability, in Trinidad everyday thousands of polystyrene containers are sold. This translates into a lack of information provided to the population, who are not aware that this material affects the quality of food, the environment and ultimately people´s health.

Polystyrene is derived from non-biodegradable petroleum-based polymers and it does not break down naturally. This means it is not renewable and according to "The Way to go" organization, the production of Polystyrene is the second most harmful to the environment (TheWaytogo, 2008). Every day in Trinidad 32.9 tons of Expanded Polystyrene foam containers go to the landfills (CBCL, 2010). Biodegradable materials are designed to degrade upon disposal by the action of living organisms. This material is not biodegradable and doesn't begin to break down for 500 years, which means space occupation in the environment, landfills or even the sea. Polystyrene containers are made of styrene, which is a suspected carcinogen and neurotoxin. Expanded Polystyrene foam contains potential cancer-causing chemicals-benzene and styrene-that can contaminate food and drinks that are hot, fatty, acidic or alcoholic. This is one of the reasons more than 100 cities all over Europe, Asia and North America have banned the use of Expanded Polystyrene foam containers (TheWaytogo, 2008).

An analysis of the international policies related to Expanded Polystyrene foam containers is performed in depth in section number **4.5.** In spite of the international context to avoid the use of polystyrene containers, Trinidad has a big offer in this segment of products. The CLCPA team visited three different supermarkets, in order to create an up to date assessment of the Expanded Polystyrene foam containers available in the island. It is necessary to understand the local production and foreign importation of containers. This allows us to clarify and understand the dynamics of

Trinidad´s market. Table 1.7 shows the different brands, presentation, cost, quantities and origin of polystyrene containers that are sold in Trinidad & Tobago.

Expanded Polystyrene foam food and beverage containers available in Trinidad and Tobago

Brand	Type	Quantity	Made in	Supermarket	Price per unit
Sunny pack	Banquettes double	100 - 200	Dominican Republic	Pricesmart	.499 TT us
Plastifar	Plates 9"	150	Dominican Republic	Pricesmart	.183 TT us
Sanicup - Santainers	Soup Plates 32oz.	15	T&T	Tru Valu	1.6 TT us
Sanicup - Santainers	Cups 16 oz.	25	T&T	Tru Valu	.459 TT us
Sanicup - Santainers	Cups 10 oz.	25	T&T	Tru Valu	.379 TT us
Sanicup - Santainers	Cups 6 oz.	25	T&T	Tru Valu	.379 TT us
Sweet Expanded Polystyrene foam – Wisynco Group Limited.	Food boxes-Mini small	50	Jamaica	Tru Valu	.6 TT us
Sweet Expanded Polystyrene foam – Wisynco Group Limited.	Food boxes - Medium	50	Jamaica	Tru Valu	.61 TT us
Plastifar	Small double tray	50	Dominican Republic	Tru Valu	.61 TT us
Plastifar	Double tray	50	Dominican Republic	Tru Valu	.65 TT us
Sanicup - Santainers	Plates 36 oz.	15	T&T	Massy	2.79 TT us
Sanicup - Santainers	Plates 32 oz.	15	T&T	Massy	2.67 TT us
DART Expanded Polystyrene foam	Cups 10 oz.	25	United States	Massy	.34 TT us
Sweet Expanded Polystyrene foam – Wisynco Group Limited.	Food boxes - Small	50	Jamaica	Massy	.52 TT us

Table 1.7. Three supermarket brands visited by the CLCPA in 2015
Source: Own resource.

Five brands of Expanded Polystyrene foam containers from three different countries were found. Jamaica exports to T&T a brand called Sweet Expanded Polystyrene foam. The Dominican Republic is present in Trinidad with two brands: Plastifar and Sunny Pack and The United States has a brand in the country called DART Expanded Polystyrene foam. In spite of the importation of food and beverage polystyrene containers, the biggest portfolio of products belongs to a local company. Under the brand Sanicup, Santainers Company has the highest diversity of products. This brand can also be found in almost all the supermarkets. Exported products are usually food boxes, but the national brand also manufactures clamshells, cups, trays, plates and soup plates.

Sanicup is the company with the largest market share. Due to National regulations, it is not possible to get selling or the manufacture information of local producers of Expanded Polystyrene foam containers. However, there is some data that helps describe the current situation. First of all, the CLCPA team's objective was to create a portfolio of the different products that are sold in the island. This allowed seeing what products are available in the national market. Figure 2.6 summarizes the variety of food and beverage containers, which are sold in Trinidad and Tobago.

Typologies of food and beverage containers in Trinidad and Tobago

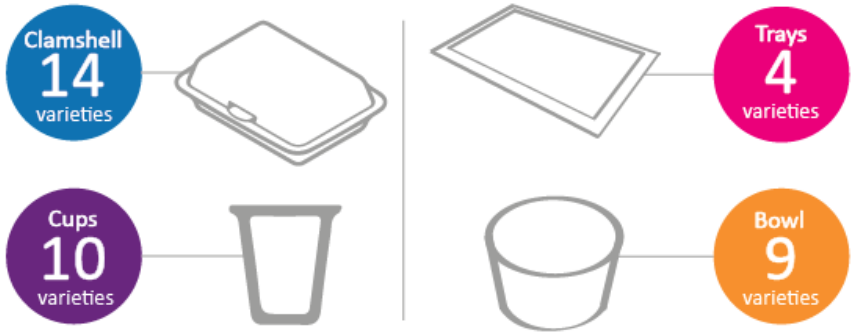


Table 2.6. Typologies of products found by the CLCPA team
Source: Own resource.

To determine the variety of typologies of products existent in T&T, supermarkets, restaurants and websites of the producers were visited. Five different categories and 40 different types of products compose the offer of Expanded Polystyrene foam containers in the country. The biggest variety of products belongs to the clamshell category with a total of 14 different kinds of clamshell containers made of polystyrene. 10 different kinds of cups and 9 types of bowls are the groups with greater variety. As the researchers of the University of West Indies indicated, the consumption of these products is the result of the cultural dynamics of the country (Peters & Badrie, 2005). As Table 1.7 showed, the cost per unit of the containers is very low, which promotes their employment, but also the absence of raising awareness about the impacts of using Expanded Polystyrene foam containers. Moreover, the national policies are not regulated to avoid Expanded Polystyrene foam containers usage.

Two supermarkets provided data related to sales of Expanded Polystyrene foam containers. Supermarkets Massy and Tru Valu specified the quantities sold of two brands. The CLCPA team could determine the market share of each typology of Expanded Polystyrene foam containers in the island. The type of product most sold in the island is represented by clamshells, with 37.72% of the total market. The following categories are cups and bowls with 34.92% and 25.36%, respectively. The category represented by trays appears with 2% of the market share, resulting that Clamshells and Cups are the products made of Expanded Polystyrene foam most consumed in Trinidad and Tobago.

On the other hand, 12 restaurants were visited to obtain information about which typology of each category is the most sold and what is the dynamics of consumption. It was found that 83.3% of the restaurants offer Expanded Polystyrene foam containers for takeaway or/and eat in. Several

restaurants were identified that only work with Expanded Polystyrene foam containers; in the interest of explaining the phenomenon some restaurant owners and employees were consulted and two main reasons were pointed out. One was the low costs and the other one was the easy access in terms of selling points. The majority of the restaurants that were visited were located in Ariapita Avenue and its surroundings. This street is very well known because it represents a cluster of various venues for social activities. Only in Ariapita Avenue alone, there are two stores in charge of supplying PS containers to all the restaurants and bars. The restaurants visited are listed in Table 1.8.

Restaurants visited in Port of Spain.

Restaurant	Containers
Luminere	Expanded Polystyrene foam
Mi Asia	Expanded Polystyrene foam
Mandiero´s	Expanded Polystyrene foam
Irie Bites	Expanded Polystyrene foam
Wicked wings	Expanded Polystyrene foam
Mario´s	Paperboard and plastic
51 Restaurant and Bar	Expanded Polystyrene foam
Trotters	Expanded Polystyrene foam
KFC	Paperboard
Paprika	Expanded Polystyrene foam
Shakers	Expanded Polystyrene foam
Cow Heel Soup Centre	Expanded Polystyrene foam

Table 1.8. Restaurants visited by the CLCPA team.
Source: Own resource.

During the visits it was observed that the products most used by restaurants are clamshells and bowls. For cups, which is the second category most sold, the majority of these places have other type of plastic. It was found that the clamshell with 3 compartments is the type most used in all the restaurants and the second in line is the one with 2 compartments. When referring to bowls, the sizes of 12oz and 16oz are the ones employed to serve soups. Furthermore, there is a culture of using disposable products even when people eat inside the restaurant, which was visible when customers were given the choice of serving their meals in traditional or in disposable containers the majority preferred Styrofoam. As these commercial establishments are being charged for the production of waste, and Expanded Polystyrene foam products are very cheap it is feasible for these businesses to use this material.

Table 1.7 depicts the provenance of the products; this means that with the data of sale of each brand, it is possible to classify the market share by brand available in Trinidad and Tobago and its country of origin. In order to quantify the economic impacts of using Expansible Polystyrene, it is necessary to know the amount that enters into T&T produced by each country, and then the amount that goes into the production of food and beverage containers. When analyzing the sales of these products during a period of one year and a half, January 2014 to June 2015, it is possible to know the precedence of the containers. Figure 2.7 shows the participation of each country within the market of these products.

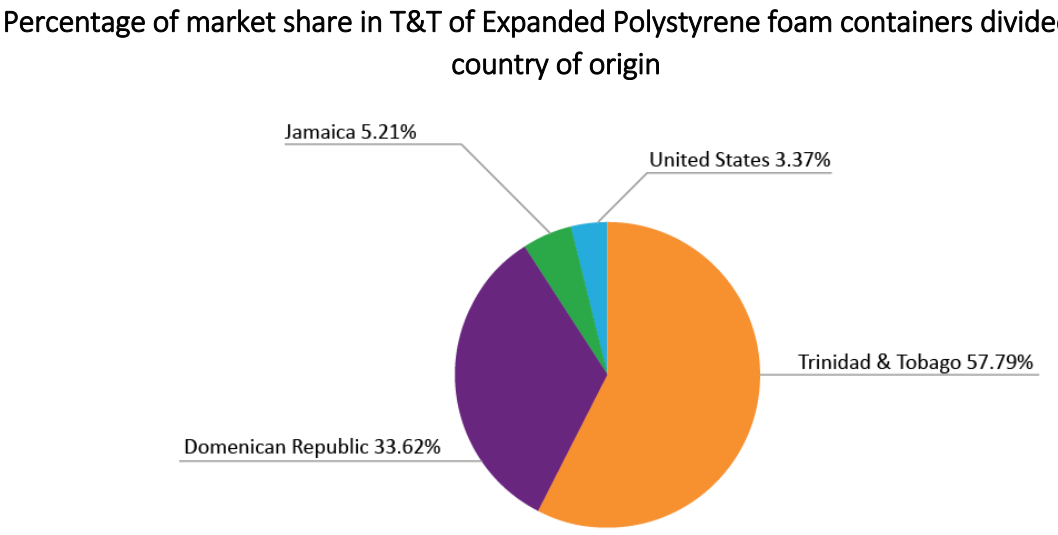


Figure 2.7. Expanded Polystyrene foam containers origin. According to the visit to the CLCPA. Source: Own resource – Sales data of supermarkets.

A percentage of 57.79% of Expanded Polystyrene foam containers are produced locally in Trinidad and Tobago. Sanicup, the brand produced by Santainers occupies the largest market share in this country. Furthermore, a percentage of 42.21% comes from outside of T&T production. The country that exported the most disposable Expanded Polystyrene foam containers to Trinidad and Tobago is Dominican Republic with 33.62%, while Jamaica and United States are presented with 5.21% and 3.37%, respectively. This also means that 57.79% of these types of products are manufactured with Imported Expandable Polystyrene.

According to the HSTariff codes guide of the Ministry of Trade, Industry, Investment and Communication of T&T, Expansible Polystyrene with Code 3903.11.00 has free rate of duty (TTBizLink, 2012). This means that when this material is imported to Trinidad, it is not susceptible to any fees. For example, in the United States, the same material has a Rate of Duty of 6.5% per each kilogram, which is the quantity used for this tariff (U.S. International Trade Comission, 2015). It could be said that the raw material imported to produce Expanded Polystyrene foam containers does not pay any tax to enter the country, which translates into low cost of production. This is one of the reasons of the high rate of utilization of these types of containers.

A main point to highlight from this section, which provided information about the typologies and products available in the island, is the importance of understanding the market dynamics of these products. This is required in order to gain knowledge of the brands, prices and precedence of the products. In the following section, an analysis of the importation and exportation of Expansible Polystyrene in Trinidad and Tobago will be conducted.

4.3 Imports and export of polystyrene in Trinidad and Tobago

According to the data provided by the Central Statistical Office of Trinidad and Tobago, the country does not export expansible polystyrene. However, the importation of this material has increased from 1,367,586 Kg in 2012, to 2,646,820 Kg in 2013 and to 1,942,789 Kg in 2014. Even though the average growth rate is 19.19%, it does not represent a percentage that allows predicting what is going to happen with the importations in this sector, because of the very high variation registered in 2013, compared to the other two years. After analyzing the reason of this variation in the imports of Expansible Polystyrene, it could be presumed that it is owed to the increase of oil prices. Companies that use Expansible Polystyrene as a raw material filled their stocks, because of the upward trend in oil prices. This product is manufactured from petrol, resulting in a correlation of its price with the volatile price of oil (TheWaytogo, 2008).

The highest average price of oil is recorded in 2013. The average value for this year was $95, 99 US Dollars per Barrel; this trend started from the beginning of that year, resulting in the increase of polystyrene prices (U.S. Energy Information Administration, 2015). With the available information, the CLCPA team assumed that the reason for the high importation of Expandable Polystyrene was the tendency of petrol prices to increase, which forced companies to fill their stocks before being forced to pay more for it. This affects the possibility of proposing a trend able to predict the exact values of polystyrene used for the production of beverage and food containers in Trinidad and Tobago.

On the other hand, the importation market of Expansible Polystyrene represented $28,771,792 TT Dollars in 2014. This signifies that each kilogram imported of this material had a cost of $14.8 TT Dollars. Between 2012 and 2014 there were 13 countries that exported this material to T&T, as follows: Brazil, Canada, China, Colombia, Dominican Republic, France, United Kingdom, India, South Korea, Mexico, Taiwan, Ukraine and United States. The three countries with the highest representation on this market during these three years were: Unites States with $57,649,021 TT Dollars, Mexico with $8,966,711 TT Dollars and India with $7,960,366 TT Dollars.

Figure 1.6 shows that 57.79% of the Expanded Polystyrene foam products are made in Trinidad. This results belong to the sales of 2014 and 2015. That value was obtained taking into consideration the Expanded Polystyrene foam containers found in the landfills, which represents a total of 12,040 tons. It could be assumed that the consumption of Expanded Polystyrene foam containers increases with the population, because of the high consumption rates of this product. This means that if the population in 2010 was 1,328,095 (Wolrd Bank, 2014) and in 2014 was 1,344,238 (Wolrd Bank, 2014), the average growth per year is 0.30%. So that if in 2010 there were 12,040 tons of Expanded Polystyrene foam containers, in 2014 the value would be 12,186 tons.

There are other categories that include the importations and exportations of food and beverage Expanded Polystyrene foam containers. One of these categories is Cups of Plastic HSTariff code 39239010. From 2012 to 2014, $13,165,217 TT Dollars were spent on importing these products to T&T. However, 424,342 Kg of Cups of Plastic were exported from Trinidad, representing an amount of $16,143,239 TT Dollar. Another category is the number 39241010, Cups, Forks, Plates, etc. Of Plastic. A total of $74,656,092 TT Dollars of this category was used to import these to Trinidad during the period of time noted above. But only $1,539,455 TT Dollars represented the exportation of the products of this category during these 3 years.

The three categories presented (Expansible Polystyrene, Cups of Plastic and Cups, Forks, Plates, etc. Of Plastic) are the ones that determine the importation and exportation of Expanded Polystyrene foam food and beverage containers. Because of its location and infrastructure, Trinidad and Tobago generally exports these types of products to other Caribbean Countries. However, the production is also very high inside of the country. This phenomenon could be observed from the high rate of importation of Expansible Polystyrene and the 0% exportations of the same product. It is necessary to clarify that not all the expansible polystyrene that enters to the country goes into the food and beverage containers production sector.

The CLCPA team also analyzed the Duty rates of the different categories. As mentioned before, there is no fee for expansible polystyrene when entering into Trinidad and Tobago. However, the Cups of Plastic category and the Cups, forks, Plates, etc. of plastic category have a duty of rate of 15% and 20%, respectively. Even though, there are other materials that have a lower environmental impact, they have a rate of duty which is the same or higher. For instance, the categories of Trays, dishes, plates, cups and the like of bamboo and Trays, dishes, plates, cups and the like of paperboard not bamboo have a rate of duty of 20%. The "environmental friendly" products of bamboo are getting to T&T from three countries: China, The Netherlands and U.S.A.

4.4 Initiatives carried out in Trinidad and Tobago

This section deals with the initiatives carried out in Trinidad and Tobago, with the aim of reducing the impact of plastics in the island. A series of programs focusing on recycling these materials are discussed in this segment of the study. The Environmental Management Authority (EMA), established in 1995 as the authority in charge of managing the processes of cooperation aimed at protecting the environment, is the primary responsible for providing recommendations for environmental policies and for promoting and monitoring the programs implemented by individuals (EMA, 2014).

- Project Tomorrow

This is an initiative held by EMA. This project is aimed at supporting the Beverage Containers Bill. Essentially, this measure aims to regulate the selling of beverage containers by requiring the producers, consumers and sellers to pay the external cost of working with these products. Part of this bill is called The National Beverage Containers Bill Clean-Up Project and is focused on removing all the beverage containers being disposed of in landfills over a six-month period. The next stage in implementing this initiative involves developing tactics to educate people and creating guidelines for future policies (EMA, 2014). The concept this initiative was built on is: "the actions of today will affect the future" and it is supported through raising awareness about the impact of consuming beverage disposable containers. Data about the scope of this implementation is not available. However, the project is part of a National Policy.

- Plastikeep

This project was launched in 2010. Its objective is to handle the high quantities of plastic and create and deliver an awareness campaign around the use of plastic, its disposal and its recycling process. Plastikeep Recovery Programme was an initiative of a non-profit organization called Greenlight Network. It emerged in support of National Environmental, which mainly focuses on reducing or preventing the production of residues like plastic. This initiative has installed 65 bins for recycling plastic waste in Trinidad. Through a public education lobby plan Plastikeep continues to promote a

recycling culture by encouraging the population to use the provided recycling bins for disposing of plastic containers.

According to the 2013 Plastikeep year-end report, 918911 Kg of plastic waste have been collected to enter in the recycling process. This means a collection increase of 90.2% from 2012 to 2013. This was attributed to the new bins provided and the programs that inform about recycling. It has been fundamental for the efficiency of this initiative the educational component, which has reached 515 students, leading to more informed inhabitants that understand the need for recycling (Plastikeep, 2013).

In spite of the high amount of plastic collected, there is a lack of initiatives to make recycling an attractive activity. As it was stated by the Plastikeep team, there is a lack of technology that supports making new products or materials. One of the reasons, the team said, is the absence of equipment able to manage this material. Although there already is a stock of plastic available to be recycled, there currently isn't a way to use these plastic containers.

- SWMCOL Education

The Trinidad and Tobago Solid Waste Management Company Limited (SWMCOL) is the authority in charge of handling waste in Trinidad and Tobago. This company manages the operations of collecting the individual waste and managing three of the landfills of the country (SWMCOL, 2014). They have also developed some protocols to teach people about recycling and work in partnership with Plastikeep, finding a way to make plastic recycling a profitable business. As the leader in handling waste, they oversee some initiatives in Port of Spain and other cities of Trinidad. However, there is no structured plan for recycling plastics that incorporates all other initiatives and different contexts in the country.

4.5 National and International policies

This section will provide an evaluation of whether the policy is required and whether its development is a priority for the citizens of Trinidad & Tobago and will determine if there are risks involved with not having this policy.

Expanded Polystyrene foam is an oil-based product, also known as extruded polystyrene and it is utilized, *inter alia,* in the manufacture of food contact materials (FCMs) and disposable food-packaging applications such as containers, bowls, plates, trays, cartons and cups. The majority of restaurants and grocery industry uses Expanded Polystyrene foam as one-time-use for prepared foods for take outs and leftovers. The extensive use of Expanded Polystyrene foam comes from its ability to cheaply and effectively insulate food products, the light-weight which makes containers easy-to-carry, and the fact that they are colorless leading to being perceived as sterile and hygienic. Styrene has known toxic effects on the central nervous system and neurological effects have been observed in workers continually exposed to styrene through inhalation (ATSDR, 2010).

Recently, in 2011, styrene was listed as "reasonably anticipated to be a human carcinogen" by the National Toxicology Panel (Department of Health and Human Services, 2011). Prior to this, the IARC (International Agency for Research on Cancer) classified styrene as "possibly carcinogenic to humans" (IARC, WHO, 2002). Currently, the USEPA (United States Environmental Protection Agency) does not

have a classification for the carcinogenicity of styrene in its Integrated Risk Information System (EPA, 1998). A study conducted in 2013 to evaluate the impact styrene monomers and oligomers in food and food contact materials found the styrene monomer concentrations in all the FCMs evaluated to be below USFDA limits and the migration of the oligomer compounds was expected to be low. (Genualdi et al., 2014) Toxicological studies have been carried out to determine the safe exposure levels (SEL) for consumers exposed to styrene via food, with the considered health effects of ototoxicity and color vision disturbance in humans as well as postnatal developmental effects in rats. The SEL based on criteria of science and health protection converged to the range of 90–120 mg/person/d (Gelbke et al., 2014).

Because of the wide use of Expanded Polystyrene foam the waste management component has become a serious problem, so recycling is receiving attention as a means of preserving the environment and reserving resources (Pantano, 2009). Polystyrene waste requires the transportation of large volumes of materials, which is costly and makes recycling not economically viable due to the high cost in hauling the lightweight and high volume waste to the recyclers as well as a lack of a market for the foam material. While many people recycle household plastic items making the assumption that they can all be fully recycled, only about 10 % of plastics are being recycled back into plastics. Food service polystyrene is difficult to recycle due to lack of optimum technology and also to being contaminated with food. Moreover, there is reluctance among organizations, businesses and consumers to collect food service polystyrene for recycling. Worldwide, almost 280 million tons of plastic materials are produced annually, much of which ends up in landfills or the oceans (Sahni & Shaw, 2014). Chong and Hermreck stated that due to the sheer quantity of waste being dumped, landfills may only be operational for some twenty years. Landfills consume a high amount of energy (to sort, treat and recycle waste) but it is far less significant in comparison with the energy (diesel fuel, electricity, petrol, bunker oil and natural gas) used to transport waste to landfills (Chong & Hermreck, 2010). In Trinidad and Tobago, as it will be more extensively detailed in a dedicated section of this report, there is a serious issue with respect to oversaturation of existent landfills. A brief analysis regarding water pollution with containers manufactured from Expanded Polystyrene foam will also be presented in the same section. Globally, at least 23 % of marine mammal species, 36 % of seabird species, and 86 % of sea turtle species are known to be affected by plastic debris (Stamper et al., 2009). At least 267 marine species, including most sea birds, have been reported to have ingested plastics and other litter (Allsopp et al., 1990-2005) leading to reduced appetite and nutrient absorption and, consequently, to starvation.

The impact on health, the complex problem of waste management, water and land pollution, the extremely detrimental effect on water wildlife, the need for innovative recyclable materials for packaging lead to the conclusion that there is a definite gap in terms of regulations to confront the problem with Expanded Polystyrene foam containers. Solutions to ensure materials are recycled or disposed of properly need to be developed. Even with research, recycling, and new technologies, alternate packaging material should be utilized to reduce the dependence on plastic goods (Sigler, 2014). Better educated individuals and increased expenditure on innovative solutions and policies are key factors in solving this problem.

- Existing related policies in T&T

Despite being an energy-based economy, Trinidad and Tobago productive diversification away from the energy sector represents a major goal. T&T has seen tremendous growth in public environmental awareness, attributable to increased media attention to environmental issues, increased NGO activity and enhanced environmental education programs (Ramlogan & Persadie, 2004). In 2013 the Government targeted for strategic development seven sectors in which the country already had a traditional resource base, established linkages and competitive advantages, which are Creative Sector, Tourism, Maritime Sector, Financial Services, Food Sustainability, ICT, and Energy (including energy services).

Additionally Trinidad and Tobago's printing and packaging industry is regarded as a leader in CARICOM and the wider Caribbean with respect to its competitiveness. Although the printing sub-sector accounts for the largest number of firms, the plastic packaging sub-sector has over 77 % of the firms in the medium to large categories. The Printing and Packaging Industries Council (PPIC) is a Cabinet appointed committee responsible for the implementation of a Strategic Action Plan published in 2007 and the overall development and growth of the sector. The activities of the Council surround three core pillars: alliances for cooperation, competitiveness program and market and research development (Republic of Trinidad and Tobago, Ministry of Trade and Industry, 2014). In order to undertake initiatives to develop the manufacturing sector, which includes the plastic packaging sub-sector $89.6 million TTD were acquired from the Consolidated Fund and the International Development Fund (IDF) during 2013. In a Quantitative Study of Printing and Packaging in Trinidad, carried out in 2014, was stated that another $1.5 million TTD will be allocated to develop Maritime, Yachting and Printing and Packaging. The envisioned projects towards this end would include the launch of the Printing and Packaging Institute and the implementation of school projects and participation in the Trade and Investment Convention (TIC) in June 2014, attracting and bringing together manufacturers, services providers, buyers, distributors, financial institutions and investors (The National Training Agency, 2014). On the 29th of May, 2015 a Memorandum of Understanding was signed by representatives of the Ministry of Trade, Industry, Investment and Communications; the Ministry of Tertiary Education and Skills Training; and the Ministry of Public Utilities for the establishment of the University of Trinidad and Tobago's Institute of Printing and Packaging.

According to the Ministry of Trade, Industry, Investment and Communications (MTIIC), investment opportunities have been identified in areas such as Recovered / Recycled plastic packaging materials, packaging and design, supply of raw materials among others. These investment incentives include:

- The Fiscal Incentives Act offers exemption from customs duties on the construction of an approved project, from VAT and from income tax on dividends or other distribution, other than interest, out of profits or gains derived from the manufacture of the approved product during the tax holiday period.
- Total relief from Value Added Tax on imports for highly capital intensive enterprises.
- The Customs & Excise Act offers duty free treatment on raw materials, machinery and equipment and in some cases packaging material based upon the provisions of the Third Schedule of the Customs Act.
- The foreign Investment Act allows a foreign investor: to own 100% of the share capital in a private company, but prior to the investment the Minister of Finance must be notified; to own up to 30% in total of the share capital of a local public company without a license; to own more than 30% in total of the share capital of a public company, if a license is obtained;

to own one acre of land for residential purposes and five acres of land for trade or business without having to obtain a license.

Aside from the major industry development incentives, Trinidad and Tobago has drafted a policy to develop green enterprises. The Draft Green Enterprise Development Policy for Micro and Small Enterprises and Cooperatives (2014-2016) will "create sustained employment, diversify domestic production and provide opportunities for resource efficient innovation. The Caribbean Small and Micro Enterprises Action Learning Group (SME ALG) had the possibility to offer an opinion on the policy before it was submitted to Parliament. Some comments included developing the social dimension in the policy by showing the link to poverty reduction, strengthening partnerships with civil society organizations and identifying different and innovative sources of financing (CANARI, 2014). A policy of this sort can encourage ideas of innovative alternatives to the existing Expanded Polystyrene foam food and beverage packaging solutions, using green non-traditional local resources. It could also provide access to finance and resources to support MSMEs that work with recovered - recycled plastic packaging materials to make new products and processes, or improve existing ones more efficiently.

- International approach to the EPS packaging employment

Over 100 US, Canadian, European and Asian cities have instituted bans on polystyrene food and beverage containers. On November 2009 San José voted to ban polystyrene carryout food packaging from large city events (City of San José, 2010). Large cities that have implemented EPS food ware ordinances include San Francisco, California (2007), Portland, Oregon (1990), and Seattle, Washington (2009).

The success of a ban is affected by the availability of alternative products and the needed infrastructure to manage the waste resulting from the alternative materials to EPS. Education and outreach is another key component of achieving compliance. The types and number of affected businesses as well as the size of the jurisdiction may contribute to the efforts of passing such a product ban.

In Portland, Oregon, the "Polystyrene Foam Container Ban" Ordinance 161573, which was passed in January 25th, 1989, became effective January 1st, 1990. As annex to the ban, the city also included the option of a hardship exemption to extend to businesses that found it difficult to comply; "The City Council, or its appointee, may exempt a food vendor, food packager or non-profit food provider from the requirements of this Code for a one year period, upon showing by the applicant that the condition of this Code would cause undue hardship" (Portland City Ordinance No. 161573, 1991). In support of the ban they gave a list of products that were forbidden to be packaged in polystyrene foam and a list of products that were not regulated under it. Further, a task force was appointed in charge with recommending policies, developing campaigns and ordinances prohibiting the use and sale of particular polystyrene foam products. They offered two handouts: one on the background of the "Ban Explanation" as well as a flyer explaining the banned food ware (PSF) citywide "No Foam Brochure".

They had a web site dedicated to it, where they could receive complaints. After receiving the complaints they immediately started investigations and, usually could resolve them by educating the establishment about the offence and doing a follow-up visit with a formal letter citing the Polystyrene Ban ordinance and informs of fines that could be imposed as well as providing material on the

ordinance. A re-inspection date is also set approximately twenty days after the date of the initial letter.

A problem after the enforcement of the ban was finding alternative materials containers still in the landfills, which highlighted the importance of having a waste management plan of these by recycling or composting. San Francisco, CA "Food service waste reduction ordinance" issued Ordinance 295-06 that was passed on November 21st, 2006 and became effective June 1st, 2007. The studies showed that there was a 41% decrease in polystyrene litter over the three year period after passage of the ordinance. The regulations here were more detailed, giving also alternative materials to be used. The product ban extended to containers, bowls, plates, trays, cartons, cups, lids, straws, forks, spoons, knives, napkins, and any item designed for one-time use for prepared foods, such as takeout and/or leftovers. They also had an exemption like in Portland, where businesses that proved to be highly affected by it could waive it for up to a year.

The conducted outreach campaigns during 4 months prior to passage of the ordinance that involved letters and notices in newspapers and through other media channels, but also meetings in neighborhoods to inform and educate about the ban institution. These campaigns continued after the passage at the affected businesses, also to inform about it and about the composting program.

In Seattle, WA the "Food service ware ordinance" # 122751 passed July 30th, 2008 and became effective in two phases; the first phase on January 1st, 2009 and the second phase on July 1st, 2010. The City first banned EPS food service ware; then eighteen months later all single use food service ware had to be compostable or recyclable. The city's comprehensive outreach program included quarterly stakeholder meetings and events with foodservice businesses, waste service providers, and food packaging manufacturers, and a print, television, radio, and social media campaign in addition to direct targeted outreach. The outreach personnel visited the businesses that had problems in transiting from the plastic containers to the alternative materials ones, to help them in the process. The City also printed four brochures in support of these regulations and did so in four languages.

- What is the context of the banning of the EPS in the Caribbean countries?

Haiti bans plastic bags, foam containers

The Haitian government issues presidential decree banning black plastic bags and foam containers. Expanded Polystyrene foam containers and plastic are everywhere in one of the many drainage canals in the Port-au-Prince metropolitan area. Most dump into the Caribbean Sea after passing through poor neighborhoods, where the human and animal fecal matter, Expanded Polystyrene foam, and other trash regularly flood the zone after heavy rains.

Despite two government decrees making their import and usage illegal, Expanded Polystyrene foam cups and plates are used and littered all over the capital, as well as bought and sold, wholesale and retail, completely out in the open.

As of October 1st, 2012, it is illegal to import, distribute and market plastic bags and polystyrene (PS) containers in the country of Haiti. Any individual or group caught importing plastic bags or polystyrene containers into Haiti could have their materials confiscated and be punished, according to the Customs Code of the country, as part of a decree that also outlawed black plastic bags, used by street vendors as well as in greenhouses all over the country. "Plastic trash is a sanitation problem

and a public health problem. It is also a problem because of the damage it causes to coral and marine ecosystems" - former environment minister Ronald Toussaint.

This logical decision drives to importing, manufacturing biodegradable items that will benefit the country´s short, mid- and long-term environmental interests. The concerned parties argue – the polluters, the importers, and the business people – were not part of its elaboration. The government's decree offered a very reductionist approach to dealing with plastic waste. In spite of the obvious failure of the 2012 decree, the government of President Michel Martelly and Prime Minister Laurent Lamothe adopted a new one, dated Jul. 10, 2013 and written in much the same language.

There is an interdiction on producing, importing, commercializing, and using, in any form whatsoever, plastic bags and objects made of Expanded Polystyrene foam for food purposes, such as trays, bottles, bags, cups, and plates. In the country, the black plastic bags are the primary mode for transporting items among Haiti's poor who shuffle back and forth to open air street markets on an almost daily basis. They also are a key, but dangerous, ingredient in curbside cooking, helping food cook faster. The bags and containers are then dumped haphazardly into canals, turning them into rivers of debris several feet deep.

As soon as this decree has becomes applicable, beginning on August 1, 2013, all arriving packages that contain these objects has pretending been confiscated by customs authorities and the owners will be sanctioned according to customs regulations, the decree reads. In addition to being a bit demagogic in nature – given that the first decree was completely ignored – the new decree has also angered the Dominican Republic's industries, Haiti's principal suppliers of Expanded Polystyrene foam plates and cups for take-out food.

In spite of its dangers, and in spite of the two decrees, Expanded Polystyrene foam products are everywhere; almost all of the street-food vendors were using the illegal products. The ban was not applied, driven by cheap prices, ease of access, and convenience, PE single-use bags and PS foam packaging have quickly become the materials of choice for Haiti's numerous street vendors and traders.

A plastic decree VS. a rigid policy? Government policy regarding the ban in Haiti

Despite charges by some critics that the Haitian government would not be able to enforce the ban, police have already raided three downtown warehouses for importing PS containers. The government has plans to continue these raids until importers realize that consequences will ensue for importing these environmentally damaging substances.

But government policy is not solely based around the "stick"; it will also dangle a few carrots in the form of subsidies and information campaigns to help Haitians embrace more sustainable options. Talks with business owners have already initiated, stating that "[the government] will offer a lot of help, such as lower import tariffs for biodegradable products."

The road to more sustainable food packaging will undoubtedly be a rocky one. But the small Caribbean country has become so inundated by plastics that it is must head the problem off now before the situation spirals completely out of control.

In the second anti-plastics decree, the Haitian government promised, "The Ministry of Economy and Finances will take the steps necessary to facilitate the import of inputs, recipients, and paper products or cardboard that are 100% biodegradable such as bags made of fiber or sisal."

To date, no "steps" have been announced, nor have there been any major confiscations or

arrests. Restaurants, street sellers and others are still using Expanded Polystyrene foam cups and plates that will eventually end up in ravines and canals.

Haiti within the global context of PE and PS consumption

Like Haiti, an increasing number of governments have realized that tackling these pressing environmental issues means implementing the right set of policy measures. Not only does it mean imposing bans or restrictions on plastic usage, it means showing business owners and consumers that more sustainable options are available.
In particular, biodegradable packaging is just as effective for transporting food as its PS counterpart – but instead of remaining in the environment for thousands of years, it breaks down naturally, thus posing few (if any) environmental consequences.

More than 100 cities in the US have already banned PS with many more cities on the way. While it is still too early to say whether Haiti will be entirely successful in its endeavor to eradicate plastic consumption in the country, its experiences will surely offer great insight for other jurisdictions looking to imposing similar bans.

Be Green Packaging manufactures and distributes Cradle-to-Cradle Certified, tree-free, and biodegradable packaging for the food service and consumer markets. The company designs and engineers products made from annually renewable plant fibers that are safe for people and healthy for the planet. For more information about the company, visit: http://begreenpackaging.com.

Environmental groups have been pushing plastic bag bans both internationally and in the United States for some time. The African nation of Rwanda became the first country to ban all plastics in 2008. Mexico City, Bangladesh, and most recently, Toronto are among the largest international cities that have imposed bans.

Argentina also is calling for all supermarkets to eliminate non-biodegradable plastic bags by October 2014.

In the United States, bans have been approved in cities and counties from Maine to Washington. Nearly 50 cities and counties in California alone embrace a celebrity-endorsed ban. In Los Angeles, the largest American city in the country to approve the ban, bags will be phased out at thousands of stores over year 2013 or so.

Meanwhile, in Florida, a 2009 attempt by the state's Department of Environmental Protection to phase out bags after five years fell flat after lawmakers didn't buy into the proposal.

Mostly cities and urban counties have adopted the ban, which targets the thin, lightweight plastic bags commonly used at grocery stores and convenience store checkouts. But some of the worst pollution from the bags occurs in poorer undeveloped nations. These items are very cheap and easy to litter, and there is very little infrastructure to recycle them.''

Guyana Ban on Expanded Polystyrene foam containers

An immediate effect stamp duty and environmental tax charges have been applied to Expanded Polystyrene foam, which are mandated by the Ministry of Trade and Tourism for non-returnable and non-reusable commodities. This restriction has also banned Expanded Polystyrene foam containers being effective from June 1, 2014.

Expanded Polystyrene foam constitutes about two percent of the waste stream in Guyana and is widely used in the food industry. At this juncture, the national restrictions on Expanded Polystyrene foam will apply only to its use as food service containers. The Government has approved the proposed actions, leading to the restriction on the use of Expanded Polystyrene foam products. Having alternatives for Expanded Polystyrene foam containers is pertinent for the ban to be in place. As such, the Ministry of Natural Resources and the Environment and the private sector have teamed up to make biodegradable containers available.

Firms as Caribbean Containers Inc. have developed ECO PAK containers, which provide similar functions as Expanded Polystyrene foam containers in terms of holding capacity and strength. The major difference with the ECO PAK product line is its positive contribution to the environment.

ECO PAK containers are 100 percent biodegradable within 90 days and are prepared from perennial plants. Additionally, incentives would be available to the private sector for the importation of biodegradable containers. This would continue even after the ban becomes effective.

The Environmental Protection Act of 2006 was amended to include the Environmental Protection (Litter Enforcement) Regulations 2012. The provisions of this regulation will be enforced by the EPA, which stance on Expanded Polystyrene foam is no different to the Ministry and therefore, joint efforts are being made to rid Guyana of this product, which can have a very deleterious effect on the environment.

For instance, Expanded Polystyrene foam is not considered hazardous waste, however, its ubiquity and impacts on the environment can be detrimental, as it will never decompose. It is a part of the Municipal Solid Waste stream and is managed as such. However, the indiscriminate dumping of solid waste including Expanded Polystyrene foam in Guyana has threatened public health, safety and welfare, urban aesthetics and resulted in death or illness to marine life.

“The Ministry of Natural Resources and the Environment has initiated a “Pick-it-up Guyana” campaign which was launched in June 2013. It focuses on several elements to achieve its objectives, including enforcement against littering; public awareness; engagement of stakeholders; and mechanisms to reduce, reuse and recycling waste. To this end, the Ministry of Natural Resources and the Environment facilitated the drafting of the Environmental Protection (Litter Enforcement) Regulations to ensure stricter enforcement of littering in Guyana.”

These regulations make provision for the establishment of an environmental court to toughen up enforcement against delinquent waste disposers. Also, the Ministry is looking at developing a ticketing system for offending individuals and businesses. Litter Prevention Wardens will have the power to issue tickets to offenders, failing to pay, which the offender will be brought before the Court.

Therefore, determining the cost Expanded Polystyrene foam has on society is not possible in monetary terms. There are other areas, which cannot be easily quantified in monetary terms; these include aesthetics, public perception, safety and welfare.

Plastic bags and plastic bottles

Authorities decided to block the importation of those containers because of public health and environmental concerns. There is hoped that the ban would help create job opportunities for the manufacture of cardboard food boxes.

From distinct sectors, is blamed the combined opposition for blocking the imposition of the environmental tax on all plastic containers and bags being imported to Guyana, the opposition deployed its one-seat majority and has killed the regulation.

Chapter 5
Sustainable alternative packaging

This chapter aims to introduce a new material to assist in facing the current problematic of Trinidad and Tobago, related to the consumption of Expanded Polystyrene foam food and beverage containers. It analyses the available feedstock from the agricultural sector and explores a sustainable alternative based on the concept of cradle to cradle.

5.1 Available Feedstock from the Agricultural Sector

- ### Agriculture sector in Trinidad and Tobago

Different sources described the agriculture sector in Trinidad and Tobago as a sector that contributes less than 1% of the national GDP and employs an estimated 4% of the population. Agro-industries (food, beverage and tobacco) are a significant segment of national GDP (3.1% in 2004) and manufacturing GDP (45.2%). The country is a net food importer but a net exporter of beverages and tobacco products.

The Government of the Republic of Trinidad and Tobago (GoRTT) has targeted to 2015 to increase contribution of agriculture to GDP by 3% and employment of this sector by 5%. Additionally the GoRTT aims to reduce the food import bill to $3 billion, this bill accounted for 3.1 billion in 2013.

According to the National Food Production Action Plan 2012-2015, the Government's strategy is to focus on the development of six commodity groups: staples, vegetables, fruits, aquaculture, selected livestock products, and pulses. And two strategic products, cocoa and honey.

On September 2014 the CLCPA team at the Organization of American States, held a mission in Port of Spain to review with different stakeholders the key crops of the country. As a result of the meetings held with different local actors, the following crops were identified as those with the highest priority for development and prioritization: cassava, rice, cocoa, coconut, and sweet potato. There is a low production of sugarcane, opposite of few years ago, but could be considered for the project due to its high potential for biomass production.

It was estimated, by representatives of the National Agricultural Marketing and Development Corporation (NAMDEVCO), that between 70%-80% of the crops production in Trinidad passes through the Norris Deonarine Northern Wholesale Market and the remaining 30%-20% is delivered from the farming production directly to the consumers. Annex I presents the total volumes at the Norris Deonarine Northern Wholesale Market and the average prices at the same market for all the commodities that went through this during the years 2010-2013.

A. Crops production

This section presents an analysis of the crops production in Trinidad and Tobago and the feedstock with the highest potential to become sustainable packaging materials according to their residues availability.

The data used for this analysis corresponds to the commodity survey conducted by the National Agricultural Marketing and Development Corporation (NAMDEVCO) of Trinidad and Tobago during the months of July and August 2014 to estimate the levels of production in Trinidad and Tobago. Due

to several differences of information on national and international databases, it was concluded that the results of the commodity survey by NAMDEVCO was the most accurate information available.

The commodity survey was based on the Ministry County designation (see figure 2.8): Victoria (VICT), Nariva and Mayaro (NAMY), Caroni (CARO), St. Andrew and St. David (STAD), St. George East (STGE), St. George West (STGW), St. Patrick East (STPE), and St. Patrick West (STPW).

Trinidad and Tobago and land use of the different areas of the country

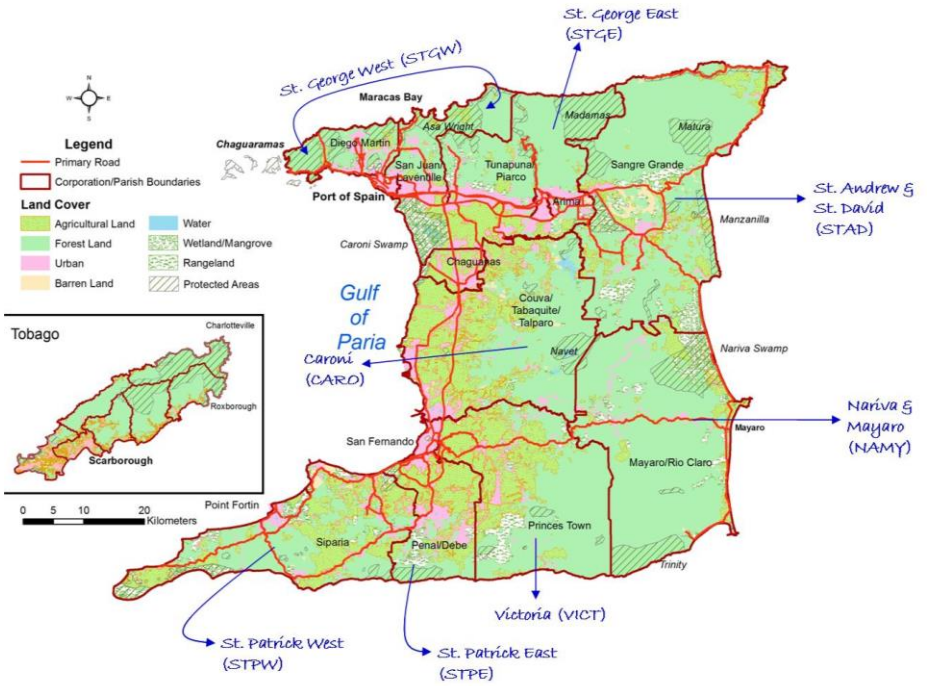


Figure 2.8. Map of Trinidad and Tobago divided by land use
Source: Ministry County designation in Trinidad and Tobago

The total number of farmers surveyed was 4,721 of which 4,126 were under active production and 575 were under land preparation. The total acreage surveyed was 11,276 of which 10,303.13 were under active production and 972.87 were under land preparation. The projected yield was estimated for a period of one year. Figure 2.9 presents the projected yield in kilograms according to the counties. The counties with the highest projected yield are those with the most extension of land: VICT, NAMY, CARO, STAD and STGE.

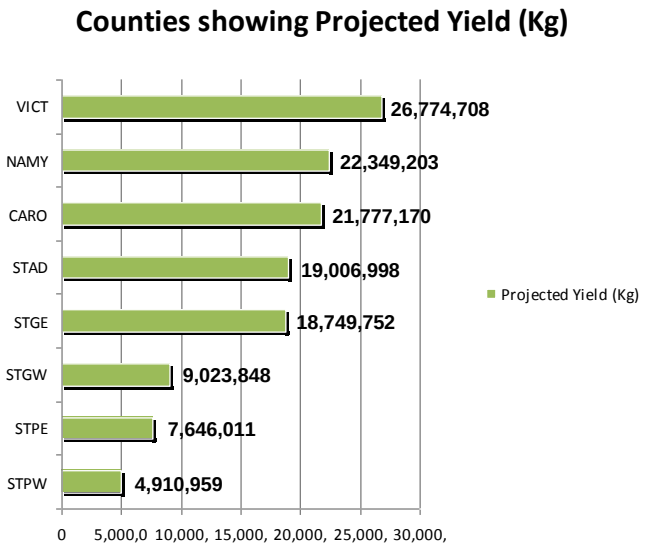


Figure 2.9. Projected yields in T&T.
Source: Ministry County designation.

As a result of the surveys, 80 commodities were identified among them cassava, rice, coconut and sweet potato. Table 1.9 below presents some of the commodities sorted by the highest acreage value, leading Cassava, Plantain, Orange, Coconut, Sweet Potato and Pumpkin respectively. Table 2.0 shows the 15 commodities with the highest projected yield (leading Coconut, Cassava, Paw Paw, Pineapple and Orange) and table 2.1 presents the projected yield and projected acreage of the key crops identified in the previous section including Orange.

Commodities with the highest acreage

Commodity	Projected Yield (Kg)	Acreage (Acres)
Cassava	11,828,355	1253
Plantain	5,865,833	1235
Orange	6,335,813	693
Coconut	22,811,940	575
Sweet Potato	5,102,859	518
Pumpkin	3,155,631	517
Dasheen	4,385,494	495
Watermelon	4,458,033	451
Corn	2,365,866	386
Hot Pepper	4,354,224	360
Banana	2,343,507	353
Pineapple	7,883,730	329
Tomato	3,298,956	314
Ochro	759,652	299
Pimento Pepper	2,955,695	263

Table 1.9. Results from the survey made by NAMDEVCO.

Commodities with the highest projected yield

Commodity	Projected Yield (Kg)
Coconut	22,811,940
Cassava	11,828,355
Paw Paw	11,651,007
Pineapple	7,883,730
Orange	6,335,813
Plantain	5,865,833
Sweet Potato	5,102,859
Callaloo Bush	5,000,304
Watermelon	4,458,033
Dasheen	4,385,494
Hot Pepper	4,354,224
Tomato	3,298,956
Pumpkin	3,155,631
Rice	2,977,767
Pimento Pepper	2,955,695

Table 2.0 Results from the survey made by NAMDEVCO.

Commodities with the highest projected yield

Commodity	Projected Yield (Kg)	Acreage (Acres)
Cassava	11,828,355	1253
Coconut	22,811,940	575
Sweet Potato	5,102,859	518
Rice	2,977,767	101
Orange	6,335,813	693

Table 2.1. Results from the survey made by NAMDEVCO

B. Residue to Product Ratio (RPR) per crops

This section uses the Residue to Product Ratio (RPR) per crops to calculate the yield of crop residue from the pre-selected agricultural products. The conversion rates were found in a literature study and the RPR converts directly wet weight of agricultural residues to dry weight feedstock. These values were calculated theoretically; therefore it is necessary to collect information about the residues generated in the field and those generated during the processing phase for more accurate information.

The projected yield of crops was estimated for a year, therefore the equation to calculate the total amount of residues per crop (R_{fpc}) can be derived through the following equation:

$$R_{fpc} = A_C \times C_{fr}$$

Where A_C is the amount of total crops production (kg) and C_{fr} is the residue factor per crop or Residue to Product Ratio (RPR). Table 2.2 presents the used values of the residue factor per crop.

Residue factor per crop

Agricultural Residue in Field	Coefficient	Reference	Agricultural Residue during a Industrial Process	Coefficient	Reference
Oranges (leaves and steam)	0.37	El Tamzini et al. '04	Oranges (skin and pulp)	0.50	Canton '08
Rice Straw	1.757	Bhattacharya et al '93	Rice Husks	0.267	Bhattacharya et al '93
Roots and Tubers (Cassava)	0.66	FAO '91			
Roots and Tubers (Sweet Potato)	0.66	FAO '91	Coconut (husk)	0.419	Bhattacharya et al '93
			Coconut (shells)	0.12	Bhattacharya et al '93

Table 2.2. Test in some crops available in the country.
Source: Own resource.

The total amounts of residues potentially harvestable according to the estimated values of projected yield for one year are depicted on table 2.3.

Potential harvestable agricultural residues

Agricultural Residue in Field	Potential Amount of Residues harvestable in the field (kg)	Agricultural Residue during a Industrial Process	Potential Amount of Residues harvestable during a Industrial Process (kg)
Oranges (leaves and steam)	2344250	Oranges (skin and pulp)	3167906
Rice Straw	5231936	Rice Husks	795063
Roots and Tubers (**Cassava**)	7806714		
Roots and Tubers (**Sweet Potato**)	3367886	Coconut (husk)	9558202
		Coconut (shells)	2737432

Table 2.3. Studies of the crops' residues that can be potentially used.
Source: Own resource.

5.2 Sustainable Packaging material technology

The following table summarizes the type of polymer and technology needed according to the feedstock used. When the Polymers are directly extracted from biomass, the feedstock needed originates from Marine and Agriculture - animals and plants. Examples of these are polysaccharides such as cellulose, starch, and chitin and proteins such as gluten, soy, pea and potato (plant origin), casein, whey, collagen and keratin (animal origin). When the Polymers are produced from classical chemical synthesis from bio based monomers/ fermentation, the feedstock needed includes maize, wheat, waste products from agriculture or the food industry such as molasses, whey, green juice (waste product from the production of animal feeds), Castor oil, seed crops and flax. When the Polymers are produced directly by natural or genetically modified organisms the feedstock needed are poly (hydroxyalkanoates) (PHAs) of which poly (hydroxybutyrate) (PHB) is the most common, these are accumulated by a large number of bacteria as energy and carbon reserves.

Polymer and technology

Technology	Feedstock	Description	Source
Polymers directly extracted from biomass. Technology depends on type	Marine and agricultural - animals and plants	Examples are polysaccharides such as cellulose, starch, and chitin and proteins such as gluten, soy, pea and potato (plant origin), casein, whey, collagen and keratin (animal origin).	http://www.biodeg.net/fichiers/Book%20on%20biopolymers%20(Eng).pdf
Polymers produced from classical chemical synthesis from bio-based monomers/ fermentation	Maize, wheat, waste products from agriculture or the food industry such as molasses, whey, green juice (waste product from the production of animal feeds). Castor oil, seed crops and flax	To date Poly Lactic Acid (PLA) is the polymer with the highest potential for a commercial major scale production of renewable packaging materials. Bio based monomers can be obtained from bio based feedstock. These may be prepared using chemical and biotechnological routes, or a combination of both.	
Polymers produced directly by natural or	Poly (hydroxyalkanoates) (PHAs)	Poly (hydroxyalkanoates) (PHAs) of which poly (hydroxybutyrate) (PHB) is the most common, are	

genetically modified organisms. Technology depends on type	Bacterial Cellulose	accumulated by a large number of bacteria as energy and carbon reserves. Production costs of bacterial cellulose are high.	
Biotechnological processes such as fermentation	agro-industrial residues such as sour cassava or bananas	Some microorganisms under specific conditions could take advantage a source of carbon, such as sugar, to transform it into a polymer material and accumulated within themselves. It is then recovered and transformed obtaining a biopolymer with a particular application. The group works the line of biopolymers, seeking the production of materials with properties such as polyester that may have the potential of being used to manufacture disposable cups, bags and other items that are currently produced with plastics conventionally derived from petroleum. There are about 300 microorganisms with the potential to produce about 150 types of different polymeric structures, and each one is unique and can offer multiple alternatives to the market.	Group of Biotransformation from the School of Microbiology of the University of Antioquia. PhD in engineering and coordinator of the biopolymers line Lina María Escobar Agudelo
Technology to produce cellulose acetate	Pure cotton, lined fiber, sugar cane bagasse, corn and wheat bran, stems and veins of banana leaves	(uses on food packaging not found yet)	http://repositorio.uis.edu.co/jspui/bitstream/123456789/480/2/116248.pdf
injection molding, blow molding, film blowing, foaming, thermoforming and extrusion	Starch based plastics are mainly harvested from wheat, potatoes, rice, and corn	The process changes the starch from a lactic acid monomer into a polymer chain called polylacitide (PLA) (Packaging Greener, 2004) or polygloycolic (PGA). When water is added, it completely disappears into the soil over a period of time. This is excellent for food packaging and farming.	
Soy Based Plastics compression and injection molding processes	Soybeans	Soybeans are composed of protein with limited amounts of fat and oil. Protein levels in soybeans range from 40-55%. The high amount of protein means that they must be properly plasticized when being formed into plastic materials and films. The films produced are normally used for food coatings, but more recently, freestanding plastics (used for bottles) have been formed from the plasticized soybeans.	

Table 2.4. Summary of Technology and Feedstock for the production of biopolymers

Source: Own resource.

According to the information displayed in Table 2.4 any type of crops or crops' residues even marine and animals are suitable alternatives for the production of biopolymers.

5.3 Cradle-to-Cradle Philosophy

As the goal is to replace the EPS containers with products that go beyond the characteristics of sustainability, Cradle to Cradle philosophy represents a way of bringing into the country, materials, processes and businesses that come with economic, social and environmental benefits for everyone.

In 2002 architect William McDonough and chemist Prof. Dr. Michael Braungart published the book *Cradle to Cradle: Remaking the Way We Make Things*. In their book the authors explain the Cradle to Cradle design framework and encourage companies and designers not to try to reduce the negative environmental impact of products but design and produce with positive effects. The current culture of consumption does not think about closing the circle of production, rather it is made today to take, make, consume and then throw away (McDonough & Braungart, 2009).

There are three guiding principles within the Cradle to Cradle design framework. The first one *Waste equals food* focuses on products to act as defined 'nutrients' in a biological or a technical 'metabolic system'. The second principle Use of solar income aims the use of energy that can be renewed as it is used (Baungart & Mulhall, 2010)]. And the third principle Celebrate Diversity seeks to celebrate diversity in means of biodiversity, cultural diversity and conceptual diversity.

Principle 1: Waste equals food

This principle aims to allow nutrients to become nutrients again. This means that nutrients that were used for a product serve as nutrients for new products or for nature. Here material flows can be divided into two cycles: biological cycle (biological nutrients) and technical cycle (technical nutrients). Biological nutrients can safely be discarded into nature to serve as 'food'. Products within the biological cycle are called Consumption Products because they get consumed during their period of use. Technical nutrients are useful for the industry, and new products can be made of them. Products within the technical cycle are called Service Products, they do not get consumed but provide a certain desired service. Figure 3.0 illustrates these two cycles and their stages.

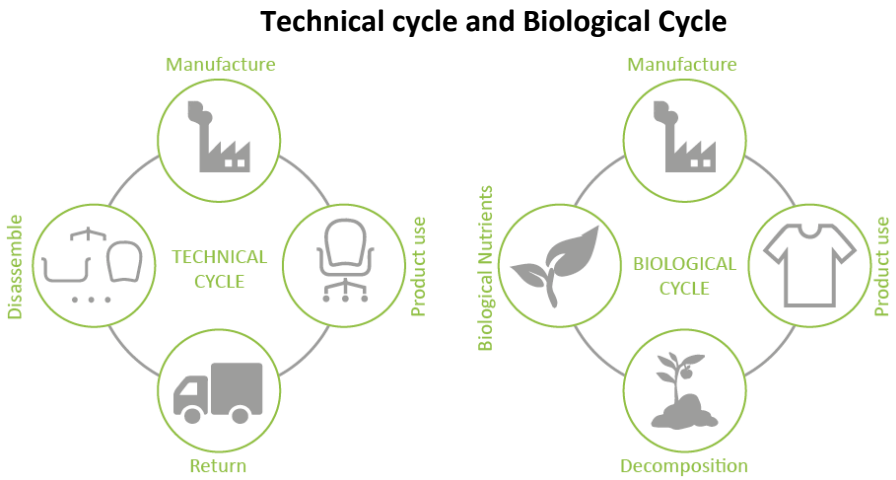


Figure 3.0. Cycles of Cradle to Cradle concept
Source: MBDC. 2013

Principle 2: Use current solar income

The sun, with its by-products (wind, water/tidal energy, heat exchange, geothermal and biomass) theoretically supplies our planet with 3.078 times more energy per day than the earth actually consumes. Therefore this principle aims to use that renewable sources powered by sun. Energy is generated by using direct and indirect solar energy and can be generated from sun, water/tidal energy, heat exchange, geothermal and biomass.

Principle 3: Respect diversity

Diversity should be respected in means of biodiversity, cultural diversity and conceptual diversity. This principle aims to manage water use to maximize quality, promote healthy ecosystems and respect local impacts. Operations and stakeholder relationships using social responsibility are also an important aspect of this principle. Additionally, systems and products should be beneficial and add value to all three domains: the economy, the society and the environment.

The conventional mentality of suitability uses the concept of eco-efficient, which focuses on reducing the negative impacts of their products and expected to result in the reduction of the negative footprint and in profitable business, whereas Cradle-to-Cradle philosophy implies the use of the notion of eco-effective, which is concerned with tailoring the industry and the society to have a positive footprint (MBDC, 2010).

The Cradle to Cradle Products Innovation Institute (C2CPII) is a non-profit organization that administers the Cradle to Cradle Certified™ Product Standard. According to the C2CPII, this certification guides designers and manufacturers through a continual improvement process that looks at a product through five quality categories and a product receives an achievement level in each category with the lowest achievement level representing the product's overall mark.

Levels of the Cradle-to-Cradle product certification

Figure 3.0. Different levels of certification of Cradle to Cradle

Categories of the Cradle-to-Cradle product certification

- **Material Health:** Value materials as nutrients for safe, continuous cycling;
- **Material Reutilization:** Maintain continuous flows of biological and technical nutrients;
- **Renewable Energy:** Power all operations with 100% renewable energy;
- **Water Stewardship:** Regard water as a precious resource;
- **Social Fairness:** Celebrate all people and natural systems.

The principles of Cradle to Cradle guided the research of a sustainable packaging and a business structure for Trinidad and Tobago. The CLCPA team reviewed around 10 different companies producing food and beverage containers that could meet these requirements, aspiring to guarantee a proposal with positive impacts in social, economic and environmental sectors.

After analyzing the products' typologies of polystyrene foam consumed in Trinidad and Tobago and comparing those products with the eco-friendly ones produced all over the world, the CLCPA team contacted the company *Be Green Packaging*, which has a C2C product certification, silver level, and produces tree-free compostable packaging. From the point of first contact this company showed its interest in being part of the project, in order to a degree of leadership as it pertains to the consumption and production of more sustainable containers in Trinidad and Tobago. It is hoped that lead to the generation of new business in the islands through the application of circular economy processes.

5.4 Be Green Packaging

Be Green Packaging was the first company from the printing and packaging industry to obtain Cradle to Cradle certification, (and has attained silver level certification), which implies adherence to strict requirements for sustainability and environmental friendliness of both their products and facilities. The company offers high quality biodegradable food packaging that is a sustainable alternative to plastic, paper and Expanded Polystyrene foam.

Currently they have six C2C product certifications that strengthen the benefits of these food and beverages containers in social, environmental and economic aspects. *Innovation*, *sustainability* and *quality* were the elements that guided the company to a new way of making food and beverage containers for massive consume. The headquarters of the company is located in Santa Barbara, California but the stages of production take place in two plants, one situated in China and the other one in Ridgeland, South Carolina (Be Green Packaging, 2011).

As this company is dedicated to conducting a business based on the care of the environment, which results in the application of the highest green standards, Be Green Packaging has created a philosophy reflected on what is called, Eco-Social commitments. This is based on generating profit through responsible business practices and working to achieve a closed-loop cycle. In order to do that, the key element is the material used to make the food and beverage containers. Be Green Packaging created a material that is derived from annually renewable resources. This material is made of six different resources including: Bulrush, Wheat Straw, Sugar cane, and Bamboo.

All the ingredients and material's formulation is confidential but the raw material and the production process guarantee that Be Green Packaging products are compostable within 90 days. Moreover, no trees are felled or used; this also means that products are chlorine and bleach free. When additives are used to provide moisture and grease resistance, the company ensures these additives are food-grade, meet FDA standards, and have minimal negative environmental impacts (Be green Packaging, 2011).

Molded pulp fiber has played a role in packaging since the first US Patent for a Fiber Pulp Mold was established in 1903. However, for a long time its use had usually been relegated to egg cartons, drink trays, or industrial packaging materials. But in recent years, a vast array of molded pulp products have entered the market, with numerous retailers embracing molded fiber packaging for a plethora of food and consumer goods. The production process used by Be Green Packaging has three main stages:

1. Mixing raw material with water

The manufacture of molded pulp starts with sourcing the right kind of input materials. In this case, the two primary inputs are fiber and water. The best fibers are materials that can easily be turned into a pulp and shaped to create a range of packaging designs.

Once the right kinds of fiber are selected, they are combined with the second input, which is water. This stage involves mixing the raw material with water to create what is called bagasse. Some of the water used in this stage can be reused as well on products that are already molded but had some imperfections. Both fiber and water are added to a giant "blender" where they are mixed together to create a pulpy slurry. At this point some companies add bleaches or additives to the mixture to improve the product's aesthetics or function in some way. However, molded pulp manufacturers mindful of negative environmental impacts may avoid additives altogether to create products that are 100% natural. Ultimately, a final product that minimizes the number of chemicals it leaches into the environment will prove more sustainable in the long-term.

2. Molding

Once the pulpy slurry is created, it is added to a mold where it is subjected to heat, drying, and vacuuming. Some of the latest technology can create molded fiber that is dense, well-defined, and smooth, just like a typical piece of clear plastic. The products made from molded pulp fiber include cups, food containers, plates, utensils, bowls, protective coverings, and cases (Be Green Packaging, 2014).

3. Packaging

The products are organized and operators put them in boxes. They also add plastic in some products to protect them. They use recyclable cardboard to package their finished products.

As it is seen the production process does not produce waste. Moreover, the defective containers can come back into the process. To achieve the silver level of certification it is required to have a strong social program that relies on bringing benefits to the communities, where the company is present. Be Green Packaging employs people who are part of the community, the company donates energy, time and money to generate positive social and environmental impacts. Be Green Packaging seeks to avoid the materials that result from deforestation or oil based materials, leading to the reduction of waste that goes into the landfills or the oceans, which is a necessity in Trinidad and Tobago, given the current condition.

Chapter 6

Current Market in Trinidad and Tobago

As described in section 4.2. the most consumed type of EPS food and beverages products is clamshells (37.72%), followed by cups (34.92%), bowls (25.36%) and trays (2%). When comparing the products consumed in the nation, with the products offered by Be Green Packaging, it is possible to define the typologies of cradle-to-cradle certified containers, which could be implemented in the short term. Issues related to the process of implementation and prices are later discussed in the report. However, in order to define the already available market and the possibility to penetrate it and infiltrate into the consumer culture, it is necessary to know the Be Green Packaging products that meet these characteristics. Due to high prices the cups are not a viable option but clamshells, bowls and trays demonstrated a high feasibility of implementation because of the consumption rates and the similarity of price with the ones already available in the country. The characteristic of the market could be classified into the following groups:

6.1 Restaurants

According to the U.S Department of Agriculture (USDA), there are about 3,800 food service outlets in Trinidad and Tobago. Approximately 2,850 are street stands and kiosks (USDA, 2012). Clearly, this is the sector that produces most waste of polystyrene foam containers in the nation. When the CLCPA team visited some street kiosks and restaurants, they found that about 80% of them used EPS food and beverage containers, for both delivery and eating in the restaurants. This means that 3,000 food clusters pack their food using EPS. The high consumption is the result of material characteristics and the low prices of expanded polystyrene foam containers, as well as the easy access provided by the local producers and dealers. As this is the market that consumes the most, the idea is to cover its demand, which calls for the participation of the private sector. The products most used in this sector are Clamshells, Cups and Bowls. Implementation of a sustainable containers programme in Trinidad and Tobago could help to raise awareness about the environment.

6.2 School Nutrition Programme

The school Nutrition Programme is an initiative of the Ministry of Education. It aims to provide breakfast and lunch to vulnerable students who are enrolled in pre-primary, primary, secondary and special schools. In order to implement this programme throughout the country the Ministry made The National School Dietary Services the official agency responsible for the programme (TT Connect, 2014). Figure 3.1 shows the roles of the Ministry and the NSDS.

Rolls in the National School Dietary Programme

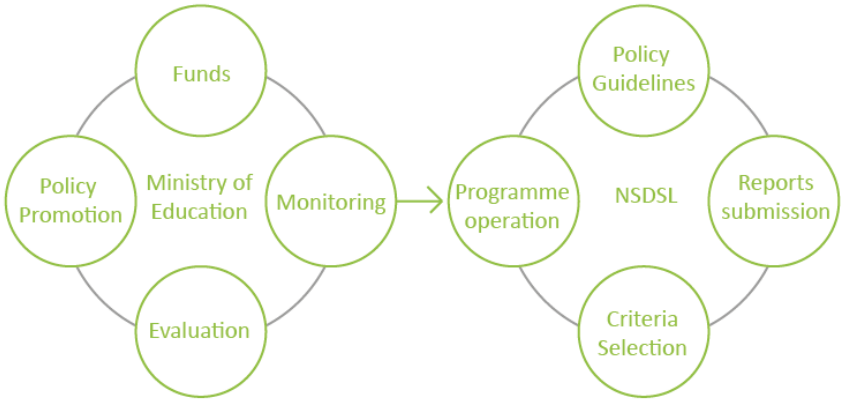


Figure 3.1: Organization chart of the programme called National School Dietary Services.
Source: Ministry of Education, National School Dietary Services and their responsibilities 2014.

According to the Ministry of Social Development and Family Services the budget for the School Nutrition Programme in 2015 was $250,000,000 TT dollars ($38,576,000 US dollars approximately). Around 120,000 students are fed daily in Trinidad and Tobago under this programme, becoming one of the most important programs in the social sector delivering very good results since 2009. About 180,000 meals are served by NSDS per day and, as it is shown in the audit carried out in 2014, one of its main goals is ensuring food safety. There is not a clear percentage of the amount of EPS containers used to deliver or serve those meals. It is important to consider that improving food safety is highly related to the use of safer food containers. Therefore implementing sustainable containers like the ones made by Be Green Packaging is needed especially in this kind of programs.

6.3 Supermarkets

The main supermarkets in Trinidad and Tobago are: *Massy*, *Tru Valu*, *PriceSmart*, and *JTA Supermarkets*. After visiting them, it was found, as it was expected, that their principal offer of disposable containers are the ones made of expanded polystyrene foam. There were few products made of sugar cane, manufactured by a North American company. When talking to owners of restaurants in Trinidad, they confirmed acquiring food and beverage containers in these supermarkets but over the time, they switched to buy the products at a lower price directly from the producers and dealers in the country. This is not the case for street kiosks' owners, whom usually stock up with food and beverage containers from supermarkets.

In the long term it is necessary to penetrate all these markets but to reach this goal it is required to develop a road that guides the implementation. The principles of this process will be discussed further in this section.

It is concluded in this section that the market that has a defined daily demand requires the implementation of sustainable containers as a matter of health. Moreover the School Nutrition Programme has the advantage of belonging to the National Government and it could be possible to start the implementation of sustainable packaging through this kind of programme.

6.4 Prices of food and beverage containers

The current costs of Expanded Polystyrene foam containers and Be Green Packaging containers are compared in this section. If the externalities are considered, it will result into a very high price for Expanded Polystyrene foam containers because of the consequences of the material on people's health and the environment. The externalities were not considered for this study but it is recommended to include them in future studies on this issue.

The products compared are clamshells, bowls and trays, because these are the ones that fulfil the characteristics of the National Market, in terms of price and design. The Current Consumption Situation section presents a list of prices collected after visiting the principal supermarkets of Trinidad and Tobago. This list has the basis to determine the prices of the Expanded Polystyrene foam containers available in the country. The prices of Be Green Packaging Containers are prices determined by the company with the aim to be implemented in the country. Figure 3.2 lists the Expanded Polystyrene foam Containers and the Be Green packaging containers, prices in TT Dollars

per unit using the exchange rate of The World's Trusted Currency Authority, www.xe.com by October 24,' 2016.

Food and beverage containers, prices and typology.

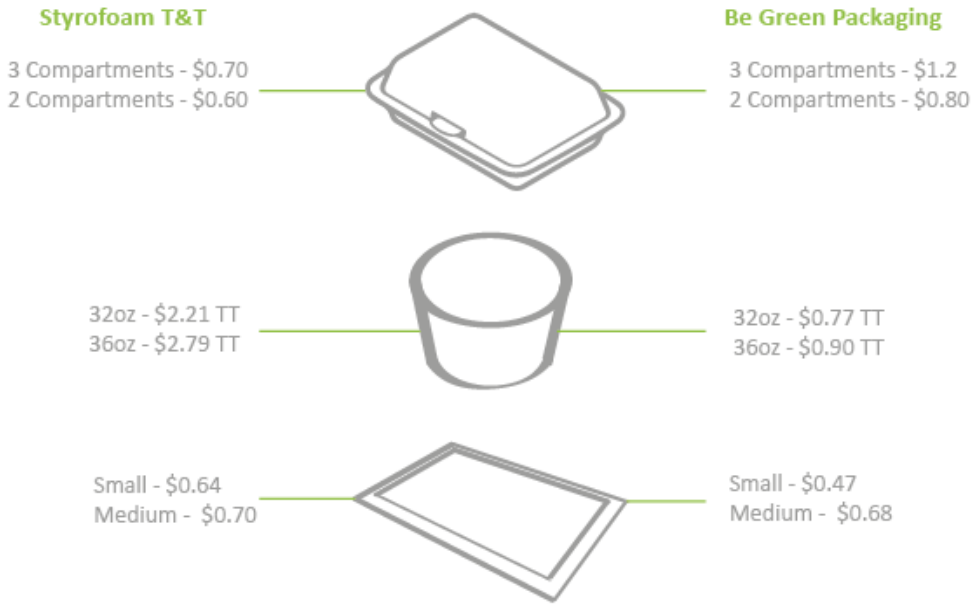


Figure 3.2: Prices according to Be Green Packaging proposal and Expanded Polystyrene foam containers available in T&T- TT Dollars. Source: Own resource.

The products of Be Green Packaging are cheaper in two out of the tree categories, Bowls and Trays. However, the category of clamshells shows a significant difference in terms of price. When discussing with representatives of Be Green Packaging about the shipping of these products they said that this price includes the freight to the destination. One other important factor to consider is the taxes these products must pay and the cost of operation to sell and distribute them.

These products have to pay 20% of duty rate to enter into the country plus a cost of operation. A local operation cost was estimated since it was not possible to collect this information from private companies in Trinidad and Tobago. To get an approximation, it has been estimated that these cost can be covered by an increase of 130% over the gross price of the containers. These values are also determinate by the market and depend on the quantity sold. The prices of the Be Green Packaging containers increase to about 150%, after adding duty tax and operation costs. Figure 3.3 shows the comparison with the new prices of the BGP containers.

Food and beverage containers, prices with tax and operation cost.

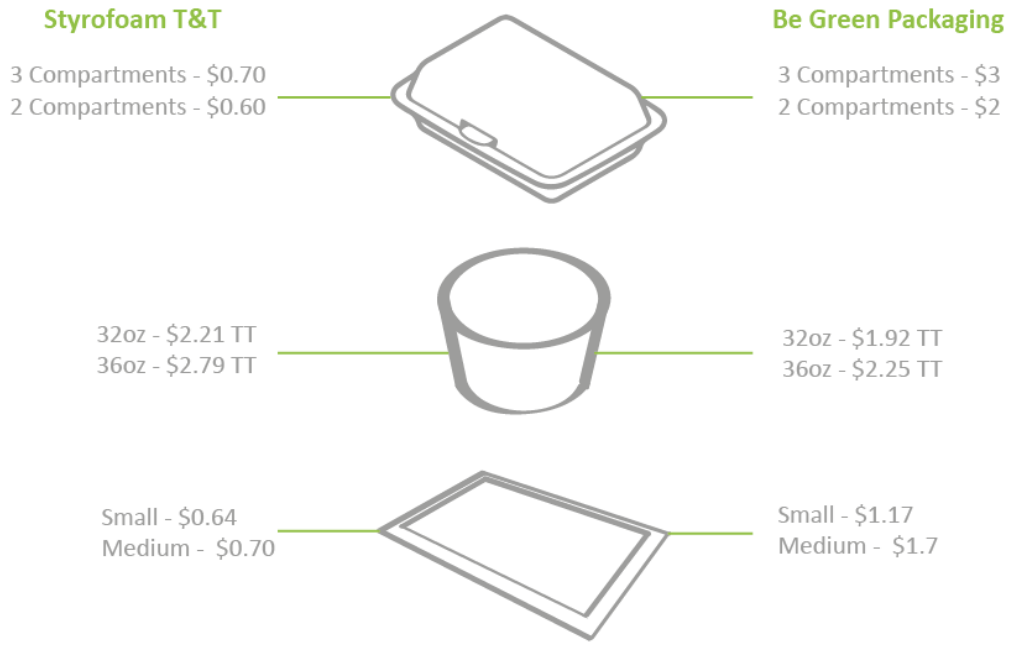


Figure 3.2 Expanded Polystyrene foam and Be Green Packaging containers with taxes and distribution costs estimated at 120% over the gross price. Prices in TT Dollars, 2015. Source: Own resource.

With this new estimation, the prices of the BGP containers are more expensive in two of the three categories, Clamshells and Trays and cheaper in the category of Bowls. For the category of Clamshells (3 compartments) the price of Be Green Packaging is more than 400% of the price of Expanded Polystyrene foam. It is necessary to understand that these prices could decrease with a higher demand and with the distribution infrastructure totally created.

Moreover, and as it has been suggested in previous sections these prices can decrease only by changing the tax rate related to these containers. Considering that the pellets of expanded polystyrene do not pay any taxes, the Government should reconsider a lower tax rate or an exemption for sustainable packaging taking into account that this type of packaging does not impact negatively on the environment or people's health.

Chapter 7
Implementation

This section presents some guidelines for the implementation of sustainable packaging containers in Trinidad and Tobago. Government and private sector are the main actors that need to start developing and implementing sustainable production and consumption practices. As a first step the market should be tested, perhaps by importing Be Green Packaging products or similar ones. After this, it is recommended that sustainable packaging prototypes be produced using local technology and resources.

Next sections describe a process to implement Be Green Packaging products while analyzing the alternatives to produce locally at a similar material. The process to implement sustainable packaging, like the ones produced by Be Green Packaging, is divided in 3 main stages, which are illustrated in figure 3.3. The objective is that each stage covers one of the target groups identified in section 6. Moreover this plan is a set of actions where the results of one stage lead into the next one.

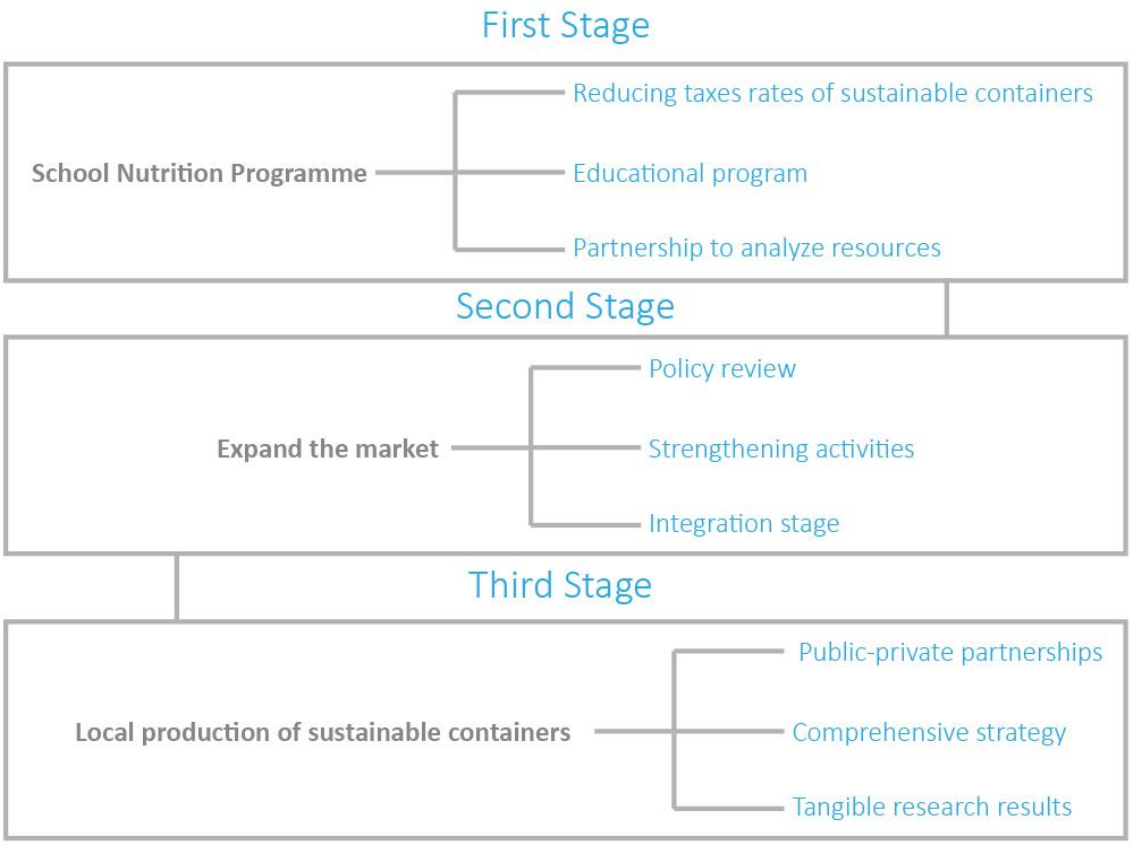


Figure 3.3 Three stages of the implementation process and the main tasks of each of them.
Source: Own resource.

First Stage

One of the most important initiatives of the country is the *School Nutrition Programme*. Be Green Packaging containers would contribute to the aspects of food quality and awareness raising. Through the use of sustainable packaging children could learn about the negative effects of using Expanded Polystyrene foam for food and beverages. Targeting 50% of the students that are fed daily through this programme, around 100,000 sustainable containers will be used per day.

7.1.1 Reducing the rate of taxes that these products have to pay (20% of duty rate to enter into the country plus a cost of operation) would contribute to a successful implementation. Currently products and materials such as the EPS, that have a negative environmental and health impacts, pay little or nothing to enter Trinidad and Tobago. A reduction on these tariffs on sustainable or green products the Government will help to promote investment from the private sector.

7.1.2 This phase will also introduce an awareness raising program that teaches about the impacts of Expanded Polystyrene foam on people's health and on the environment. This program should tackle important issues like responsible consumption, recycling and the diversity of Trinidad and Tobago. It could result in the reduction of the consumption of Expanded Polystyrene foam in the years to come and will ensure the new generation realizes the importance of protecting the resources of the country. For this step there are already ongoing initiatives such as Plastikeep or the recycling program of the University of West Indies.

7.1.3 A partnership with Be Green Packaging or a another organization is recommended to start analyzing the natural resources that can be used to produce sustainable packaging locally. Some of the natural ingredients used by Be Green Packaging are not available in Trinidad and Tobago; therefore, it is necessary to analyze the resources and technology available in the country, some of them identified in section 5.1, to modify the composition of the biodegradable material.

Second Stage

In this stage the aim is to increase the participation in the *School Nutrition Programme* and to introduce the biodegradable containers to restaurants. *Sumo Sushi* is a company located in Trinidad that is currently using Be Green Packaging containers to serve its food. Its products can be found in local supermarkets, see figure 3.3.

Sumo Sushi is very interested in being part of this project. In addition, the company has contacted Be Green Package to explore the options to become distributors of these containers.

Packaging Sumo Sushi

Figure 3.3. Packaging of Be Green Packaging, used by Sumo Sushi.
Source: Own resource.

Sumo Sushi Company only uses this kind of container, which is not the typology (bowls) that is intended to be implemented in the first stage of the implementation process. However, all the experience Sumo Sushi has had can contribute positively to the implementation plan stated herein. Sumo Sushi did not provide information related to the dealer in Trinidad and expressed that the variation of prices between regular containers (EPS) and biodegradable containers is about 250%. The presence of these products in the country shows an initial interest of the private sector.

7.1.4 On this step, it is recommended that policies related to the entrance of sustainable packaging and products into the country be reviewed, in order to incentivize products that are environmental friendly.

7.1.5 The sustained supply and cost of biodegradable materials to support the manufacture of biodegradable packaging is a critical component of the implementation phase. Once the available feedstock (biodegradable residues) as were identified and quantified on previous stage, it should be assessed here whether the identified feedstock can be collected in a cost-effective manner to be converted into biodegradable polymer. Additionally, the available technological capacity to convert the feedstock in packaging products should be evaluated as well.

7.1.6 This stage should focus also on increasing the use of biodegradable or sustainable packaging used by the School Nutrition Programme, implementing a high number of cups, cutlery, clamshells, and bowls made of renewable resources.

7.1.7 The importance of raising awareness programs on responsible consumption has been highlighted within this report. At this point it is necessary to promote even more this idea, which will be the preamble of the last stage. It is necessary to create a community, which promotes the consumption of products that impact positively the economic, society and environment. This community could be responsible of promoting the use of products that bring environmental benefits in Trinidad and Tobago, helping to increase the production and consumption of these goods.

Third Stage

This stage should be the beginning of a new scenario, in which all the process to produce a sustainable packaging to replace the EPS foam takes place inside the country, and has a closed loop cycle. To get to this point is necessary to study the agricultural activities and understand how they contribute to improving the economy of Trinidad and Tobago, especially affected by current prices of oil.

7.1.8 Trinidad and Tobago could place the ban of the use of Expanded Polystyrene foam for food containers. It has to be done when there is already investment and profitable business in this sector, that way the current producers of Expanded Polystyrene foam in Trinidad will not be affected at the same scale. This also means that it is necessary to integrate them from the first stage of implementation, that way in partnership with the private sector the country will be driven into a circular and green economy, as a way of generating income and protecting national resources.

7.1.9 The entire process of implementation is about scaling the consumption of more sustainable resources and materials. The increased production and consumption of biodegradable and compostable cups and food containers within the economy of Trinidad and Tobago may justify investment in collection and separation efforts to recover a large fraction of compostable biodegradable materials to be used as feedstock for a bio-digestion system to generate biogas and fertilizer that may be replenished on the agricultural lands in Trinidad and Tobago.

7.1.10 This stage should conclude with the start of local production, and also with the delimitation of uses for Expanded Polystyrene foam and a review of relevant policies. This implementation must follow a comprehensive strategy, which includes materials, products, process of production, policies, market studies and a community that includes the Government, the private sector, organizations and initiatives as the main authors. Trinidad and Tobago can easily become the leader in the field of sustainable production processes among Caribbean countries.

Chapter 8
Conclusions

Under the diagnostic study of the production sector in Trinidad and Tobago it was recognized that its GDP is highly dependent on oil prices. Even though the manufacturing industry has benefited from the availability of cheap fuel, the sector did not experience any outstanding growth during 2000-2012 according to the contribution to the National GDP. Unlike the energy sector where exports represent around 84%, exports in the manufacturing industry are weak. None of its sub-sectors exports more than 0.5% of the total exports of the country.

Therefore, the non-energy related sectors have been prioritized by the Government of Trinidad and Tobago for further economic diversification and strategic development. Within the manufacturing sector, *Printing and Packaging* and *Food and Beverages* were identified as the sub-sectors with the greatest potential for further growth that warrant the Government's attention and assistance from the CLCPA Program for their sustainable development.

The subsectors of *Food, Beverages, and Tobacco*, and *Printing and Publishing* were the only subsectors from the manufacturing industry that by the end of the year 2012 exhibited positive growth. In fact, the *Food and Beverages* sub-sector maintained positive growth for 12 years in a row and presented the highest amount of establishments since 2001 represented mainly by larger companies. Data from the Central Statistical Office of Trinidad and Tobago for the year 2010 shows that 21.4% of all manufacturing establishments belong to this sub-sector. Its employment rate accounted 53% of all employment generated by the manufacturing industry. Other sub-sectors that represent an important number of establishments are *Printing, Publishing and Paper* converters, *Wood and related products*. Each of these industries represents approximately 15% of the total establishments of the manufacturing industry.

Printing and Publishing; and *Food, Beverages and Tobacco*; together with *Chemicals and Non-Metallic Minerals* are as well the sectors with the highest amount of waste production. The activity of those sectors produces more than 1,300 tons of waste. Organic matter, Plastic and Paper are the most common type of material disposed by the Domestic and Industrial sectors.

Due to the high consumption of Expanded Polystyrene foam food and beverage containers in the country; this document focused on the analysis of the current scenario and finding an alternative sustainable material. It is estimated that in 2016 the Expanded Polystyrene foam and beverage containers consumed in Trinidad and Tobago will be around 12,258 tons. If measures are not taking place, this trend of consumption will continue to rise during the upcoming years.

Today here are five brands of Expanded Polystyrene foam containers available in the country. Those brands are from Jamaica, Dominican Republic, the United States of America and Trinidad and Tobago. The containers produced locally use imported raw material. The beads of polystyrene imported into the country in 2014 were valued at a total of $18,270,884 TT dollars.

As it was shown, the country has several policies to protect the environment, some programs to collect the plastic waste and to raise awareness about recycling. It a clear cohesion between the different initiatives was not found. Therefore, it is necessary that the government, as the principal authority, organizes and defines the actions of each entity in the process of recycling, regulating, collecting waste and awareness raising campaigns. First of all, it is fundamental that the Environmental Management Authority (EMA) focuses on regulating actions. It is necessary to create a plan with the different active authors led by EMA that allows the National Government to have all the information it requires to take action.

If the aim is reducing the consumption of Expanded Polystyrene foam containers there are several policies that benefit the importation of this material that need to be reviewed. This study found that

among the reasons why companies and citizens favoured Expanded Polystyrene foam containers over other available products was price. This report found that Expanded Polystyrene has 0% of duty rate when entering the country, while other products, like containers made of bamboo had a duty rate of 20%. While the current international trend is to band this material from the markets, the rates of duty in Trinidad and Tobago only serve to stimulating the consumption of polystyrene containers.

In order to create an attractive market environment to stimulate the introduction of alternative and sustainably designed packaging, policies and duties need to be reviewed in favour of sustainable packaging, products and materials.

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This publication was produced by the Department of Sustainable Development of the Organization of American States (OAS).

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Gobierno de los
Estados Unidos

This publication was produced with financial support from the Permanent Mission of the United States of America to the OAS.

ISBN 978-0-8270-6601-4