



**Selkirk District Community Learning Centre
Responsible Electronics Recycling
e-Waste End Of Life White Paper**

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e-Waste

Electronic Waste, or e-waste, is the term commonly used to describe old or broken, end-of-life electronic equipment. There appears to be **no** generally accepted universal definition of e-waste. And so, the task of e-waste collection and disposal is often confusingly different by country, state, province, local municipality or even municipal landfill management and staff.

In most cases, “e-waste is comprised of relatively expensive and essentially durable products used for data processing, telecommunications or entertainment in private households and businesses.”¹

The very first hurdle in any discussion of e-waste is to find the appropriate definition as e-waste used as a generic term embraces various types of waste containing electronic components.

Electric Waste

Electric waste, commonly known as white goods, encompass an array of items such as washing machines, vacuums, refrigerators, ranges, microwaves, lighting equipment and other small and large appliances. Although they may have electronic components the bulk of electric waste products require an entirely different recycling method and are therefore intentionally excluded from many e-waste collection efforts.

Electronic Waste

E-waste in most cases focuses specifically on computers, monitors, television sets, hi-fi sets, mobile phones, personal digital assistants (PDAs), game consoles and controlling electronics from industrial sources. Complicating electronic waste collection and disposal is the issue of cabinetry removal. The related demanufacturing process is time consuming and yields large quantities of woods, metals and plastics, which in turn must be disposed of. Some jurisdictions do not think of TVs and Hi-Fis as e-waste and treat it as Electric Waste. However, most acknowledge that entertainment centres of today are more electronic than electric. Currently there is no central facility for demanufacture of e-waste that specifically takes into account the “bulk” of cabinetry. It remains an inefficient, expensive and problematic disposal problem.

Forward Thought:

Bulk removal of the non-toxic components from waste stream must include the extra costs associated with shipping and handling.

¹ http://www.ewaste.ch/welcome/ewaste_definition/

Grey Waste

From these brief descriptions it is easy to visualize the many “grey” areas where electric and electronics appear to be very much alike. Examples of grey area goods include calculators, musical instruments (keyboard, soundboards, Audio Visual equipment), fish finders, metal detectors, electronic watches and clocks, remote controlled toys and health monitoring devices. Classification of these items into an appropriate area and determining a responsible disposal method remains a concern. Grey waste is hard to classify and it does not easily fit into the “first seller” category as well as e-waste or electronic waste does. While not often considered a major waste item it does add considerably to the waste stream and it is just as toxic as other “e” wastes.

E-waste, by any description, contains both valuable as well as harmful materials and the responsible, complete recycling of these materials requires special handling and recycling methods. Thus, and in short, ***the motive for recycling must go beyond “profit” and move through to complete, responsible product recycling.***

E-waste in Manitoba

Manitoba has not yet (2006) provided a clear definition of e-waste. The definition will be constructed and refined through the product stewardship and policy exercises now being undertaken by provincial regulators and various other organizations.

However, Manitoba is aligning itself generally with Western Canada and the Saskatchewan model so the list of e-waste products will include:

- Televisions
- Computer monitors (CRT and LCD)
- Computer boxes containing CPU, motherboards, cards, etc.
- Computer accessories: mouse, keyboard, cables, desktop computer speakers
- Laptop and notebook computers
- Desktop printers and printer combinations, such as desktop printers with faxing and/or scanning capabilities.

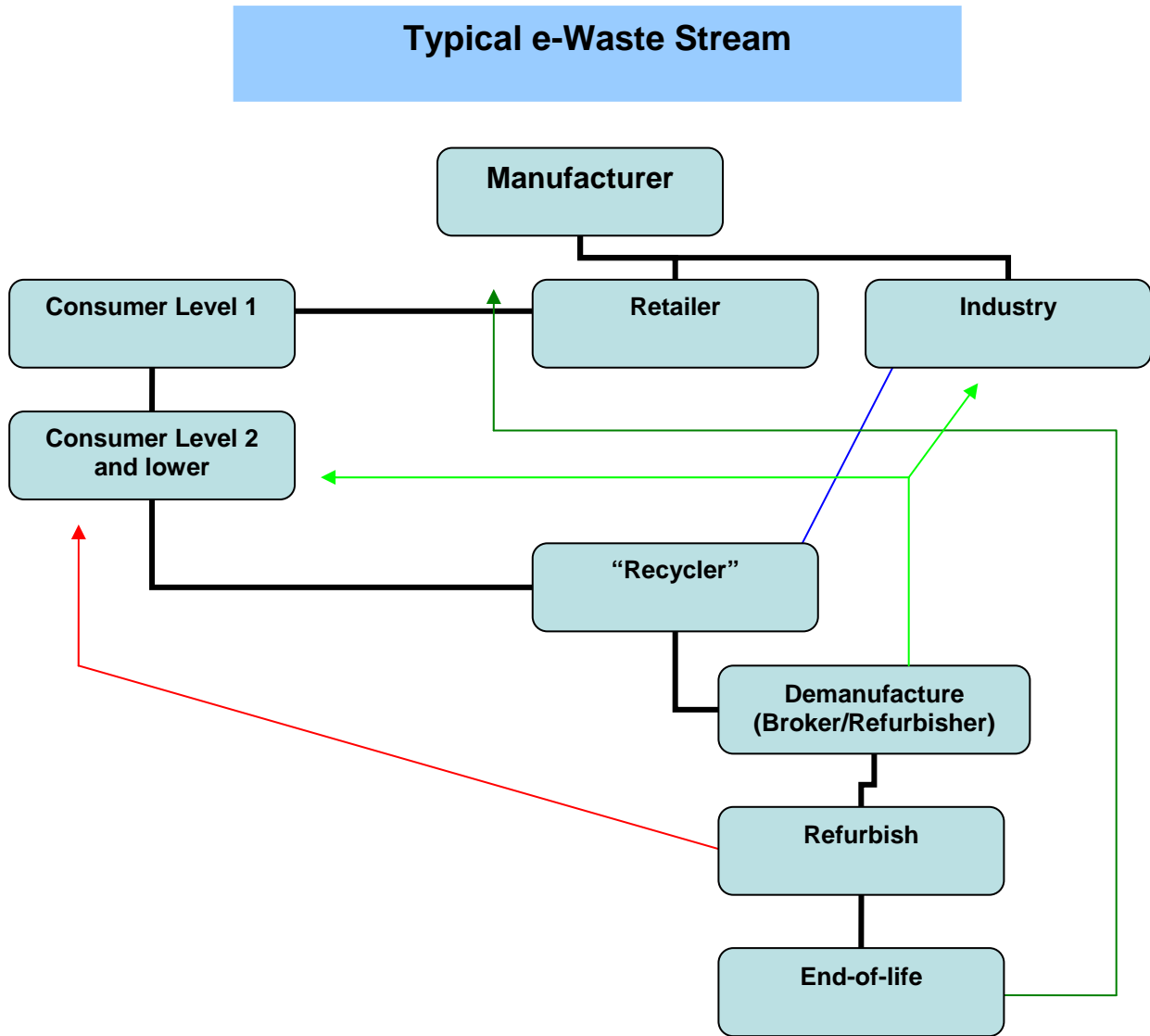
Recycling Defined²

While not a definition the following quote does offer insight to what a modern view of recycling is: “Recycler is a catch-phrase for a company providing a number of different services and processes. Consolidators and recyclers engage in ***asset management***. First, they perform a triage on products received, not just electronic equipment, sorting products into ones that can be reused or refurbished, then sending the rest to be demanufactured into component parts that can be resold, and then processed further into individual commodities, such

² www.technology.gov/reports/2006/Recycling/Beg-Appendix7.pdf

as ferrous, non-ferrous, plastics, glass, and metals.” In this report the term “recycler and recycling” may mean any or all of the functions of e-waste handling, and must be taken within the correct context of the specific wording, sentence or paragraph referred to.

Following this example of a definition, we can visualize the logical movement of product through the flow chart:



- The heavy black line indicates a typical manufacture to consumer flow of electronic products.

- The red line indicates a flow back to consumers at the level two or lower range. Level one consumers tend to buy new and are not as likely to purchase refurbished electronics.
- The blue line indicates a flow back to industry from the recycler. This flow back occurs when recycled raw materials are reused by the manufacturer to create new product.
- The light green line indicates a flow back from the demanufacturer of component parts that will be used by consumer to customize or refurbish existing product or by industry, who will use the components for other purposes.
- The dark green line indicates the flow back from end-of-life to the manufacturer.

Forward Thought:
The component value for reuse and refurbishment
of electronic products
increases as volumes increase
and as the **age of the products decrease.**

Demanufacturing in Manitoba

The current capacity to demanufacture in Manitoba is limited, as there are few organizations or companies actively involved with the collection and disposal of e-waste. Recyclers of the by-products of e-waste are more numerous.³ However, there are some serious gaps in local recyclers and scrap merchants; a major gap includes monitors and TV tubes, which remain problematic. As well, although many are interested in saleable scrap the most harmful components are still often dumped⁴ after the easily resold components are removed.

The local capacity varies for those actively involved in e-waste recycling and demanufacturing:

- Syrotech Industries – Syrotech Industries is Manitoba’s leader in e-waste handling and has a long history of e-waste recycling involvement. They operate from several locations with the primary e-waste location on Higgins Ave. Syrotech is enthusiastic and supportive of proper e-waste end-of-life disposal and has experience that is unmatched and well respected by most. Syrotech exports approximately 65% of all waste, the remaining 35% is harvested for resale or delivered to local metal merchants and smelters.

³ See Appendix A Manitoba Recyclers

⁴ “dumped” is a catch-all phrase that includes further recycling by process (grinding up), landfill disposal, or incineration amongst others

- Powerland – Powerland is a local computer manufacturer that has made refurbishing computers a priority. Their recycling program is primarily geared to their own products but they will accept other products for refurbishment as well. The main thrust of their efforts goes into reuse of older computers, which they sell for a reduced price. Their capacity is limited to their own facilities and staff members who work on the refurbishment of computers when they have time. Materials not utilized internally are deposited in the landfill.
- Computers For Schools and Libraries – Computers For Schools (CFS) is by necessity involved in the end of life disposal of e-waste. They specifically deal with computers and computer peripherals that are mandated to be given to them by government (primarily Federal), school divisions and some corporations. From the received units, usable systems, parts and pieces are salvaged for reintroduction to the population as refurbished computers. The leftover materials are considered to be at end-of-life and are disposed of to recyclers. The bulk of these recyclable materials (nearly 100%) are exported out of province.
- Responsible Electronics Recycling – Responsible Electronics Recycling operates in Selkirk, Manitoba. Its mandate is to keep electronics out of the landfills in the St. Andrews and Selkirk region. They remove electronics from the landfill to their storage compound. They also accept e-waste delivered to their location at 511 Robinson Ave. in Selkirk. Primarily they function as a depot but do perform limited demanufacturing to salvage usable computer components for their sister-project the Computer Lending Library.
- Computer Lending Library – Operated by the Selkirk & District Community Learning Centre the Computer Lending Library accepts computer system donated to them. These computers are refurbished and returned to the population through a lending program. The computers on loan must be returned to the CLL once the loan period has expired. If deemed at end-of-life when returned they are passed through to their associate program RER, which assumes responsibility for proper end of life disposal.
- Thomas Sill Foundation – The Thomas Sill Foundation sponsored and supported the EPSOM recycling pilot program and study. The program and subsequent study provided valuable statistics and data on recycling e-waste in Manitoba. Thomas Sill also sells a limited number of legacy computer systems, they are sold for nominal fee (\$150 - \$250)
- Producer participants of Extended Producer Responsibility (EPR) have a presence in Manitoba by virtue of their sales into Manitoba. HP, IBM, Apple, Mind, Panasonic, Epson, Toshiba, Lexmark, Dell, Compaq and many others already accept product returns at end of life for product produced by their plants. In most cases information is easily obtained from their respective websites and it is often included in the post sales information provided at product delivery. In many cases there is no cost attributed to the consumer for the return.

Demanufacturing Defined

Demanufacturing reverses the original manufacturing process. Demanufacturing is done so that the items taken apart can be separated into basic components for the purpose of recycling, refurbishment or end-of-life disposal.

In the electronics industry this could mean simply separating the metals, plastics and non-metallic components from each other, or it could be a more involved process that would separate the components even further. Sophisticated demanufacturing would involve processes as complex as de-soldering diodes and chips from resin based boards for reuse in other applications. For clarity a class structure is applied:

- Class One - Simple demanufacturing (simple break apart, screw removal, etc.) can be considered a low skill task.
- Class Two – Moderate skill levels are required to discern valued components from those with little or no value (assessments are made).
- Class Three - Complex demanufacturing is considered a high skill task (chip removal, cutting, soldering, capacitor discharging).

Although there are several companies who claim to recycle e-waste, true and sizable demanufacturing is currently practised by three easily recognized organizations:

- 1) **Syrotech Industries** – Syrotech has a dedicated staff level of 4 - 5 persons doing this work on a year round basis. Syrotech practises in Classes One, Two and Three. Syrotech operates under the Broker, recycler and demanufacture models.
- 2) **Computers for Schools** – CFS has several funded⁵ programs that supply resources for labour to demanufacture/refurbish systems entering their organization that are assessed to be at end-of-life. The demanufacturing is at Class One and some Class Two, but by their own description the activities CFS undertakes are more clearly defined as “brokering e-waste” (see description following). Staffing ranges from 4 to 20 depending on the level of funding achieved, and the level of satellite operations underway at any given time.
- 3) **Responsible Electronics Recycling** - Electronics entering RER are assessed as reusable, recyclable or at end-of- life. Reusable items are presented to Computer Lending Library (CLL) for distribution, recyclable items are refurbished and then presented to CLL for distribution and end-of-life items are forwarded to other recyclers for disposal. RER operates at Class One and Two and

⁵ Government, NGO, organization or corporate funding is provided towards the employment of technicians and the activities of recycling or demanufacturing

more closely follows the “brokering” model as does CFS. RER operates on a volunteer level and currently has no employees or staff.

Brokering e-Waste in Manitoba

Brokering e-waste is very similar to demanufacturing and warehousing. It involves both activities; the end net result is the e-waste is moved (in most cases exported) to true recyclers after a storage capacity limit is reached.

Other Recyclers⁶

There are other computer recyclers and their contribution to Manitoba’s recycling capacity while worthy is not significant in the overall scheme. Most have a definite profit motive and are retailing the recycled units or components. They for the most part use internal staff labour and are not considered high volume recyclers. An estimate of workers officially involved in this capacity is 20 throughout Manitoba.

Forward thought:

In Manitoba we tend to use our own existing recyclers who generally have the labour and equipment to do only minor recycling tasks

Remanufacturing

Remanufacturing is a by-process of demanufacturing and recycling. It is similar to refurbishment with the exception that remanufacturing involves the possible repair or replacement of components. Remanufacturing also implies the end product may have a different use than the one it started out with. Example: A common use of older web and file servers is to convert them to IP Telecommunication devices, firewalls, auto-answering devices and function-control devices in industry and farming applications.

Forward Thought:

No recycler wants just the junk.

Pure junk is often worthless or costs too much to recycle.

The entire product may be worth demanufacturing but only if you deal with the complete item from start to finish, thus allowing some profitable or reuse exercises along with the costs of disposal.

If not, you will simply end up paying someone else to take the junk off your hands.

⁶ See complete list of recyclers and stated capacities at the Manitoba Government site at: <http://www.gov.mb.ca/conservation/pollutionprevention/hhw/computer.html>

*Understanding Consumer Electronic Usage and Waste*⁷

Facts that assist in understanding consumer electronic use and waste:

- 89% of Canadian households have telephones
- 74% of Canadian households have CD players
- 60% of Canadian households have VCRs
- 54% of Canadian households have Colour Televisions and 21% had more than 3
- 54% of Canadian households have at least one computer in Year 2000
- Life span of a computer before disposal is typically 3 - 6 years
- Projections exceed 17,583 tonnes of computers will be disposed of in 2002⁸
- Projections exceed 18,231 tonnes of colour computer monitors will be disposed of in 2002
- Projections exceed 1,171 tonnes of telephones will be disposed of in 2002

Typically, the personal computer (PC) of today contains:⁹

- 40% Steel
- 40% Plastics
- 10% Aluminium
- 10% other metals such as
 - Copper
 - Gold
 - Silver
 - Cadmium
- Monitors add glass and lead to the components.

The recycling process on end-of-life electronics may separate the various components into the materials listed above. These materials are further utilized in several ways:

- Steel is sold to mills where it is melted down for remanufacture into cars, steel beams and miscellaneous metals.
- Aluminium is used to make aluminium cans and foils.
- Precious metals are sold to chip makers, jewellers and dentists.
- Other metals such as copper are used in the manufacture of copper wire and pipes.
- Lead can be used in the creation of car batteries and film.

Monitor glass is more difficult to recycle because many monitors used leaded glass. Leaded glass is crushed and may only be used in such products as asphalt for roadwork. Non-leaded glass can be more easily utilized; it is crushed and often used to make new glass.

⁷ Stats Can 2003 Canada wide Statistics

⁸ ec.gc.ca/nopp/sustainable/itwaste/trend_table_e.gif

⁹ www.bhs.k12.nj.us/colhomepage/component2.htm

Plastics from older electronics may have paint (colours) or other finishes in them that make them unsuitable for general reuse. Even clean plastics from electronics are not easily reintroduced to the consumer and often end up in roadbeds as filler.¹⁰

In reviewing past pilot program outcomes it is noted that the weighted average of all collection programs was comprised of:¹¹

- TVs (36%),
- audio and stereo equipment (16%),
- monitors (11%),
- computers (8%),
- VCRs (6%)

Key Issues for Manitoba

- 50% of Manitoba households had at least one computer in 1998¹²
- Life span of consumer electronics before disposal is 3-6 years
- There is an inherent rapid obsolescence due to technology advances and demands
- Hazardous components are currently land-filled or incinerated and only small portion of materials are currently recycled

Reviewing the Results of Previous Programs

- The cost of collection per pound of material collected varies from less than \$0.10 per pound to \$0.50 per pound.
- The net costs of the programs were largely driven by the de-manufacturing costs, the shipping costs and final disposal.
- In terms of pounds of material collected per resident, the curbside collection programs appeared to be more efficient while the one-day collection events appeared to be the least efficient.
- Other received equipment consisted of:
 - keyboards (5%),
 - printers (4%),
 - telephones (3%),
 - computer peripheral devices (1%); and
 - miscellaneous other equipment (9%)
- Items that contained CRTs (e.g., televisions and monitors) predominated.
- Promotion and planning were essential to the effectiveness of the program.
- Most of the equipment collected was outdated and in poor condition, so it was expensive to handle and had low “scrap” value
- Items that contained CRTs drove up the program costs.

¹⁰ Even this application is being questioned as the shredded by-product has been associated with leeching into the sub soils even if it is embedded in concrete or asphalt.

¹¹ EPA-901-R-98-003

¹² Environment Canada EEE Waste

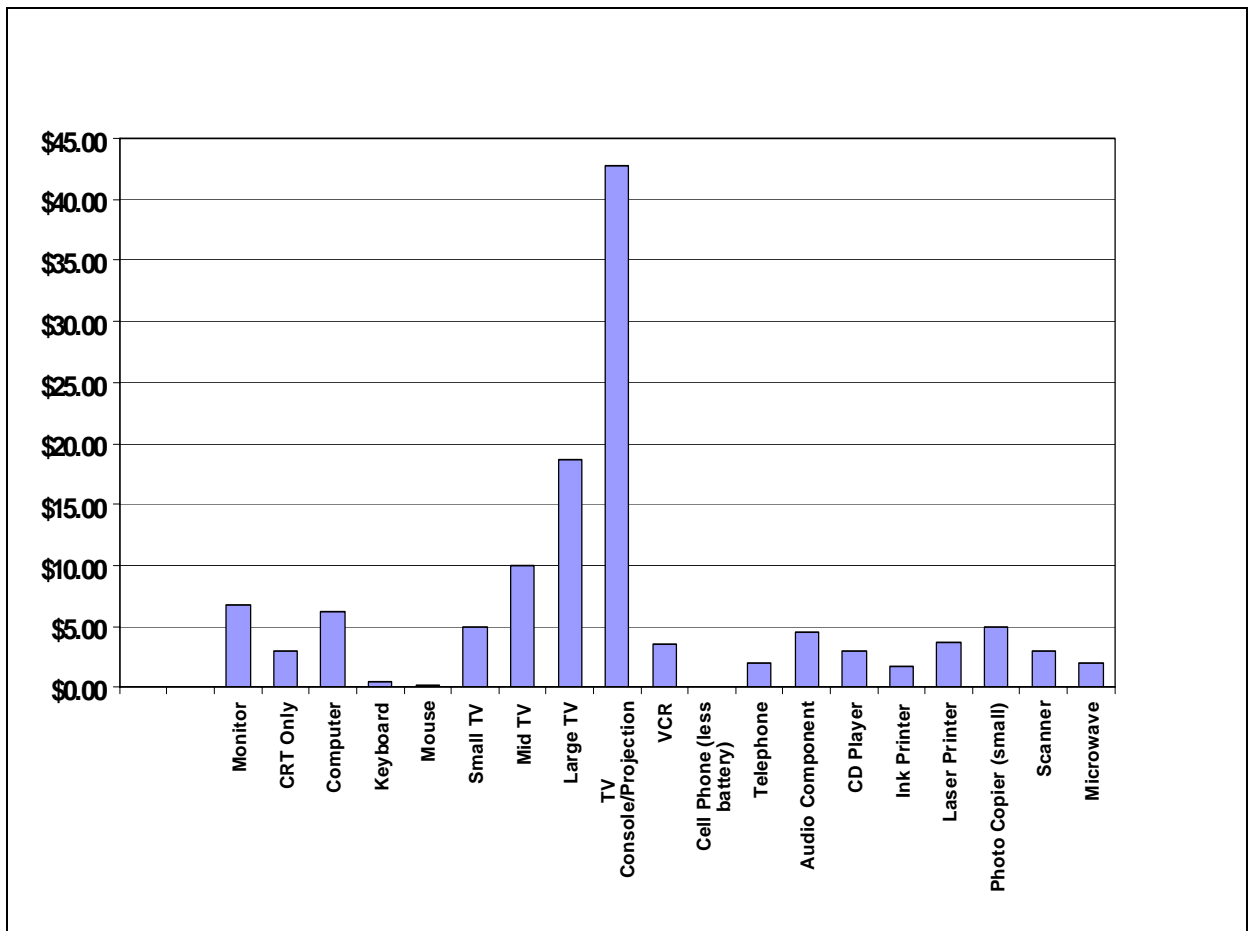
Typically in North America, the cost to recycle many of the consumer electronic items is much higher than it is for exporting them to other countries (which today is becoming a more common and environmentally ethical practice¹³), or when compared to the cost of providing and maintaining landfill sites for waste disposal. When electronics are shipped out of country for recycling or disposal it is often feasible to do so for the receiver due to the precious metal and metal content and the less expensive labour costs, and, within the past several years an apparent advanced recycling technology level has developed in the receiving countries.

However, there may still be concerns with exporting (shipping out) because once a product leaves the country it is out of the jurisdiction of the shipping country and there may be little or no control on the actual method of recycling or final disposal that can be or is documented.

¹³ In China some “plants” are now claimed to be certified and licensed to do demanufacturing and recycling of electronics; these plants must pass strict environmental testing and comply with employment standards. Some argue this is not the case and diligence is required in making this decision.

Chart One - Typical Consumer Electronic Items

Estimated Cost to Recycle¹⁴



General rules that can be applied to consumer electronics disposal:

- The larger the item, the more it will cost for disposal and/or recycle
- The heavier the item, the more it will cost for disposal and/or recycle
- Items containing glass, particularly CRTs, are more expensive to dispose of or recycle
- Certain items such as batteries and CRTs contain dangerous levels of lead and other metals that can contaminate the environment during recycling and during final disposal processes. Handling of these materials is normally conducted in a contained environment so cross contamination and human exposure cannot occur.
- It would be difficult for one facility to accommodate complete recycling of all consumer electronics because there are too many individual components, many that require a sophisticated disassembly process.

¹⁴ Table is taken from Cathedral Group Recycling Facility Study of **2002**. These figures for the most part are still accurate with the exception of monitors; these have risen to nearly 2X what they then were to approximately \$30 each, depending on where they are sent.

Employment for Manitobans

Currently, Manitobans are finding only limited opportunities in this emerging(?) industry. There may be potential for greater opportunity but as is commonly believed, not until the volumes of e-waste are increased substantially. Like mining where the amount of ore needed to make an ounce of mineral is enormous, recycling is dependant on large quantities of raw materials to be profitable. *Manitoba alone will not likely ever have the critical mass required for a sustainable e-waste recycling initiative.*

The workforce involved directly in recycling e-waste is minimal, estimated at approximately 40 workers in Manitoba. Of these, approximately 30 workers are employed by the top three or four main players in the industry while small individual operators make up the rest. However, there is a growing group of related industries and their workers that are seeing opportunity. This group of related industries may have a negative impact on the core industry as they tap into the overall profitability of the industry by “siphoning off” prime product(s) or components before they end up with the true recycler. Also, there is no guarantee that the leftover materials that are deemed to have little value are adequately disposed of (may end up in landfills or incinerated). The loss of profit to the recycler is mounting and will become even more significant if e-waste components gain value. And the landfills may still receive harmful waste.

Forward Thought:

Most recyclers rely on receiving e-waste intact and whole, before all the value is stripped away and only true waste remains.

Employment Opportunities

There are at least two views on capitalizing any Manitoba employment opportunities for this industry:

- 1) Strengthen the existing recycling industry and enhance the current workforce with additional training; a non-competitive environment
- 2) Augment the industry by developing a specialized and trained workforce and organization that is keyed to the specific needs of a demanufacturing industry; a more competitive position

Either way, the results need to be sustainable for at least the short term, justify the need, and be measurable as a value added. There are key reasons to believe that employment in e-waste recycling may be best viewed as “jobs” and not necessarily “careers,” when discussing e-waste recycling. This has much to

do with the issue of legacy waste and the hoarding cycles that consumers are prone to.

The Short Term

It is well documented that there is a mass of great volume of e-waste in our basements, warehouses, storage buildings and garages. There are varying and different estimates but what is agreed on is that this legacy e-waste will be some of the first to enter the waste stream when e-waste programming is announced. Some estimates state that in Manitoba alone there is more than 15,000 tons of legacy consumer e-waste.¹⁵ The EPSOM study of 2002 delivered over 93.5 tonnes of e-waste over a 2-day, event styled collection period. The bulk of this e-waste was made up of legacy materials and the majority consisted of televisions and other household electronic units.

Once the legacy materials are passed through the recycling system there will basically be only new stock turnovers to contend with. Although this is still a substantial amount of e-waste, the quantity does not support the development of a sustainable long-term, Manitoba-based industry investment. Long-term capacity can only be given passing consideration. The problem of e-waste management on the other hand must be dealt with sooner rather than later as the amassed amounts continue to grow. Thus, a short-term view may be a prudent choice. The short-term approach allows us to:

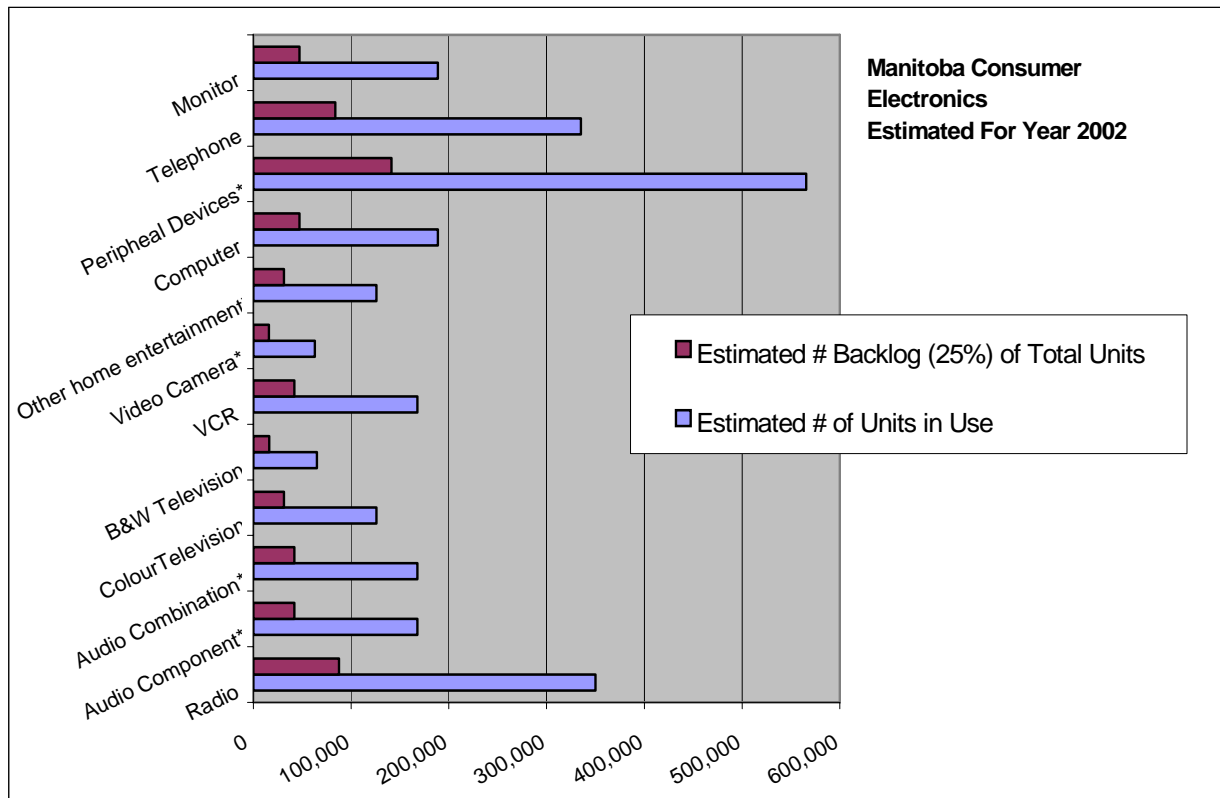
- Address the issue
- Conduct further research
- Build a sustainable local capacity if warranted
- Conceive a realistic long-term strategy if warranted

Forward Thought:

Manitoba may not have the critical mass
(i.e.: enough consumers and the related e-waste generation)
to support more than one full-scale e-waste recycling operation.

¹⁵ See Chart Three for breakdown Note: this is a Consumer Stat and does not include any industrial, educational or government assets.

Chart Two – Manitoba Consumer Electronics 2002¹⁶



Note: Backlog indicates legacy units

The Manitoba position of adopting a Product Stewardship and Extended Producer Responsibility (EPR) model should ensure that further entries into the e-waste stream are accounted for by the manufacturers and/or retailers. While this lessens the burden on the local environment in the long-term, it will also affect the recyclers gearing up for operations under any new stewardship programs as a purge of legacy e-waste is inevitable. **Therefore, the view of short-term should be thought of as the time it will take to purge the local legacy waste;** and that is estimated to be 3 to 5 years, based on processing 3,000 tonnes per year. If processing capabilities exceed that then the time line is shortened accordingly. One notable industry participant now processes in excess of 20 tonnes per month and has room to expand if necessary (meaning should volumes increase).

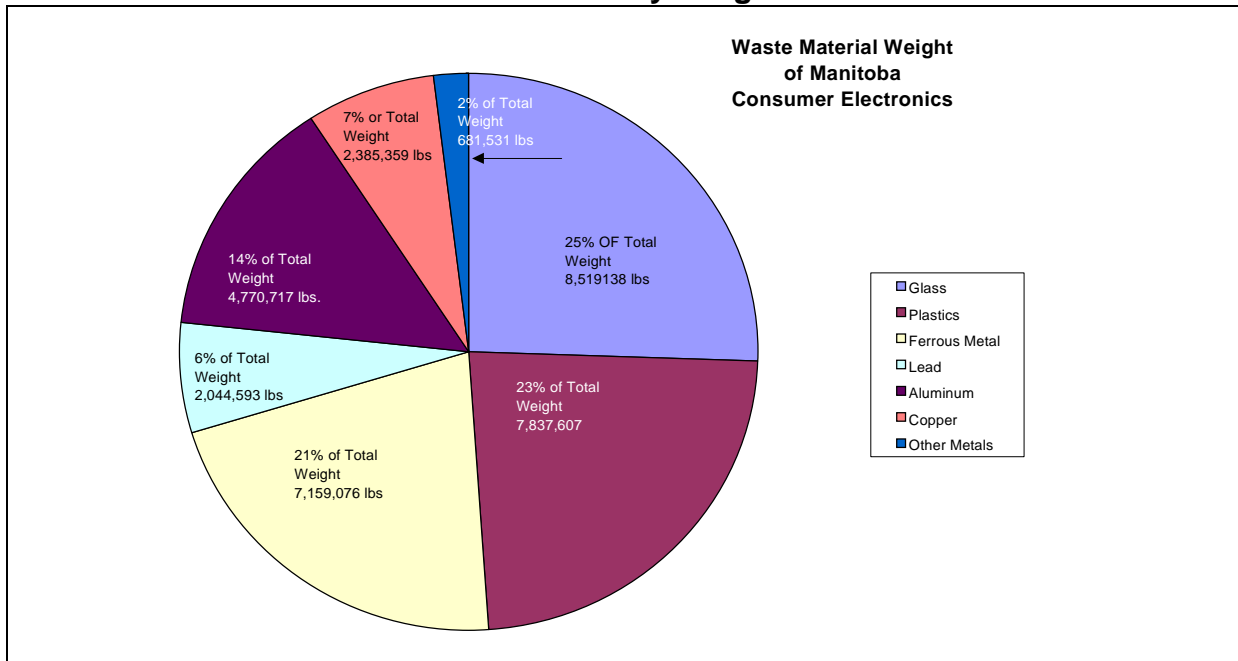
Forward Thought:

Legacy (now stored) e-Waste in Manitoba could be processed in 3 to 5 years.

¹⁶ Chart data taken from Cathedral Group Recycling Facility Study worksheets

Competition while not yet a major concern for current participants in the local demanufacturing and recycling industry, may become a major concern. As legacy waste is brought through the system in the projected large amounts and then, after the purge will come the anticipated reduction in volume. The small or inefficient operators may soon succumb due to lack of product.

Chart Three - Manitoba Electronic Waste by Weight



Space Requirement

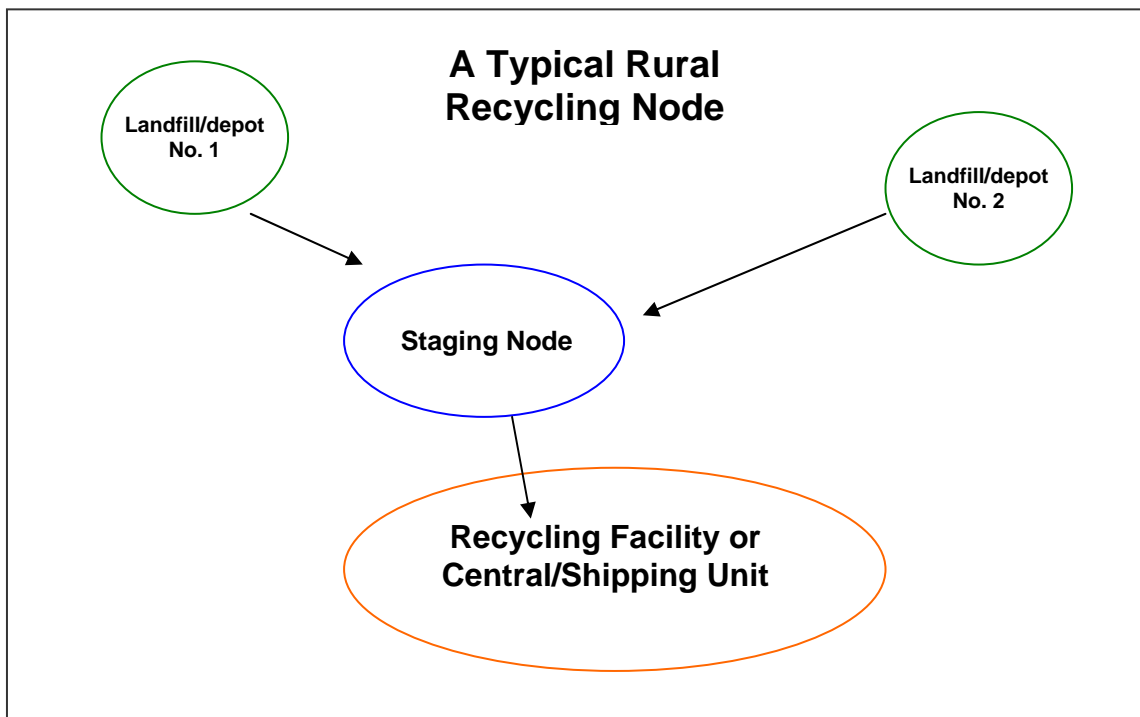
Recycling consumes much physical space. As many as three separate locations may be required for each collection point outside of the central unit(s); these may be termed “typical recycling nodes.” Rural locations will likely require drop-off depot(s) and a staging area, where items are sorted and packed for shipping to the central unit.¹⁷ Responsible Electronics Recycling¹⁸ (located in Selkirk, Manitoba) operates in a typical node fashion; e-waste is dropped off at the landfill (2 are located in the region) as well as the central drop-off point which is also the staging area. From the staging area the e-waste is stored and sorted and packed for transport to the Winnipeg located recyclers or shippers. RER undertakes some demanufacturing at the staging area to harvest raw materials required for the sister program Computer Lending Library. Worthy of note is that much of the component value is already removed by the time it is retrieved from the landfill or is dropped of at the staging area; as well the vast majority of dropped off e-waste is legacy waste with little component value. A point to

¹⁷ Supported by the EPSOM report of 2003

¹⁸ RER is supported in part by the R. M. of St. Andrews

consider is “What is happening to the removed components? When and how will they end up in the waste stream?”

Manitoba has limited recycling capability.¹⁹ Nearly all of our e-waste is shipped out of province; the exception is the metal content. Several Manitoba companies can recycle metal to some degree but two of the largest are Gerdau Ameristeel and Ancast Industries. Of the approximately twenty recyclers listed in Manitoba only one specializes in complete e-waste recycling. Four others do partial e-waste recycling that is best described as demanufacturing or brokering; all five have worked together to some degree. As previously mentioned there a number of periphery players, but these are not classed true recyclers.



Typically a node will have these space requirements:

- One or more 10'-0" x 20'-0" fenced enclosures to contain drop-off electronics. These would not require weatherproofing ***if*** the pickups are scheduled so as not to allow an over accumulation of e-waste and prolonged exposure to the elements.
- 2,500 square feet of weather protected and secure enclosure for staging; along with adequate access to allow truck trailer pickup and delivery.

The recycling facilities will vary according to capacity and degree of recycling undertaken.

¹⁹ This is supported in detail by the EPSOM report of 2003 and the Cathedral Group report of 2002.

- The Cathedral Group report of 2002 suggested a full recycling plant could encompass 34,000 square feet.

Manitoba would require several operational nodes to adequately cover the whole province. However a local (rural) node may not be required to have a central processing facility. Logic dictates that Winnipeg and/or Brandon would have these larger central facilities already in place or that they could be developed relatively easily.

Product Stewardship

Defined, a Steward is someone who manages property or other affairs for someone else. A Product Steward then manages the product and the related affairs of the product for the product creator.

Manitoba has chosen Product Stewardship and the Extended Producer Responsibility, or EPR model for electronic waste. The definition of EPR is taken as “a demonstrable process which identifies and manages business conduct, arising in development, manufacture, distribution, marketing and use and the ultimate disposal of product in a safe, healthy, environmentally sound and sustainable way.”

Manitoba continues to move forward with implementing a producer responsibility model for waste reduction and recovery, in consultation with industry and other stakeholders. In Manitoba Electronic Product Stewardship Canada²⁰ (EPSC) may represent the first seller industry.

EPR Model

As it is currently understood, the EPR model allows that a producer will be responsible for their own products in the current market and in the after market. In simple terms, a manufacturer of computers will bring to market their products and once that product has come to end of life they will be responsible for the ultimate disposal of the product, directly or indirectly. First Sellers are identified as the last link in the chain in the EPR model.

This model could work well for products not yet in the hands of the consumer. However, for the legacy product already in the hands of the consumers it may not be as clear as to who should be responsible for end of life disposal as the original ownership of this product may not be clearly evident. Whether the consumer pays, industry pays or a government pays (or indeed they all pay!), end of life disposal of the legacy product must be accounted for in a responsible way.

²⁰ EPS Canada has been offered a MOU by the Manitoba Government, August 2006

The Players, Policymakers and Planners

It could be stated that there are over 20 e-waste recyclers in Manitoba.²¹ This however, is not really the case. All 20 of these recyclers contribute to the recycling of e-waste but few are true, full-scale e-waste recyclers. By definition, they are more in-line with demanufacturing. Most will remove components of value to them for either resale or remanufacturing and then find ways of disposing of the components that have little value to them; unfortunately this may include stockpiling, incineration, landfills and exporting.

In order for Manitobans to completely and responsibly recycle e-waste we must export to other Provinces or other countries in order to state we practise complete recycling. Currently, there are not enough adequate facilities available to accommodate more than approximately 40% of the required recycling process. This is particularly true of monitors, TVs, plastics, batteries and several types of circuit boards where the local capacity is non-existent and 100% of these items must be exported. These, sadly and of course, are the main components of most electronics.

Players

The main Manitoba Players²² in e-waste recycling are:

- Syrotech Industries
- Computers For Schools
- Powerland Computers
- Responsible Electronics Recycling

Note: Nearly all of the listed players co-operate with one another in their efforts to keep e-waste out of the landfills and consumer waste streams.

The definitive leader of the players is Syrotech Industries. The reason Syrotech is considered the leader is that they serve government, commercial, industry, households and consumers with e-waste services. They provide demanufacturing as well as some true recycling services, both internally and through export to other provinces and countries. Syrotech states they receive no financial support from government for recycling.

Computers For Schools is also a major recycler by volume. They primarily serve government and the school systems as a brokerage outlet for e-waste. The e-waste may be demanufactured into component categories for disposal and in certain cases rebuilt/refurbished for reintroduction to the consumer product stream. CFSL states they export end-of-life e-waste to other Provinces as there is no suitable local capacity in Manitoba. CFSL also states financial support from government and school districts and industry is present and is currently based on a cost recovery formula.

²¹ Appendix A lists more than 20 recyclers capable of contributing to e-waste recycling.

²² Appendix D lists "Opportunities for e-waste recycling." To review participant capacity see Demanufacturing in Manitoba.

Powerland Computers are basically a reseller of used equipment. What cannot be reused is presented to other recyclers or brought to the landfill. Powerland states no financial support is present for their efforts.

Responsible Electronics Recycling is based in Selkirk and serves the St. Andrews region of Manitoba. RER warehouses e-waste. When capacity is reached a transfer to a recycling facility is undertaken. RER receives a small grant for administrative support and hard cost recovery (fuel, mileage) from the R. M. of St. Andrews.

The Unknown Recyclers

There is a segment of unknown recycling capacity and facility that is linked as well to an unknown quantity of e-waste. This e-waste may not be directly linked to consumer styled products. It involves two major participants in Canada's e-waste production capacity:

1) Defence e-waste includes many traditional e-waste classes such as computers, communication devices and surveillance equipment. However there are also many non-traditional e-waste items that are specific to defence. The methods of disposal are not clearly understood due to the nature of the e-waste products; therefore, any opportunities or concerns related to this area is also not fully understood at this time.

2) Healthcare e-waste encompasses many consumer as well as industry specific e-waste materials. On the consumer side are things like meters, readers and communicators specific to an individuals own health care. On the industry side there are computers, scanners, readers, broadcasters, communication devices, controllers, complex machinery and equipment of many types. Much of this e-waste is handled by the producers or as an internal function of the industry. Again the opportunities are not as well understood because the processes are largely "out of public view." Opportunities or concerns therefore are not fully understood at this time.

Eventually all e-waste in Manitoba ends up being dealt with in one or more of five ways:

1. Reintroduced as refurbished/remanufactured product, locally or abroad
2. Sold as raw materials (metals, precious metals, reusable components), locally or abroad
3. Landfill or incinerated at end-of-life, locally
4. Exported as end-of-life, abroad
5. Returned to manufacturer

In Manitoba, by weight e-waste is distributed as end-of-life in one or both of two ways:

- 1) Metals, for the most part remain local and end up a Gerdau Ameristeel or Ancast Industries once and if they are demanufactured, or they are moved along as items of point 2

- 2) The vast majority of Glass, Resins and Plastics are exported out of Province (near 100% by most consultations)

Forward Thought:

Existing Players know more about the local requirement than can be expressed in this report.

Legacy e-waste and the cost of dealing with it has been repeatedly identified as a concern by all the Players.

Monitors, for the most part, are not demanufactured due to the safety aspects of dealing with them. They are left intact, placed on pallets and shipped whole to one of several (2 or 3 in Canada) out of province locations for processing of the glass, lead (and other metals) and the plastic components.

Policy Makers

Manitoba is clearly moving towards an Extended Producer Responsibility EPR policy. Product Stewardship is thought by many to be the best long-term solution to the issues and concerns that e-waste has and will continue to introduce. Harmonization with Canada is viewed as desirable and many of the national policies may be inherited by Manitoba under this harmonization scheme. All final policies adopted will need to be ratified by Manitoba and although most are seen to be beneficial and required there may be duplication of effort and jurisdictions if care is not exercised in final policy selection.

Forward Thought:

Some policies that may be adopted in Manitoba state that export out of country of e-waste is not favoured or even allowed. This is a definite concern as currently, directly or indirectly, much e-waste is exported outside of Manitoba and Canada.

Planners

The planners of Manitoba include all the active participants of e-waste recycling and the forerunners of product stewardship in the province. Manitoba may not be limited to one stewardship proposal as Manitoba's policy has allowed that several plans could be acceptable, as long as the long-term stewardship goals of Manitoba are met or exceeded. There has been much work already undertaken and the lessons learned will cause the planners to act/react in appropriate fashion when formulating e-waste recycling plans.

Notable Planners and plan influencers include:

- Thomas Sill and their EPSOM project
- Aboriginal Centre and their recycling facility study
- Syrotech Industries and their 20 years experience in the industry

- Powerland Computers and their recycling project
- Responsible Electronics Recycling and their current recycling project
- Computers For Schools and their vast experience in refurbishing and recycling
- Computer Lending Library and their partnership based lending project
- Green Manitoba
- Manitoba Conservation
- Community Connections

The Plan

The planners have not yet come forward with a final approved plan. It is anticipated that Manitoba will follow a similar model to plans used by Alberta and Saskatchewan. Harmonization is considered a goal.

The plan model would likely include:

- Depots or collection points
- Movement tracking capability
- Bulk Storage facility
- Transportation network
- Bulk or partial demanufacturing capability
- Approved export locations and methods for non-local disposal

There is a potential of more than one steward to be involved in that waste products are varied enough to accommodate more than one. If so, the lucrative e-waste (financial recovery potential is higher) may be naturally sorted from the less lucrative (junk).

EPR – Extended Producer Responsibility

As we learn more of e-waste, consumer habits, the power of industry marketing and the commercial application of e-products, we see that EPR is a definite and very worthy goal. The consumer alone cannot hope to control future e-waste and handle the legacy waste now within the system. This is due mainly to the complex methods of construction of most e-products. Simply, if we do not know how this stuff is put together we will have great difficulty taking it apart again.

This is where the producers must take the greatest responsibility. But there are challenges in EPR as well. The most notable is the location of many of the producers. Most producers of e-product are not resident in North America and therefore the “take back” approach of some producers is for many observers suspect. The common question is “take back to where?” And then, “what is done with it once it is back there?” Internal audits of asset movement can in most cases be questioned, in particular, if it involves the destruction and rebuilding of an old asset into a new asset.

The benefits are numerous for an EPR policy. Most noteworthy is that the producer, in theory, will construct products that are easier to deal with at end-of-life if they are responsible for them until and beyond end-of-life. That is providing the producer is still solvent at the time. Even better than EPR, is an industry wide acceptance of producer responsibility for all products. This has been recognized and is a goal now sought after by some noteworthy and long-lived producers.

***In theory,
after legacy e-waste is removed from the waste stream,
a strong EPR policy that is well supported by producers
should make e-waste concerns little more than a shipping exercise.***

End Of Life

For each consumer or business owner end-of-life has a different definition, and perhaps as close as we can get might be, “old electronic equipment that no longer fully meets a need and has little residual value.”

End of life, at the consumer level, means that a decision has been made that the product needs to be disposed of away from the household; equally so for a business owner, disposal away from the business. For many the real issue is how and where this disposal can best be made. The path to end of life is not for many clearly understood as the difference between garbage and e-waste is not a major part of our formal or informal education system.

Collecting the Forward Thoughts

0) Forward Thought:

Bulk removal of the non-toxic components from waste stream must include the extra costs associated with shipping and handling.

Analysis: The extra costs for the removal of the bulk are currently being born for the most part by the landfill sites. Attendants must strip off the cabinetry and then burn or bury it. The e-waste gut is then packaged for safety and end of life disposal is undertaken. Currently, not many “recyclers” will take the bulk items, especially not without a fee attached. Estimates range from \$30 to \$50 per unit is paid in demanufacturing and disposal costs per large screen projection style TVs. Further no one wants to pay for the added shipping cost at either end (receiving and forward shipping). Specifically there needs to be a targeting of e-waste items such as large screen and cabineted TVs for specialized treatment at the depot level.

1) Forward Thought:

The component value for reuse and refurbishment of electronic products **increases as volumes increase** and as the **age of the products decrease**.

Analysis: Like mining it takes a large amount of raw material to yield a little ore. The newer the waste, the more likely it is to be reusable by someone, as it can be sold or reused easier. Therefore, legacy waste is only valued if it is available in sufficient quantity to build a business case on.

2) Forward thought:

In Manitoba we tend to use our own existing recyclers who generally have the labour and equipment to do only minor recycling tasks

Analysis: Some Industry participants advised that there is a shortage of trained labour in the demanufacturing industry. They stated that there are several reasons for this:

- Generally, this is a “low pay” industry.
- The work often is outside due to the bulk nature of the industry. It takes a lot of space to collect, dump, work on and sort e-waste. Being that it is outside, it is also seasonal in nature.
- Garbage of any description has negative connotations, it is not pleasant to deal with.
- Much of the work is contract based and the waste collection systems are sporadic by nature. People tend to purge in spring and fall, resulting in waste being generated at these peaks time. Contracting allows recyclers to do just-in-time styled services.

Is there any advantage to providing training to existing workers? There appears to be little rationale to support starting new industry participant companies or organizations; but there is some data supportive of providing training for filling a small amount of vacancies in the local industry. Also research discloses this fact: there are few applicants applying to meet the apparent need and that there are not enough vacancies current or projected to warrant large-scale training exercises.

3) Forward Thought:

No recycler wants just the junk. Pure junk is often worthless or costs too much to recycle. The entire product may be worth demanufacturing but only if you deal with the complete item from start to finish, thus allowing some profitable or reuse exercises along with the costs of disposal. If not, you will simply end up paying someone else to take the junk off your hands.

Analysis: This thought is self-explanatory.

4) Forward Thought:

Most recyclers rely on receiving e-waste intact and whole, **before** all the value is stripped away and only true waste remains.

Analysis: This thought is self-explanatory and is directly related to Thought 3.

5) Forward Thought:

Manitoba may not have the critical mass (enough consumers and the related e-waste generation) to support more than one full-scale e-waste recycling operation.

Analysis: This thought is self-explanatory.

6) Forward Thought:

Legacy e-Waste in Manitoba could be processed in 3 to 5 years

Analysis: This thought is self-explanatory and is directly related to Thought 5.

7) Forward Thought:

Existing Players know more about the local requirement than can be expressed in this paper. Legacy e-waste and the cost of dealing with it has been repeatedly identified as a concern by the Players.

Analysis: Recycling is a highly competitive industry (high volume = low profit). The value of e-waste fluctuates daily and is subject to long periods of "low value." Stockpiling is one method that is used by recyclers to take advantage of the market. Recycling purely for environmental purposes is a well known and openly acknowledged "money pit." Therefore, basic decisions on recycling may be best taken with a view of the "total picture" of recycling. Simply, the social values may

be sufficient to justify strict adherence to recycling policies that favour the environment only. But one could argue the social value must also include the basic values that involve economic wellbeing of industry sectors and employment opportunities, both existing and potential.

Legacy e-waste is somewhat of an unknown as a quantity. However, most industry participants agree it can be cleared in 3 to 5 years with existing facilities. The issues are in whom and how will it get paid for. Without clear stewardship and EPR policy that carries through to legacy waste, the unease of industry, residents and retail operations will remain very real and may act as a barrier to development of long term solutions to e-waste.

8) Forward Thought:

Some policies that may be adopted in Manitoba state that export out of country of e-waste is not favoured or even allowed. This is a definite concern as currently, directly or indirectly, much e-waste is exported outside of Manitoba and Canada.

Analysis: This thought is fraught with difficulty. Much of the “speak” around the export policies is not explained in terms that are easily understood. Facts emerge from time to time that challenge the export concerns. One such fact is that the majority of the manufactures of e-products are offshore by origin. Take back programs, which are the main point of most EPR policies, may mean that the e-product could very well be taken offshore, back to where the original manufacturer resides. The audit trail often discussed by policy makers may very well end at the front door of the manufacturer. Clearly, on-going monitoring is called for.

Key Questions and Issues

Issue - Legacy waste - New waste:

Legacy e-waste processing is estimated to have approximately a 3 to 5 year lifespan with enhanced (read financially supported) current capacity; likely not enough to build an industry around even in the short-term.

As previously discussed new waste under current EPR schemes would be largely “taken care of” through the internal efforts of the electronics industry. As these policies apparently now exist and they utilize returning **whole** units through transport companies (couriers) it could be assumed no new major quantities of e-waste would be created. This assumption could well be and should be challenged.

Issue - Advantages/disadvantages of developing an e-waste capacity:

An advantage is local control along with (albeit limited) job potential.

A disadvantage is the short-term industry and employment expectations around policies that clearly favour the manufacturer (EPR), who in nearly all cases is not located in Manitoba.

Question - Does Manitoba require more recycling capacity?

No, very probably not as there appears to be little profit doing it and there appears to be sufficient participants to handle the volume both current and anticipated, without large increases in capacity. It is highly likely participants can self-train any new employees for the work. There may be a challenge in finding workers ready to enter the industry, so recruitment issues may arise.

Issue – Recycling, with a view to economic development opportunities, is not sustainable; how can it be made to be at least cost recoverable?

A contribution from a Stewardship body would assist in making it cost recoverable. As only first-sellers are mandatory contributors to the Steward (IFO), this may be a diluted effort and limited to the contributions collected. They, the contributions, may not be sufficient to cover more than the absolute minimum for proper EPR policy to be enacted.

Question - How much of an economic contribution would it take to achieve cost true recovery?

If added to the current recycling capacity and infrastructure, any new demand could add several layers of procedure:

- shipping to the newly created layer
- labour at the newly created layer
- additional packaging for more product
- shipping to eventual recyclers, brokers or manufacturers
- occupancy costs such as rent, utilities, telephones, etc.
- administration costs such as management, wages, benefits

In turn these additional layers would yield little, if any, revenue to offset the costs:

- The effort would yield no higher value for any resultant products
- Limited cost off-set opportunities could be created i.e.: retail sales parts, revenues generated by refurbished sales
- Most opportunities, if any are even realized, would be short-term and estimated to be 3 to 5 years maximum

Any contributions would therefore have to be utilized to directly offset the disposal operations. Although estimates vary greatly most suggest that on a per unit basis the cost of disposal would be in the area of:

Monitors	between \$12 and \$18 each
Computer Cases	between \$4 and \$10
Printers	between \$6 and \$8
Keyboards and Mice	approximately \$2

Whole computer systems that include all of the above brought together as system approximately \$25 to \$30 per system

On top of this, the administration and delivery of any program would add to the total disposal cost. The total of the two, the disposal cost and the program administration, could then be considered the **total industry, consumer and/or municipal (tax) contribution**, it could also be known as a levy, a fee or a yet to be determined term.

Question - What is the value of Product Stewardship if EPR policy already exists?

This question is difficult to answer because if you assume EPR is a valid concept and that through industry integrity it cannot be challenged, Stewardship becomes a mute point. Acceptance of pure EPR allows that the producers will do what is required to ensure that EPR policy is enacted at all levels. However, we already know that product becomes far removed from the producer and so Stewards may become the eyes and ears of the producer; and they would be expected to ensure the EPR policy is enacted at even the most remote product use location. Simply, Stewards have a role as monitors, enactors and guides in the EPR process.

Conclusion

There can be no one, decisive conclusion to this complex issue, as there are as many conclusions as there are scenarios.

Clearly, the issues are complex.

This paper introduced some decision-making aids:

- Based on the current general and healthy economic environment of Manitoba, additional costs to the ratepayers to dispose of e-waste may be a supported policy
- Given the research disclosed herein and that of other reports done in the recent past we could conclude that now is an opportune time to introduce e-waste policy with long-term, sustainable e-waste disposal programs
- Considering manufacturers will desire to have cost recovery as a goal in EPR and considering we already have some knowledge of what recovery costs are likely to be through take back programs, we may conclude that handling e-waste beyond straight shipment back to the producer will entail additional costs
- There is little doubt financial opportunities are limited. In the best of circumstances estimates are that recycling an e-waste product (computer is used as an example) will cost at least \$25. Therefore, the contribution level

will begin in this cost range; and then be increased to carry the cost burden of any program delivery mechanisms.

This report was prepared utilizing the public information resources. Also reviewed were the policies and models of other provinces, industry leaders and leading EPR supporters. The global information resource of the Internet also provided numerous examples of how others are approaching e-waste and the related subject matter. The white paper authors also conducted extensive research and obtained interviews with leading industry participants.

Appendix A - Manitoba Recyclers

Note: The quoted URLs and listed recyclers may from time to time change. The information presented was current at the time of first publication.

Recycling and Salvage/Scrap Companies²³
www.recycle.nrcan.gc.ca/recyclingdb.asp

Winnipeg

Ace Recycling
William Sokol
600 Provencher
233-3615, Fax 233-0443
Document shredding, Recycling of ONP, OCC, tin, aluminum and plastic

Ancast Industries
Bradley McCormac
1350 Saskatchewan
786-7911, Fax 786-2548
Consumer/End User of recycled materials
Copper, iron

BFI
375 Oak Point
633-9730
cardboard, office paper, household recyclables

Canada Metal
John Collo
1221 St. James
774-7455, Fax 783-6398
Consumer/End User of recyclable material
Aluminum, copper, lead, tin

Canadian Waste
70 paramount
956-6360, Fax 694-7007

Chisick Metal Ltd.
Cliff Chisick
2141 Logan Ave.
632-1045, Fax 694-1637

²³ Taken from Cathedral Group Facility Report of 2002 – certain contact information may have changed.

Buyers and Brokers of all ferrous and non ferrous scrap metals, Aluminum refiners and smelters
All metals and auto batteries

General Scrap

Mel Lazareck

1 mi. east of Hwy. 59 on Springfield Rd.

222-4221, Fax 224-0561

Collector, Consumer/End User of recycled metals; Dealer/Processor

Aluminum, batteries, brass, bronze, cadmium, copper, iron. Lead, magnesium nickel, titanium, zinc

Industrial Metal Processing

Bill Holt

550 Messier

233-1908, Fax 233-1933

Collector, Dealer/Processor

Aluminum cans, alloys, copper, scrap steel, brass, batteries, stainless, iron, lead, magnesium, nickel, titanium, zinc

Lazareck Scrap Metal

Jack Lazareck

1021 Logan Ave.

774-2492, Fax 783-7130

Electric/Electronic Equipment Collector, Dealer/Processor,

Wholesaler/Processor, Wire chopper

Aluminum, batteries, brass, bronze, copper, iron, insulated wire, lead, magnesium, nickel, precious metals, titanium, zinc

Metro Material Recovery

100 Omands Creed

632-4457

Orloff Scrap Metals

David Orloff

410 King at Sutherland

589-4303, Fax 589-4304

Collector, Dealer/Processor

Scrap metal, aluminum cans, batteries, brass, bronze, copper, insulated wire, iron, lead, magnesium, nickel, precious metals, titanium, zinc

Phoenix Recycling Inc.

76 Hoka

222-5096, Fax 224-2798 www.phoenixrecycling.ca

Cardboard, waste removal-reduction, buy recyclable paper, metal and plastic

Tessler's Iron & Metal
Ken Klassen
10 Charles St.
586-2704, Fax 586-2706
Dealer/Processor, Wholesaler/Processor
Aluminum, copper, steel, brass, tin, lead, batteries, zinc

Versatech Industries
115 Plymouth (processing plant)
436 William
Phone 956-9700
Processor of newsprint, magazines, corrugated cardboard and office paper

WRS Waste & Recycling Services
940 Redonda
Phone 661-3683

Western Recycling Services/Western Scrap Metals
E. Linder
18 Sutherland
Phone 947-0251 (scrap), 943-8752 (recycling services), fax 947-5697
Collector, Consumer/End use of recycled materials, Dealer/Processor
Aluminum cans, plastics, plastic soft drink bottles, metal food cans, batteries,
copper, brass, bronze, aluminum, steel, appliances, iron, lead, nickel, precious
metals, titanium, zinc

Right Way Recyclers
50 Burnett
Phone 667-2243

Brandon

Wesman Salvage
John Pelletier
Box 1717 855 49th St. E.
Phone 726-8080, Fax 726-8654
Dealer/Processor
Aluminum, batteries, brass, bronze, copper, insulated wire, iron, lead,
magnesium, nickel, tin, titanium, zinc
Brandon Waste & Recycling
440 Rosser Ave.
Phone 725-3302

BFI Recycling
230 van Horne
Phone 725-2570, fax 727-4044

Brandon Scrap Iron & Metals
David Wilds
9 1st St.
Phone 725-5170, fax 727-5170
Broker/Trader, Dealer/Processor, Recycling collection depot
Aluminum, batteries, brass, bronze, copper, iron, insulated wire, lead

Appendix B - Materials Composite Table

Material name	Content (% of total weight)	Weight of material in computer (kg)	Use	Location
Plastics	22.9907	6.26	Insulation	Cable, Housing
Lead	6.2988	1.72	Metal joining	Funnel glass in CRTs, PWB
Aluminium	14.1723	3.86	Structural, Conductivity	Housing, CRT, PWB, connectors
Germanium	0.0016	< 0.1	Semiconductor	PWBs
Gallium	0.0013	< 0.1	Semiconductor	PWBs
Iron	20.4712	5.58	Structural, Magnetivity	Housing, CRTs, PWBs
Tin	1.0078	0.27	Metal joining	PWBs, CRTs
Copper	6.9287	1.91	Conductivity	CRTs, PWBs, connectors
Barium	0.0315	< 0.1		Panel glass in CRTs
Nickel	0.8503	0.23	Structural, Magnetivity	Housing, CRT, PWB
Zinc	2.2046	0.6	Battery, Phosphor emitter	PWB, CRT
Tantalum	0.0157	< 0.1	Capacitor	Capacitors/PWB, power supply
Indium	0.0016	< 0.1	Transistor, rectifier	PWB
Vanadium	0.0002	< 0.1	Red Phosphor emitter	CRT
Terbium	0	0	Green phosphor activator, dopant	CRT, PWB
Beryllium	0.0157	< 0.1	Thermal Conductivity	PWB, connectors
Gold	0.0016	< 0.1	Connectivity, Conductivity	Connectivity, conductivity/PWB, connectors
Europium	0.0002	< 0.1	Phosphor activator	PWB
Titanium	0.0157	< 0.1	Pigment, alloying agent	Housing
Ruthenium	0.0016	< 0.1	Resistive circuit	PWB
Cobalt	0.0157	< 0.1	Structural,	Housing, CRT, PWB

Palladium	0.0003	< 0.1	Magnetivity Connectivity, Conductivity	PWB, connectors
Manganese	0.0315	< 0.1	Structural, Magnetivity	Housing, CRT, PWB
Silver	0.0189	< 0.1	Conductivity	Conductivity/PWB, connectors
Antimony	0.0094	< 0.1	Diodes	Housing, PWB, CRT
Bismuth	0.0063	< 0.1	Wetting agent in thick film	PWB
Chromium	0.0063	< 0.1	Decorative, Hardner	Housing
Cadmium	0.0094	< 0.1	Battery, blue- green Phosphor emitter	Housing, PWB, CRT
Selenium	0.0016	0.00044	Rectifiers	rectifiers/PWB
Niobium	0.0002	< 0.1	Welding	Housing
Yttrium	0.0002	< 0.1	Red Phosphor emitter	CRT
Rhodium	0		Thick film conductor	PWB
Platinum	0		Thick film conductor	PWB
Mercury	0.0022	< 0.1	Batteries, switches	Housing, PWB
Arsenic	0.0013	< 0.1	Doping agent in transistors	PWB
Silica	24.8803	6.8	Glass, solid state devices	CRT, PWB

Appendix C – Public Resources

<http://www.ewaste.ch/services/downloads/default.asp>

<http://www.gov.mb.ca/conservation/pollutionprevention/hhw/computer.html>

<http://www.ewaste.ch/services/links/default.asp>

<http://www.ewastecanada.ca/>

<http://www.ec.gc.ca/epr/inventory/en/DetailView.cfm?intInitiative=58>

<http://www.selkirklearningcentre.ca>

http://www.resourceconservation.mb.ca/news/pdfs/RCM_brief_on_stewardship_principles_March_2006.pdf#search=%22definition%20of%20Product%20Steward%22

Epsom Recycling Report. Available at numerous government sites and the Thomas Sill website.

Powerland Recycling Report available at the Powerland Computers website.

Appendix D - Opportunities to Recycle E-waste²⁴

Company	Address	Pick up?	Materials Accepted
<u>Syrotech</u>	93 Gomez Street Winnipeg MB R3B 0G7 942-7900 info@syrotech.mb.ca	\$25 for pick up. Can drop off as well.	Not currently accepting electronics - check back for updates in the future.
<u>Computers for Schools and Libraries</u>	170 Wyatt Road Winnipeg MB R2X 2X6 988-1792 cfsl@cfsl.mb.ca	No	Working laser printers, P3 500 Mhz or better, 17 inch CRT monitors, any LCD monitor. Call if older equipment
<u>Tec Voc High School</u>	1555 Wall Street East Winnipeg MB R3E 2S2 786-1401 ext. 157	No	Computers, printers, VCRs, radios, microwaves, cell phones, etc. They are used for study purposes in the electronics program. Call the school first, as there is limited space for storage.
Salvage Kraft Recycling	669 Logan Avenue Winnipeg MB R2C 0A1 786-1495 salvagekraft@shaw.ca Open Monday to Saturday from 10 a.m. - 5 p.m.	Call first. Fees assessed for pick up of some materials.	Accepts wide variety of computers and electronics. No charge for drop-off of computer monitors in working condition. \$5 to \$25 charge for computer monitors with broken cathode ray tubes (CRT), clipped cords and severely damaged cases. \$5- \$20 charge for drop-off of TVs, video and terminal monitors and other CRT containing devices. Please use side loading door on Chambers Ave for your convenience.
<u>Powerland Computers</u>	170 Marion Street Winnipeg MB R2H 0T4 237-3800	No	Computer equipment, call first.
<u>Thomas Sill Foundation</u>	115 Plymouth Street Winnipeg MB R2X 2T3 947-3782	Yes	They donate to charities and will provide a tax receipt. Call first to determine if they need the item.

²⁴ <http://www.gov.mb.ca/conservation/pollutionprevention/waste/electronics.html>

Selkirk and District Community Learning Centre	511 Robinson Ave. Selkirk, Manitoba R1A 1E5 482-2111	No	Materials accepted listed at website . Bring e-waste directly to 511 Robinson. Alternatively, e-waste can be dropped off at collection points within the landfill site on Earl Grey Road or the Clandeboye Landfill on Bell Road during their regular hours of operation. From the SDCLC site the electronics will be forwarded to certified recyclers ensuring proper end-of-life disposal.
Blue Angel Technical Services	488-B Kensington Street Winnipeg MB 772-0055		Take photocopiers, fax machines and laser printers. Call first.