Waste Management
From Production to Recycle

Includes:
Research Report
Presentation

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Completed for:

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Department: ***Environmental Studies***
Course code: ***ERSC 483, WI2005***
Date of Project Completion: ***April 5,2006***

Project ID: *644*

Call Number:

ERST483 Community-based Education Program
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April 20, 2006

Sustainability Indicators for Waste Management in Peterborough

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1. Introduction

The purpose of this research is to define waste indicators in Peterborough, Ontario, Canada. The research will determine what indicators are available, what these indicators can tell us, and what other information is needed to reduce waste. This paper discusses a number of waste indicators, which identify waste patterns, activities reducing waste, and related regulations. It is important to note that waste indicators are not restricted to mechanical measures such as weight or percentages of recycling and composting. Although numbers give a definite idea, their context: where the numbers come from and what they mean, must be explained. The Organisation for Economic Co-operation and Development (OECD) mentions that indicators are "complemented with background information, data, analysis and interpretation"[1]in order to specify the relation between cause and effect or a process and a result. For this reason, the research offers an overview of the issue, an evaluation of each

[1] OECD. (2003). OECD Environmental Indicators Development, measurement and use. Retrieved February 22 from http://www.oecd.org/dataoecd/7/47/24993546.pdf

indicator, its accessibility, and recommendations as well as numerical indicators.

This research especially emphasizes the importance of waste material flow. This is because waste generation occurs throughout the material flow from production to distribution, consumption and disposal. This paper mainly discusses the indicators which are found at the production and disposal phases since many indicators are found in these two stages. While assessing waste amounts at the disposal phase, the research addresses the possibilities of source reduction at the production phase.

I will construct my arguments in the reverse material flow from waste disposal to source creation. In Section 4, I will discuss eight types of waste indicators according to this order and add other types of indicators in Section 4.9. The argument topics are arranged as follows: industrial waste, household waste, landfill, recycling, composting, reusing, green consumption, source reduction, and miscellaneous. The reason for approaching the material flow in reverse is that I would like people to notice their current waste issues at the disposal phase and to track the sources of these issues. Thus, the first three topics will raise awareness, and the latter topics seek ways of reducing waste.

Indicators are identified with several features. Those are: indicator selection, data types, the users of indicators, the purpose of indicators, and evaluation methods. The following sections explain the functions of these features.

<Indicator Selection>

The first step in developing waste indicators is the selection of indicators. There are two frameworks for the selection: objective-based and issue-based.[2] Objective-based indicators are chosen according to goals such as a 60% diversion rate[3], or 100% access to Blue Boxes. Establishing objectives will provide scope for the project and define the context for the indicators. Objective-based indicators measure progress towards the defined objectives.[4] Issue-based indicators reflect issues such as the loss of landfill capacity and lack of natural resources. The issues which a community raises will help to establish and prioritize its goals. Considering what obstacles the community has can help to take the first step to achieve its goals. Those two elements are the foundation for choosing useful indicators and both are used in this paper.

<Indicator Type>

There are two datum types for indicators: quantitative and qualitative. Quantitative indicators are numerical data, which can be counted, such as waste amounts and waste diversion rates. Quantitative data are objective and allow readers to explicitly compare their situation with others'. Qualitative indicators are descriptive data which are elicited by using questions. Qualitative indicators

[2] Environment Canada. (August 2001). Sustainable Community Indicators Program. Retrieved February 22 from http://www.ec.gc.ca/soer-ree/English/scip/guidelines.cfm
[3] Ontario released Ontario's 60% Waste Diversion Goal on June 10, 2004
[4] Environment Canada. (August 2001). Sustainable Community Indicators Program. Retrieved February 22 from http://www.ec.gc.ca/soer-ree/English/scip/guidelines.cfm

capture processes and qualitative differences rather than counting items. However, they can be transformed into numerical information with descriptive scales (dividing items into different types) or with nominal scales (classifying and counting the degree of quality).[5] Qualitative data include waste-related performance and regulations such as the Waste Diversion Act, operation of the Blue Box program, and implementation of Extended Producer Responsibility. Those activities and regulations can be measured by whether they are practised and to what extent their goals are achieved.

<Indicator Users>

Identifying users is also a key element of choosing indicators. The users of waste indicators include governments, industries and communities. Indicators are often used by decision makers in governmental sectors. However, this paper stresses the responsibility of an entire society. Each stakeholder including governments, companies and individuals plays an important role. By designating the responsible people, indicators become more meaningful and useful.

<Purpose of Indicator>

Indicators are also designed for two purposes: measuring results and assessing processes. Waste reduction performance such as recycling and reuse does not indicate results but the processes. Such indicators help decision makers assess whether appropriate management is being carried out or planned. On the other hand, waste diversion rates and waste amounts indicate the current condition, which helps people to recognize current problems and past achievements, and to make decisions for the next step towards new objectives or to address the problems.

<Evaluation of Indicator>

Indicator values are measured with several factors. The value of indicators can be identified with accessibility, readability, relevance to the matter, and reliability.[6] These attributes define respectively whether anyone can find and get the indicators, whether the indicators are well explained so that anyone can understand them, whether the indicators clearly represent the problems, and whether data are accurate. Because indicators play a role in informing people what happens in a community, indicators should fulfil such criteria. In addition, comparability is an essential factor of indicator values because waste indicators enable responsible people to be aware of waste issues by comparing the waste amounts, generators, types of materials, regulations, methods of treatment and management performance. If these elements are satisfied, then the value of waste indicators for sustainability, and their use by responsible agents (communities, governments and industries) will become clear. With an inclusive evaluation of waste indicators, improvement of the waste management performance as well as the indicators' function itself is expected.[7]

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[5] Andreas Springer-Heinze. (2004). Indicators. http://www.dgroups.org/groups/leap/impact/docs/PW3IndicatorsEDIT6June2004.doc?ois=no

[6] Sustainable Measures. (1998-2000). Characteristics of effective indicators. Retrieved February 23, 2003. from: http://www.sustainablemeasures.com/Indicators/Characteristics.html

[7] Japan for Sustainability. (2002-2006). JFS Indicators. http://www.japanfs.org/en/view/index/index.html

I will analyse each waste indicator according to the above items. The next section describes the relation between waste management and indicators. Section 3 shows definitions of key terms which are used through this paper. Section 4 provides waste indicator analyses. Finally, I will make suggestions to the city of Peterborough.

2. Waste Management and Indicators

This research focuses on waste indicators because waste problems are often huge and complex, and so need to be broken down into their component parts in order to be understood. The daily lives of people also seem distant from waste issues happening at the national level. With waste indicators, people will be able to recognize the implications of these issues in terms of their own lives. Each individual's action definitely relates to the issues. For example, if each person achieves the 50% waste diversion at home, the total waste as a whole would be reduced by a half.

Statistics Canada identifies that waste-related issues include "the generation of waste, the impact of waste on the environment and what are governments and others doing to address these concerns." Such concerns can be addressed by waste indicators, which help break the issues down into each small matter. Waste indicators identify the generation of waste, evaluate the impact and decide who should take care of the issues. Indicators cannot solve an entire problem, but they point out the origin of matters and help lead the way to ultimate goals step by step.

There are three patterns of waste problems. The first is a lack of public involvement due to troublesome manual work and less understanding of the importance of waste management. The indicators could raise awareness among people with the indicators which show the amount of waste, recycling rate and the changes of waste pattern. Waste indicators work for educating people to take care of their waste. Unless consumers know how much waste they generate, how waste reduction performance affects the environment and how waste can be reduced, they would not even notice waste crises. The next obstacle is weak enforcement. There are few obligations to force waste generators to do proper treatment. Regulations are not strong enough to change people's behaviour towards waste. Indicators examine whether such regulations and laws exist and whether they are effective. The third obstacle is lack of waste management initiatives by industries. To reduce waste in the first place, redesign of production is necessary. Industries as a producer of services and products have to take responsibility for investigating the entire life of their products. Indicators can encourage producers to reconsider their waste management and stimulate companies by comparing the waste management performance and the achievement with their rivals. Using indicators, governments, citizens and industries can learn their current conditions and the future direction they should take. Thus, this paper links waste indicators and the responsible agents to help improve waste management.

3. Definitions

Diversion rate: *Ontario Ministry of the Environment* [8]

"The total quantity of waste diverted from disposal as a percentage of the total waste diverted plus disposed," and calculated with this formula, (Waste Diverted / Waste Diverted and Disposed) x 100%.

Waste Disposal: *US Environmental Protection Agency*

"Final placement or destruction of toxic, radioactive, or other wastes; surplus or banned pesticides or other chemicals; polluted soils; and drums containing hazardous materials from removal actions or accidental releases. Disposal may be accomplished through use of approved secure landfills, surface impoundments, land farming, deep-well injection, ocean dumping, or incineration."

Waste diversion: *Ontario Ministry of the Environment* [9]

The act of diverting waste from disposal, which includes recycling and composting but incineration.[10] The methods of waste treatment are classified into three: landfill, energy from waste, compost and recycle. The last two methods are considered as diversion.

Waste generation:

The total waste generation including waste disposal and waste diversion

Waste Management: *Waste management Industry Survey: Business and Government Sectors (Statistics Canada System of National Accounts)*[11]

The collection and transportation of wastes and of materials destined for recycling, the operation of non-hazardous and hazardous waste disposal facilities, the operation of transfer stations, and the treatment and disposal of wastes deemed to be hazardous

4. Waste Indicators

The following chart shows waste indicators by area and by phase of material flow. From the left column to the right, items are Material Flow, Target Audience, Section Number, Waste Indicators, MG (municipal government: Peterborough), PG (provincial government: Ontario), FG (federal government: Canada) and Others. Material Flow is divided into two phases: disposal and production. At the disposal phase, products are used and no longer needed. Production stands for the first phase before products are distributed to consumers. Although material flow is often divided into production, distribution, consumption and disposal, this paper mainly discusses disposal and production phases.

[8] Ontario Ministry of the Environment (2004. June 11). Ontario's 60% Waste Diversion Goal. From http://www.ene.gov.on.ca/programs/4651e.htm

[9] ibid

[10] Jackson, J. (2005. Sep. 26). The Direction of Resource / Waste Management. Lecture. ERST308. Trent U.

[11] Statistics Canada. (2002). Waste Management Industry Survey: Business and Government Sectors 2002. http://www.statcan.ca/english/freepub/16F0023XIE/16F0023XIE2002001.pdf

Target Audience stands for individuals and organizations that are responsible for the designated indicator. This suggests that responsible people should examine and utilize the indicator within their society and work places. The following is the definition of abbreviations: I=industry, C=citizen. Section Number corresponds to the sections that follow. Detailed information on each indicator is provided in the following sections. In the Waste Indicators column, the list of selected waste indicators is designated. The rest of the column shows the outcome of each waste indicator. In the municipal government column, the data in 2002 and 2004 are indicated. Both provincial and federal columns show the data in 2002. Others consist of example indicators in other countries and municipalities.

Table 1

Material Flow	Target Audience	Section Number	Waste Indicators	MG (Peterborough) 2002	MG (Peterborough) 2004	PG (Ontario) 2002	FG (Canada) 2002	Others
Material flow: Disposal (Recycling, Composting, Recovery, Incineration and Landfilling)	I, PG	4.1	Total industrial waste generation	*41,230*	*43,326*	6,514,191	15,075,307	
	I, PG		Total industrial waste disposal	38,550	41,377	5,193,240	11,563,999	
	I, PG		Total industrial waste diversion	2,680	1,949	1,320,951	3,511,308	
	I, PG		Industrial waste diversion rate (%)	*6.5*	*4.5*	20	23	
	C, MG		Total household waste generation Total household waste generation per capita	*26,289* N/A	*27,150* N/A	4,388,239 N/A	12,008,338 N/A	
	C, MG		Total household waste disposal Total household waste disposal per capita	12,550 N/A	13,035 N/A	3,438,408 N/A	9,455,204 N/A	
	C, MG		Total household waste diversion Total household waste diversion per capita	13,739 N/A	*14,115* N/A	949,831 N/A	2,553,134 N/A	
	C, MG		Household waste diversion rate (%)	*52*	*37*	22	21	
	C, FG, PG, MG		Total waste generation per capita (kilograms)	N/A	N/A	363	383	
	I, C, MG	4.2	Composting amount	4,795	6,715			
	C, MG, PG	4.3	Recycling (City residential)	7,106	7,400			
			Recyclable material capture rate		84%			
	MG, PG	4.4	Landfill					
Production (Packaging and Product design)	I, C, MG	4.5	Green consumption (%)					29.9
	I, MG, PG, FG	4.6	Waste intensity		N/A			
	I, MG, PG		Extended Producer Responsibility				Packaging	
	I, C, MG, PG		Corporation Social Responsibility				Non-legislative	
	MG, PG		Act / regulation (taxes, charges, subsidies and deposit-return systems)	Waste Management By-law		OR 104/92		

*Measurement=tonnes (unless otherwise stated)
*I=industry, C=citizen, MG=municipal government (Peterborough), PG=provincial government (Ontario), FG=federal government (Canada)

4.1 Industrial Waste / Household Waste

Over view of the issue

Ontario's disposal per capita was 797kg per capita, and diversion per capita was 200kg in 2002. While Canada's rate of diversion per capita is 22%, Ontario's is 20%. Between 2000 and 2002, Ontario's waste diversion rate per capita rose slightly from 20.8% to 21.6%, but waste generation per capita also increased from 966kg to 997kg. As a result, the total generation of residential solid waste in Ontario increased from 4,191,337 tonnes to 4,388,239 tonnes. Ontario is clearly the largest generator of waste in Canada and produces 37% of the total residential waste. In Canada, the composition of solid waste generated by households is organics 40%, paper 26%, plastic 9%, glass 3%, metal 4% and others 18%. Peterborough's organic waste was 21% of the total residential waste in 2002. At both the national level and the municipal level, organic diversion would bring a high diversion rate.

Waste generation in Canada has increased approximately 15% while real GDP has increased 25% between 1996 and 2002. Also, it has been recognized that high-income countries, which accounted for one-sixth of the world's population, generated one-quarter of the world's municipal waste.[12] Thus, the relation between waste generation and wealth, which might lead to over-consumption, is seen in this indicator.

Changes in lifestyle are also one of the causes of waste increase in Canada. In 1981, 41% of total households comprised one or two people, compared to 58% in 2001. The more small families increase, the more waste is generated because all households need certain basic facilities including furniture, appliances and kitchenware regardless of their size. Moreover, disposable and convenience products, which produce container and package waste, are preferred by modern people. Items such as electrical appliances are often upgraded, and the old ones become obsolete. Even though the design and functions are advanced according to the customer needs in changing times, adaptability of products has to be taken into account. Producers need to design products in which the components can be replaced.

Table 2: **http://www.statcan.ca/english/freepub/16F0023XIE/16F0023XIE2002001.pdf**
Waste Disposal, Diversion and Generation per capita, all Sources, by Province and Territory, 2000 and 2002

Province/Territory	Disposal[1]		Diversion		Generation		Rate of diversion per capita	
	2000[r]	2002	2000[r]	2002	2000[r]	2002	2000[r]	2002
	kilograms per capita						percent	
Newfoundland and Labrador	742	725	80	74	822	799	10	9
Prince Edward Island	x	x	x	x	x	x	20	28
Nova Scotia	416	417	150	182	566	598	26	30
New Brunswick	550	551	152	164	702	715	22	23
Quebec[2]	787	745	209	234	996	979	21	24
Ontario	764	797	202	200	966	997	21	20
Manitoba	798	776	188	217	986	993	19	22
Saskatchewan	804	799	147	147	951	946	15	16
Alberta	914	928	140	189	1 054	1 117	13	17
British Columbia	636	667	278	269	914	936	30	29
Yukon Territory, Northwest Territories and Nunavut	x	x	x	x	x	x	3	10
Canada	753	760	199	211	952	971	21	22

[12] Statistics Canada, "Human Activity and the Environment," 2005: 4

Table 3: **http://cat1.lib.trentu.ca:2941/content/HAE/pdf/English/2005.pdf**

Disposal of Waste, by Source and by Province and Territory, 2000 and 2002[1]

Province/Territory	Residential sources		Industrial, commercial and institutional sources		Construction and demolition sources		Total waste disposed	
	2000[r]	2002	2000[r]	2002	2000[r]	2002	2000[r]	2002
	tonnes							
Newfoundland and Labrador	x	216 218	146 843	140 377	x	19 999	398 818	376 593
Prince Edward Island	x	x	x	x	x	x	x	x
Nova Scotia	171 627	169 649	x	176 625	x	42 921	391 827	389 194
New Brunswick	198 603	203 506	x	154 812	x	55 288	415 058	413 606
Quebec[2]	2 679 000	2 876 000	2 655 000	2 261 000	472 200	406 800	5 806 200	5 543 800
Ontario	3 318 478	3 438 408	4 606 409	5 193 240	1 006 714	1 013 985	8 931 600	9 645 633
Manitoba	451 505	412 612	x	405 954	x	77 990	914 511	896 556
Saskatchewan	272 104	278 692	x	441 109	x	75 323	821 946	795 124
Alberta	824 990	866 398	x	1 380 306	x	643 590	2 750 004	2 890 294
British Columbia	890 789	936 774	1 264 056	1 346 669	426 490	461 458	2 581 336	2 744 901
Yukon Territory, Northwest Territories and Nunavut	x	x	x	x	x	x	x	x
Canada	9 069 170	9 455 204	11 203 613	11 563 999	2 896 087	2 816 528	23 168 870	23 835 730

Table 4: **http://www.statcan.ca/english/freepub/16F0023XIE/16F0023XIE2002001.pdf**

Generation, disposal and diversion of residential solid waste by province and territory, 2000 and 2002

Province/territory	Generation[1]		Disposal[2]		Diversion	
	2000	2002	2000	2002	2000	2002
	tonnes					
Newfoundland and Labrador	x	231 291	x	216 218	x	15 073
Prince Edward Island	x	x	x	x	x	x
Nova Scotia	246 792	252 012	171 627	169 649	75 165	82 363
New Brunswick	243 300	256 190	198 603	203 506	44 697	52 685
Quebec[3]	3 175 000	3 471 000	2 679 000	2 876 000	496 000	595 000
Ontario	4 191 337	4 388 239	3 318 478	3 438 408	872 859	949 830
Manitoba	501 921	494 535	451 505	412 612	50 416	81 923
Saskatchewan	305 901	321 069	272 104	278 692	33 797	42 376
Alberta	994 555	1 159 697	824 990	866 398	169 565	293 300
British Columbia	1 292 999	1 354 177	890 789	936 774	402 209	417 403
Yukon Territory, Northwest Territories and Nunavut	x	x	x	x	x	x
Canada	11 242 405	12 008 338	9 069 170	9 455 204	2 173 236	2 553 134

Peterborough issues annual reports related to its waste management activities. From the annual report, City of Peterborough Waste Management Activities 1987-2004, the amount of garbage has decreased, and at the same time, waste diversion including recycling, green waste and composting has improved since 1987. However, from 1995 to 2004, the amount of waste started to rise while diversion has still continued to increase. This may be because of over-consumption and short-term use of products. The diversion rate has stopped or slightly dropped from 1996. It could be said that the diversion corresponds to the increase in the amount of waste. The reports show that the city has three noticeable waste tendencies:

1. Industrial, commercial & institutional (IC&I) wastes account for 70 % of the waste at the landfill.[13] Indeed, the recycling rate of IC&I waste is lower than that of municipal waste.
2. The next possibility of reducing municipal waste will likely result from the collection and composting of food waste.[14]
3. Although the recycling rate has risen, the total amount of garbage going to the Bensfort Landfill site has also increased.[15] Over-consumption might be a major cause of the increase in the quantity of garbage in general.

[13] City of Peterborough. Waste Management Activities 1987 - 2001

[14] City of Peterborough. Solid Waste Management in 2002

The city's waste generation has gradually increased since 1997 (Chart 1). Accordingly, the diversion rate, which had risen after the introduction of the Blue Box program from 1987 till 1996, has levelled off since then. These results suggest that the city's waste management system is worth reconsidering. This report is accessible for the public to read if they contact the city's waste division office.

Purpose

The purposes of indicators, which include waste generation, disposal, diversion and diversion rates, are to identify issues and to set objectives. The waste amount is a fundamental tool for identifying the current situations and the change of waste generation. By comparing the amount with other municipalities, people can see what positions they are in. By examining waste amounts in a particular period, an increase or decrease in waste is clearly identified. When a municipality or a company introduces a new recycling program, the amount of waste generation is a core indicator to assess the achievement of the project.

Users

Users consist of decision makers such as municipalities, managers of organizations, and the general public. For the public, the results of waste amounts and diversion rates play a role in raising awareness. People can know how much the Blue Box program affects the final result, or how much bigger / smaller amounts of waste they are generating compared with other organizations. For the decision makers, those numbers can be the objectives of waste reduction plans and also the indicators of situations they are in.

Indicator Evaluation

While waste generation stands for the total amount of waste including recycling and composting materials, waste disposal means the final waste going to landfills or incinerators. To reduce the amount of waste disposal, municipalities seek ways of diverting waste from landfills. The ways of waste diversion include composting and recycling. Using specific numbers such as xx tonnes or xx %, decision makers can set clear objectives. Decision makers tend to set objectives with diversion rates rather than waste amounts generated, but we have to be careful when using diversion rates as objectives because the diversion rate does not necessarily mean waste reduction. For example, the 50% diversion of 100kg of total waste accounts for 50kg of waste going to a landfill site while the 50% diversion of 200kg of total waste accounts for 100kg of waste going to a landfill.

The waste amount per capita is useful to compare the result with other municipalities. Waste amounts of course depend on populations.

Thus, either type of data including waste generation, diversion, diversion rates and generation per capita can be used for objective setting and the identification of problems. However, if the purpose is a comparison with other organizations to identify your rank, waste generation per capita

[15] Township of North Kawartha. Announcements. From: http://www.northkawartha.on.ca/announcements.html

and the diversion rate are useful indicators. If the purpose is to save the landfill capacity or to reduce the real amount of waste, waste amounts generated are effective.

The types of waste are also useful indicators for identifying the patterns of waste. Companies, for example, often generate uniform types of waste because they produce the same products routinely. Also a municipality can identify what kind of waste is most generated. By identifying the types of waste, one can find specific treatment for the materials. For example, Eco-Industrial Networking is an initiative linking different types of organizations in order to trade various by-products with high efficiency within a community.[16] This is an example of creating a new market by examining the types of waste produced.

Waste sources stand for generators of waste such as households, institutions and commercial sectors. The source identification is used for planning new regulations and programs for specific waste generators.

Statistics Canada published a report presenting the results of the 2002 *Waste Management Industry Survey: Business and Government sector*. This survey is a census conducted biennially, and is available for free from the Statistics Canada website. Summary tables of *Waste disposal, diversion and generation per capita, all sources, by provinces and territories* and *Disposal of waste by source, by provinces and territories* are also available from: http://www40.statcan.ca/l01/cst01/envi26a.htm and http://www40.statcan.ca/l01/cst01/envi25a.htm. However, these two summary tables are now discontinued, and seem not to be issued regularly.

Peterborough's information is accessible to the public through the Internet. However, only the 2002 report is currently available on the City of Peterborough website, and the 2004 report is available through direct contact with the city's waste division (over the phone). Also, Peterborough does not provide waste amounts per capita, so that it is difficult to compare its amounts with other municipalities and provinces. Population data are provided according to the census, so it is again difficult to calculate per capita amounts for the population. Using a chart to describe the changes of waste trends over time is recommended. The chart below is a sample of a visual indicator showing waste trends in Peterborough (Chart 1).

Chart 2 shows the city's population history and waste generation. While waste disposal decreased from 1988 to 1996 (Chart 1), total generation kept increasing during the period (Chart 2). This result points out that waste disposal and diversion are important indicators but not complete indicators. The population data of the census years are only available from the city's website. The total waste generation has risen as the population has increased although it is difficult to conclude so with only 4 census data. Also, I did not identify waste generation per capita because Peterborough's waste generation consists of residential waste while Statistics Canada's waste generation per capita is calculated from all sources including IC&I and construction and demolition sources. Therefore,

[16] The Canadian Eco-Industrial Network, "What is Eco-Industrial Networking?" <http://www.greenroofs.ca/cein/resource_index.html>

diverse information needs to be standardized to work as an indicator.

Chart 1: Residential Waste Trends in Peterborough

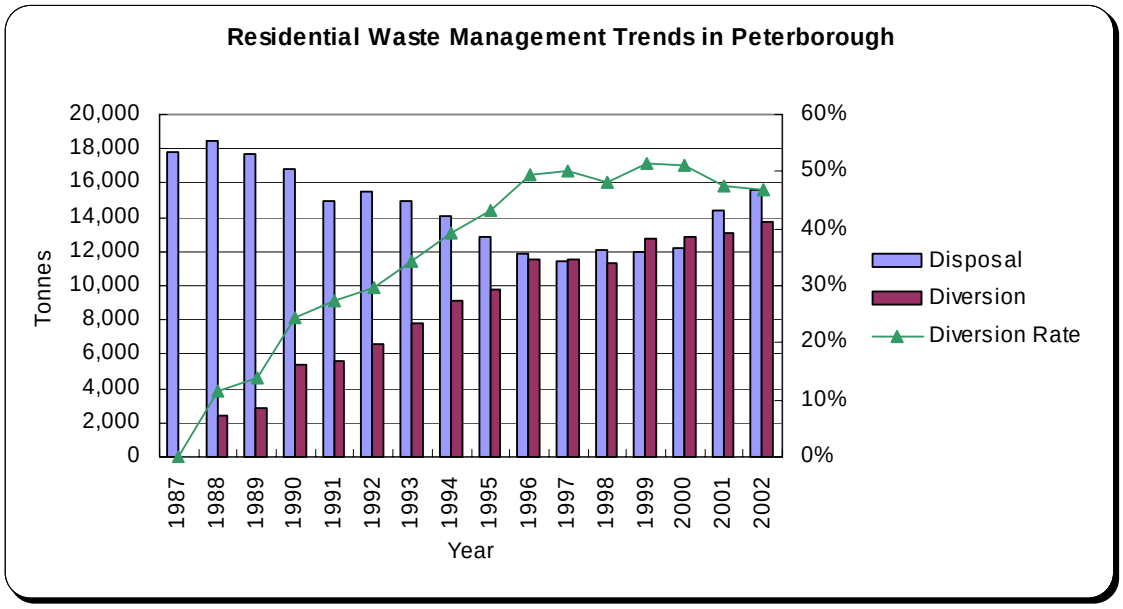
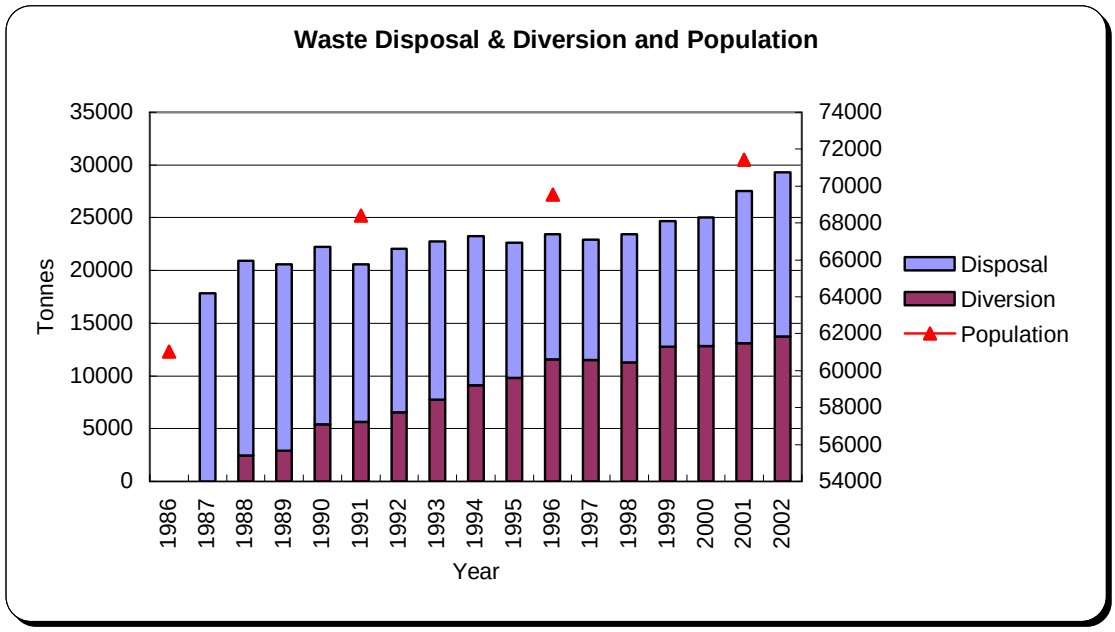


Chart 2: Waste Disposal & Diversion and Population



As a tendency, waste statistics and waste management reports are often issued annually or biennially. It is relatively easy to access data of recent years. Although long-term, more than ten years, planning is required for strategic waste management, it is difficult to assess such a long period of data and compare the data with those of different municipalities. This is because surveying waste management has improved for a decade and measuring methods have been changed, and such methods vary in places.

Data Source

- Statistics Canada “Waste Management Industry Survey: Business and Government Sectors 2002” <http://www.statcan.ca/english/freepub/16F0023XIE/16F0023XIE2002001.pdf>
- Statistics Canada “Human Activity and the Environment 2005”
- City of Peterborough “Solid Waste Management in 2004”
- City of Peterborough “Waste Management Activities 1987-2004”

4.2 Composting

Overview

The City has provided a green waste weekly collection service since 1993. Because green waste was banned from the landfill in 1994,[17] it must be at curbside separately from regular garbage. Green waste includes leaves, weeds, plants, flower and tree pruning except food scraps, soil and stones.[18] In Peterborough, a pilot composting project was implemented in September 2001. The city provided 600 homes with a kitchen collector, a curbside bin, sample liner bags and information on how to compost. The amount of kitchen waste has averaged about 750kg/week outside the green waste season.[19] In 2002, 2,598 tonnes of organic waste, which included green waste collected from all households and kitchen waste from the pilot area, were composted at the Harper Road Composting Facility. In 2004, 4,806 tonnes were collected at curbside with an additional 1,765 tonnes diverted from the city’s landfill site. Together with 145 tonnes from the pilot program, a total of 6,716 tonnes of organic waste was processed in 2004.

The City also sold subsidized home composters from 1990 to 2002. Through the program, 13,480 home composting units had been purchased by December 2002. Assuming the typical household composts 100kg of food waste per year, 1,387 tonnes of organic waste was diverted in 2004.[20]

The City estimates that centralized and home composting divert 15,000 tonnes of organic waste from the waste stream per year.

Purpose

Composting indicators are especially useful in Peterborough since kitchen organics account for the highest weight at residential curbside garbage. The organic waste indicator helps save the landfill capacity and benefits the economy. Considering that organic waste is one of major forms of waste in Peterborough, this indicator promotes a large amount of diversion from landfill. Also, composting activity creates a community market. In 2004, a total of 3,624 cubic yards of completed compost was sold to the City and County of Peterborough. Gross revenues from sales were $65,429,

[17] City of Peterborough. “Solid Waste Management in 2002”
[18] City of Peterborough, “Green Waste Collection Program,” Flyer, 2005.
[19] City of Peterborough. 2004 Waste Management Summary Report.
[20] ibid

which offset the operational expenses of composting. Thus, the purpose of this indicator is to reduce a large amount of waste and to make a local market.

The framework of composting indicators can be objective-based and issue-based. Some municipalities carry on composting programs because of the loss of landfill capacity. Some set specific objectives to reduce waste. Examining whether a composting program is implemented and how much is composted because of the program is measured from this indicator. The proportion of the composting amount to the waste amount is also a strong message to readers.

Users

The municipality's decision makers examine the amount of composting and the accessibility of the municipal services. The composting activity itself as an indicator is used by the general public. Also, organizations which deal with organic substances in their work have to examine the possibility of composting or the amount of organic waste diverted from the waste stream.

Indicator Evaluation

Peterborough provides information on the amount of composting and its operation with descriptive data and a table. The descriptive data are from the city's Waste Management Summary Report, which is on the waste division website, and the table is obtained on request (Table 8). About home composting, it is difficult to measure the amount for a city, but one could estimate how many composters have been sold and how much compost is produced from one composter.[21] However, because composters can sometimes be troublesome to operate, not all composters distributed may actually be in regular use.. Therefore, the accuracy of data would be questioned as an indicator.

The summary report explains the context of the City's composting services, and the table also illustrates the changes of composting amounts and the types of organic waste from 1990 to 2004. Thus, the municipality has quite informative data, but it does not provide visual information. To understand its transition in the composting amounts and collection services, a visual image such as the chart shown below is more readable (Chart 3).

[21] ibid

Chart 3: Peterborough Composting 1990 - 2004

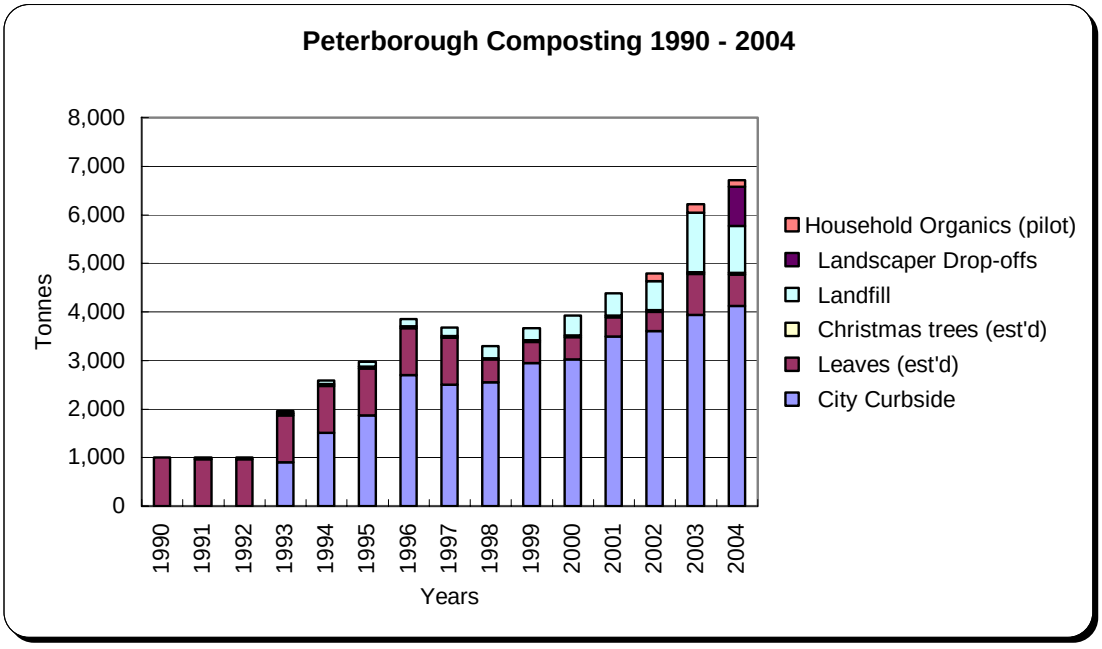
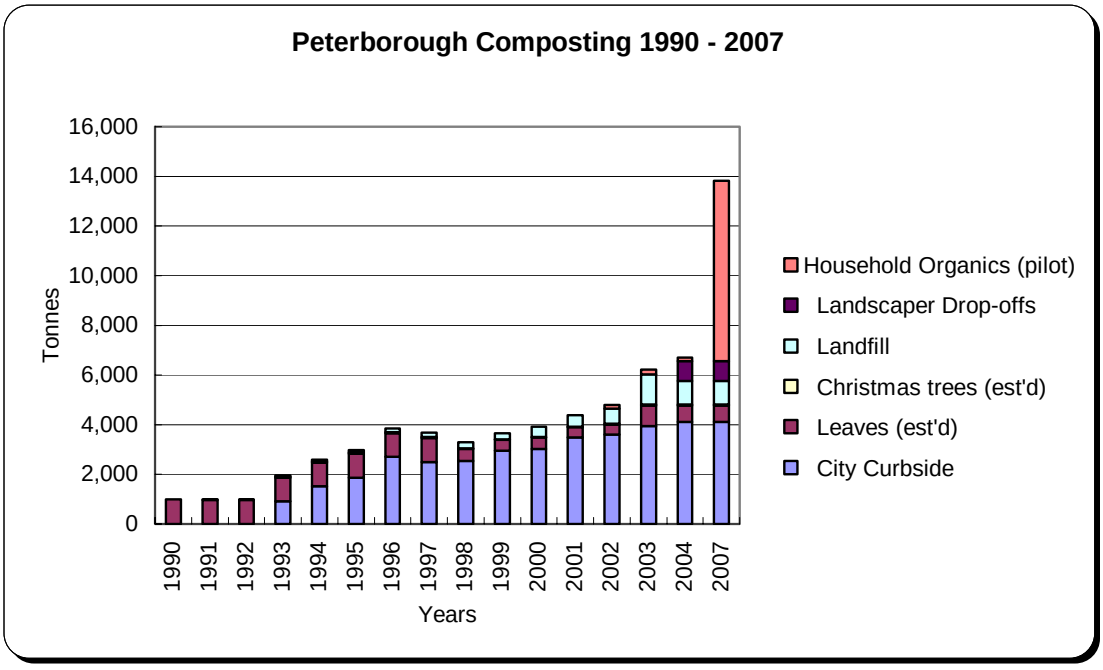


Chart 4: Peterborough Composting 1990 - 2007



Composting indicators include not only reporting but also the service itself. The City provides the curbside composting collection in the pilot area, and currently 600 households have access to the service. City-wide service will be introduced in 2007. Chart 4 shows an estimation of composting amounts after the introduction of City-wide collection. Assuming that there are 30,000 households in the City, the food waste collected will grow by 50 times.

Data Source

- City of Peterborough “2004 Annual Report Table(1) in Peterborough”

- City of Peterborough “Solid Waste Management in 2004”

4.3 Recycling

Overview

Peterborough has implemented Blue Box program since 1984, and the residents have become accustomed to the program.

Purpose

Recycling is one of the most common indicators for waste management. The loss of landfill capacity is a major issue, and recycling largely contributes to diversion of waste materials from the landfill. A recycling program also raises awareness of the importance of natural resources.

Users

The Blue Box program is one of the waste management activities, with which citizens get involved directly. Citizens and industries are users of the service, and the municipality is also a user of this indicator as an operator. All stakeholders can utilize this indicator to understand the municipality’s situation.

Indicator Evaluation

The municipality collects cans, plastic, paper and glass through the program across the City, and the capture rate of 84% was achieved as of 2004. Although the City identifies the total amount of recycling materials, it does not designate the amounts of each material. The city needs to distinguish types and quantities of substances recycled.

Data Source

- City of Peterborough “2004 Annual Report Table(1) in Peterborough”
- City of Peterborough “Solid Waste Management in 2004”

4.4 Landfill

Overview

The Bensfort Landfill is Peterborough’s only landfill site. The South Fill Area (SFA) of the site has been designed to accommodate approximately 521,000 tonnes. As of December 2003, the gross landfill volume remaining was 200,000 cubic meters (142,000 tonnes). A remaining site life of SFA is approximately 1.5 years as of December 2004. This calculation is based on outlining that 82,360 tonnes of waste and the net volume landfilled of 115,500 cubic metres provide a waste density of 0.71 tonnes per cubic metre. Also, the final cell for the SFA is currently under construction, and the capacity should last 3 to 4 years at the city’s current fill rate (12,000 to 13,000 in recent years). In addition, the North Fill Area will be developed in the future. The area is designed to accommodate approximately 1,136,000 tonnes of waste.

Combined with new programs for waste reduction, the landfill is calculated to last between

17 to 25 years. The city is scheduled to introduce City-wide Organics collection in April 2007, and also is going to start enforcing the waste collection by-law with respect to mandatory recycling, especially for the business sector. Moreover, there will possibly be a 1 bag limit or every other week collection of garbage.[22]

Purpose

The landfill capacity is limited. Saving the landfill is a top priority for every municipality. Establishing a new landfill facility is not an easy process since no one wants to have it nearby, and also closure of the facility is particularly expensive. For these reasons, many waste management activities are motivated by recognizing the loss of landfill.

Users

The user is currently the only municipality since the city is responsible for the landfill operation. (The actual operation is carried out by Waste Management Inc.,)

Indicator Evaluation

The City is well aware of its landfill capacity and planning with a long-term view (30years). Its estimation is based on a complex calculation, so that the planning method is reliable. However, the data are not available to the public. The information above is obtained through personal e-mail and is not an official document.

Data Source

- Melanie Kawalec, the manager of the City of Peterborough waste division, "E-mail communication"

4.5 Green Consumption

Overview

Green consumption refers to the purchase of environmentally preferable products, which can be reused, repaired and up-graded with less packaging. For green consumption, consumers can use services (e.g. rental services) instead of purchasing products, buy products in bulk, bring their own shopping bags, select durable and reparable products, and maintain products. The Ministry of the Environment in Japan, for example, measures the rate of people who are aware of green consuming. Green consumers are consumers who are inclined to buy goods that are environmentally friendly. If green consumers increase, then distribution of those goods will increase in the marketplace, and vice versa.[23] The green consumer rate is measured with questions such as "When you buy goods or services, do you select them after considering their impact on the environment?" Options are agree, partly agree, partly disagree and disagree. 29.9% stands for the rate of persons who agree and partly

[22] Kawalec, M. (Manager, Waste Management Utility Services Department of Peterborough). (2005. December 12). Re: 2004 City of Peterborough Waste Management Summary [e-mail].
[23] Japan for Sustainability, "JFS indicators: The rate of green consumers" <http://www.japanfs.org/ja/view/index/n-5.html>

agree with the question.

Purpose

Green consumption is promoted with the intention of raising public awareness of waste reduction and of actually minimizing the final waste generated. This indicator is also seen as an educational method, which influences people to modify their life style with regard to product consumption. Thus, this indicator is expected to change the social behaviour towards waste as a long-term strategy.

Users

People in the community use this indicator for their wise shopping. Also governments use it as an educational method. By promoting green consumption, they can educate the public as well as reduce waste. Providing green products is industries' responsibility. They can expect to gain good reputations from the public by selling eco-products. They should also provide maintenance services and up-grading services.

Indicator Evaluation

Green consumption indicators are often qualitative. The methods are to measure public participation and the provision of information on green consumption. Like the Japanese example, public participation can be converted into quantitative indicators by measuring the number of people who recognize themselves being involved in green consuming performance. However, such indicators are rarely available at local level.

The city of Peterborough provides many opportunities for residents to exercise green consumption. Peterboroughreuses.com is a joint program of Peterborough Green-Up, the City of Peterborough and Peterborough County. This helps people understand how used material should be dealt with and where it can be recycled. Peterboroughreuses.com encourages people to reuse and recycle through three channels: the reuse & recycle guide that provides a list of 64 waste reduction categories from large items such as building materials to small items such as books and cosmetics, the classified ads system that gives residents of the City and County a place to buy and sell used items, and the green shopping guide that provides a great deal of information about how to purchase products selectively.

Data source

- Peterboroughreuses.com, <http://www.peterboroughreuses.com/recycling/default.asp>
- Japan for Sustainability, "JFS indicators: The rate of green consumers" <http://www.japanfs.org/ja/view/index/n-5.html>
- The Ministry of the Environment, "The national survey of the environmentally friendly life style" <http://www.env.go.jp/policy/kihon_keikaku/lifestyle/h1610_01.html>

4.6 Source Reduction

There are regulations for the amount of garbage and the classification of materials, but no performance in terms of life cycle assessment has been recorded. The challenge of waste reduction has to be faced at production not disposal. To solve this problem, some indicators would be useful.

The Canadian National Round Table on the Environment and Economy (NRTEE) promotes source reduction, which started ten to fifteen years behind recycling, and it is still unfamiliar to the public. NRTEE says, “The reduction of waste at the source of generation is considered one of the most important strategies for reducing the volume of solid waste.” However, “source reduction remains the least developed option in the waste management hierarchy.” Along with the material flow, the indicators which designate waste and waste management patterns have to be identified at different waste generation phases: production, distribution and consumption. At production, manufacturers can enhance the quality and durability of products, reduce the volume of products and packaging, and design products to be repaired. Indicators here would examine what kind of approach is taken or not taken. At distribution, retailers can use reusable containers to carry products and provide services instead of products. Most source reduction is done before products are sold such as the smaller input of raw material and the use of reusable carrying containers. Such efforts can be examined generally through environmental corporation reports by which industries voluntarily inform the public. The other possibility is legislative treatment. Regulations can govern the use of material and the methods of product distribution; for example, products must contain a certain proportion of recycled material, and packaging has to be taken back by the producers. Another way is that consumers can examine products whether they are reusable and reparable at retail stores.

4.6.1 Waste Intensity

Overview

A waste intensity indicator is a method for improving material efficiency by measuring how much waste is generated through production processes. Companies use this indicator both to save costs and to reduce their environmental impact. Germany and Denmark, for example, use the waste intensity indicators at their Statistics Bureau, and describe the sequence of material flow with regard to natural resource and waste issues.

Purpose

Waste intensity indicators help businesses maintain and enhance competitiveness while reducing environmental burdens. By examining the difference between inputs as raw materials and outputs as the final products / services, companies can recognize the amount they waste.

Users

Although Global Reporting Initiative (GRI), The National Round Table on the Environment and the Economy (NRTEE) and OECD describe the efficiency of waste intensity indicator, there are few companies utilizing the indicator.

Indicator Evaluation

NRTEE made the standardization of definitions for calculating waste intensity indicators. Companies can set measurable targets for waste minimization and material efficiency with the standards. Also, a standardized indicator can facilitate comparisons between companies when it is widely accepted, and when the data are verifiable, quantifiable and transparent.

This indicator helps to benefit from source reduction by measuring a hidden profit and loss. The hidden material flow is identified with the following calculation: the total material entering the product boundary (e.g. one facility or factory) minus material that ends up in the product and co-product, per unit of production or service delivery.

Table 5: Core waste intensity indicator basic calculation

$$\text{Core waste intensity} = \frac{\text{Total material (direct or indirect) entering the project boundary – (minus) material that ends up in the product and co-product}}{\text{Unit of production or service delivery}}$$

To measure the hidden material flow in a manner that is most useful to particular operations, there are two ways of the core waste intensity indicator calculation: the mass balance approach and the waste output approach. The mass balance approach is calculating what materials enter and leave a project boundary. For companies whose manufacturing processes are based largely on chemical reactions (e.g., chemical and plastics manufacturers) or have few input materials, the mass balance approach is suitable.

Table 6: The mass balance approach

$$\text{Core waste intensity} = \frac{\text{Total material entering the project boundary – material in the product and co-product}}{\text{Unit of production or service delivery}}$$

$$= \frac{\text{Total material taken in – total amount of product and co-product [kg]}}{\text{Denomination value (t, \$, \#)}}$$

On the other hand, the waste output approach can calculate how much waste is generated per unit of products. This approach focuses on waste amounts rather than the number of products. If a company tracks and monitors waste and has too many material inputs to use the mass balance approach, then the waste output approach is the easy way to calculate the waste intensity indicator.

Table 7: The waste output approach

$$\text{Core waste intensity} = \frac{\text{Total waste leaving the project boundary}}{\text{Unit of production or service delivery}}$$

$$= \frac{\text{Total wastes generated [kg]}}{\text{Denomination value (t, \$, \#)}}$$

Working examples explained on NRTEE's website are also help to understand. The whole system is broken down to each step with informative descriptions so that companies which have various business styles can adopt.

Data Source

- NRTEE, "Eco-efficiency Indicators Workbook," <http://www.nrtee-trnee.ca/Publications/HTML/Complete-Documents/Eco-efficiency_Workbook/en/waste.htm>
- Japan for Sustainability, "Economy / Resource Productivity," <http://www.japanfs.org/ja/view/index/e-2.html>
- GRI, "GRI Indicators," <http://www.globalreporting.org/guidelines/2002/dannex5.asp>

4.6.2 Extended Producer Responsibility

Over view

Extended Producer Responsibility (EPR) brought a change of the traditional responsibilities with regard to waste management. EPR extends the producers' and distributors' environmental responsibilities previously assigned to include treatment at the post-consumer stage.[24] So the producers and distributors are responsible for reducing environmental impact and managing the product across the whole life cycle of the product, from selection of materials and design of products to disposal of the products.[25]

Producers' financial or physical responsibility for the treatment or disposal of products is discussed more and more. Producers may adopt EPR voluntarily or compulsorily as a result of government regulations. There are three examples of EPR in Canada.

- Prince Edward Island lead acid battery take-back program
- Ottawa's "Take It Back!" Program
- The Beer Store deposit program

In 1993, Prince Edward Island introduced the lead acid battery take-back program as mandatory. Retailers must charge a fee of $5 per new battery to consumers, and are also responsible for safe storage and processing of collected batteries.

The City of Ottawa launched the "Take It Back!" Program in November 1997. Retailers take hazardous waste back directly from their customers and take responsibility for the environmentally safe management of it. The participating vendors have increased to 500 across Ottawa. The City saved $150,000 in annual costs of waste treatment through the Program.[26]

In the deposit-return system, a deposit is collected at stores and returned to consumers when they return containers and associated packaging to a retailer. The deposit-return system is operated by

[24] Environment Canada, "Extended Producer Responsibility & Stewardship" <http://www.ec.gc.ca/epr/en/epr.cfm>

[25] B.C. Ministry of the Environment, July 2005. "Product Stewardship in B.C." 3 March 2006. <http://www.env.gov.bc.ca/epd/epdpa/ips/progdev/index.html>

[26] R.G. Hewitt, Acting Deputy City Manager of Public Works and Services, "Integrated Waste

Ontario' Brewer's Retail organization (The Beer Store). The Beer Store accepts empty containers sold by the Liquor Control Board of Ontario (LCBO) stores, and achieves a recovery rate of 107%. Through this program, 120 million glass bottles, 144 million aluminium cans, 26,311 tonnes of corrugated cardboard and boxboard, 150 tonnes of steel and 77 tonnes of plastic were recycled.

Purpose

The purposes of using this indicator are to reduce a large amount of waste and pollution, and to save raw materials. There are many opportunities to reduce waste since materials are reused or recycled in bulk through the system. Producers can also benefit from the reuse of packages and containers by reducing the costs of raw materials.

Users

The governments play a role in enforcing EPR on producers while the producers take responsibilities for their products at the post-consumer stage as well as the design and production stage. Citizens also use the EPR system as consumers.

Indicator Evaluation

EPR is a qualitative indicator, which is assessed by examining whether it is implemented or not. Or it is measured by counting how many companies and what type of companies carry out. The Beer Store and LCBO carry out the deposit-return system in Peterborough. However, the City of Peterborough has not implemented EPR as a city. The City recognizes that 70% of the total garbage is generated by IC&I sectors, but it does not make them responsible for their waste. The public has little access to take products back to the producers. Also, by making the implementation of EPR mandatory, the system's workability is improved.

EPR is a useful indicator for enhancing the efficient use of resources and reducing waste. The producers have the highest opportunity for the reuse of their products taken back, and also can treat the products properly since they know what materials consist of. The EPR system makes material flow smooth and avoids extra costs and time through the processes of recycling and treatment.

Suggestion

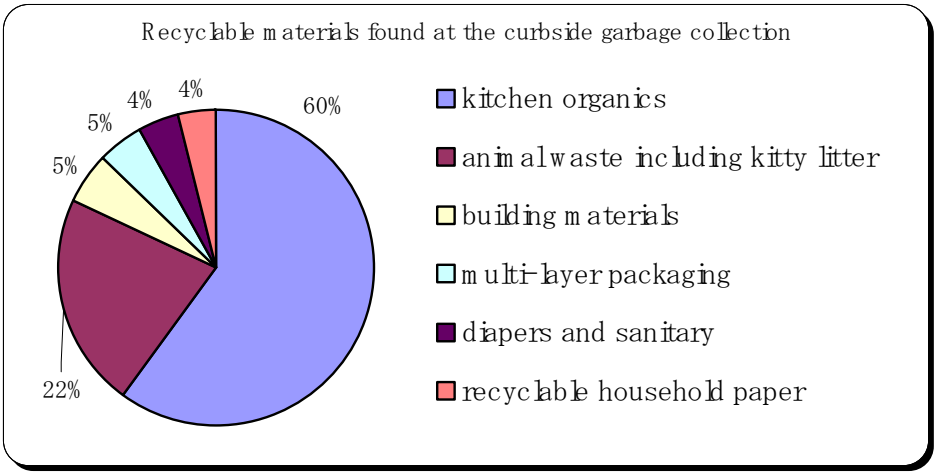
The City identifies the materials found in the residential curbside garbage that represent the major weight. Designated materials include building materials, multi-layer packaging, and diapers and sanitary waste (Chart 5). Multi-layer packaging is one of the materials the citizens cannot reduce for themselves. For such a substance, the City needs to take a responsibility to impose re-design of products on companies. Moreover, the materials which are currently recycled, for example, glass beverage bottles, can be reused through the system. Thus, industries' voluntary involvement as well as government enforcement action for EPR are needed. To introduce take back systems, industries have to have a capacity for collection, dismantling, washing, reuse or recycling, and re-manufacture. The initial costs and operation costs of EPR systems are obstacles for local industries. However, EPR offers several approaches to the implementation of the systems, which can apply to different communities, and Peterborough can choose the most suitable system. For example, Germany has adopted a dual system,

in which a curbside collection or a drop-off system is provided for packaging recovery. The non-profit organization Duales System Deutscheland AG (DSD) organizes industries to share the take-back burden, and requires the separate collection and sorting of packaging waste. DSD contracts with a nation-wide network of more than 400 municipalities and waste industries to carry out the collection and recycling of the packaging waste.[27] This system enables waste firms and governments to work in collaboration with local businesses by taking charge of collection and recycling.

Japan has implemented the take back system for certain electrical appliances. Electricity retailers and producers are responsible for taking back television sets, refrigerators, air conditioners and washing machines under the Specified Home Appliance Recycling Law (SHARL).[28] In this system, consumers pay tipping fees, which depend on appliance: television sets 2,835yen[29], refrigerators 4,830yen, air conditioners 3,675yen, and washing machines 2,520yen. The problem is, however, illegal disposal. On the other hand, some countries adopt tipping fees that are required at the point of purchase.

Furthermore, EPR legislation or agreements for take back depend on countries; for example, the EU, Japan and Canada have dealt with packaging; Germany, Sweden and Austria have dealt with automobiles; and the EU, Sweden and Japan have dealt with electronics. Thus, even at the local level, municipalities can start with a small scale specifying products or materials according to the area's situation.

Chart 5: Recyclable materials found at the curbside garbage collection



Data Source

- The City of Ottawa, "Management Master Plan – Strategic Service Delivery – update," 15 April 2005. <http://ottawa.ca/calendar/ottawa/citycouncil/pec/2005/04-26/ACS2005-PWS-UTL-0008.htm>

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[27] DeAnne Toto, 15 October 2004, "Green With Envy" <http://www.sdbmagazine.com/articles/printer.asp?ID=5330&IssueID=219&Source=back>

[28] Clean Production Action, "EPR in Japan," *Clean Production Action Home Page*, 8 April 2006, < http://www.cleanproduction.org/epr/EPR_Japan.htm>.

[29] 100yen = C$1.00

4.6.3 Corporation Social Responsibility

Overview

In many countries, an increasing number of companies, academic institutions and local governments are preparing corporate sustainability / environmental reports. An environmental report specifically focuses on environmental performance. There is a trend towards sustainability reports focusing on economic and social performance as well as environmental.

Some countries, such as Denmark, the Netherlands, France and New Zealand have made the reporting of sustainability performance mandatory. In Canada, Stratos Inc. presented an analysis of corporate sustainability reporting, and identified 79 companies that currently publish sustainability annual reports. Those companies are listed on the Stratos website.

Purpose

Reporting is intended to make companies' operation transparent to the public. Through reporting, companies need regular monitoring and become aware of their problems. By publishing waste related data such as the waste amounts generated and the types of waste materials, companies take a responsibility for their waste.

Users

The prospective benefits of Corporate Environmental/Sustainability Reporting are not only for companies but also for governments and other stakeholders. Governments can evaluate progress on domestic commitments to international treaties such as the Kyoto Protocol.[30] The public plays a role in watching and evaluating industries' environmental performance.

Indicator Evaluation

According to Stratos, all sectors of Canadian businesses started reporting, and they have their reports independently verified. Because companies independently construct their report, they tend to avoid their weak topics such as environmental liabilities and contingencies. In this aspect, the report as an indicator lacks reliability. For example, if companies do not have enough information on waste management, they may avoid reporting this area. From the accessibility perspective, if corporations produce a report, it is accessible to the public. However, Canada has not introduced legislation on environmental / sustainability reporting, so accessibility to these reports is still limited.

Companies also benefit from reporting. They can save themselves making different reports for different stakeholders. Instead, they will be able to produce one report for all stakeholders. Corporations can track their performance internally with a systematized report. By dispersing the report all over the world, companies will get responses and advice from their stakeholders and can improve and make the information more usable and valuable. Also, one can analyze companies' environmental performance and expect better from those companies trying to distinguish themselves from under-performing competitors.

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[30] Fried, R., The State of Environment & Business.
http://www.sustainablebusiness.com/features/feature_printable.cfm?ID=808

According to Statistics Canada, *Environmental Protection Expenditures in the Business Sector*, "35% of reporting establishments indicated cost savings after adopting pollution prevention or environmental management practices in 2002."[31] Thus, mandatory environmental reporting is worth introducing. Overall, corporate environmental reporting is valuable as an indicator when a majority of companies provide their report and adopt the same method or a designated format.

I contacted several IC&I sectors in Peterborough to ask about how they treat their waste. Although I e-mailed major organizations including Minute Maid, Sysco Food Services, Bryston Limited, General Electric Peterborough and Kawartha Pine Ridge District School Board, I received answers from only two companies: Bryston and Sysco Food Services. Indeed, I could not get much useful information from them. Bryston uses a flat rate waste disposal company, and there is no record as to weight or volumes being kept. The amount of metal work recycled is also sporadic. Next, Sysco Food Services answered that they have no resource to respond to my question about their waste amount and management system. Trent University also makes a contract with a waste management industry with a flat-rate method,[32] which does not require to have detailed information on its waste. Thus in Peterborough, reporting responsibility is too weak to work as an indicator.

Data Source

- Statistics Canada, "Environmental Protection Expenditures in the Business Sector," <http://www.statcan.ca/english/freepub/16F0006XIE/16F0006XIE2002000.pdf>
- Stratos Inc., "Corporate Sustainability Reporting in Canada: A 2002 Update," <http://www.stratos-sts.com/sts_files/2002_Sustainability_Reporting_Update_Final_Report_Nov_19.pdf>

4.6.4 Act /Regulation

Overview

Waste Diversion Act, 2002 which passed on June 27, 2002 gave Waste Diversion Ontario the mandate to develop, implement and operate waste diversion programs to reduce, reuse or recycle waste. WDO is a non-crown corporation created under the Waste Diversion Act to implement waste diversion programs.[33] The Blue Box Program is one of their main initiatives. There are other programs including the Used Tire Program, Used Oil Program and Electronics and Electrical Program. Currently, Ontario has been aiming at 60% waste diversion through those programs.

Under the Ontario Regulation 102/94, designated industries and institutions are required to conduct a waste audit. For example, an educational institution at which more than 350 persons are enrolled at any time during the calendar year must implement a waste audit program; if an office

[31] Statistics Canada. (2002). Environmental Protection Expenditures in the Business Sector. Retrieved February 23, 2004 from http://www.statcan.ca/english/freepub/16F0006XIE/16F0006XIE2002000.pdf
[32] Wayne Craft, Personal interview, 15 February 2006.
[33] Ministry of the Environment. http://www.ene.gov.on.ca/envision/land/wda/index.htm

building has at least 10,000 square metres of floor area for use as offices, it must implement a waste audit program; restaurants with gross sales of $3 million or more in any of the two preceding calendar years must implement a waste audit.[34]

Peterborough has a waste collection by-law, which bans recyclables and green waste from the landfill site. Recyclable materials and green waste are rarely found at the landfill due to the by-law.[35]

Purpose

Legislative indicators can measure enforcement of appropriate waste treatment on municipalities, communities, and industries and institutions.

Users

Users are mainly municipalities and individuals in the case of Waste Diversion Act, and are IC&I sectors in the case of Ontario Regulation 102/94.

Indicator Evaluation

A legislative indicator is measured by its existence and efficacy. Some work effectively, and some do not work as indicators. For example, Waste Diversion Act has an enforcement power of implementing waste diversion activities. Under the Act, Waste Diversion Ontario (WDO), a non-crown corporation created on June 27, 2002, is responsible for encouraging municipalities to implement waste diversion activities. Although the City of Peterborough already has carried out the Blue Box program before the Act, other municipalities also started implementing such recycling programs due to the Act. In this case, the indicator plays a role in measuring whether municipalities have appropriate recycling programs or not.

Because acts and regulations can bring certain outcomes by powers to force specific organizations or individuals into carrying out designated activities, they are effective as indicators. In the case of Ontario Regulation 102/94, however, there is no waste audit documentation officially. Peterborough has a general record of IC&I waste which is sent to the landfill site. However, each organization is not required to submit its waste audit record to the ministry. Only when the city receives complaints about waste disposal and inappropriate waste treatment does the ministry require the concerned sector to submit the waste audit.[36] Even if designated sectors keep their waste audit record, it is not accessible to the public. Thus, such indicators are not practically available, and it is not possible to compare waste amounts, patterns and treatment methods among IC&I sectors. If all companies and institutions provided their waste audit documentation to the public, they would become more aware of their waste and put more effort to reduce their waste.

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[34] Ontario. Ministry of Environment and Energy. (1994). *3Rs A Guide to Waste Audits and Reduction Workplans for Industrial, Commercial and Institutional Sectors as required under Ontario regulation 102/94.* Toronto: Publications Ontario.

[35] City of Peterborough. 2004 Waste Management Summary Report.

[36] Waste Management Division staff. (February 23, 2006). Telephone communication. About an IC&I sector's waste audit.

Information about Ontario Provincial programs and initiatives is available on the Province of Ontario website. There is an easily acceptable list of publications of the Ministry programs. Also the Province provides e-Laws which anyone can access and on which Provincial laws can be searched.

Data Source

- Ontario, e-Laws, < http://www.e-laws.gov.on.ca/home_E.asp?lang=en>
- Ontario. Ministry of Environment and Energy. (1994). *3Rs A Guide to Waste Audits and Reduction Workplans for Industrial, Commercial and Institutional Sectors as required under Ontario regulation 102/94.* Toronto: Publications Ontario.

5. Analysis

Statistics Canada and the City of Peterborough have provided general indicators for waste management including the industrial / household waste generation, disposal, diversion, recycling and composting indicators. Either information is important to identify changing waste patterns and waste amounts. However, they are often difficult to function as indicators because of diversity; for example, Statistics Canada identifies provincial and national levels of waste generation per capita while the City provides waste disposal, recycling and composting amounts except waste generation as well as per capita generation. Such differences make it difficult to compare their situations.

The City has issued informative data such as its annual report and table indicating the history of waste amounts and types. However, the table and the updated annual report are only accessible through personal contact with the City. Also, those data can be explained with graphs and charts to make them easily understandable. For instance, I used charts and graphs to analyze the changes in waste diversion, disposal and generation. By doing this, I found the important pitfall that waste diversion and disposal solely cannot reveal a real situation, and waste generation has to be examined to evaluate the situation. Also, simulation using a graph makes it clear that the city-wide composting collection is a key to substantial increase in waste diversion in the city. To function as an indicator, information should be readable, accessible and comparable.

Next, in spite of the fact that 70% of Peterborough's waste is generated from IC&I sectors, there is no strict enforcement of regulations for those organizations to implement a specific waste reduction performance. Ontario Regulation 104/92 does not effectively induce designated organizations to conduct waste audit programs. Such organizations as a result tend to depend on a waste industry to ship their waste to the landfill without auditing. Waste indicators need to be more strong and useful to reduce IC&I waste.

Peterborough has used indicators of waste amounts, recycling rates, and composting amounts for many years. Such indicators show the city's current situation and transition of waste management carried out at the disposal phase. However, the indicators which promote source reduction are weak. Source reduction indicators, including waste intensity, EPR, material flow, strong

regulations, and waste management reporting, are worth implementing. The city will have to seek landfill expansion or a possibility for incineration if it focuses only on waste indicators at the final phase of waste flow.

6. Recommendations

I suggest four waste indicators to be used in the City of Peterborough. Suggested indicators are EPR and corporate sustainability reporting, in addition to the conventional waste indicators: composting indicators and waste generation. Furthermore, to increase the functionality of the indicators, more focus should be on the improvement of readability and accessibility.

As I pointed out in the analysis section, waste indicators for IC&I sectors are weak because proper waste auditing has been rarely conducted by those sectors. To solve this problem, EPR is a useful indicator for getting industries, as primary waste generators, involved in waste management flow. Peterborough may use this system: visible fees are added on the prices of products at the point of purchase; consumers use municipal collection services or retailers' collection depots to take back the products; producers bear processing fees for reuse / recycling of their products; the processing fees depend on products and makers, so that the more companies make efforts to design eco-products, the less processing fees customers and companies pay.

Corporate sustainability reporting strengthens corporate social responsibility. This indicator will work as the monitoring tool for corporations, as the observation tool for the public, and as the regulating tool for the government. Recognizing the benefits and the challenges such as the lack of standards, the City needs to introduce this indicator.

The reason for recommending composting indicators is that diverting organic waste from the landfill is the most effective waste reduction method for Peterborough. I assume that after introducing the city-wide composting program, the total of waste disposal will dramatically decrease. The city needs to analyse the relation between composting amounts at the central composting facility and the total waste disposal to measure the effect of the program.

I suggest using waste generation as a waste amount indicator. Many municipalities make efforts to increase their diversion rate, but it does not necessarily reflect waste reduction. The City's primary objective should be to reduce total waste generation.

The use of visual images for those indicators will enhance the readability of indicators. To improve the accessibility to the indicators, the summary of an annual waste report including composting amounts and waste disposal amounts can be posted on *Enviro Times*, which is the city's waste management periodical, or the top page of the waste division website, so that there will be more opportunity to catch people's eye.

Overall, the City needs to focus on four indicators. The first is sustainability reporting which stimulates IC&I sectors' waste management systems. Although sustainability reporting is still

discussed at the national level, it is worth noting due to the benefits to companies, communities and the government. Second, EPR promotes source reduction as well as disposal treatment, and expands industries' responsibility. Third, organic waste indicators will show rapid improvement of the city's waste generation in a couple of years. Measuring home composting amounts is one of the challenges of the improvement of organic waste indicators. Fourth is the total waste generation indicator. The first two indicators are not available at present; the last two are currently used but should be developed to work effectively as waste indicators.

7. Conclusion

The purpose of this research is to improve waste management indicators in the City of Peterborough. Waste indicators can show people what situation they are in, how they should respond, and how they can approach their goals. I discussed the availability of current waste management indicators and the possibilities of using new indicators which are found in other institutions and municipalities. The City has collected the data of waste amounts, recycling amounts and composting amounts for decades. Those data are useful for analysing Peterborough's waste patterns. However, the data can be updated and be easily comprehensible.

This research found Peterborough's waste patterns: organic waste is a major material going to the landfill site and 70% of total waste is IC&I waste. Also, source reduction indicators such as EPR and waste intensity indicators are not available. The use of indicators like EPR, sustainability reporting, composting measurement and waste intensity is the potential development of the City's waste management system.

Another finding shows that although people tend to solely focus on diverting waste from a landfill, they cannot reduce waste generation itself. This is because waste indicators are generally recognized as the waste measuring method at the very final stage in its life cycle. Nothing is measured at the production phase and distribution phase despite the fact that waste is generated through the whole production process from manufacturing and distribution to consumption. Moreover, material selection and redesign of products play an important role in reducing the final waste generated. Thus, the focus should be broadened in scope to include an entire material flow: material selection, design, manufacturing, distribution, consumption and disposal. Similarly, I questioned the people's dependency on diversion rates and disposal amounts as waste indicators. Those indicators are useful to recognize changing waste patterns but do not indicate the inclusive waste generation.

This research allows better waste management introducing new indicators and redesigning conventional indicators for the City. The central point is to look at the reduction of the total waste generation and the management of total waste flow aiming for zero waste.

8. Appendix

Landfill																		
City																		
Curbside	17,821	18,512	17,721	16,786	14,943	15,495	14,956	14,111	12,842	11,829	11,414	12,126	11,964	12,195	12433	12550	12,846	13,035
Drop off area																		6,305
Ptbo. Res. Drop-off															3000	3000	5191	10860
IC&I	58,951	50,958	43,031	37,577	27,782	19,233	17,794	16,932	29,672	30,422	28,615	32,754	34,019	34,916	35156	38550	42,328	41,377
Sub-total - City	76,772	69,470	60,752	54,363	42,725	34,728	32,750	31,043	42,514	42,251	40,029	44,880	45,983	47,111	50589	54100	60365	71577
County																		
Residential					1,114	1,268	1,328	1,300	1,174	988	924	908	708	897	2770	2879	7,552	8,587
IC&I					0	0	0	0	0	0	0	0	0	0	0	2317	1,936	2,837
Sub-total - County	0	0	0	0	1,114	1,268	1,328	1,300	1,174	988	924	908	708	897	2770	5196	9,488	11,415
MRF Residue				186	21	238	493	424	260	741	650	508	716	509	432	420	472	488
Total	**76,772**	**69,470**	**60,752**	**54,363**	**42,725**	**34,728**	**32,750**	**31,043**	**42,514**	**42,251**	**40,029**	**44,880**	**47,407**	**48,517**	**53791**	**59716**	**70325**	**83490**
Landfill																		
Soils	N/A	N/A	10,110	12,697	15,437	2,311	736	5,745	0	7,664	3,569	3,663	1,476	10,759	1824	50312	35,009	17,976
Scrap Metal	0	0	0	0	0	0	0	84	93	114	88	164	180	181	269	258	308	333
Tires	0	0	0	0	0	60	65	84	85	89	64	115	70	85	174	78	203	114
Drywall														183	240	198	178	286
Recycling (tonnes																		
City Residential	2,000	2,432	2,879	4,016	4,029	4,499	4,627	5,199	5,346	6,289	6,268	6,301	6,956	7,146	7,120	7,106	7273	7400
City IC&I and Drop-off	0	662	1,010	1,424	1,746	1,497	1,657	2,072	759	2,028	2,000	2,544	2,622	1,458	2,418	2,680	2064	1949
County	0	0	0	190	2,251	2,363	2,482	2,565	2,999	3,908	4,281	4,295	4,383	4,539	4,660	4,571	4664	4757
Total	**2,000**	**3,094**	**3,889**	**5,630**	**8,026**	**8,359**	**8,766**	**9,836**	**9,104**	**12,225**	**12,549**	**13,140**	**13,957**	**13,143**	**14,198**	**14357******	**14001******	**14106******
Organics																		
Green Waste																		
City Curbside	0	0	0	0	0	0	910	1,516	1,873	2,700	2,504	2,552	2,950	3,021	3,489	3,600	3934	4124
Leaves (est'd)				1,000	965	965	965	965	965	965	965	465	431	456	400	400	845	647
Christmas trees (est'd)					35	35	35	35	35	35	35	35	35	35	35	35	35	35
Landfill	0	0	0	0	0	0	45	68	97	152	176	244	246	418	462	602	1225	964
Landscaper Drop-offs																		800
Household Organics															4	158	175	145
Total	**0**	**0**	**0**	**1,000**	**1,000**	**1,000**	**1,955**	**2,584**	**2,970**	**3,852**	**3,680**	**3,296**	**3,662**	**3,930**	**4,389**	**4,795**	**6,214**	**6,715**

Table 8: Peterborough 2004 Annual Report Table

Measuring Progress Towards Sustainability

Waste Indicators

Ikuyo Kikusawa

堺市指定都市推進協議会
http://www.suishinkyo.jp

Introduction

Why are waste indicators useful?

Waste problems are huge and complex

- Break down the issues
  - Who? What? where?
- Help people understand their situation and objectives they should aim for
  - How much? What should be done?

Determining Indicators

The state of Peterborough's waste

1. 70% of the total waste generation comes from IC&I sectors
2. Organic waste is a major substance in the total waste generation
3. Waste indicators promoting source reduction are weak

Suggested Waste Indicators for Peterborough

1. Waste Generation
2. Composting Indicator
3. Corporate Sustainability Reporting
4. Extended Producer Responsibility

1. Waste Generation

Waste generation:

- Waste disposal + Waste diversion

Waste disposal:

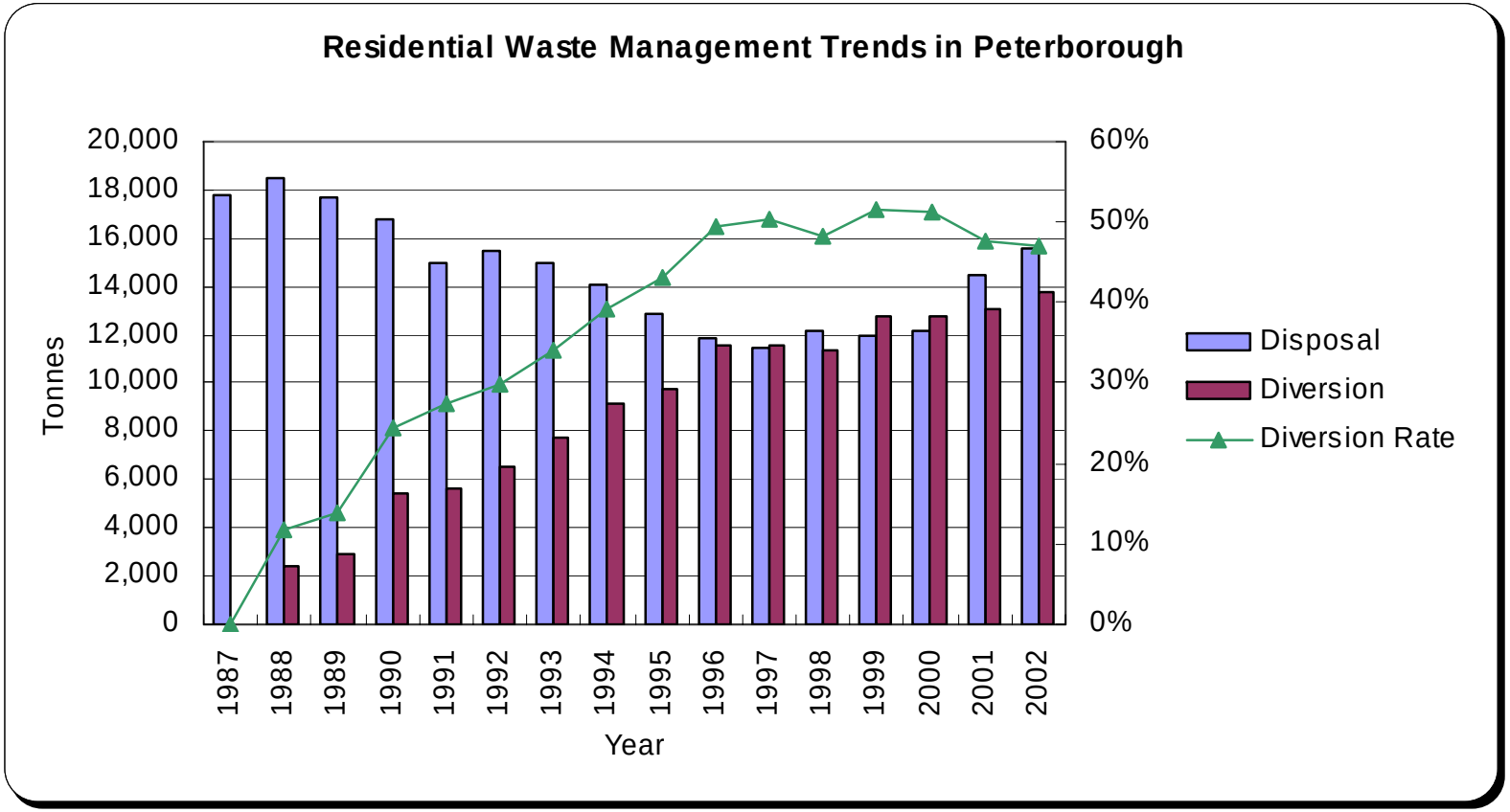
- Waste after diverting recyclable and compostable materials

Waste diversion:

- Waste diverted from landfills by recycling and composting

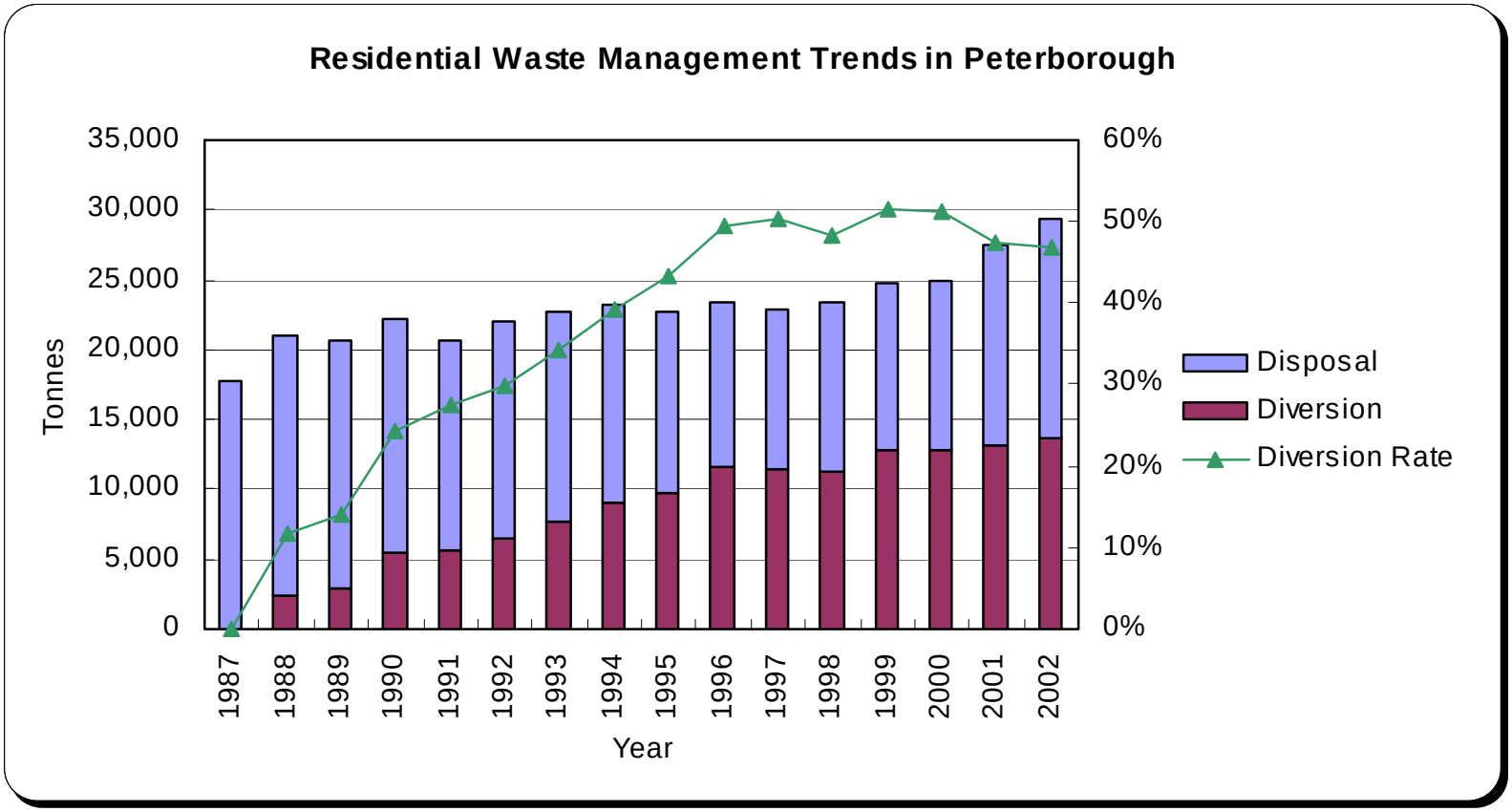
1. Waste Generation

3. The diversion rate has levelled off since 1996



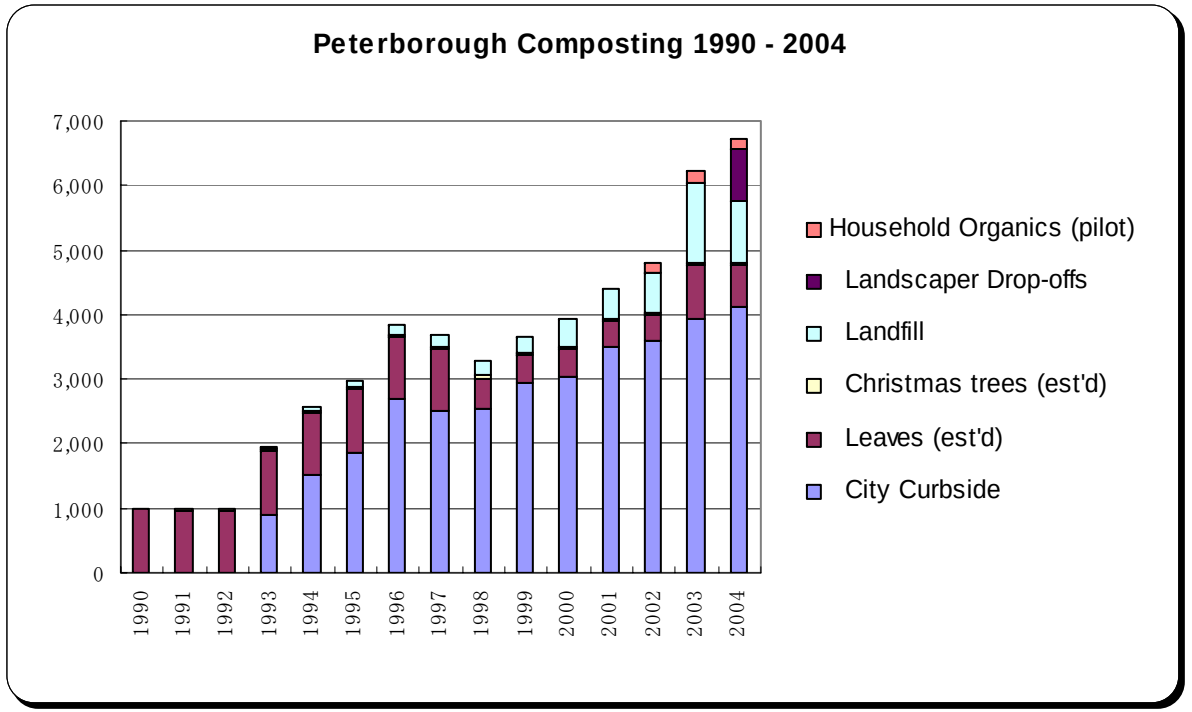
1. Waste Generation

2. The total generation may also increase



2. Composting Indicator

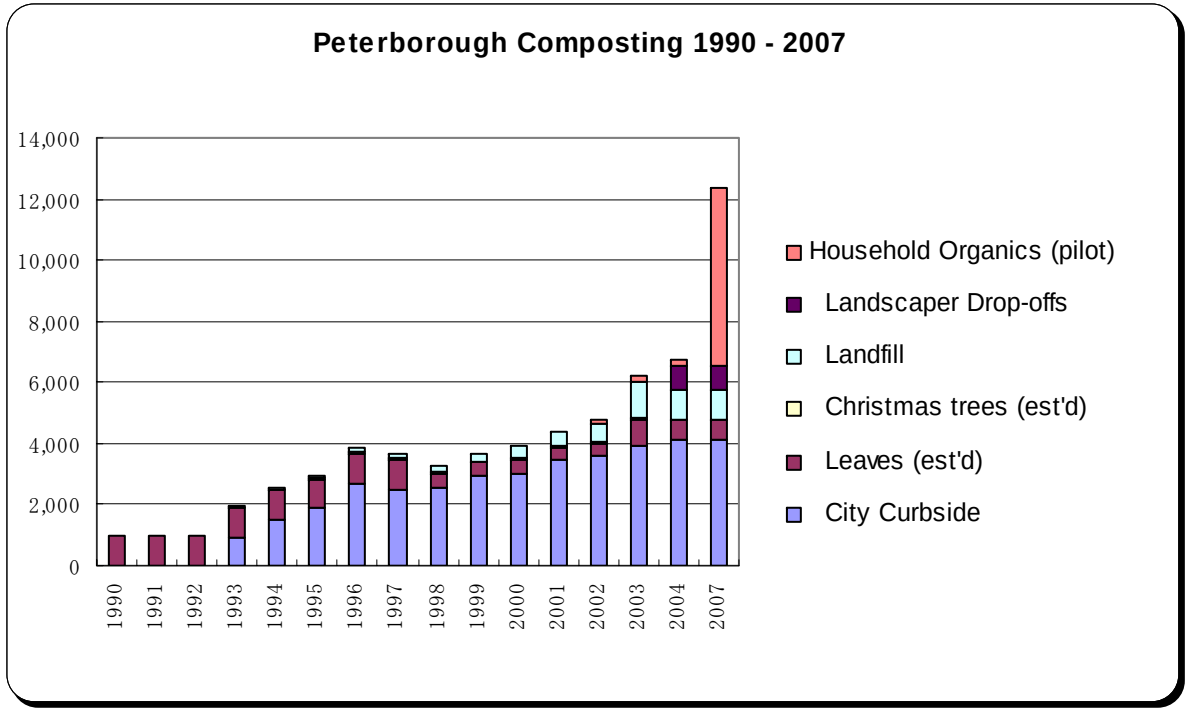
- The composting amount at the city's composting facility



- City-wide composting collection service will be introduced in 2007

2. Composting Indicator

- The composting amount at the city's composting facility



- City-wide composting collection service will be introduced in 2007

3. Corporate Sustainability Reporting

Measure corporations' sustainability performance (energy use, toxicity reduction, social contribution..etc)

→ Corporations

- Help corporations to monitor their environmental / sustainability performance

→ The public

- Make companies' operation transparent

→ The government

- Evaluate progress on commitments to municipal waste reduction

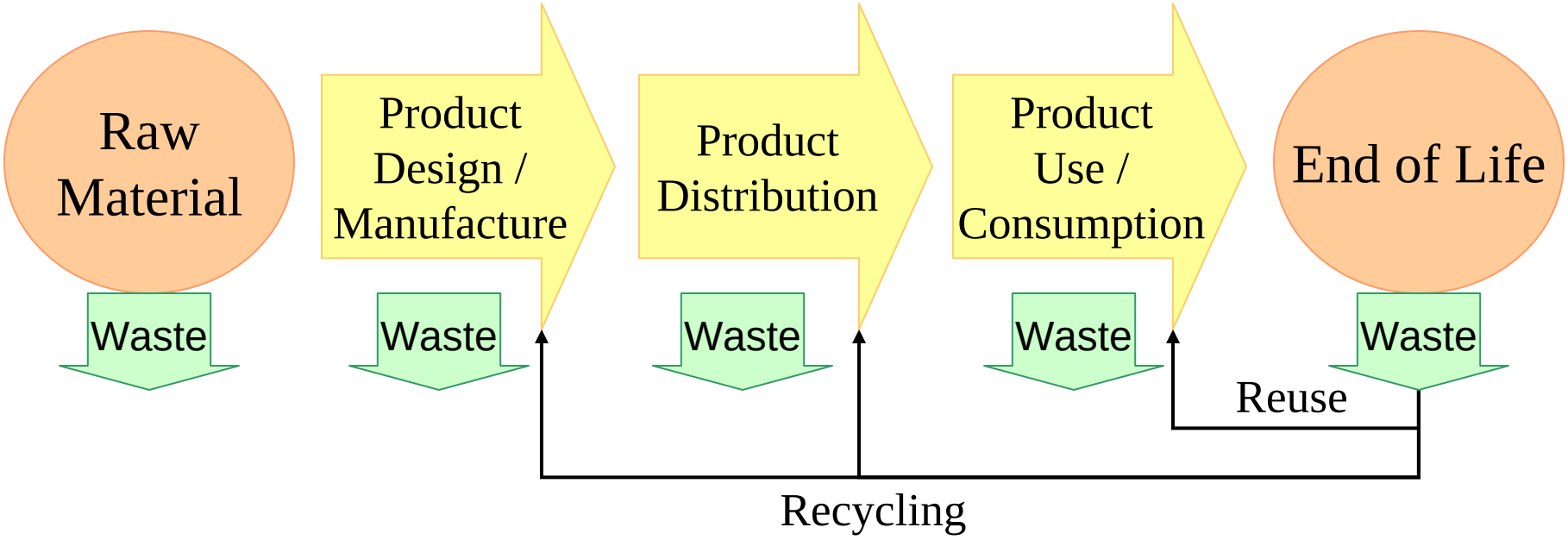
3. Corporate Sustainability Reporting

Challenges

- Canada has not introduced legislation on sustainability reporting
- There are no specific criteria

4. Extended Producer Responsibility

- Producers are responsible for the life-cycle environmental impacts of their products



Reference: University of Tennessee Center for Clean Products and Clean Technologies

Additional Suggestions

To share objectives and information,

- Be accessible (e.g. Enviro Times)
- Be readable (e.g. visualize indicators)

Conclusion

- Organic waste reduction is the next target
  - Composting indicators
- Improve IC&I waste management
  - Extended Producer Responsibility (EPR)
  - Corporate Sustainability Reporting
- Emphasize source reduction
  - Waste generation
  - EPR

Aiming for zero waste…