

CARTON RECYCLING PRIMER



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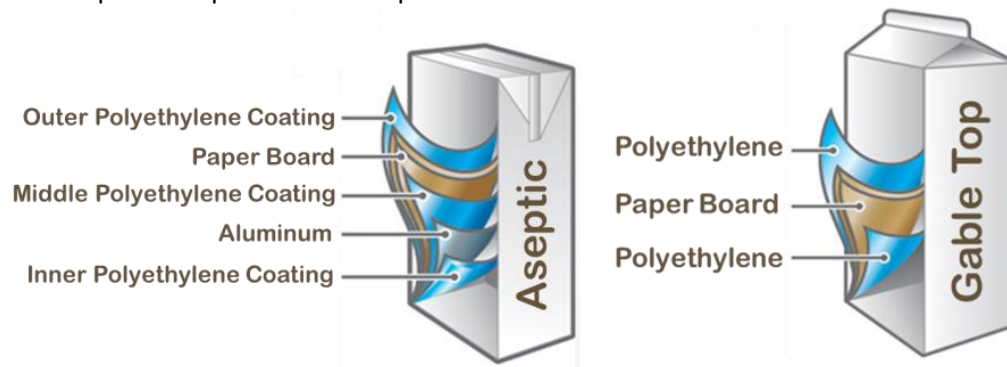
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*Disclaimer: This primer is intended to assist municipalities and MRFs in their carton recycling efforts. It should not be considered to be all inclusive and is **in no way** designed to replace qualified engineering, architectural or legal advice.*

Definitions

Cartons – Gable top and aseptic cartons (cartons) are food and beverage paper packaging types. Gable top cartons, otherwise known as “refrigerated”, are made up of about 80% paper and 20% polyethylene; aseptic cartons, otherwise known as “shelf stable”, are made up of about 74% paper, 22% polyethylene and 4% aluminum (**Figure 1**). Cartons are generally used as a package for various non-carbonated beverages like fruit juices and dairy products and for liquid food products like soup and broth.

Figure 1. Gable top and aseptic carton composition



Carton Council of Canada (CCC) – A group of leading carton manufacturers that seeks to maximize the environmental performance of carton packaging by growing carton recycling across Canada and continuously improving the overall environmental performance of the carton package.

The CCC provides a platform for carton manufacturers in Canada to promote cartons as renewable, recyclable and low-carbon packaging solutions. Engaging with like-minded stakeholders and partners, Council members contribute their expertise to the development of sound environmental policy and legislation, while working together to demonstrate that carton packaging is the sustainable choice today and in the future. Members include Elopak, SIG Combibloc, Evergreen Packaging and Tetra Pak.

Material Recovery Facility (MRF) – A facility designed to intake and process recyclables in preparation for sale to market. The MRF sorting process can be highly automated or conducted manually. Most MRFs are configured as single or dual stream.

Single Stream Recycling¹ – Process in which containers and fibre materials are collected from residential and/or businesses in a single, fully commingled form and subsequently separated and processed into marketable secondary materials at a single stream MRF.

Dual Stream Recycling¹ – Process in which containers and fibre materials are collected from residential and/or businesses in two streams, separate from each other and processed separately into marketable secondary materials at a dual stream MRF.

Manual Sorting – refers to sorting materials by hand (e.g. picking off material from a conveyor belt).

Automated Sorting – refers to the sorting of material by machinery (e.g. separation of paper from containers via a disc separator, separation of material types by optical sorting technology, separation of aluminum by eddy current).

¹ Reference: Blue Box Enhancement and Best Practices Assessment Project, 2007. KPMG. Available at http://www.stewardshipontario.ca/wp-content/uploads/2013/03/KPMG_final_report_vol1.pdf

1. Purpose of this primer

Over the course of its five years of existence, the Carton Council of Canada (CCC) has commissioned a number of technical studies and has assembled a knowledge base. The purpose of this Primer is to bring this information together into a single reference guide in order to support sorting facilities in their carton recycling efforts.

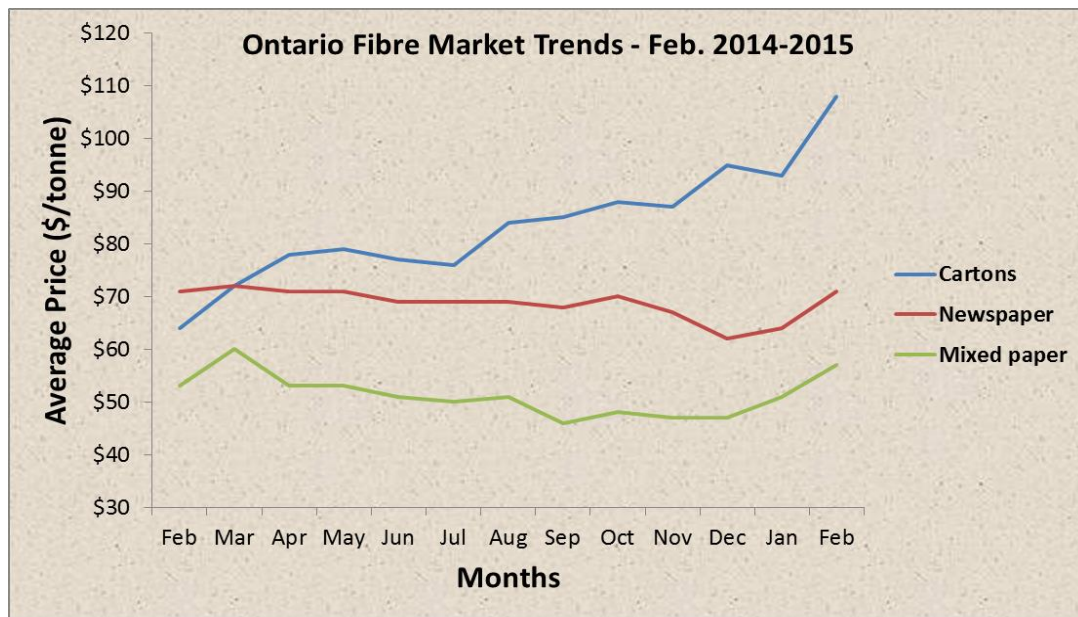
Please note: this Primer is intended to assist municipalities and MRF's in their carton recycling efforts. It is not intended to replace qualified engineering and/or legal advice.

2. Why recycle cartons?

Cartons are recognized as an environmentally sound packaging choice. Their primary component is paper fibre, derived from renewable resources, in a format that is lightweight and transport-efficient, with an excellent product-to-package ratio.

On the recycling front, as volumes of recovered sorted office paper continue to decline, the demand for the long, virgin fibres from which cartons are made is increasing, which is reflected in its overall market value. Commodity pricing for used cartons in Ontario has continued to increase over time (**Figure 2**).

Figure 2. Pricing trends in Ontario for various fibre grades



Source: Reclay StewardEdge – The Price Sheet, 2015. www.reclaystewardedge.com

3. Sorting cartons in the MRF – preferred sorting approaches

Cartons are generated from the residential as well as institutional, commercial & industrial (ICI) sectors. Depending on the sector, cartons can be placed into small volume, individual bins by citizens and placed at the curbside for eventual collection by municipalities or contracted, private collection companies. If collected from the multi-family or business sector, cartons can be placed in large volume front-end loading type bins. Material is compacted and transported to the MRF.

When used cartons are transported to a MRF, there are three paths cartons can follow. The first is into a dedicated carton grade (grade PSI-52, see **Section 4.3**), the second is into any paper grade and the third is into the residue stream. The most economically and environmentally beneficial path is for cartons to be sorted into their own grade (grade PSI 52) for the following reasons:

1. It provides for the highest environmental benefit as the end-markets that recycle cartons sorted into their own grade achieve the highest fibre yields and it can allow for the recovery of the polyethylene and polyethylene/Aluminum residuals (poly/Al).
2. It minimizes the impact on other commodity grades (e.g. ONP, mixed paper bales) by realizing the highest potential price for those commodities (refer to **Figure 2** above).
3. Historically, the price paid for cartons has been relatively stable and has not been subject to the same volatility as other commodities (e.g. plastics). In that sense, the marketing of cartons as an additional commodity can help the MRF and/or municipality mitigate the price volatility of other, highly fluctuating, commodity grade prices.

3.1. Sorting cartons into a dedicated carton commodity grade (PSI-52)

- Used cartons are either collected in a single or dual stream system
 - Single stream: Cartons along with all other containers are mechanically separated from fibres by mechanical screens and are directed to the container stream at the MRF. Based on several on-the-belt studies conducted in single-stream MRFs in Ontario, CCC estimates about 70% of all cartons flow to the container stream with the remaining 30% flowing as paper.
 - Dual stream: Cartons enter the MRF in the container stream and are sorted either manually or mechanically (for example, via optical sorters) or a combination of both.
- Once cartons are directed towards the container stream at the MRF, sorting typically begins with the separation of glass (trommel screens, star screens) and ferrous metals (magnet). The sorting process continues with other materials such as PET and HDPE (typically optically sorted in larger facilities and manually sorted in smaller facilities). After this point, all that remains on the sorting lines are fine paper, aluminum, cartons, and non-acceptable blue box material. Cartons can be optically sorted (using optical sorters that can be used for a variety of plastic resins) if the design of the MRF and economics permit or they can be manually sorted as they are more easily identifiable once most other recyclables are removed and the burden depth is reduced (**Figure 3**). They are placed in their own bunker and baled for sale to market.



Figure 3. Material on container lines after glass, metal and plastic have been removed.

3.2. Sorting cartons into another fibre commodity grade

- Mixed paper, old corrugated cardboard (OCC) and newspaper bales can accommodate a low level of cartons in end market processing by paper mills, however, the CCC prefers cartons to be separated. Some components in cartons can impact the pulping process and lead to decreases in fibre yields in paper pulping applications. When cartons are sorted into their own grade, these problems are avoided.
- The economic value of cartons therefore is decreased if cartons are commingled into mixed paper bales or newspaper bales (refer to **Figure 2**).

3.3. Cartons not sorted into any commodity grade

- The least desirable outcome is not sorting cartons into any commodity grade. Carton bales are a growing commodity, and there are strong and stable markets, both domestic and overseas. If cartons are not currently being captured at the MRF and therefore ending up in the residue stream, there is an increased cost to the MRF operator and the municipality for disposal. There is also a public relations risk, as residents expect that materials they place in their blue box are recycled.

3.4. Suggested best practices

Assuming a MRF has made the decision to sort cartons into their own bunker, the CCC offers the following suggestions to increase sorting efficiency and maximize carton capture rates. **CCC understands that each MRF has unique conditions associated with quantities and types of materials accepted and processed, the design/layout of the MRF, the type of sorting and processing methods used, and the markets to which they're selling their recovered materials. As such, the following Best Practices are offered as guidance only. It is understood that each facility will have to determine whether these practices make sense for them based on their individual realities.**

3.4.1. Adequate signage and easy to understand illustrations of cartons

Gable top and aseptic cartons are industry terms for what most people know as milk cartons and juice boxes (portion packs). A larger suite of carton types are part of this category including soup & broth, alcohol (wine) and dairy substitutes (soy, almond milk, etc.). In a number of sorting facilities, the CCC observed manual sorters treating juice boxes and milk cartons differently. The CCC developed posters and signage that MRF operators can position above the carton sorting station to assist sorters in recognizing the different carton formats and treating them similarly. These posters were developed in discussions with a number of MRF operators and are designed to be customizable. Please refer to the Appendix section for a sample carton poster, and contact the CCC if you wish to request various sizes and formats of the poster.

3.4.2. Cartons collected in the container stream

Through a series of household waste audits, the CCC measured that in dual stream programs, a large fraction of cartons were often placed incorrectly into the paper bin by consumers. In one program in Southwest Ontario for example, gable top and aseptic cartons were placed in the paper bin 37% and 21% of the time, respectively.

Carton recycling is maximized from an environmental and economic perspective if they are sorted and marketed in their own bale. Sorting cartons from the paper stream is typically more difficult and resource intensive compared to sorting them from the container stream. Cartons are often nested between cardboard and newspapers and the paper screens in the MRF cannot always separate cartons. Manual sorters also have difficulty seeing hidden or nested cartons. Therefore, if cartons are placed in the container stream they are more easily recognizable throughout the sorting process and are less likely to be sorted into a fibre grade, reducing their economic and environmental value.

3.4.3. Reclaim conveyors/bins on the fibre line

Regardless of single or dual stream configuration, a small proportion of cartons end up on the fibre lines. When this happens, it is generally preferred that the MRF configure a reclaim line to redirect cartons back to the container line. The reclaim line is typically done mechanically via a reclaim conveyor or manually by having staff remove cartons and place them in adjacent bins and then physically bring these to the carton bunker. Other options include screen adjustment or replacements. In order to determine which options makes most sense, it is recommended that MRF operators measure the rates of containers ending up on fibre lines, and then conduct a return-on-investment calculation to gauge the economic feasibility and to support the selection of the optimal solution.

3.4.4. Consider the MRF configuration to understand the best areas to sort cartons

- One of the practices that the CCC has observed is for cartons to be manually sorted just before the eddy current, if aluminum is the final material to be sorted out. The benefits of this practice is that cartons will be more recognizable and there will be far less burden depth because all of the other container materials including glass, metal and plastic will be removed. Sorters can perform dual functions by also recovering other missed recyclables at this point.
- If capacity and resources permit, an optical sorter can be a good investment to sort cartons along with other container types such as PET and HDPE. Cartons are easily recognized by single and dual eject optical sorters that are programmed to recognize the polyethylene outer layers on all carton types. Most manufacturers will provide expected efficiency and purity rates² of a properly installed optical sorter and you may also want to request references to gauge real-world performance in facilities similar to yours. For example, in a MRF test in Ontario, the efficiency rate of the optical sorter in use



Figure 4. Air separation system (vacuum).

Photo credit: CP Manufacturing, 2015. www.cpmfg.com

² The efficiency rate refers to how many pieces of a certain material visible on the belt, are ejected by the optical sorter, while the purity rate refers to what the actual material stream looks like when it comes out of the other side.

was 90-98% on all materials targeted, as specified by the manufacturer. Once tested, the dual eject unit actually operated at 57% efficiency for one stream (cartons) and 91% for the other (PET). The challenge was higher-than-recommended burden depth on the infeed belt and once resolved, the CCC expects much better carton sort rates. Once sorting facilities acquire these performance figures, they can follow-up with the equipment manufacturer to resolve such problems and increase sorting efficiency.

- There have been rapid advances in MRF equipment and technology in the past decade. For example, vacuum systems (**Figure 4**) are designed to increase picking efficiency and allow you to install bunkers in areas of the MRF with more space and not necessarily adjacent to the sorting station. Cartons can be sorted efficiently with vacuum systems as their light weight lends itself well to air-forced transport from sort station to commodity bunker.
- Each MRF is configured differently and there is no specific rule to determine if cartons should be sorted manually or mechanically. Mechanical sorting may be more efficient but also requires greater capital costs.

4. Storage, marketing and transport considerations

4.1. Storage

Generally speaking, cartons should be free of liquid and residual food products when they arrive in the MRF. As with all food and beverage container types, consumers are asked to empty and rinse cartons, but this may not always occur. Although the compaction that goes on in the collection truck and the baling process removes the majority of liquid from inside the cartons, they will always retain some moisture. As they are primarily made up of organic material (wood fibre), damp cartons can begin to decompose in the MRF. Depending on the season, the decomposition process can be delayed but eventually when this occurs, their value to the end market is diminished.

Ambient temperature, humidity, air circulation, exposure to sunlight and bale compaction all affect decomposition rates in different ways leading to material degradation within days, weeks or months during colder periods. MRFs that cannot make regular loads of carton bales can explore ways to work with neighbouring municipalities to collectively market carton bales. The CCC has worked to identify a number of brokers who are able to provide collective marketing options to smaller municipalities and MRF operators (see Section 4.2).

In terms of storing carton bales, it is recommended to store bales indoors or at least under cover to avoid exposure to the elements, and to keep them on a clean and dry impermeable surface. Moisture and sunlight exposure could accelerate carton bale degradation as it degrades fibre structures.

4.2. Marketing carton loads

The CCC has identified the following brokers who purchase carton bales from municipalities and MRF operators. CCC can facilitate introductions and provide contact information if required.

Berga Recycling
St-Eustache, QC
gates@bergarecycling.com

Recyclable Materials Marketing
Brantford, ON
atul@remm.ca

Continental Paper Grading of Canada Inc.
Mississauga, ON
pvaleriote@cpgcanada.com

Potential Industries, Inc.
Wilmington, CA
tony.fan@potentialindustries.com

Recyclage Laroche
Candiac, QC
germy@larocherecycling.com

Storelli Recycling Company
Fort Lauderdale, FL
vstorelli@bellsouth.net

The Paper Tigers
Bannockburn, IL
nhalper@papertigers.com

Newport CH International LLC
Orange, CA
chahne@newportch.com

4.3. Grade specification

The CCC was successful in working with the Institute of Scrap Recycling Industries (ISRI) to create specifications for a new carton grade called PSI-52 in 2011:

Bales consisting of liquid packaging board containers including empty, used, polyethylene-coated, printed one-sided aseptic and gable-top cartons containing no less than 70% bleached chemical fibre and may contain up to 6% aluminum foil and 25% polyethylene film.

*Prohibitive materials may not exceed 2%
Outthrows plus prohibitives may not exceed 5%*

- Institute of Scrap and Recycling industries Inc. 2014.

4.4. End markets and carton users

Carton markets have been stable, consistent and competitively priced. Since 2009, the number of domestic paper or pulp mills accepting cartons has grown from one to ten (**Figure 5**).

Figure 5. Map of North American carton recycling end market locations as of February, 2015



Please note: End markets shown in Figure 5 have their own purchasing specifications and requirements. Some may buy directly from generators of grade PSI 52 while others may use their existing sourcing network or the brokers/traders listed above to purchase their volumes of post-consumer cartons.

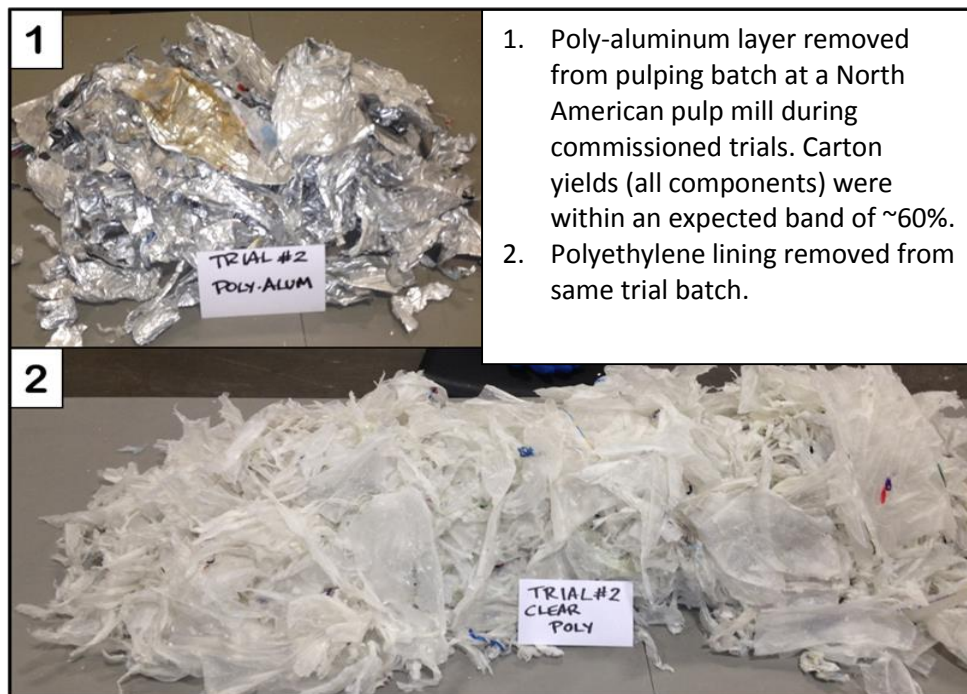
As with all other recycled commodities, there continues to be a strong demand for recovered cartons from export markets. In fact, export markets for post-consumer fibre have existed for more than 30 years, with mills that employ unrivalled state-of-the-art technology. CCC believes that a strong North-American market, coupled with this international demand, provides the most flexibility to recycling operators, brokers and other participants in the recycling value chain. At this time, overseas mills accepting cartons from North America are located in South Korea and Thailand. As with North American end-markets, the recovered fiber from cartons is primarily used to produce tissue and toweling.

4.4.1. Pulp production

Pulp production from cartons can be completed under several pulping configurations, including continuous or batch pulping. The details of pulping technologies are not discussed in this primer; however more information is available upon request from the CCC.

Each configuration has benefits and limitations, however, regardless of the configuration, carton fibre is recovered by mechanical and chemical application. The pulpers are, in effect, industrial-sized blenders. Cartons are fed into the blender and ripped apart by mechanical agitation of the mixture. The fibre separates from the plastic and aluminum layers and everything is filtered through a screen. The smaller fibre pieces pass through the screens unimpeded and the larger, non-fibre components are removed. What's left is long fibre to be transformed into pulp sheets which are sold to market for the manufacturing of paper-based products. In some cases, the non-fibre material (**Figure 6**) can be sold to processors who make it into new products or use it as alternative energy sources in their facilities.

Figure 6. Non-fibre carton components removed during pulp production



The CCC commissioned pulping trials to determine fibre yield rates and gauge possible challenges faced by the end market in regards to carton recycling. Results indicated the batches were easily recycled and have high fibre yield rates. (Pictures taken during CCC pulping trials at a North American pulp mill, 2014).

4.4.2. Whole carton recycling

Whole carton recycling is the process of using the carton as-is to manufacture usable products. Typically, cartons recycled in this way are turned into construction material including plastic lumber, wall tile, wall board, etc. (**Figure 7**). The process does not require any added glue, water or chemicals as heat is used as the bonding agent. Non-fibre material from pulp production (**Figure 6**) can also be utilized in whole carton recycling.

Figure 7. Typical construction material made from whole carton recycling

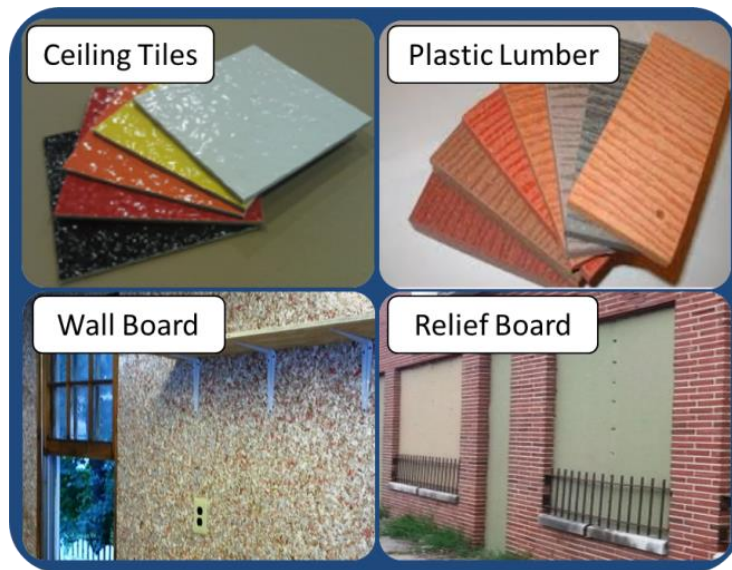


Photo credits: The ReWall Company, 2015. www.rewallmaterials.com.

5. Information supporting the development of a business case to sort cartons

The following information is provided to support the decision to sort cartons into their own grade and can be used by individual MRFs and/or municipalities in developing a business case that reflects their own unique circumstances.

- Based on tip floor, curbside and MRF audits conducted by CCC, cartons typically represent 0.5 – 1.5% of the inbound recycling stream measured on a weight basis.
- In Canada, long haul trucks are typically limited to carrying a payload not exceeding 44,000 lbs. (~20 tonnes).
- Based on the most recently available data³, the average price for carton bales in 2014 was \$79/tonne in Ontario and \$140/tonne in Quebec. These prices can be utilized in building the revenue estimates.
- As a side effect and added benefit, sorting cartons into their own grade effectively removes them from other commodity grades which can increase the value of these other grades. Although it is

³ Ontario pricing information is obtained from the Reclay StewardEdge Ontario Price Sheet (<http://reclaystewardedge.com/resources/rse-ontario-price-sheet/>). The Quebec pricing information is obtained from Recyc-Quebec (<http://www.recyc-quebec.gouv.qc.ca/client/fr/industrie/prix.asp>).

difficult to quantify the incremental cost variations of sorting cartons out of other commodity grades, this is an added economic incentive worth considering.

Appendix – Carton poster

**ALL CARTONS ARE RECYCLABLE.
TOUS LES CARTONS SONT RECYCLABLES.**



**Cartons – juice, milk, soup and others
Cartons - jus de fruits, lait, soupes et autres**

