



**CARTON  
RECYCLING  
PRIMER  
FOR MATERIAL  
RECOVERY  
FACILITIES**



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# 1/ PURPOSE OF THIS PRIMER

Carton Council of Canada (CCC) is a coalition of carton manufacturers working together to deliver long-term solutions to help increase carton recovery and recycling in Canada. Its members are Elopak, Pactiv Evergreen, SIG and Tetra Pak. CCC can assist material recovery facilities (MRFs), for example, by financing and producing carton-recycling awareness campaigns; providing consulting services to optimize sorting processes; financing audits, pilot projects and equipment, and connecting sellers and buyers of carton bales.

Over the course of its existence, 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 MRFs, municipalities, producer responsibility organizations (PROs) and other stakeholders involved in the preparation of cartons for recycling. It is not intended to replace qualified engineering, architectural or legal advice.



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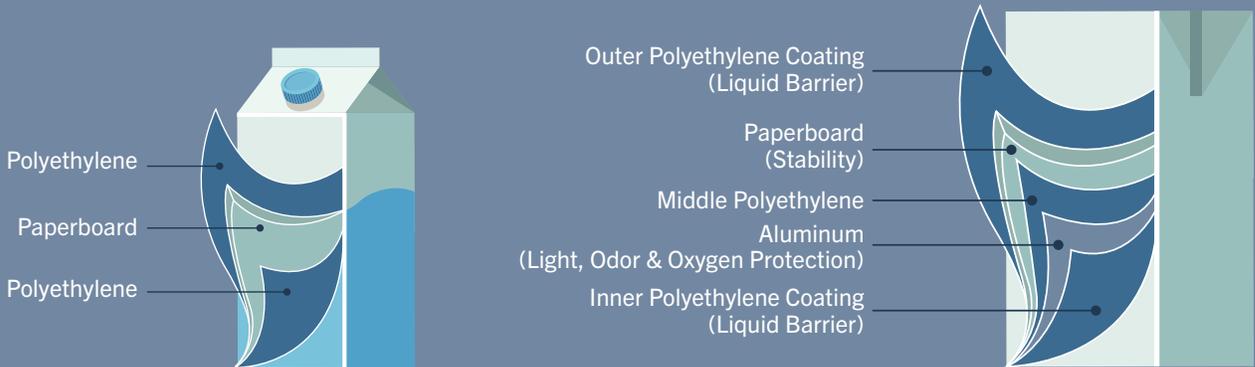
# WHAT ARE CARTONS?

Gable top and aseptic 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). They are not coated with wax. What some still think is wax is actually the outer coating of polyethylene.

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.

Cartons are recognized as an environmentally sound packaging choice. Their primary component is paper board made from fibre, a renewable resource. They are lightweight, transport-efficient thanks to their format, and have an excellent product-to-package ratio.

FIGURE 1. Gable top and aseptic carton composition



**GABLE TOP OR REFRIGERATED CARTONS**

**ASEPTIC OR SHELF STABLE CARTONS**

### 3/

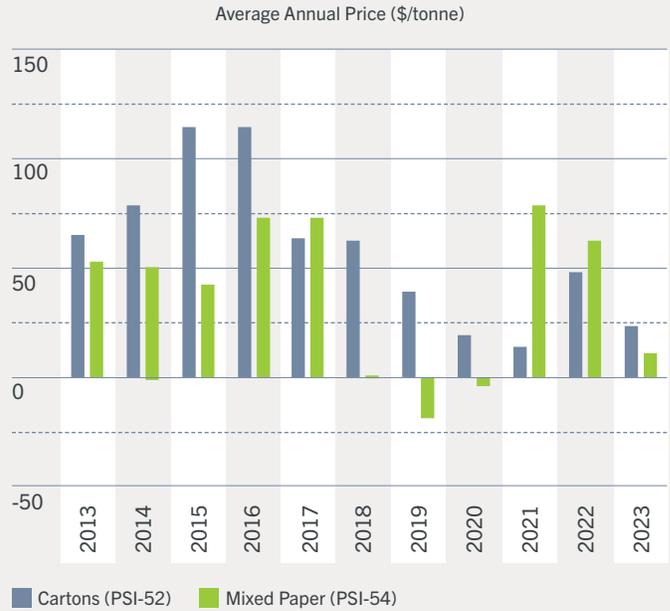
# WHY ACCEPT CARTONS FOR RECYCLING?

Both gable top and aseptic cartons are recyclable and there is demand for them. The long, virgin fibres that they contain represent one of the highest quality sources of fibre in the recycling stream. As volumes of recovered sorted office paper continue to decline, cartons are used to produce pulp for recycled paper products such as tissue, towelling and writing paper. They can also be transformed whole into usable products, typically construction materials.

This demand is reflected in cartons' market value. In the past ten years, commodity pricing for used cartons in Ontario and Quebec (the only two provinces for which data is publicly available) has been superior or comparable to pricing for mixed paper, with the notable exceptions of 2021 and 2022 (Figures 2 and 3). The average price over this ten years period was \$59 for cartons and \$39 for mixed paper in Ontario and \$77 and \$52 in Quebec, a difference of 51% and 48%, respectively.

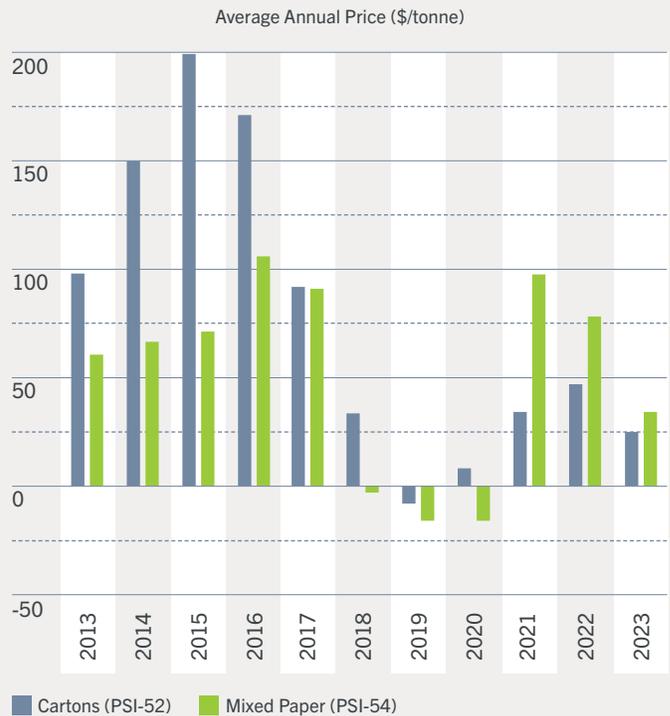
The vast majority of recycling programs in Canada already accept cartons for recycling. According to CCC's calculations, 97% of Canadians have access to beverage carton recycling in their community, and 90% to non-beverage carton recycling. The quantity of cartons in the recycling stream is appreciable (around 1% of blue box materials) but still manageable, even for smaller MRFs. Often, little additional investment is needed before starting to accept cartons and storage requirements are minimal.

**FIGURE 2. Average price paid for carton and mixed paper bales in Ontario, 2013–2023**



Source of data: [CIF Price Sheet](#) Note: Prices are FOB the MRF.

**FIGURE 3. Average price paid for carton and mixed paper bales in Quebec, 2013–2023**



Source of data: [RECYC-QUÉBEC materials price index](#) Note: Prices are FOB the MRF.

## 4/ SORTING CARTONS IN THE MRF: PREFERRED SORTING APPROACHES

Cartons are generated from the residential as well as institutional, commercial and industrial (ICI) sectors. Depending on the sector, cartons can be placed into individual bins or carts by residents/users and placed at the curbside for eventual collection. 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. In many provinces, a portion of cartons are also recovered through a deposit return system.

Once used cartons are transported to a MRF, there are three paths they can follow. The first is into a dedicated carton grade (grade PSI-52, see Section 5.3), the second is into another fibre 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 mills 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 (polyal). It also makes possible their complete transformation into building materials.
2. It minimizes the impact on other commodity grades (e.g., sorted residential and mixed paper bales) by realizing the highest potential price for those commodities.
3. The price paid for cartons has generally been higher than the one paid for mixed paper bales, an option commonly used by MRFs that choose to bale cartons with other fibre materials (refer to Figures 2 and 3).

Note that some MRFs produce a variant carton grade which includes other fibre-based polycoat materials, such as single-use beverage cups (hot and cold) and ice cream containers. These bales are produced in accordance with the specifications of established buyers.

# 4.1/ SORTING CARTONS INTO A DEDICATED CARTON COMMODITY GRADE (PSI-52)

Used cartons are either collected in a single or dual stream system:

- ▶ **SINGLE STREAM** (all materials in one collection container): Cartons along with all other containers are mechanically separated from fibres by disc screens or, increasingly, by ballistic separators and are directed to the container stream at the MRF. Once on the container line, they are sorted either manually or mechanically or a combination of both. 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. The proportion of cartons flowing to the paper stream is, however, greater when they undergo flattening through compaction at a transfer station, prior to being delivered to the MRF. This is common in a hub and spoke recycling system, where materials from various small programs are consolidated in a central location before being transported to the MRF.
- ▶ **DUAL STREAM** (containers in one collection container, fibres in another): Cartons enter the MRF in a specified container stream and are sorted either manually or mechanically or a combination of both. A few programs alternatively chose to collect cartons in the same container as fibres.

Once cartons are directed towards the container stream at the MRF, sorting typically begins with the separation of 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 sorted using optical sorters or robots (that can both be used for a variety of materials) 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 4). They are then placed in their own bunker and baled for sale to market.

FIGURE 4. Material on a container line after glass, metal and plastic have been removed.





## 4.2/ SORTING CARTONS INTO ANOTHER FIBRE COMMODITY GRADE

Sorted residential paper, mixed paper, and old corrugated cardboard (OCC) can accommodate a low level of cartons, which can vary depending on the tolerance levels of the receiving paper mills. However, this approach lessens the economic and environmental yields of cartons.

At the paper mill, more time is required to extract the fibre from cartons than from these other materials. Pulping cartons with other fibre grades can therefore lead to decreases in cartons' fibre yield. Moreover, typical paper mills are not equipped to handle the aluminum and plastic components of cartons. When cartons are sorted into their own grade, these problems are avoided.

Lastly, the commercial value of cartons for the MRF is decreased if cartons are commingled into mixed paper bales (refer to Figures 2 and 3).

## 4.3/ CARTONS NOT SORTED INTO ANY COMMODITY GRADE

The least desirable outcome is not sorting cartons into any commodity grade. Carton bales are a well-established commodity, and there are several domestic, North American and overseas markets for them. 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/or the municipality for disposal. There is also a reputational risk, as residents expect materials they place in their blue box to be recycled.

## 4.4/ SUGGESTED BEST PRACTICES

Assuming a MRF has made the decision to sort cartons into their own grade, 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 are 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.



### 4.4.1/ Adequate Signage and Easy-to-Understand Illustrations of Cartons

Gable top and aseptic cartons are not limited to well-known containers such as milk cartons and drink boxes (portion packs). This category covers a larger suite of carton types that include containers for soup and broth, wine, water, other dairy products (cream, buttermilk, etc.), dairy substitutes (soy, almond, etc.), protein drinks

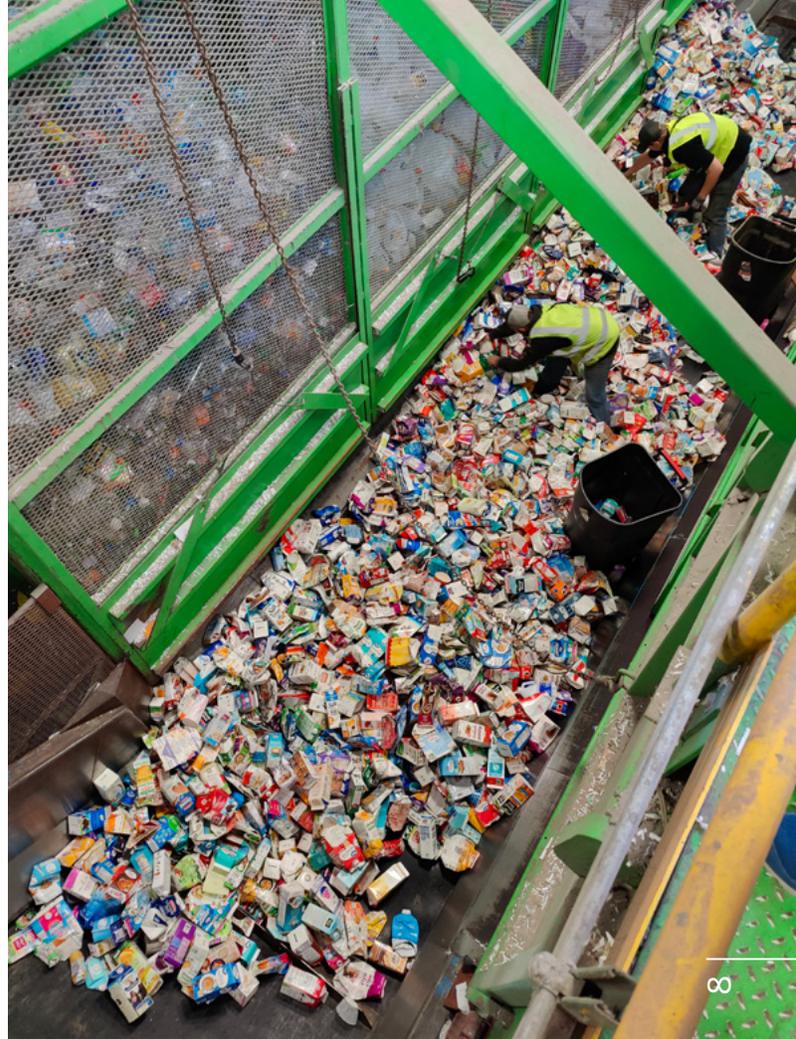
and molasses. In a number of sorting facilities, CCC observed manual sorters treating drink boxes and milk cartons differently. CCC developed posters and signage that MRF operators can position above the carton sorting station to assist sorters in recognizing the different carton formats and treating 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 CCC if you wish to request various sizes and formats of the poster.

## 4.4.2/ Cartons Collected in the Container Stream

Through a series of household waste audits, CCC measured that in dual stream programs, a large fraction of cartons were often placed incorrectly into the fibre 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 bales. 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.

Increasing promotion and education (P&E) efforts is likely the best solution for dual stream programs that find that an excessive amount of cartons are being placed in fibre bins.



## 4.4.3/ Reclaim Conveyors/Bins on the Fibre Line

Whether MRFs are configured for single or dual stream recycling, a small proportion of cartons invariably 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 option 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.

## 4.4.4/

# Consider the MRF Configuration and Latest Technological Advances to Understand the Best Areas to Sort Cartons

- ▶ One of the practices that 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. One benefit 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. Another advantage is that it avoids any aseptic carton being ejected by the eddy current, due to the presence of the layer of aluminum in this type of cartons.
- ▶ Sorters can perform dual functions by also recovering other missed recyclables at this point. Alternatively, a growing number of MRFs are installing an optical sorter at the end of their line that ejects valuable materials, including cartons, that were missed earlier in the process (commonly referred to as a “last chance optical”).

- ▶ 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 low-density polyethylene outer layer on all carton types. Most manufacturers will provide expected efficiency and purity rates<sup>1</sup> 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 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, 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.

- ▶ In terms of technological advances, artificial intelligence (AI) coupled with robotics has been in MRFs for a number of years and perform well on minority materials such as cartons. AI has also been applied to traditional optical sorters to improve recognition of challenging materials and AI cameras are even being used in place of NIR sensors in some optical sorters, substantially lowering the installed cost of optical sorting for some materials. This technology is applicable to carton sorting and, according to some industry experts, substantially outperforms robotic sorting.

- ▶ 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.

1. 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.



# 5/ STORAGE, MARKETING AND TRANSPORT CONSIDERATIONS

## 5.1/ 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 their 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.



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.

Carton Council is willing to work with MRFs that cannot make a full carton load on a regular basis (often referred to as LTL, Less Than Load) to explore ways to consolidate carton volumes from neighbouring facilities at a given MRF location (hub and spoke model).

## 5.2/ MARKETING CARTON LOADS

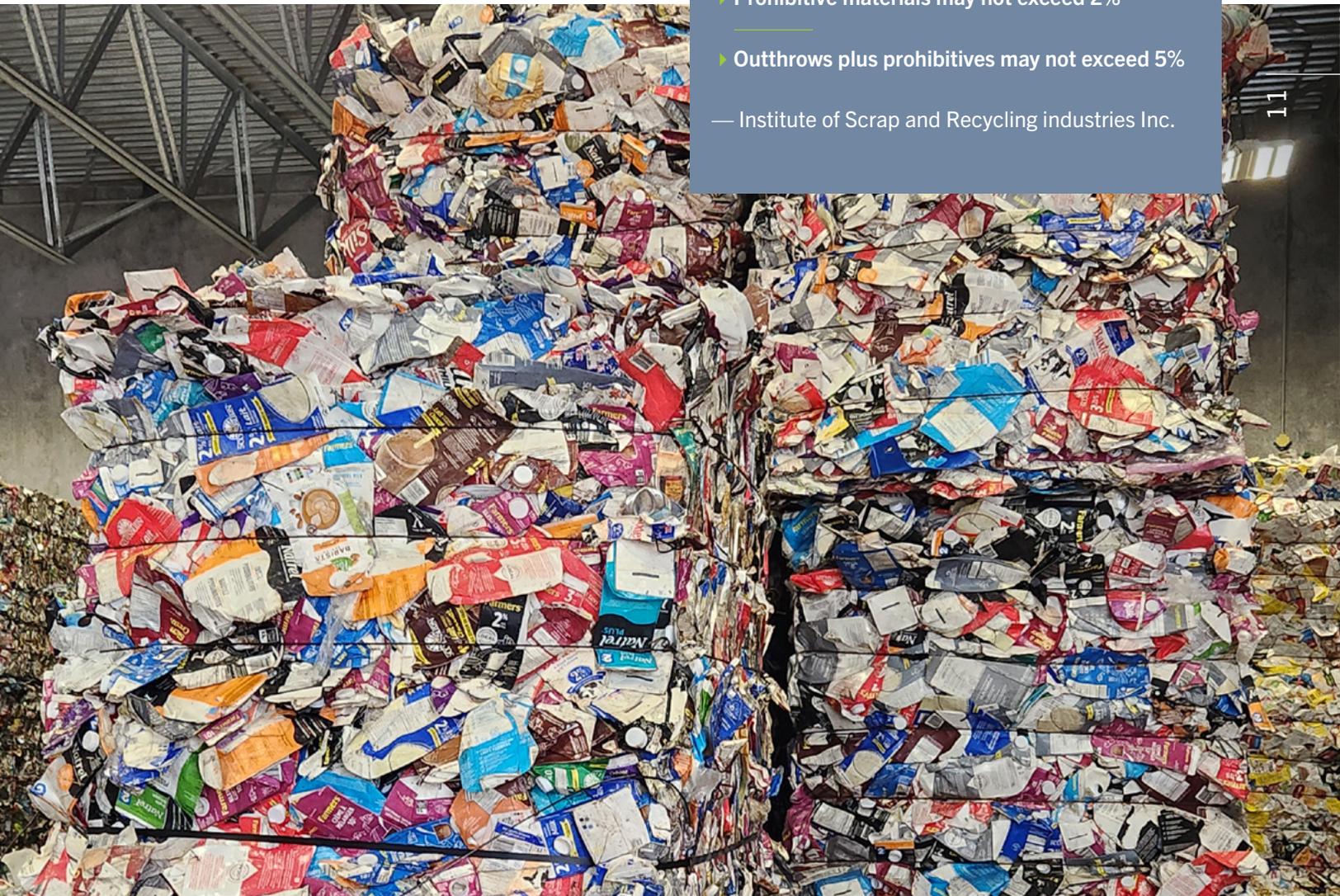
CCC has identified a number of brokers who purchase carton bales from Canadian municipalities and MRF operators. A regularly updated list is provided on CCC's website at [www.recyclecartons.ca/end-markets-brokers](http://www.recyclecartons.ca/end-markets-brokers). CCC can facilitate introductions if required.

## 5.3/ GRADE SPECIFICATION

CCC was successful in working with the Recycled Materials Association (ReMA), formerly 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.





## 5.4/ END MARKETS

At the time of writing, there were six end markets in North America accepting cartons: Sustana in Quebec and Wisconsin; Kelly Green Products in Connecticut; Continuous Materials in Iowa; Essity in Alabama; and Kimberly-Clark in Mexico State. For the most up-to-date list of end markets, see CCC's website at [www.recyclecartons.ca/end-markets-brokers](http://www.recyclecartons.ca/end-markets-brokers).

Note that end markets 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 brokers/traders to purchase their volumes of post-consumer cartons. As with many other recycled commodities, there continues to be a strong demand for recovered cartons from export markets. At this time, overseas mills accepting cartons from North America are located in South Korea, India, Malaysia, Vietnam and Thailand. As with North American end markets, the recovered fibre from cartons is primarily used to produce tissue and towelling.



## 5.4.1/ 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 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, along with a liquid solution. Through mechanical agitation of the mixture, the fibre separates from the plastic and aluminum layers and everything

is filtered through a series of screens. The fibre slurry passes through the screens unimpeded while the non-fibre components (polyethylene and aluminum layers together with openings and closures) are removed (Figure 5). What's left is long fibre (Figure 6) to be transformed into pulp sheets which are sold to market for the manufacturing of paper-based products (Figure 7). In some cases, the non-fibre material can be sold to processors who make it into new products or use it as alternative energy sources in their facilities.

**FIGURE 5.** Large and small fragments of non-fibre carton components removed at different stages of pulp production



**FIGURE 7.** Bales of pulp sheets

**FIGURE 6.** Fibres from cartons and other fibre materials being cleaned to remove the last impurities



## 5.4.2/ Processing of the Polyethylene and Aluminum Components

Currently, certain paper mills that take cartons for recycling recover 100% of the carton. Kimberly-Clarke in Mexico uses the polyal to heat their facility. Some mills in Malaysia produce LDPE pellets with the polyal, which are then used to make new plastic products.

In Europe, Mexico, India, Thailand, and other countries, there are numerous examples of polyal being recycled into products such as ceiling tiles, wallboard, and injection moulded parts (e.g., automotive components). Carton Council of Canada is currently looking for end markets for polyal produced by North American mills so that this material can also be used to its full potential.

As for openings and closures, these are generally made of high-density polyethylene (HDPE). This does not affect the recyclability of cartons, since HDPE is a polymer, just like the plastic layers that they contain. CCC recommends that cartons be placed in recycling bins with their caps on, since paper mills that process them already handle the polyethylene and aluminum layers of the containers. Openings and closures are therefore processed with the polyal.

## 5.4.3/ Whole Carton Recycling

Whole carton recycling is the process of using the carton, including openings and closures, as-is to manufacture usable products. Typically, cartons recycled in this way are shredded (Figure 8) and turned into construction materials, mainly roof cover boards at this time (Figure 9). The process does not require any added glue, water or chemicals as heat is used as the bonding agent. The non-fibre material left over from pulp production (Figure 5) could technically also be utilized in whole carton recycling.

FIGURE 8. Shredded cartons before being turned into construction materials



Photo credit: Continuous Materials

FIGURE 9. Roof cover boards made from whole carton recycling



Photo credit: Kelly Green Products



Photo credit: Continuous Materials



## 6/ 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, municipalities and producer responsibility organizations (PROs) 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).
- ▶ 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 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

To request free posters, contact CCC at [info@recyclecartons.ca](mailto:info@recyclecartons.ca). Posters can be customized (material, size, text, carton types, colours, etc.).

