



AN ASSESSMENT OF THE WASTE DIVERSION PROGRAMS IN ONTARIO, CANADA

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Abstract: The purpose of this study is to examine and evaluate various waste diversion programs in Ontario during the period 1996 to 2010. Waste diversion is a very important component in modern solid waste management, and the key objective is to minimize the amount of landfill disposal. A review of literature suggested that municipal solid waste management in Ontario is complex, and a multidisciplinary approach is needed. Waste management teams are required to understand the sources and generation of wastes, waste characteristics, risk management, emerging technologies, laws and regulations, waste trends, and economic aspects of waste. In this study, Statistics Canada waste data were collected for the period from 1996 to 2010. Although Ontario started waste diversion programs in the 1980s, data during the earlier periods of this study were not readily available. It was found that Ontario had made significant progress in waste diversion until 2008, when the volumes of diverted wastes started to decline. For instance, Ontario generated over 9 million tonnes of solid waste in 2010, but only 2.7 million tons (or 29.7%) was diverted. The results suggested that Ontario should review its current waste diversion programs, and develop new waste management frameworks. The new approach should include the following concepts: implementation of 3Rs, producers based approach, product development and packaging protocols, and development of specific waste management techniques based on materials or locations.

Keywords: Waste Diversion, Sustainability, Recycling, Landfills, Extended Producer Responsibility

1.0 INTRODUCTION

William Mueller has observed that waste recycling has become a critical element as more wastes are generated (Mueller 2013). Policymakers have the daunting task of choosing the best recycling practices to ensure effective diversion of wastes from landfills. Consequently, waste diversion has increasingly become a vital element of solid waste management across the globe. In this regard, cities in Ontario adopted a waste diversion act to enhance solid waste management. Ontario's *Waste Diversion Act, 2002* aims to "promote the reduction, reuse and recycling of waste through the development, implementation, and operation of waste diversion programs" (Ministry of the Environment 2008). In short, the Act focuses on reducing waste disposal in landfills.

To understand the effectiveness of Ontario's Waste Diversion Act, 2002, the Environment Accounts and Statistics Division of Statistics Canada has become a critical body for collecting, analyzing, and providing trends and practices on waste management in Canada. Statistics Canada gathers waste management data from private companies and local government authorities because they have access to the data required for studies related to waste diversion in Ontario, and other cities in Canada.

The aim of this report is to evaluate the effectiveness of waste diversion efforts in Ontario by using data collected between the year 1996 and 2010. The results would be useful for effective decision-making for waste diversion in Ontario and other parts of the world.

2.0 LITERATURE REVIEW ON RECYCLING PROGRAMS AND DIVERSION PRACTICES

2.1 *Traditional methods are no longer effective*

Available literature (MacBride 2013; Ministry of the Environment 2008; Mueller 2013; van Haaren et al. 2010) was reviewed on recycling and waste diversion practices in Ontario and other big cities in North



America, such as San Francisco. Landfills, incinerators and other traditional methods of managing waste materials are not effective enough, as Ontario generates huge amounts of waste. Consequently, it is hard-pressed to look for alternative ways of managing waste materials. This calls for effective waste disposal through planning and controlling via economical and environmentally-friendly methods in Ontario. According to Tchobanoglous and Kreith (2002), the focus should be on waste reduction at the source, toxic material reduction, recycling and reuse, waste composting, and conversion of wastes to energy.

2.2 Landfill challenges

For Ontario, which has depended on landfills for the solid waste materials, landfill disposal alone is no longer viable due to a lack of suitable locations, and large volumes of waste materials. In fact, the purpose of Ontario's *Waste Diversion Act, 2002* is to reduce the volume of solid waste materials that end up in landfills. Currently, the Conference Board of Canada has noted that Ontario has continued to rely on U.S. landfills in New York and Michigan to manage its solid waste materials (Conference Board of Canada 2014). Noble had noted that landfill siting was a significant component of solid waste management and disposal, but it was imperative to choose the best location, which is as far as possible from residential areas (Noble 1992). The landfill selection process should rely on available information and management resources to ensure that the process is effective and acceptable to communities, environmentalists, and other stakeholders.

Today, solid waste management has experienced changes, as new forms of waste, technology, and regulatory frameworks emerge. Ontario must therefore adapt to these changes in solid waste management, specifically by focusing on diversion. Diaz (1993) argued that solid waste management program and resource recovery should turn municipal waste from cities such as New York into useful materials. Diaz noted that Municipal Solid Waste (MSW) management should encourage collection with a particular focus on recycling and reuse (Diaz 1993). Solid waste materials, however, present considerable challenges. For instance, both local authorities and businesses involved in solid waste management must determine the composition, quality, and volume of solid wastes in order to understand how to manage and process them effectively.

2.3 Sustainability

Typically, as large volumes of waste materials are produced, a significant challenge for a clean environment arises because the production of waste has exceeded what nature can handle, while the depletion of natural resources continues at increasing rates. The challenge that arises is how people should utilize the available resources without compromising the needs of future generations. This requires sustainable practices, which can ensure that individuals meet their current economic needs, and derive social benefits on an ongoing basis without depleting the environment.

Ontario annually generates millions of tonnes of solid waste material (9,247,415 tonnes in 2010, from 6,913,786 tonnes in 1996). However, a small portion of this waste is recycled or diverted while the rest goes to the landfill or incinerator. For example, less than 22 percent of materials were diverted in 2010 (Statistics Canada 2013). With careful consideration, the Conference Board of Canada (2014) has noted that better waste management should lead to recycling or reuse of a significant portion of the generated wastes that would otherwise be disposed. In turn, there would be a significant reduction in waste materials for landfills, job creation, a decreased dependency on U.S. landfills, and thus a boost for Ontario's economy.

Williams (2005) focused on understanding waste process engineering and disposal strategies in the European Union member states. According to Williams, different technologies such as waste-to-energy incineration, gasification, pyrolysis, anaerobic digesters and composting have offered the best solutions for both household and industrial waste materials in Europe (Williams 2005). William has argued for integrated waste management practices that consist of these techniques for improved results. Ontario, perhaps, disposes huge volumes of waste materials because of poor diversion practices.



Sustainability is the effective utilization of natural and technological resources in order to meet current and future needs. The Government of Ontario has recognized that waste diversion is challenging because of its complex nature, and therefore may not be easy to sustain. As a result, Ontario's *Waste Diversion Act, 2002* strives to reflect the importance of environmental laws and regulations through the 3Rs (Reduction, Reuse, and Recycling), thus protecting natural resources and the environment and thereby promoting environmental sustainability. In addition, Ontario has also taken an interest in reducing the amount of waste generated, preventing pollution, and utilizing resources effectively to protect the environment (Ministry of the Environment 2008).

The collection of waste materials from both residential and commercial sources has played an important role in the integrated approach to solid waste management across Ontario. Such programs focus on wastes that could be corrosive, flammable, toxic, or reactive. These waste materials may include chemicals used in farms, pools, cleaning, paint, fluorescent bulbs, glue, and batteries, among others.

According to the Ontario Ministry of the Environment (2008), huge volumes of MSW originate from non-residential areas in Ontario. Hence, residential wastes constitute a small percentage of solid wastes. However, such waste materials contain hazardous elements, which require diversion from standard landfills, water sources, energy sources, and the environment in order to ensure environmental protection and sustainability. Ontario's municipal authorities, alongside residents, promote waste collection programs in order to divert wastes and improve collection. These are programs which aim to maximize waste collection, reduce environmental risks, and enhance public safety, welfare, and health. Over the past few decades, local authorities have developed their waste management programs to meet increased waste generation per capita in Ontario with a focus on sustainability. Hence, waste generation, collection, and disposal have become ongoing practices, and require effective management and proper facilities.

Sustainability practices, therefore, require the use of engineering principles to study, design, and implement critical aspects of solid waste management; design must be based on waste characteristics, recycling, reuse, storage, treatment, hazards, and potential contamination (Reddi & Inyang 2000). At the same time, engineers should evaluate social, economic, environmental, and health characteristics of proposed waste disposal sites. On this note, the concept of solid waste management should focus on growing concerns and increasingly complex issues such as controlling waste generation, and processing wastes from municipalities.

2.4 Waste Diversion in Ontario, Canada

As Ontario residents and commercial entities continue to generate huge amounts of waste, landfill sites can no longer accommodate such quantities of waste materials. During the 1980s, the province had already started to grapple with the challenge of managing solid wastes due to limited landfill capacity. This resulted in initiatives to promote recycling through business and community efforts. Such strategies focused on changing the laws and regulations on soft drinks. However, the idea drew support primarily from environmentalists, while the majority of the population continued to support a deposit and return model. This marked the introduction of the Blue Box program for waste diversion in Ontario.

Today, many Ontario residents associate waste diversion with the Blue Box. The Blue Box has served as a waste collection point for curbside recycling. As the number of city residents continued to increase, the volume of solid waste also increased tremendously. The declining number of potential landfill sites, increasing volume of MSW, hazardous waste, pollution, and costs of managing such wastes led to the introduction of the *Waste Diversion Act, 2002*. The Act transformed how Ontario manages and recycles its solid waste. The Act's history provides an insight on waste management activities before and after its enactment.

In some instances, many organizations have noted that it is costly to develop and implement effective waste diversion plans (Staff Report 2013). The 3Rs have failed to focus on the producers of wastes due to some weaknesses in the waste diversion framework. Instead, the framework has concentrated on generators of wastes in order to facilitate diversion (Ministry of the Environment 2008). The Ministry noted that industrial, commercial, and institutional (IC&I) sources were the major generators of solid waste, but



they only diverted “12 percent of the total waste they generated in 2006” (Ministry of the Environment 2008). On the other hand, in 2006, Waste Diversion Ontario estimated that residential diversion rates had reached 38 percent (Ministry of the Environment 2008).

The Conference Board of Canada recently indicated in its 2014 report that Ontario managed to divert 47 percent of residential waste, and only 11 percent of non-residential waste, while the overall rate of waste diversion was 23 percent (Conference Board of Canada 2014). Relative to other, international major cities, Ontario has a low rate of waste diversion. For instance, San Francisco diverts 80 percent of its waste materials, while Berlin diverts 40 percent (MacBride 2013). Ontario’s low rate of waste diversion has attracted attention from critics (Recycling Council of Ontario, and the Ontario Waste Management Association) that have called for the removal of the Act.

2.5 The Current Waste Diversion Framework in Ontario

The current Waste Diversion Framework (Chart 1) in Ontario focuses on IC&I sources to facilitate waste diversion. These are the major waste producers in Ontario, but they have poor diversion practices (Ministry of the Environment 2008). These domains or divisions within the framework have significant responsibilities for managing and diverting wastes in Ontario. They rely on the 3Rs under the Environmental Protection Act to increase waste diversion rates. Under the Act, waste generators must make reasonable efforts to separate and promote waste recycling (Ministry of the Environment 2008). There have been several initiatives to encourage waste diversion through regulatory frameworks such as: the Blue Box; technical and financial aid such as e-waste management, “eco” fees and Continuous Improvement Fund; public education, such as waste sorting; and manufacturing of recyclable materials, such as environmental-friendly bags and reusable plastics (Canadian Institute for Environmental Law and Policy 2008).

It is vital for IC&I sectors to develop waste management plans, keep data, and audit their waste management activities. These are fundamental data which help the government to understand waste dynamics in Ontario, develop policies, and allocate resources. The approach also aims to promote a culture of waste diversion in Ontario through major IC&I entities. The fundamental aim is to ensure that many organizations adhere to standard waste management practices.

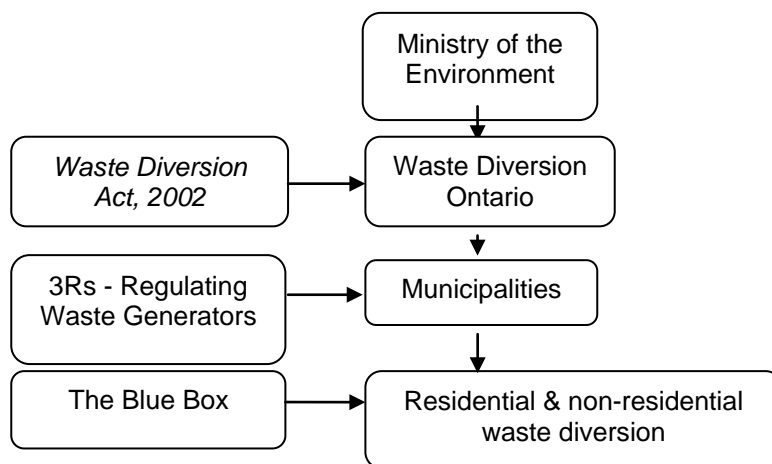


Chart 1: Ontario’s Current Waste Diversion Framework

IC&I sectors have low rates of diversion because of the different types and characteristics of wastes which they generate compared to residential wastes. These attributes make it difficult for them to manage or divert their wastes effectively. Moreover, there are different forms of business establishments (small, medium, or large), services, sectors, and types of ownership that present challenges to waste diversion in Ontario. Still, there are inadequate resources for waste collection and diversion in most organizations. This is a major impediment to the waste diversion initiative in Ontario. Hence, the IC&I sectors, which are



waste producers, have failed to meet the waste diversion standards set under the 3Rs (Ministry of the Environment 2008). At the same time, Ontario’s *Waste Diversion Act, 2000* has also failed to account for extended producer responsibility (EPR), such as enhanced recycling, and the use of alternative materials in waste management.

2.6 The Need for a New Framework

Some of the stakeholders such as the Recycling Council of Ontario (RCO), and Ontario Waste Management Association (OWMA) have called for the scraping of the current waste disposal act (Staff Report 2013). These two organizations have asserted that the current framework has failed to account for the role of waste producers, and therefore it is fundamentally flawed and impractical. Furthermore, these organizations have claimed that the current framework lacks “transparency, accountability, proper implementation systems and oversight” (Staff Report 2013). The decade-old framework has achieved low rates of diversion (current 23%) relative to other regions, and Ontario still disposes over 77 percent of its waste materials. Major issues have been cited regarding the controversial eco-fees, a lack of focus on producers, and repeatedly-missed targets for diversion rates (currently, Ontario targets a diversion rate of 60 percent).

3.0 ANALYSIS, TRENDS AND RESULTS

This study focuses on waste diversion and other management practices in Ontario between 1996 and 2010. It covers data from government and private (business) sectors collected by Statistics Canada. It presents data on waste disposal, waste per capita, tonnes of wastes diverted, and percent changes in diversion rates. Data were collected on major processes involved in managing solid wastes by the two sectors (public and private sectors) in Ontario, Canada.

In 1996, there were less than 10 million tonnes of waste disposed in Ontario landfills (Figure 2). The volume of waste disposed started to rise steadily as both the government and private sectors increased their waste collection activities.

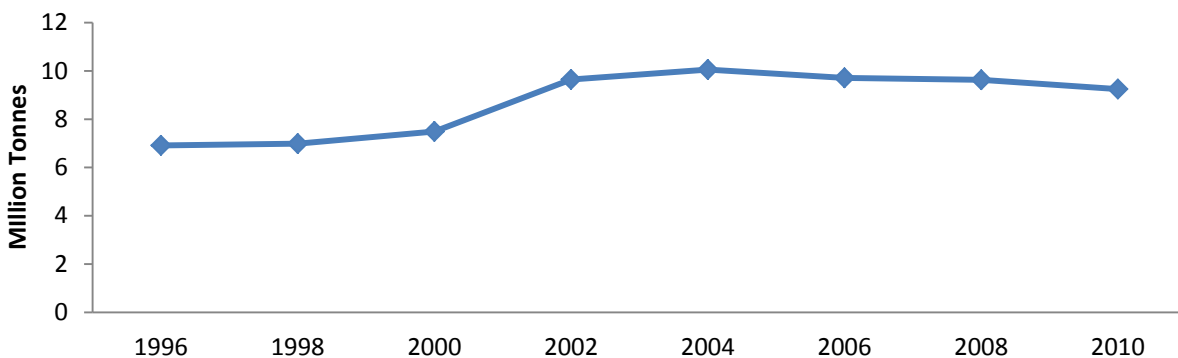


Figure 1: Tonnes of Waste Disposed between 1996 and 2010 in Ontario, Canada (Data from Statistics Canada 1999-2013)

Waste disposal reached over 10 million tonnes in 2004. However, in subsequent years, the volume of waste disposed in Ontario started to decline marginally. By 2010, Ontario disposed only 9,247,415 tonnes of waste in landfills. Although the decrease was marginal, it resulted from the diversion efforts driven by IC&I and residential generators (Statistics Canada 1996-2010).

Waste disposal per capita also started to increase steadily from 621 kg/capita in 1996, and reached 809 kg/capita in 2004 (Figure 2). However, in the subsequent years, the rate of waste disposal per capita declined and reached 699 kg/capita in 2010. This also reflected changes brought about by waste



diversion campaigns such as the Waste Electrical and Electronic Equipment (WEEE) program, Used Tires, Blue Box Program Plan and Municipal Hazardous or Special Waste (MHSW) Program.

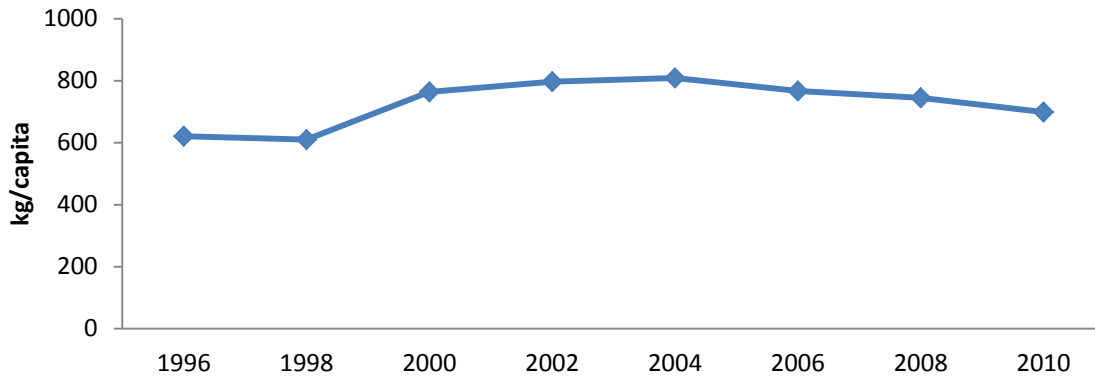


Figure 2: Waste Disposal per capita between 1996 and 2010 in Ontario

Until 1998, there were no records on waste diversion per capita in Ontario. Except for 1998, Ontario diverted wastes at a higher rate per capita than in any other years between 1996 and 2010 (figure 3). For instance, the rate of diversion per capita was 28 percent, but declined to 20 percent in 2002, which could be attributed to scope of waste definition and introduction of new e-waste materials. However, in 2004, it increased by 2.5 percent to 22.5 percent, but recorded a low of 18.7 percent in 2006. In the following year, it rose to 22.6 percent and any further improvements in 2010 were negligible (0.03 percent).

Therefore, one may conclude that the city has been unable to sustain high rates of waste diversion per capita because of poor diversion activities.

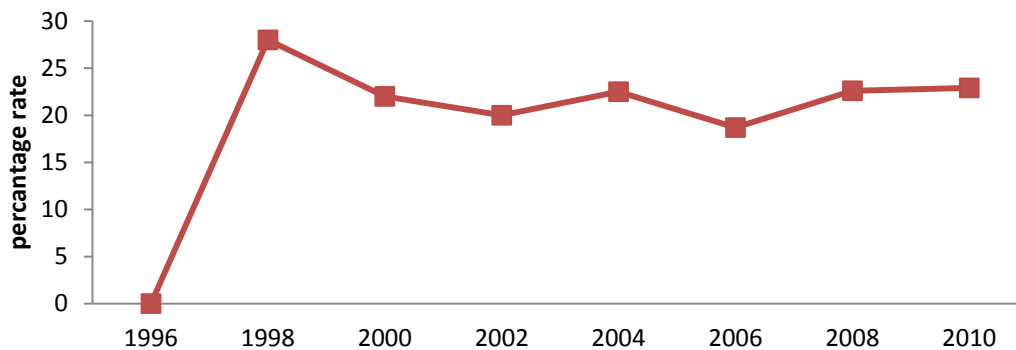


Figure 3: Percentage of waste diversion per capita in Ontario (Data from Statistics Canada 1999-2013)

When Statistics Canada started to publish data on waste diversion, it became apparent that the program was effective between 2000 and 2006. Ontario diverted over 2.2 million tonnes of the total wastes generated in 2002. It reached a record high of 2.78 million tonnes in 2008, but declined to 2.74 million tonnes by 2010. Although Ontario recorded an impressive growth in waste diversion between 2002 and 2006, there was a major challenge afterwards due to declining diversion rates (Figure 4). This situation can be attributed to ineffective implementation of programs and inadequate resources.

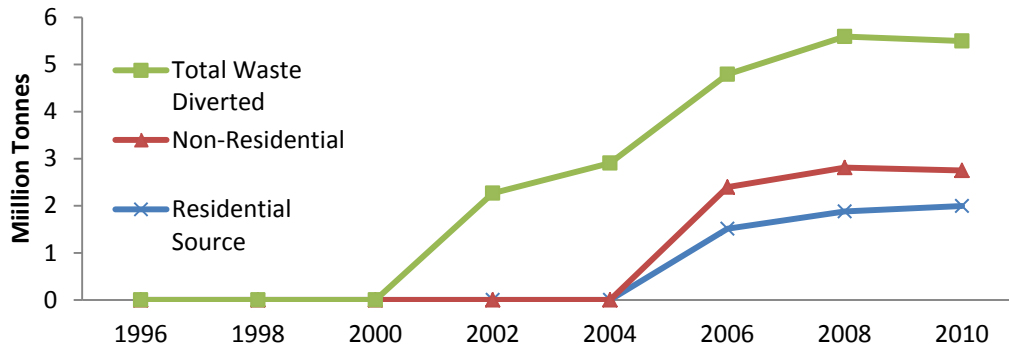


Figure 4: Tonnes of waste materials diverted in Ontario (Data from Statistics Canada 1999-2013). It should be noted that there were no data for diverted waste between 1996 and 2000. In 2010, Ontario diverted 2.7 million tonnes, which represented only 29.7 percent of the wastes (see Figure 5). This variation shows that Ontario has been slow in promoting waste diversion programs to waste generators.

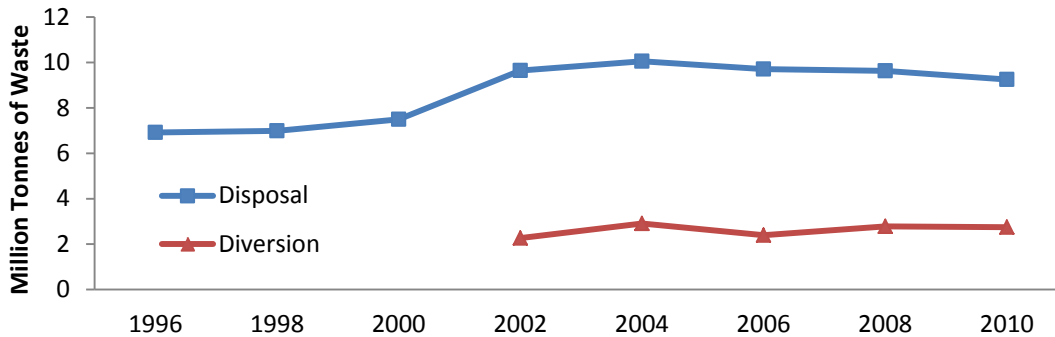


Figure 5: Waste Disposal against Waste Diversion 1996 to 2010 in Ontario (Data from Statistics Canada 1999-2013)

Ontario has recorded changes in the total materials recycled or diverted (Figure 6). For instance, the rate of diversion declined from 2000 but rose in 2004, and in the subsequent years, it continued to decline but rose again 2010. The Ministry of Environment (2008) had attributed such declines to poor diversion activities within the IC&I sector.

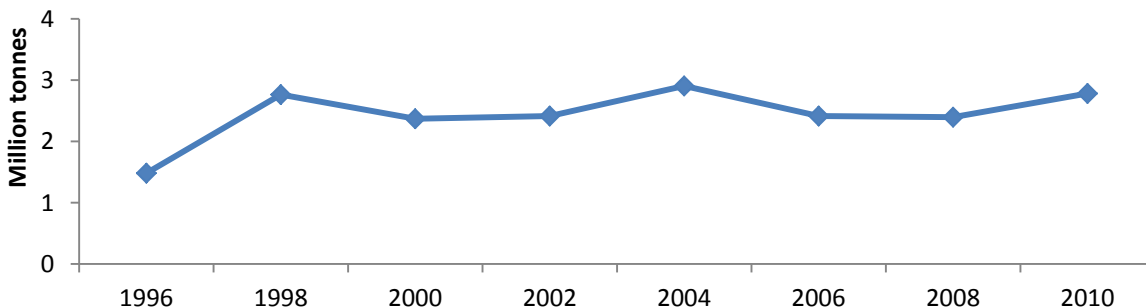


Figure 6: Total Hazardous and Non-hazardous Materials Prepared for Recycling, Reuse, or Diversion (Data from Statistics Canada 1999-2013)

IC&I sectors have diverted both hazardous and non-hazardous waste materials as indicated in Figure 7. However, between 2000 and 2010, waste materials diverted in the IC&I sectors declined from 1,361,743 tonnes to 752,990 tonnes. The poor implementation of regulations on producer responsibility has led to



this decline in diversion rates among waste producers. For instance, individual companies do not have full responsibilities for their wastes, but share such responsibilities with municipalities (Ministry of the Environment 2009). In addition, waste producers can extend diversion responsibilities to residential sectors (Ministry of the Environment 2009). These two factors associated with the extended producer responsibility could explain the decline in diversion rates in the non-residential sector.

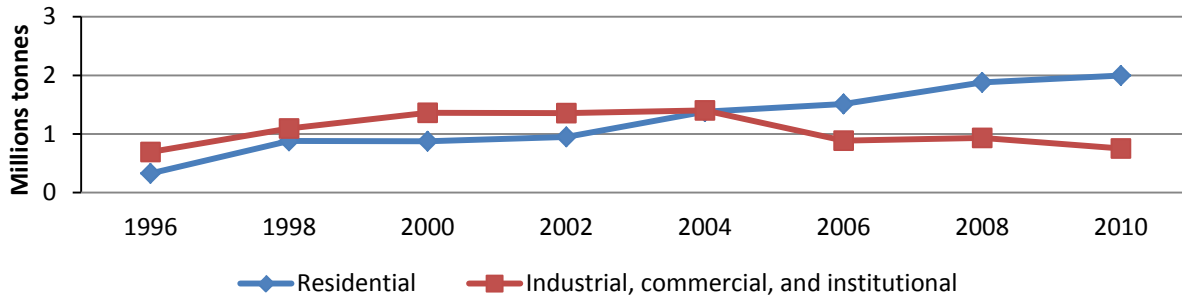


Figure 7: Waste Materials for diversion, recycling and reuse 1996 – 2010, Ontario

On the other hand, residential waste diversion programs have achieved the desired objectives. For instance, between 1996 and 2010, residential waste diversion rose from 326,693 tonnes to 1,996,057 tonnes. Hence, one can conclude that residential waste diversion initiatives have increased diversion rates in Ontario. Conversely, IC&I sectors require new initiatives for managing and diverting waste (Ministry of the Environment 2009).

Non-residential sources like IC&I generate more waste materials than residential sources (Figure 8). This implies that non-residential sources did not manage waste materials efficiently. Figure 8 shows that non-residential sources generated 65 percent of the waste materials disposed in 2010, while residential sources were responsible for 35 percent.

■ Residential sources ■ Non-residential sources

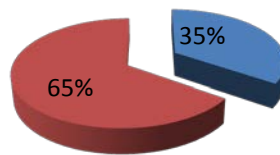


Figure 8: Non-residential and residential contribution to waste disposed in Ontario in 2010 (Data from Statistics Canada 2013)

Non-residential sources are the largest generators of waste materials in Ontario, and their waste diversion practices were poor. These sources clearly did not enact waste diversion initiatives (see Figure 9).

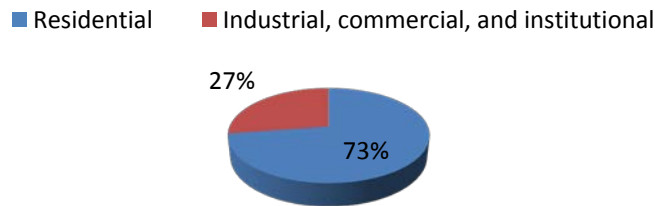


Figure 9: Waste materials diversion by sources, 2010 Ontario

3.1 Effectiveness of the Programs

Since the early 1980s, Ontario implemented waste management programs to reduce pollution and the amount of solid waste disposed in the landfill. Ontario's progress on waste diversion has reached a phase of slow growth (see Figures 5 and 6) except in the case of residential waste diversion programs, which have increased over the years. These low trends of waste diversion have undermined the effectiveness of the waste diversion programs in Ontario. Therefore, Ontario must review its approaches to diversion, particularly the EPR for waste producers, which would support the diversion act and its 3Rs (Staff Report 2013). This can enhance waste diversion, reduce the quantity of solid waste disposal, and create jobs in Ontario (Conference Board of Canada 2014).

4.0 CONCLUSION AND RECOMMENDATIONS

The waste diversion programs in Ontario have partially worked, but they face some challenges. An evaluation is required for the current framework, and definition of a new waste diversion program. Overall, the new framework must be cost-effective, user-friendly, based on engineering principles, science and technologies, as well as industry best practices.

Ontario needs to encourage waste producers to enhance waste diversion. The current waste diversion puts much emphasis on waste generators and less on waste producers. This would ensure that waste producers find innovative approaches to diversion.

- There is a need to enhance data collection among waste generators based on their diversion activities. There are missing data, particularly in waste producer responsibility for waste diversion.
- The new framework should also promote waste diversion based on materials or sectors. This would ensure that waste diversion programs meet some specific conditions, focus on specific wastes, or promote the development of programs like the Blue Box and Municipal Hazardous Waste programs.

Such programs could offer many benefits to the province, such as:

- Reuse centres should offer free materials for the public under product exchange programs.
- The focus should be to reduce the costs of waste disposal by bulking materials
- Convenient facilities which reduce costs of transportation by transporting full loads rather than small portions
- Waste management facilities should be able to handle volumes of wastes from a specific municipality.

Managing municipal solid waste is a complex process. Waste management practices continue to evolve as new forms of wastes emerge, and global conditions change. To comprehend such dynamics, waste management professionals must understand sources and generators of wastes, waste characteristics, scientific and engineering principles, laws and regulations and cost-effective approaches.

5.0 ACKNOWLEDGEMENTS

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