Prepared for the Government of
the Northwest Territories

Inventory and Feasibility Assessment of Electronic Waste Recovery in the Northwest Territories

Executive Summary

Date: December 2012

DESSAU

LIST OF ABBREVIATIONS

ACES	Atlantic Canada Electronics Stewardship
ARMA	Alberta Recycling Management Authority
BCUOMA	British Columbia Used Oil Management Association
CAP	Canada-wide Action Plan
CCME	Canadian Council of Ministers of the Environment
EE	Electronic Equipment
EHC/EHF	Environmental Handling Charge / Environmental Handling Fee
ENR	Northwest Territories Department of Environment and Natural Resources
EPR	Extended Producer Responsibility
EPRA	Electronic Products Recycling Association
EPSC	Electronic Product Stewardship Canada
ESABC	Electronic Stewardship Association British Columbia (now EPRA BC)
GDP	Gross Domestic Product
GEEP	Global Electric Electronic Processing
GNWT	Government of the Northwest Territories
IFO	Industry Funding Organization
NWT	Northwest Territories
OES	Ontario Electronic Stewardship
OTS	Ontario Tire Stewardship
PEI	Prince Edward Island
PRO	Producer Responsibility Organization
PWS	Northwest Territories Department Public Works and Services
SAO	Senior Administrative Officer
SARC	Saskatchewan Association of Rehabilitation Centres
SWEEP	Saskatchewan Waste Electronic Equipment Program
USEPA	United States Environmental Protection Agency
WEEE	Waste Electrical and Electronic Equipment

DISCLAIMER

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EXECUTIVE SUMMARY

Since 2005 the Department of Environment and Natural Resources (ENR) has aggressively pursued the development and expansion of waste reduction and recovery programs in the Northwest Territories (NWT). The design development and implementation of an electronic waste (e-waste) program is the last item in the five year plan to be addressed.

The current study intends to investigate the feasibility of addressing e-waste recovery in the NWT and to investigate whether and how an Extended Producer Responsibility (EPR) program for e-waste could fit into a northern context and/or what other options may exist for program structure and cost recovery. This undertaking is consistent with Waste Reduction and Recovery Program commitments and with the commitments in-principle made to the Canadian Council of Ministers of the Environment (CCME) Canada-wide Action Plan (CAP) for EPR in 2009.

There are two primary objectives for this study:

- To identify the amount of e-waste in various categories and prepare an inventory of existing and future waste electronics which could be managed by an e-waste program.
- To undertake a feasibility assessment to determine the best approach to developing and delivering an effective, efficient, transparent, accountable, and self-sustaining e-waste management system for residents of the NWT that also accrues social and/or economic benefits within the NWT and to assess and recommend whether an EPR framework could work.

Estimation of the quantity of historic and future e-waste in NWT

The study was initiated by an intensive literature review to identify information on quantities of electronics equipment and product categories handled in other programs. The categories of electronic equipment (EE) covered by the study are:

- Desktop and portable computers and peripherals;
- Desktop printers;
- TVs and Display devices;
- Personal or portable audio/video systems;
- Vehicle audio/video systems (aftermarket);
- Home theatre in a box systems;
- Home audio/video systems;
- Non-cellular phones;
- Cellular phones and wireless devices.

The data collection was supplemented by direct contact with managers of other recovery programs in Canada, US and Europe, including all e-waste recovery programs in Canada. Market research firms with expertise in media and communication technologies were also contacted. Based on theses sources of data:

- It is estimated that 36,696 units of electronic equipment (EE) were sold to NWT residents in 2011 (not including cell phones and other wireless devices).
- Based on available standard unit/kg data this represents approximately 236 tonnes of equipment.

In addition to the annual sales figures in NWT, the total functional and non-functional EE currently in NWT were estimated. This estimation is primarily based on three calculation methods based on different assumptions. Considering their limitations, the analysis of the three estimations did not allow selection of one method. However, it is possible to estimate that the total number of selected categories of EE in NWT range from a minimum of 176,358 to a maximum of 323,959 items.

Historic and future e-waste in the NWT which will need to be managed as part of any e-waste program are based on 2012 estimated numbers of EE items, collected historic sales figures and calculations using the Ontario Electronic Stewardship (OES) discard model.

Table ES-1 displays the estimation of the quantity of historic and future e-waste in NWT. It is possible that a large number of historic items (2009-2011) has been managed through existing practices in NWT, such as discarded in garbage or returned to existing e-waste recovery initiatives. Storage of end-of-life units is another consideration. These stored quantities and tonnages are expected to be a factor at the beginning of any e-waste collection program but will be less of an issue over time as units which have been stored in anticipation of a program are collected for recycling.

Table ES-1: Estimated historic generation of e-waste

CATEGORY	2009-2011		2012		2016		2020	
	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX
Desktop computers	3,991	6,506	1,336	2,178	1,469	2,395	1,615	2,633
Portable computers	16,952	39,622	5,676	13,267	6,241	14,587	6,862	16,038
Printers/Fax Machines/Peripherals	12,309	16,488	4,121	5,521	4,531	6,070	4,982	6,674
Display devices	9,239	16,485	3,093	5,520	3,401	6,069	3,740	6,673
Personal or portable audio/video systems	27,044	32,123	9,055	10,756	9,956	11,826	10,947	13,003
Vehicle audio/video systems (aftermarket)	2,335	3,053	782	1,022	860	1,124	945	1,236
Home theatre in a box systems	1,460	2,006	489	672	537	739	591	812
Home audio/video systems	7,380	18,542	2,471	6,208	2,717	6,826	2,987	7,505
Non-cellular phones	9,402	22,435	3,148	7,512	3,461	8,259	3,806	9,081
Cellular phones and wireless devices	8,687	34,267	2,909	11,474	3,198	12,615	3,516	13,871
TOTAL Estimated e-waste generation (units)	98,799	191,527	33,081	64,128	36,372	70,510	39,992	77,526
TOTAL Estimated e-waste generation (kg)	514,882	950,661	172,396	318,307	189,552	349,982	208,415	384,810
TOTAL - Estimated e-waste generation (kg/capita)	12	23	4.2	7.7	4.6	8.4	5.0	9.3

Description of program options

Five basic options for structuring an e-waste program were identified and evaluated. Four options include an EPR component. The fifth option, which is product stewardship, public sector operated program, involves a publicly managed and operated program similar to the existing beverage container program.

The primary options which were reviewed are as follows:

- EPR with full producer responsibility for funding and operation

Producers would be given a legal obligation to collect and recycle designated end of life electronics in the NWT and meet program performance targets and reporting obligations. Final decisions on program design, funding, including any fees and how they are collected, and program operation would be a responsibility of producers themselves.

- Directed EPR

Producers would have the primary operational and funding responsibility for the EPR program, but the GNWT would prescribe key program elements such as possibly using the existing beverage processing and depot network for e-waste collection.

- Shared responsibility: Public Sector Operation with Full Producer Funding

The public sector would have full responsibility for the establishment, operation and direct costs of the e-waste program including the delivery of collected e-waste to a final processor and payment for recycling. Producers would be responsible to fund the program and would pay the public sector operators for their net program costs based on an agreed upon funding formula.

- Shared responsibility: Divided Operational Responsibilities/Collection and Recycling Split

Operational responsibilities for a program and the associated funding for operations would be divided between the public sector and producers. Producers would be given responsibilities for designated e-waste under an EPR regulation but with only a partial share of responsibility for overall operations and financing. The GNWT would determine the degree of shared operational responsibilities with each partner responsible to fund their own operational program element.

- Product Stewardship program: Public sector operation

The e-waste program would be operated as a stewardship program by government or an independent agency with no direct producer involvement in either program funding or operations. Funding would likely be achieved through the placement of visible fees charged to consumers at point of sale.

Costs and benefits of an e-waste recovery program

Costs of an e-waste recovery program

Operating and overhead costs are estimated based on Electronic Stewardship Association British Columbia (ESABC), Saskatchewan Waste Electronic Equipment Program (SWEEP), OES and

Atlantic Canada Electronics Stewardship (ACES) programs' reported costs per tonne[1]. The dollar values found in the programs' 2011 annual reports were used to get a minimum-maximum cost range. This enables the lowest and highest program costs to be taken into account when estimating potential program costs for the NWT.

Since the cost of living in the NWT is substantially higher than the Canadian average, the 2009 Cost of Living Statistics provided by the NWT Bureau of Statistics were used to determine how costs should be adjusted to the NWT specific context.

Overall program costs, including overhead and operating costs are estimated to range between $357,000 and $579,000 per year. Table ES-2 provides a summary of the estimated program costs.

Table ES-2 Estimated NWT Program Costs Summary

COSTS CATEGORY	COST ESTIMATE FOR NWT	
	MIN. ESTIMATE	MAX. ESTIMATE
Total Operating Costs	$1,323 / T	$1,720 / T
Collection	$251 / T	$308 / T
	$59,000 / yr	$73,000 / yr
Transportation	$382 / T	$605 / T
	$90,000	$143,000
Processing/Recycling	$690/ T	$807/ T
	$163,000 / yr	$191,000 / yr
Total Overhead Costs	$186 / T	$630 / T[2]
Administration	$115 / T	$280 / T
	$27,000/ yr	$66,000/ yr
Communication & Education	$67 / T	$288 / T
	$16,000/ yr	$68,000/ yr
Other expenses	$4 / T	$62 / T
	$1,000/ yr	$15,000/ yr
Total Program Costs ($)	$357,000	$555,000
Total Program Costs (Per Tonne)	$1,509 / T	$2,349 / T
Total Program Costs (Per Capita)	$8.60	$13.40

As an example for Year 1 of a program, when start-up costs are added to these figures, estimated program costs range from $371,000 to $594,000 for Year 1 of the program or $1,570 to $2,514 per tonne. Another way to express these costs is between $8.95 and $14.34 for each resident of the NWT.

[1] Those four programs were selected because cost breakdown was made available in their annual reports.

[2] Minimum and maximum overhead cost estimates correspond to the sum of minimum and the sum of maximum costs estimates for administration, communications and other expenses for the NWT as show on the lines below.

Benefits of an e-waste recovery program

The benefits of a collection and recycling program for NWT e-waste are described on the basis of benefits to the environment, overall economic activity and community awareness. Benefits are described in qualitative terms and not financial terms.

In terms of environmental benefits, recycling e-waste enables an overall lifecycle reduction in GHG emissions, reduces the need for extraction of new raw materials, extends the lifetime of landfills and reduces environmental and human health liabilities through the reduction of global e-waste loadings. Moreover, as demonstrated by the successful beverage container recovery program, e-waste recovery would provide additional social benefits by enabling local full and part-time employment which in turn builds local economies, promotes the environmental education and awareness of citizens as well as promotes a sustainable lifestyle.

Feasibility assessment of options

To facilitate a comprehensive and thorough analysis of the options previously described, the following methodology and steps were undertaken resulting in a quantitative ranking of the five options. It is upon this ranking and a subsequent discussion of program implementation issues that recommendations for the GNWT are built. The steps are described as follows:

Establishment of principles, goals and objectives

A set of core principles and goals and objectives for an e-waste program in the NWT were first identified in consultation with GNWT Environment and Natural Resources (ENR). The principles reflect existing GNWT environmental and waste management policy as set out the Waste Reduction and Recovery Act (WRRA) adopted in October 2003, policies expressed through operational waste diversion programs and further reflect the GNWT's adoption of the CCME's Canada-wide Action Plan for EPR in October 2009. The principles, goals, and objectives are:

Principles

- The natural environment continues to be protected and enhanced;
- The collection, recycling and environmentally sound management of electronic waste is a responsibility of producers with roles to be played by distributors, retailers and consumers;
- Adaptability and innovation are the foundations of waste electronic equipment best management practices.

Goals and objectives

- Maximize the recovery and recycling of electronic waste and reduce the overall volume of waste disposed to landfills;
- Implementation and operation of an electronic waste recovery and recycling program are revenue-neutral for the GNWT;

- All residents of the NWT have reasonable access to local electronic waste collection systems. The collection and recycling of electronic waste results in minimal impact to existing electronic equipment sales and existing recycling infrastructure;
- Increase the public awareness and understanding of multi-material waste recovery and recycling and encourage environmentally responsible and ethical purchasing;
- The recovery and recycling of electronic waste results in new local employment and economic development opportunities for residents;
- The NWT electronic waste recovery and recycling system is integrated to the extent practicable with electronic waste recovery and recycling programs in Alberta and British Columbia;
- Program design implementation and administration is simple and efficient, and can be effectively managed;
- E-waste collection and recycling operates transparently and meets established program performance measurement and reporting requirements.

Identification and weighting of evaluation criteria

Drawing on the principles, goals and objectives, a number of evaluation criteria were identified, grouped by program effectiveness, program efficiency, legality and program implementation. These criteria were also weighted with 15, 10 or 5 points out of a possible 100 to indicate their relative importance.

The evaluation criteria and the point weightings are set out in the table ES-3 below.

Table ES-3 Evaluation criteria and point weighting

CRITERIA CATEGORY	CRITERIA	POINTS
Program effectiveness 50	Ability to reduce and divert electronics from landfills, responsibly recycle e-waste, and meet targets	15
	Service to residents	15
	Ability to measure performance	10
	Program transparency and accountability	10
Program Efficiency 30	Least cost and risk for GNWT	10
	Impact on existing retail market and consumers	10
	Ease of administration and flexibility	5
	Respect for existing infrastructure	5
Legality 10	Regulatory authority	5
	Clarity of roles and responsibilities	5
Program implementation 10	Addresses municipal and community concerns	5
	Program communication	5
Summary score		100

Evaluation of program options

In a final step, the five program options were evaluated using the Holmes Ordinal Evaluation Method. The Holmes methodology has been used since 1971 and was developed and first used by the Jack Holmes Planning Group under contract to the UK Secretary of State for Scotland as a process for evaluating a number of proposed new road alignments. The process has been widely used, particularly in urban planning and development studies, to evaluate and rank various proposals and options. It is based on grouping criteria based on greater and lesser importance as and ranking options as 1st, 2nd 3rd place etc, against the criteria.

Once rankings are given for each evaluation criterion, each option is granted a number of points depending on the criterion's weight. The sum of the points equals a mark out of 100.

Summary Score

Table ES-4 provides a summary of the rankings obtained by each option for the evaluation criteria.

According to the evaluation of the five different program options, the directed EPR model ranks first, followed by the Product Stewardship/ Public Sector Operation, while the full EPR model places third. The Shared Responsibility options come in fourth and fifth places.

Table ES-4 Summary score of the evaluated program options

CRITERIA CATEGORY	CRITERIA	PRODUCT STEWARDSHIP: PUBLIC SECTOR OPERATION	SHARED RESPONSIBILITY : DIVIDED OPERATIONAL RESPONSIBILITIES/ COLLECTION AND RECYCLING SPLIT	SHARED RESPONSIBILITY : PUBLIC SECTOR OPERATION WITH FULL PRODUCER FUNDING	DIRECTED EPR	FULL EPR
Most important	Ability to reduce and divert electronics from landfills, and responsibly recycle e-waste	3	3	1	1	3
	Service to residents	1	1	4	1	4
Important	Least cost and risk for GNWT	3	3	3	1	1
	Impact on existing retail market and consumers	4	1	1	4	1
	Ability to measure performance	2	4	4	1	2
	Program transparency and accountability	1	3	3	1	3
Somewhat important	Ease of administration and flexibility	1	5	4	3	1
	Addresses municipal and community concerns	3	3	1	1	5
	Respect for existing infrastructure	1	3	3	1	5
	Regulatory authority	1	2	2	2	2
	Clarity of roles and responsibilities	1	5	4	3	1
	Program communication	3	5	4	1	1
Summary score	Out of 100	78	63	65	89	70

Option implementation issues

Regardless of the option chosen for the end-of-life management of electronics waste in the NWT there are a number of issues which cut across and are common to all of the options evaluated. These are issues largely related to option implementation and they will need to be considered as the GNWT determines the next steps that it wishes to take towards the development and implementation of an electronics waste program. In the case of each issue a set of key actions are identified as next steps.

Issue: Electronics Purchased Outside the NWT

Key actions:

- Initiate further study to determine the extent of NWT resident purchases in Alberta and secondarily in other jurisdictions;
- Approach Alberta Environment and Alberta Recycling Management Authority (ARMA) for discussion on fees collected from NWT residents;
- Initiate discussions with the Electronics Products Recycling Association (EPRA) and ESABC on the possible partnership of a NWT program with existing provincial extended producer responsibility programs.

Issue: Levels of service and public access to collection system

Key actions:

- Set a goal for the overall territorial level of public access (percentage of population to be served by a program);
- Develop standards for the provision of service to the various sizes of community in the NWT (type and frequency of service to different size communities).

Issue: Building on existing recycling infrastructure

Key actions:

- Undertake a detailed review of the capacity and possibilities of the existing beverage depot and processing network being used as a basis for an e-waste collection system;
- Develop depot standards and operational and management terms and conditions to operate a depot.

Issue: Transportation Logistics

Key action:

- Identify companies available and qualified to provide transportation services by barge, air and road (year round and winter).

Issue: Cost internalization or visible point of purchase fees

Key action:

- Review the legal authority necessary to mandate cost internalization of fees along similar lines to the approach taken by Quebec.

Issue: Return to retail

Key actions:

- Recommend in the guidance for stewardship plans that return to retail be considered;
- Review any applicable regulations which might have a bearing on the operation of a return to retail depot.

Issue: Phasing in program options

Key action:

- Develop the listings of designated products and their phasing based on comparable implementation steps taken in British Columbia.

Issue: E-waste processors and end markets

Key action:

- A standard for e-waste processing should be established or referenced and used as the benchmark for selecting e-waste processors for all materials collected in the NWT.

Issue: Historic and orphan products

Key actions:

- Work with public institutions, businesses, government departments and communities which may have significant stockpiles of waste electronic equipment in order to reduce the quantities of waste EE prior to implementation of any recovery program.
- Ensure that provision is made for handling extra volumes at the beginning of a program and make addressing this issue a requirement of any stewardship plan.

Issue: Program Development and Oversight

Key action:

- The GNWT should review its existing resource and staff capacity to develop, implement and oversee an e-waste program and determine what capacity is required if current resources are not sufficient.

Issue: Performance Measurement and Reporting

Key action:

- Existing key performance indicators and auditing protocols are available from other e-waste programs to adopt as the performance measures and reporting protocols for an e-waste program in the NWT.

Issue: Reduction, Reuse and Refurbishment

Key action:

- That stewardship plans required by the GNWT must address reuse and refurbishment and that an e-waste program includes support and encouragement, as is done in Ontario.

Conclusion

The two main objectives of this report were to conduct an inventory of existing and future electronic equipment in the NWT and to assess the feasibility and options for addressing electronic waste. In summary the report first focuses on defining the main issue parameters and the development of an e-waste inventory and a methodology, including sales estimates, historic and future e-waste quantities per product category. This allows a determination of the quantities available for collection and recycling, now and in the future. The current state of e-waste management and the other available recycling infrastructure in place in NWT is also portrayed.

The review of different e-waste and comparable initiatives in other jurisdictions and in remote communities confirmed that there was only limited directly applicable or comparable program experience elsewhere that could be applied to the NWT's situation. This review also made possible the drafting of product designation phase-in and timeline setting for program implementation. The authority provided under the *Waste Reduction and Recovery Act* as well as other Canadian regulatory frameworks regarding stewardship and EPR programs were also reviewed.

Five e-waste program options were then fully described and assessed using 12 evaluation criteria and a series of issues to be considered in the specific NWT context were presented.

The primary conclusion of the study and the analysis presented is that the GNWT should consider the establishment of a regulated EPR program for e-waste in the NWT following the Directed EPR model. This option offers the financial advantages to the GNWT of full EPR while allowing public control on the way the program is implemented.

The following concluding sections draw together the key findings of the feasibility assessment, list some final recommendations for implementing an e-waste collection and recovery program in NWT and suggest priority next steps to be followed to facilitate program implementation.

Key Findings

Legislative and regulatory framework/ Cost internalization

The ability of the GNWT to mandate the establishment of an EPR program needs to be confirmed with NWT legal services. A regulatory framework to allow an establishment of a Directed EPR program will need to be developed by GNWT and it would need to include the service requirements acceptable to the GNWT that will ensure communities across the NWT's five regions are provided with an appropriate level of e-waste recycling service and an appropriate level of public access.

Visible point of purchase fees to support the operations of an e-waste collection program applied only on purchases made in the NWT through internet sales and from NWT retailers may not be sufficient to cover the entire cost of such program in the NWT given the significance of electronic equipment purchased outside the NWT. It is recommended that a cost internalization approach, as adopted in Quebec and in New Brunswick for paint and for electronics in Quebec be considered for a waste electronics program in NWT..

Product category phase in

It is recommended that a new end-of-life electronics program be implemented in at least two phases. The ESABC experience suggests two phases and two groupings of product categories:

- Phase 1: Display devices, Desktop computers, Laptop computers, Printers/Fax machines/Peripherals;
- Phase 2:. Portable Audio/Video and Recording, Home Audio/Video Systems, Home Theatre in a Box, Cellular phones, Non-cellular phones, After-market vehicle audio/video systems.

It is recommended that discussions be initiated with public institutions, businesses and communities who may have significant stockpiles of waste electronic equipment in order to reduce and schedule the quantities of end-of-life electronics prior to implementation of any recovery program. It is recommended as well that a Directed EPR e-waste program make provisions to handle extra volumes at the beginning of the program.

Collection, transportation and processing of materials

Collection

Managing e-waste in all NWT communities appears feasible. However, because of wide variations in community size, facilities and local resources variations in the level of collection service will need to be developed and offered. Depending on the program model chosen or mandates required by the GNWT, existing infrastructure, such as Beverage Containers Depots, and return to retail may be used in an e-waste collection program. It is recommended that goals or mandates be set in the regulations and/or stewardship plan requirements for the overall level of public access.

It is suggested as well that depot standards, operational and management terms, and conditions to operate a depot be developed based on EPRA's Collection Site Approval Program (CSAP).

Transportation and processing

Transportation will be an important part of program expenditure. Means to mitigate transportation costs include preferred backhaul rates, which exists with some shipping companies, sufficient volumes, proper materials handling and careful shipment planning. Under the Directed EPR model producers would be entirely responsible for transportation costs and logistics. It is recommended that companies qualified to provide transportation services and that options to combine shipment of waste electronic equipment with collected beverage containers be investigated.

Standards for reuse, refurbishing and processing

Any stewardship plan required by the GNWT should address reuse, refurbishment, and recycling in a similar way as the current approach in Ontario, and using a similar facility approval approach as the EPSC standards for processors. It is recommended that such standards be used as the benchmark for selecting e-waste processors for all materials collected in the NWT.

Roles and responsibilities

In a Directed EPR program the following are the core elements and requirements that must be addressed by producers in a producer responsibility program:

- Full producer responsibility for program management and operation costs so that costs are not borne by government or taxpayers;
- Follows the 3R hierarchy, i.e. reuse the material before it is recycled;
- Respects environmental objectives and requirements;
- Consumers are offered equitable opportunities to participate in the program regardless of their location with service and access standards set by the GNWT;
- Orphan and historic products are managed by the program in the same fashion as all waste electronics;
- Reporting based on CCME's CAP for EPR performance indicators;
- Communication initiatives to ensure public awareness and support participation.

Under a Directed EPR program the following are the key responsibilities for GNWT:

- Develop a clear regulatory framework and requirements for stewardship plans;
- Provide staff resources to support the program's development and implementation and, subsequently provide for the continuing program oversight;
- Ensure NWT communities have reasonable access to collection without charge;
- Ensure environmental objectives and program performance measures and targets are met;
- Provide guidance on stewardship plans and EPR program elements as set out in the CCME Canada-wide Action Plan for EPR.

Recommendation for Priority next steps

In conclusion the following priority next steps for program implementation are presented for consideration:

- Verify legal authority and initiate any of the changes that might be necessary;
- Review GNWT's existing resource and staff capacity to develop, implement and oversee an e-waste program and determine if any additional capacity is required;
- Undertake a detailed review of the existing capacity and potential for the beverage container depot and processing network to be used as the foundation for an e-waste collection program;
- Investigate companies for transportation and haulage opportunities and prices;
- Initiate discussions with Electronics Product Recycling Association (EPRA) regarding possible development of an NWT EPR e-waste program;
- Investigate and set service and public access standards for collection;
- Initiate discussions with Alberta Environment and ARMA regarding fees paid on products sold in Alberta but used and recycled in the NWT.