by Clarissa Morawski

"In one year the Orange Drop program doubled its collection sites and collects more per site than other programs."

Zap!

Benchmarking battery recycling in Canada

As extended producer responsibility (EPR) programs for various byproducts proliferate across Canada, government, industry and the public should be asking stewards: How well are you doing, and can you do better?

Unfortunately, it often seems that the data, supporting methodologies and presentation of that data make the answers opaque and ambiguous. In a game of "fun with numbers," masters of the data can manipulate numerators and denominators, including this and excluding that, while complying with broad definitions in the supporting laws.

This spring, CM Consulting released the first report of its kind to measure battery collection and recycling in Canada. The work involved independently assessing the transparency and certainty of data in order to present objective findings on the basis of compatible results. It serves to benchmark performance of battery collection and recycling programs.

Mandated collection growing fast

By the end of this fall, more than two thirds of Canadians (those in BC, MB, ON, QB) will have mandatory collection and recycling programs for primary portable batteries in their province. Three of these provinces (BC, MB, QB) also mandate the recycling of rechargeable batteries. Stewards are required to provide estimates of sales and collection as part of their annual reporting requirements. Collectively, the reports are inconsistent with each other; they derive sales using different methodologies, and may lack third-party oversight and detail. *Managing Canada's Waste Batteries, 2012* provides transparent performance measurements by identifying not only how many batteries are collected but also what happens to them (how they're recycled, and what they're made into).

Canada-specific parameters help define the methods needed to review performance. For example, should the weight of waste batteries used as waste-to-energy (WTE) be considered as recycling? Similarly, should slag collected from the bottom of a thermal treatment facility and used as fill in construction projects be considered recycling? Given these complexities, five separate performance rates are defined (*see Definitions table*).

The recycling efficiency rate (RER) is the amount of material recycled into a raw material for future application by manufacturers com-

	DEFINITIONS
COLLECTION RATE	The amount collected compared to the weight of batteries placed on the market in that jurisdiction, excluding exports.
DIVERSION RATE	The amount of collected material that is not sent to landfill after processing (includes material used as slag and EFW) compared to the weight of batteries placed on the market in that jurisdiction.
RECOVERY RATE	The amount of material that is recovered for recycling and energy recovery (EFW) compared to the weight of batteries placed on the market in that jurisdiction, excluding exports.
RECYCLING RATE	The amount of material after processing that is recycled into a raw material for future application by product manufacturers compared to the weight of batteries placed on the market in that jurisdiction, excluding exports.
RECYCLING EFFICIENCY RATE (RER)	The amount of material that is recycled into a raw material for future application by manufacturers (excluding EFW and slag) compared to the amount of material that was processed (a measure of input-output efficiency).

pared to the amount of material that was processed (a measure of input-output efficiency). Not all stakeholders define the RER the same way. Specifically, some choose to accept the weight of material burned for energy as recycling; others the weight of slag from thermal treatment for construction projects (and some include both).

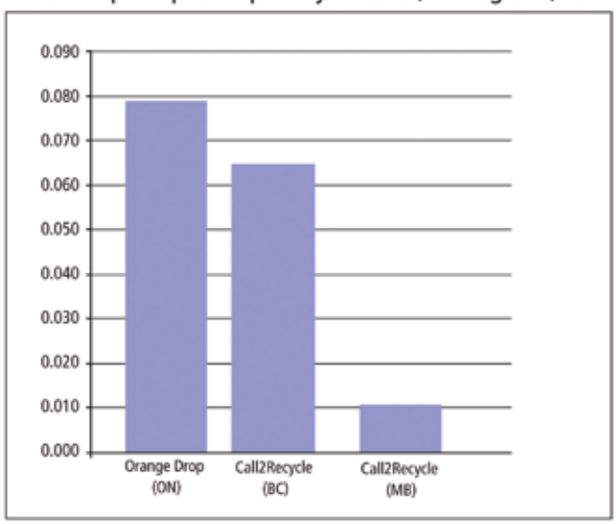
The consultant decided to exclude slag use as recycling, but include it as diversion from landfill. This decision is guided by the methodology used by the European Commission for its own determination which incorporated the social, economic and ecological impacts to compare options. It can be applied to the Canadian context, where existing recycling capacity enables Canada to exceed the mandated RER in Europe, as well as the targets in Canadian provinces without the inclusion of the weight of the slag or WTE in the recycling rate.

Recycling efficiency should be based on high metal recovery rates and elements to be used as substitutes for virgin materials, thereby achieving the maximum environmental benefit. Avoiding virgin metals extraction is the most significant factor in the LCA. If a process has a high RER, it will likely also have a favourable environmental profile.

Battery Type	Alkaline/ Zinc Carbon	Alkaline	Li-ion	Li-ion	Li-ion	NiMH	NiMH	Ni-Cd	Ni-Cd
Process/Company	Inmetco	RMC	Xstrata	RMC	Toxco	Inmetco	RMC	Inmetco	Toxco
% IN METALS AND ELEMENTS					N/A				N/A
Fe, Ni, Mn, Cu, Co				29%		57%	60%	50%	
Zinc Oxide, MnOxide, Potassium		59%							
Co, Al,Cu				27%			11%		
Co, Ni, Cu			27%						
Fe, Ni, Mn, Cu	35%								
Fe, Cu		25%							
Hg, Zn, Mn									
Zn*	6%					1%		1%	
Cd								12%	
METAL and ELEMENT RECOVERY	41%	84.5%	27%	56%		58%	71%	63%	
SLAG*	38%					17%		4%	
ENERGY RECOVERY	8%	15%	44%	25%		10%	25%	12%	
TOTAL DIVERSION	79%	99.5%	71%	81%		85%	96%	79%	
DISPOSAL	21%	0.5%	29%	19%		15%	4%	21%	

*Zinc bearing dust is sent with other electric arc furnace (EAF) dust for further processing. It is blended with other material in a rotary kiln. Industry reports that approximately 60% of the dust is separated into an iron-rich slag and sent for use in cement and asphalt. The remaining 40% by weight—known as "crude zinc oxide"—is used as feedstock in a zinc smelter. Approximately 60% is recovered as zinc for zinc bearing products, and the remaining approximately 40% non-zinc residual material is sent for disposal. The values reflected in the table account for this downstream processing.

Collection per capita for primary batteries, in kilograms, 2011



Battery recycling in Canada

Canada is fortunate in having recycling capacity for all the battery types available in North America. The recycling industry is making investments to continue to improve and expand its capacity to recycle batteries, and boost battery diversion and recovery.

Most of the primary batteries collected in Ontario are sent to Raw Materials Company (RMC) in Port Colborne, Ontario. RMC uses a hydrometallurgical (aqueous) process to recycle all primary batteries except lithium primary batteries, which are sent to Toxco in Trail, BC, where they are recycled using a cryogenic (freezing) process. This program also voluntarily collects rechargeable batteries, which are recycled by RMC, and Ni-Cd batteries, which are sent to Toxco in Ohio for recycling.

Batteries collected in British Columbia are sent to Toxco in Trail, BC where they're sorted and sent to different processors depending on battery chemistry. Lithium primary and secondary batteries stay with Toxco for processing. The largest portion of BC and MB batteries are sent to Inmetco in Pennsylvania, where they're put through a pyrometallurgical (thermal) process.

Comparing programs

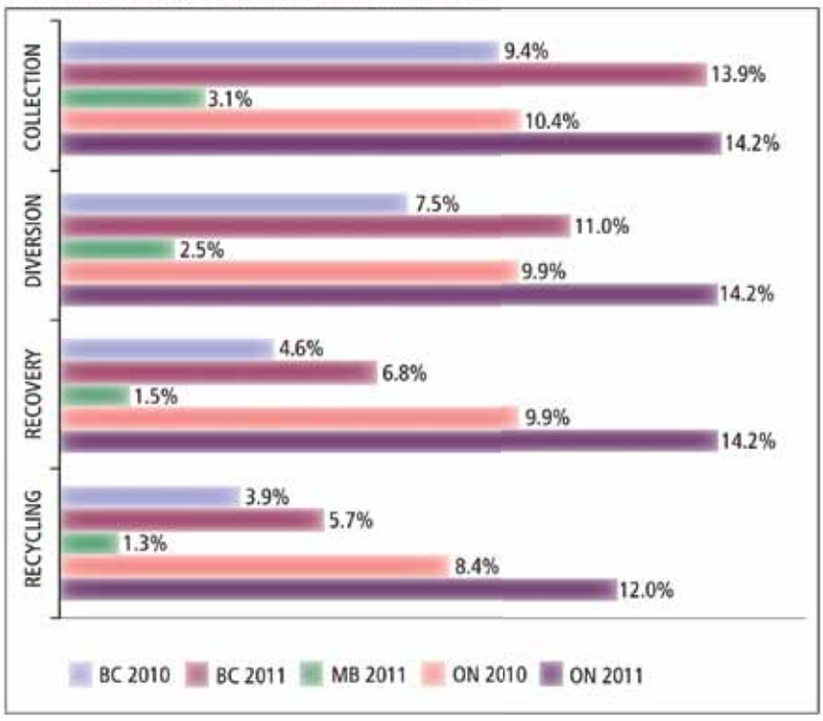
Program comparison is slightly tricky because different programs may use different methodologies to provide their best estimate of what's available for collection (i.e., the denominator). Indeed understanding the exact number of primary and rechargeable batteries available for collection (i.e., that will be discarded) is not an exact science. For example, the per capita available for collection estimate for primary batteries in Ontario is 17 per cent higher than in British Columbia, and 60 per cent higher than in Manitoba, which leads to the question, why do Ontarians buy so many more batteries than other Canadians?

On the collection side in 2011, British Columbia (Call2Recycle) collected 0.063 kgs of primary batteries per capita, and 0.011 Kgs in MB (yr1). Ontario (Stewardship Ontario) collected 0.079 kgs of primary batteries per capita — 25 per cent more than in BC.

When the RER is applied to collected batteries by program, a clearer picture begins to emerge. (*See bar chart.*) Specifically, both BC and ON programs have improved significantly since their first year (or half-year) of operation. However, after processing, the recycling rates in British Columbia and Manitoba decline considerably due to their lower recycling efficiencies. Ontario's rate drops from 14.2 per cent (collection) to 12 per cent (recycling), and British Columbia's rate drops from 13.9 per cent (collection) to 5.7 per cent (recycling); losses which are a result of thermal treatment, a technology able to recover approximately 41 per cent of metals and elements.

Reports on secondary (rechargeable) battery collection and recycling offers less information, because the types of batteries collected (Ni-Cd, NiMH, Li-ion etc.) are not disclosed by stew-

Performance rates: (BC, MB, ON) PRIMARY BATTERIES



ards, making it impossible to provide a recycling rate. (*See chart for collection rates.*)

How well are you doing?

The 2011 data suggests there's considerable room for improving battery collection and recycling rates. Both ON, BC, and MB have set ambitious collection targets for the third year of the program of 30 per cent, 25 per cent and 18 per cent respectively; this means effectively doubling the existing collection performance over one year.

With the introduction of the Battery Incentive Program (BIP) in February 2011, Stewardship Ontario (SO) now offers a financial incentive for collection and processing of batteries. The incentive is designed to support privately-initiated collection channels. In one year alone the Orange Drop program (run by SO) nearly doubled its collection sites and also collects significantly more per site compared with the other programs.

Finally, there are clear environmental differences in the recycling technology (pyrometallurgical vs hydrometallurgical). Investigation of the life cycle impacts of these technologies and each facility (including downstream processing) would be a useful tool for governments or quasi-government Boards when assessing the right standards to put in law.

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