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Milestone Study on Post-Consumption Paper and Cardboard Waste Management and Secondary Markets in Mexico

Transforming Recycling and
Solid Waste Management in Mexico



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Acronyms and Abbreviations

CC	Collection Center
CDI	<i>Comisión Nacional para el Desarrollo de los Pueblos Indígenas</i> (National Commission for the Development of Indigenous Peoples)
CE	Circular Economy
CEC	Commission for Environmental Cooperation
CEPI GMP	Confederation of European Paper Industry - Good Manufacturing Practice
CNGM	<i>Censo Nacional de Gobiernos Municipales</i> (National Census of Municipal Governments)
CNICP	<i>Cámara Nacional de las Industrias de la Celulosa y del Papel</i> , also known as the <i>Cámara del Papel National</i> (National Chamber of the Pulp and Paper Industries, also known as the Chamber of Paper)
CSys	Cleaning System
DBGIR	<i>Diagnóstico Básico para la Gestión Integral de los Residuos</i> (Basic Diagnosis of Integral Waste Management)
ERP	Extended Producer Responsibility
HDPE	High Density Polyethylene
ICI	Recovery of the Industrial, Commercial and Institutional Sector
INECC	<i>Instituto Nacional de Ecología y Cambio Climático</i> (National Institute of Ecology and Climate Change)
INEGI	<i>Instituto Nacional de Estadística y Geografía</i> (National Institute of Statistics and Geography)
INPI	<i>Instituto Nacional de los Pueblos Indígenas</i> (National Institute of Indigenous Peoples)
kt	Kilotons
LDPE	Low Density Polyethylene
LF	Long Fiber
LGEEPA	<i>Ley General del Equilibrio Ecológico y la Protección al Ambiente</i> (General Law on Ecological Balance and Environmental Protection)
LGPGIR	<i>Ley General de Prevención y Gestión Integral de Residuos</i> (General Law on Prevention and Integral Management of Waste)
MF	Mixed Fiber
MI	Manufacturing Industry
MSW	Municipal Solid Waste
Mt CO ₂ e	Millions of tons of CO ₂ equivalent
Mt	Millions of tons

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NGO	Nongovernmental Organization
NOM	<i>Norma Oficial Mexicana</i> (Mexican Official Standard)
PET	Polyethylene Terephthalate
PP	Polypropylene
PS	Polystyrene
RF	Recovered Fiber
RI	Recycling Industry
Semarnat	<i>Secretaría de Medio Ambiente y Recursos Naturales</i> (Ministry of Environment and Natural Resources)
SF	Short Fiber
SHW	Special Handling Waste
SP	Selection Plant
SR	Shared Responsibility
TS	Transfer Stations
UNEP	United Nations Environment Programme

Definitions

Apparent consumption	Defined as domestic production of paper and cardboard products plus imports minus exports
CSi	Controlled site. It is inadequate for final disposal, as it meets the specifications for a landfill, but not for waterproofing, in accordance with NOM-083-Semarnat-2003
FDS	Final disposal site. Place where municipal solid waste and special handling waste are permanently disposed of
GP	Garbage pickers. Individuals who perform paper waste recovery activities in final disposal sites other than sanitary landfills. These collectors do not provide receipts or invoices with fiscal value.
PGP	Private garbage pickers. Individual or legal entity that performs paper waste recovery activities from large generators, industry, commerce or services. They provide invoices with fiscal value
Pulper	Industrial equipment used in papermaking to transform raw material into paper pulp by mixing cellulose fibers, recycled paper or shredded paper with water, creating a suspension that is then processed to make paper
Regenerated fiber	A fiber obtained from cellulose, generally from wood or cotton, which has been previously processed with chemical materials and then transformed into a new fiber. This type of man-made fiber is used in the production of paper and other textile products
SLF	Sanitary landfill. Infrastructure work that includes engineering methods and works and final disposal sites that comply with NOM-083-Semarnat-2003
Standards	Technical document that establishes rules, characteristics or test methods for products, processes or services, including terms, symbols, packaging, labeling and other specifications previously considered Mexican Standards
UCSi	Uncontrolled site. Inadequate final disposal site because it does not comply with the requirements of NOM-083-Semarnat-2003

Summary

As part of the *Transforming Recycling and Solid Waste Management in North America* project of the Operational Plan 2021, the Commission for Environmental Cooperation (CEC) commissioned studies on recycling and waste management of paper and cardboard, plastics and bioplastics for Canada, the United States and Mexico, with the objective of accelerating the adoption of circular economy (CE) practices aimed at promoting strategies for the sustainable management of these materials that generate economic and environmental benefits in the region.

This study describes the value chain, infrastructure, handling, and primary and secondary markets for paper and cardboard in Mexico and shows the current state of waste recovery and recycling among the population. It also includes a summary of current public policies and regulations within the framework of the circular economy. Best practices in waste management that could be applied based on the recommendations and findings are also identified.

A similar study focused on Canada and the United States was recently published,¹ with the aim to enable decision makers to know the current state of post-consumption paper and cardboard waste recycling in these countries.

Differences in waste management and handling capacities determine recycling efficiency in the various entities of the country and between countries. Mexico does not follow the solid waste management and handling patterns used in Canada and the United States, so there are important differences, for example, in the way in which recovery and recycling of post-consumption waste is carried out. Mexico does not charge fees for waste collection. This is a significant difference with respect to the other two countries and the budget allocated to infrastructure and public services for waste management.

Limited infrastructure, as well as poor operation and management of the cleaning services provided by municipal governments, have indirectly fostered the emergence of an informal sector, known as "*pepenadores*" or "garbage pickers" who, in exchange for a tip or the sale of these materials, recover waste.

These activities affect the waste management process, as irregular work is carried out in official vehicles and at local government disposal sites. Government-owned materials are extracted for personal use. This has consequences on the composition of the waste sent to the plants where the waste destined for recycling must be extracted. This is an informal activity, but it is not illegal, as its social usefulness is recognized.

¹ CEC (2024), [Transforming Recycling and Solid Waste Management in North America](#), Commission for Environmental Cooperation.

Garbage pickers do not issue invoices. They sell waste to other collectors with greater financial capacity, who have vehicles to transport it in large quantities to the collection centers. These collectors do issue invoices and meet their tax obligations, thus formalizing an informal activity. Materials recovered in this way are cleaner than those from a sorting plant, where mixed waste is received and processed.

Formal collection or recovery centers are entrepreneur-run micro- and small businesses who buy recovered paper and cardboard waste and sell it to the manufacturing or recycling industry.

The *2023 Annual Report* of the National Chamber of the Pulp and Paper Industries (CNICP), also known as the Chamber of Paper, reported an apparent consumption of paper and cardboard in Mexico of 8,983 kilotons (kt), of which nearly 90 percent is converted into secondary raw material for paper manufacturing.

The country collects and recycles around 4,863 kt of paper and cardboard, representing 54.14 percent of all apparent consumption of this material, which places Mexico in 27th place in the world in the recovery of secondary fiber of domestic origin.

However, this recovery was not sufficient to supply the secondary fiber requirements of the pulp and paper companies affiliated to CNICP, so 1,551 kt of secondary fiber were imported, mainly from the United States. Thus, Mexico ranked third in the world, with a total consumption of secondary fiber, domestic or imported, reaching a recycled content rate of 89.53 percent in final products.

The recovery and recycling of paper and cardboard waste is carried out through private sector infrastructure and activity, complemented by the import of secondary fiber. The recovery percentage achieved in Mexico (54 percent) is similar to those of Canada (59 percent) and the United States (55 percent). However, the percentage of recycled material is substantially different in Mexican products in terms of content, tariffs, infrastructure and involvement of garbage pickers and collection centers (see sections 3 and 4 of this document).

Regulatory structure in Mexico, although solid, is not sufficient to control informal activity or to reduce social, economic and environmental inequality in the handling and management of paper and cardboard waste in the states. The legal-administrative structure and its local implementation are key to the efficiency of plans and strategies to promote recycling.

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1. Introduction

The United Nations Environment Programme (UNEP), in its *Global Waste Management Outlook 2024*, estimates that from 2020 to 2050 the generation of municipal solid waste (MSW) will increase globally from 2.1 to 3.8 billion tons, of which uncontrolled waste sent to a disposal site is estimated to increase from 1.45 to 3.66 billion tons, representing a growth of more than 1.5 times (see p. 77 of the UNEP report).

Semarnat's *Basic Diagnosis for Integrated Waste Management, 2020*, estimates Mexican per capita waste generation of between 0.8 kg and 1.1 kg, total generation of 120,128 tons per day and waste collection coverage of 83.87 percent. Waste management by the public system is carried out in 47 plants, of which 26 are sorting or recycling plants, five are shredding plants, thirteen are compaction plants, 19 are composting plants and 5 are biodigestion plants.

There are 2,203 registered final waste disposal sites located in 1,722 of Mexico's 2,478 municipalities. Most of these sites do not comply with environmental regulations (NOM-083-Semarnat-2003).

The population generally does not pay fees for public collection services. This resulted in insufficient infrastructure that, in short order, requires major maintenance or ceases to operate. When accompanied by inadequate technical capacity (as is often the case), this infrastructure leads to poor waste management in environmental terms and great inequalities in waste management, treatment and final disposal throughout the country.

As for paper and cardboard waste, a significant amount is recovered by informal garbage pickers (or *pepenadores*) who work in final disposal sites, controlled or not, in collection vehicles owned by the cleaning systems or in public and private facilities. They separate waste with economic value that they then sell to collectors or private collection centers.

Garbage pickers extract mixed waste and sell it without an invoice or tax document, which affects the first purchasers because they do not have a formal mechanism to document the acquisition of these materials. Despite being informal, the activity is not illegal, as it is considered important for recycling and socially beneficial.

Note that most of the paper and cardboard for recycling are obtained from collection centers that receive waste from formal or informal waste collectors, directly from the population or from service providers that recover waste in industry, commerce or services.

There is little recovery from public infrastructure, since the waste that sorting plants receive from the *pepenadores* is mixed with other products (such as organic waste) which does not enable them to obtain clean materials suitable for recycling.

CNICP is a key participant in the production and recycling of paper and cardboard, since it has at least 50 paper mills and two pulp mills in 21 states, with an installed capacity of 7.8 million tons per year. They are owned by 36 brand owners or companies that produce practically all of the paper and cardboard used in Mexico. This industrial contingent operates at 78.9 percent of its capacity.

In 2012, CNICP developed the *Management Plan for Paper and Cardboard Waste in Mexico*, in compliance with NOM-161-Semarnat-2011, which lists all the companies that make up the Chamber of Paper, prepares a review of the handling and management of paper and cardboard waste and proposes actions to increase its recovery and recycling. According to Semarnat, the Chamber of Paper must report progress in the recycling of this waste in Mexico every year.

This study describes the management of post-consumption paper and cardboard waste, secondary markets, and the actors, the value chain and the social, economic and infrastructural variations. The results obtained are also compared with those published in similar CEC studies for Canada and the United States.

2. Information sources and assumptions

For the value chain, our main source was the CNICP *Annual Report (2023)*. It includes companies that produce, market and recycle more than 90 percent of paper and cardboard products. The report is also the main source of data and information on technologies in the industry.

This information was complemented with that of the *Management Plan* prepared, administered and implemented by the Chamber itself. To verify the validity of the information, consultations were carried out with CNICP to improve the clarity of the data, terms and conditions of operation before this document was prepared.

The study lists the percentage of urban, rural and Indigenous populations in each state so that public policies for infrastructure and mechanisms for waste management and handling can take into consideration the social composition of each region.

The "Market Overview" section is presented at the municipal level. However, it should be noted that, in the case of infrastructure, the biannual data from the INEGI *National Census of Municipal Governments and Territorial Districts of Mexico City (2023)* were insufficient to identify the volume of infrastructure for waste management, so a detailed correlation between the type of population, infrastructure, service coverage, environmental quality and other aspects could not be obtained. The information from the *Basic Diagnosis for the Prevention and Integral Management of Waste*, by Semarnat (2020), was also insufficient for establishing correlations.

Since the purpose of this study is to present comparable information with that obtained in Canada and the United States in order to consolidate common strategies for improving the management and handling of paper and cardboard waste, in the Mexican version of the Sankey diagram we use

the same colors, terms and components that were used in the versions for the other two countries. We added the manufacturing and raw material segments, which we consider appropriate additions.

Table 1 provides a summary of the data we used to present the flow of materials in the Sankey diagram in Section 4: "Market Overview." The summary can be compared with information recorded by the other countries.

Table 1. Summary of data used in the material flow analysis (kilotons)

Data	United States		Canada		Mexico	
Year	2021		2020		2023	
Domestic production of paper products	67,300		8,300		6,217	
Net trade balance of finished goods	18,400		-2,100		2,767	
Apparent consumption	85,700		6,300		8,983	
Newsprint	4,500		1,400		126	
Mixed fibers	32,600		2,200		2,562	
Cardboard	48,600		2,600		6,295	
Recovered for recycling	47,400	55.0%	3,700	59.0%	4,863	54.1%
Newsprint	2,100	47.0%	800	60.0%	32	25.5%
Mixed fibers	17,300	53.0%	1,300	56.0%	832	32.5%
Cardboard	27,900	55.0%	1,600	61.0%	3,959	62.9%
Separated for recycling	45,800	53.0%	3,500	57.0%	4,823	53.7%
Net trade balance of secondary fibers	-15,500		-500		1,511	
Recycled material used in domestic production	27,700		2,800		6,374	
Percentage of recycled content	41.0%		33.0%		89.5%	

Source: Prepared by the authors with data from the CNICP *Annual Report* (2023), and the CEC studies for Canada and the United States, CEC (2024).

Information in the table for Mexico comes mainly from the *National Balance of Fibers and Greenhouse Gas Emissions (GHG)* of the CNICP *Annual Report* (2023), as well as from the INEGI *National Census of Municipal Governments and Territorial Districts of Mexico City* (2023) regarding the recovery of paper and cardboard for recycling in the local districts.

Note that the category "mixed fibers" groups sanitary, specialty and white paper for writing and printing, which were originally described in the CNICP *Annual Report* (2023). Also, the data for apparent paper consumption consider the concept of "paperboard for edible liquids" used by the food industry.

The Sankey diagram was developed on the SankeyMATIC open access platform, and the same color palette was used to distinguish the material flows (newspaper, mixed fibers and cardboard) used in the Canadian and US studies, except for the initial raw material flows.

We assume that the flow of materials (from the apparent consumption node to the final recycling, non-recycling and secondary fiber export nodes) maintains the same proportion. On the other hand, unlike the studies for Canada and the United States, Mexico records information on the quantities of raw material used, as well as the proportion of virgin and secondary, domestic and imported fibers.

For coverage of municipal solid waste (MSW) collection services, we used data from the *National Census of Municipal Governments and Territorial Districts of Mexico City* (2023), which shows information from 2,475 municipalities, of which, in this study, we excluded 49 that did not have complete records.

3. Value chain

The value chain of paper and cardboard that is manufactured, consumed, recovered and recycled in Mexico ranges from the stages of production and import of raw materials to the recovery of waste and its reintegration into new products, including the actors that connect the flow of materials and waste along the chain.

Most paper and cardboard companies are part of CNICP, known as the Chamber of Paper, and produce more than 90 percent of the products in the market, with almost total coverage. This means that it is the big brands that drive production of certified wood to make virgin fiber from pulp or cellulose, as well as waste recovery and thus secondary fiber. This results in a circular process with a high recovery rate for paper and cardboard waste and of its use in recycling.

This chain is therefore efficient because it enables recovery of high-quality material with little contamination, since it is collected close to the source of origin. It relies heavily on the work of garbage pickers, organized collectively or individually, with or without their own infrastructure, who recover paper and sell it to collection centers. This structure enables Mexico to achieve a high recycling rate of 53.69 percent and recycled material content in marketed products of close to 90 percent.

It also records loss of materials during the waste recovery, handling and recycling processes due to the presence of contaminants in the bales, the mixing of paper and cardboard with organic waste, as well as the decrease in recycling capacity due to a reduction in the size of the fibers or because the maximum number of recycling cycles has been reached.

Some types of paper, such as tissue, which are used in sanitary services or health care, are disposed of through water or by sending them to final disposal sites, thus nullifying any possibility of recovery and recycling.

Another paper that is not recycled is that used in books or legal or scientific documents which, unlike other papers, remains in storage for a long period of time before being destroyed by use, shredding or final disposal, which is why this paper is difficult to recover.

Figure 1 summarizes the value chain, which begins with the sources of virgin or secondary raw materials. In Mexico, secondary pulp is the main raw material transformed by pulp mills into pulp, regardless of whether it is integrated into the paper and cardboard industry.

Waste generated by paper and cardboard consumption is recovered through the public and private systems. The public cleaning system promotes, to a large extent, the mixing of waste that causes loss of potential for recycling, as it is mixed with organic and liquid waste during collection. Once paper and cardboard are separated by garbage pickers in the cleaning vehicles, it is sent to collection centers or larger scale buyers.

When paper is not separated, it arrives mixed at a transfer station or sorting plant and is sent to final disposal sites. If the site is a sanitary landfill (SLF), no recovery occurs, but in the case of controlled (CSi) or uncontrolled (UCSi) sites, additional recovery of paper and cardboard for sale may occur.

In a private system, services can be provided on an individual or organized basis. In both cases, waste collection services are offered to large generators such as industries, businesses or services. Increasingly, valuable waste, such as paper and cardboard, is bought and sold among private individuals until it reaches the collection centers (CC) of the large brands involved in this activity, where the dominant companies are Biopappel, Ecofibras Ponderosa and Smurfit Kappa (now WestRock).

Mexico does not have differentiated recovery systems to obtain unmixed waste at the source. However, private collection centers are the closest infrastructure to the sources of generation, which enables recovery of waste with high cleanliness (from the population and public or private collection systems) which is taken in by manufacturing or pulp companies to start the paper manufacturing process again.

The paper and cardboard recovery cycle is possible when the fiber meets quality requirements to manufacture products required by the market. Mexico recovers a significant amount of secondary fiber from its domestic market. The remainder of its input is covered by imports, mainly from the United States (CNICP, 2023).

In 2011, the Chamber of Paper presented to Semarnat its *Management Plan for Paper and Cardboard Waste in Mexico*, which was authorized a year later. This plan separates collection according to the type of paper, its generator and specific logistics. The waste is recovered, handled and recycled in three families: white, brown and gray.

Generators are classified by type, according to the amount of waste produced per day or its annual equivalent. Households, small businesses and offices are considered as small generators that

produce less than 27 kilograms of waste per day. Large generators are those that produce waste above this value, such as industry, businesses and services.

Large generators are generally serviced by private collectors. Some companies, such as Smurfit Kappa, install on-site balers to make material recovery more efficient and productive. They make bales that are sent directly to their collection centers and industrial plants for recycling.

Large paper and cardboard production companies are also recycling companies. They serve large generators first, although they have also created a parallel collection network for small- and medium-size generators, which includes garbage pickers and collection centers (CC). The entire network is privately owned and is dedicated to the direct purchase and sale of separated and clean waste.

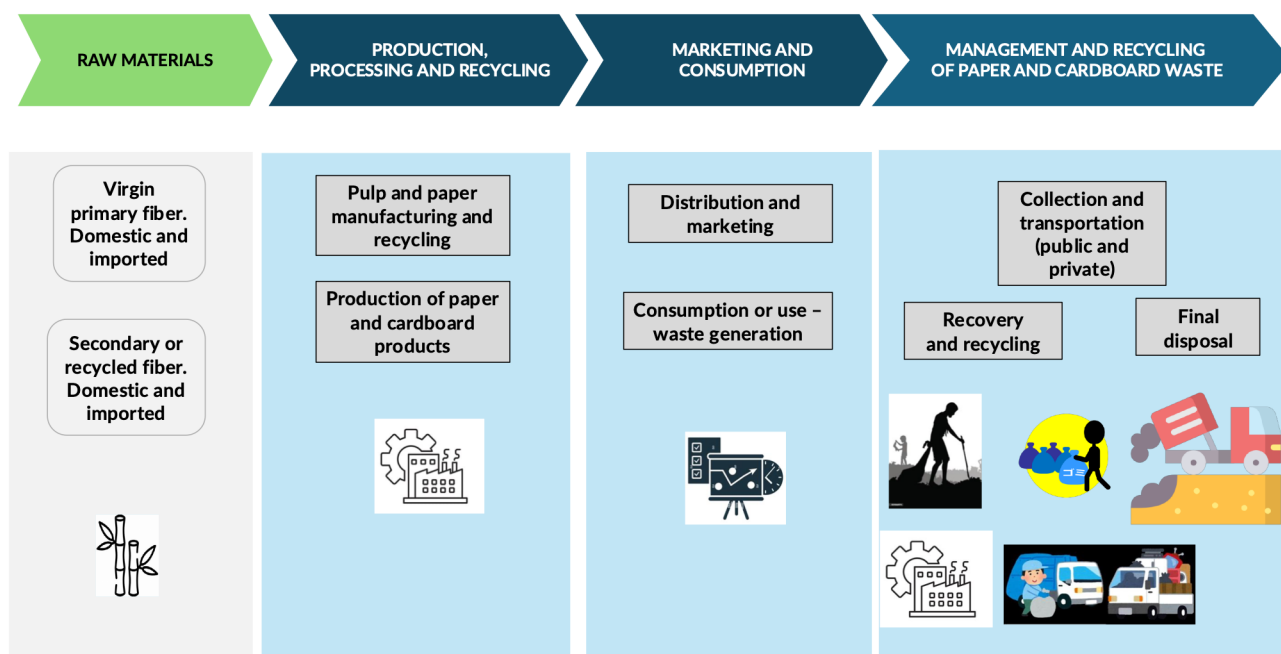
Currently, 4,863 million tons are collected and recycled annually in Mexico, representing 54.14 percent of apparent consumption. Complementary imports of secondary fiber, mainly from the United States, amounted to 1.551 million tons. This recovery places the country in 27th place in the world, with 89.53 percent of recycled material.

3.1 Value chain components

Figure 1 shows the paper and cardboard value chain in Mexico. The actors are grouped into the four stages of the process:

1. Raw material
2. Production, transformation and recycling
3. Marketing and consumption
4. Recovery and management of paper and cardboard waste

Figure 1. Paper and cardboard value chain in Mexico



Source: prepared by the authors, using information from CNICP (2012) and CEC (2024).

The value chains in Canada, the United States and Mexico have similar actors at each stage, with key differences in waste management and recycling. In all of them, the major brands determine how they operate.

The value chain begins with actors who supply pulp from domestic or imported secondary fiber, mainly from the United States, and natural fiber from Mexican timber crops.

The volume of natural fiber is small—about 1 percent of total consumption—while imported fiber accounts for about 9 percent. Major brands foster domestic production by hiring foresters for authorized crops. In the case of imports, there are no records that identify the actors.

Secondary fiber recovered in Mexico covers 67 percent of total requirements. The actors are individual or collective, informal or private garbage pickers who sell waste to collection centers run by major brands, which in turn take it to the manufacturing or recycling industry.

Since this is an informal activity, there is no official record of the number of garbage pickers in the country. Only indirect estimates can be made of their number using the volume of waste arriving at collection centers and their daily sorting capacity.

Imported secondary fiber, which represents 21 percent of the total used, is introduced mainly by the major brands. The actors are importers who carry out customs formalities.

The next group deals with production, transformation and recycling, and mainly includes the manufacturing industry's major brands. Details are shown in Table 2: Characteristics of the type of paper and cardboard, and sources of material by category.

Next are the actors at the commercialization and consumption stage for the domestic market or export. This group handles all paper and cardboard products used in the country, sold on a large scale by the major brands through an extensive logistics network with distribution centers that enable them to quickly reach the entire territory. However, this enormous dimension makes it difficult to identify areas of influence in detail because the distribution centers serve entire regions and large-volume consumers, such as food supply centers, department and self-service stores, as well as networks of franchises, stores, restaurants, hotels and entertainment centers, among others.

Note that this section does not include e-commerce, where use of packaging materials has increased substantially in recent years. Bans on the sale of plastic products have also triggered increased trade in paper and cardboard products on the international market.

Lastly, there is the block identified as *Management and recovery of paper and cardboard waste generated by consumption*. It is assumed that practically all paper generates post-consumption waste, except for paper that cannot be recovered, such as tissue paper, paper with a long useful life (for books and document files with a long shelf life), and paper used in handicrafts, such as papier-mâché, paper used in piñatas, alebrijes and pyrotechnics, which is also not recovered or loses value for recycling.

The chain closes with the manufacturing industry, which is also a recycler. Mexico has maintained this circularity in the management and use of paper for at least 14 years.

Once secondary fiber returns to papermaking, the industry determines which application the fiber will be used for. The technologies used and the formulation of the products are trade secrets of each company.

3.1.1 Paper and cardboard components and production

When natural raw materials are used in the manufacture of paper and cardboard, the wood or fibers are crushed and cooked with chemicals (hot caustic soda and other components) to form a pulp or cellulosic paste which is transferred to a pulper, where the fibers are dissolved in a liquid base. Something similar occurs when the raw material is recycled fiber; the difference being that the liquid phase is focused on eliminating impurities and homogenizing fiber quality.

Once the raw material is transformed into pulp or cellulose, the paste is bleached, using chlorine, ozone or enzymes, among other products, to form a very thin film. At this point, paper manufacturing begins. Some companies integrate pulp or cellulose and manufacturing plants in the

same facility. The pulp is transported through a pipeline to where the paper or cardboard is manufactured.

The processed sheets are used to make 26 types of paper or cardboard, such as bond, coated, newsprint, coated or uncoated cardboard, kraft, white, corrugated, toilet paper, tissues, napkins, towels or special products, among others.

Natural fibers are obtained from softwoods, such as pine or spruce or hardwoods like poplar, birch, beech, maple or eucalyptus. Secondary fibers come from post-consumption waste that is recovered through public or private cleaning systems, aided by the significant participation of garbage pickers or collectors.

They extract paper and cardboard from mixed waste at disposal sites (low quality and highly contaminated) or directly from collection vehicles (which yield better quality and less contamination). There are also formal waste collectors (individual or collective) which utilize large generators of wastepaper, i.e., factories, offices, shopping centers and other economic sectors, and more effective waste separation methods, thus leading to very high quality. After the waste separation step, it is sold to manufacturing or recycling industries, where the amount and type of fiber to be used is based on applications or market requirements. In all cases, the wastepaper will have been sorted according to color (white, brown or gray) and then compacted into bales for transport to the manufacturing or recycling industries.

During secondary fiber recovery, losses are tallied as the differences between the amount of waste recovered, the amount that is recycled, and the amount of new product. In waste recovery, volumetric losses are related to the amount of contaminating materials found in the bales, such as tape, labels, glues, pieces of string, plastics, and liquid contaminants. In shredding for recycling, loss occurs most frequently when the fiber is shortened after several cycles of use and, although pulverized, is sought to be used for further processing. When the fiber is lost, this procedure is no longer possible.

Paper and cardboard applications in end products have greater recycling potential when they are unimaterial (i.e., made from a single type of paper or cardboard), in contrast to polymaterial products, such as laminated cardboard or those that use plastics or waxes to contain liquids. Likewise, the recyclability of paper decreases when large quantities of glues are used, as in handicrafts, which when discarded become non-recyclable waste.

The types of paper produced in Mexico are classified as newsprint, white papers for writing and printing, packaging, sanitary and facial papers, and specialty uses; however, for the purposes of this report, all paper and cardboard is grouped into three categories:

- Newsprint
- Mixed fibers
- Cardboard

This classification is used homogeneously in Canada, Mexico and the United States to describe and group information from all stages and actors in the value chain.

3.1.2 Paper and cardboard categories and grades

Unlike Canada and the United States, the Mexican paper and cardboard industry depends mainly on domestic secondary fiber, collected via separate networks for large and smaller generators, and uses little virgin fiber.

Secondary fibers used to manufacture paper or cardboard must meet certain source specifications. For example, to make white paper, the fiber must come from white paper waste. Similarly, to make cardboard or paperboard, waste from the same materials must be used. For this reason, the industry has promoted specialized systems in the collection and transfer centers that receive, sort and bale paper and cardboard waste according to the classification of white, brown or gray.

This difference in raw material sourcing has a direct impact on production processes and recycling strategies. Mexican mills must prioritize the removal of contaminants and optimize recovery techniques to maintain product quality, compared to their North American counterparts, which have greater access to virgin fibres and different recycling infrastructures.

This reliance on secondary fibres encourages the development of efficient collection and sorting systems, ensuring higher rates of material recovery. Additionally, it supports local economies and reduces dependence on imported virgin pulp, contributing to environmental sustainability and resource conservation.

In this way, the recovered material is classified under the following headings:

- Material of a single type, no mixing of different papers or cardboards
- Material that contains no other materials, such as plastics, textiles, adhesives, etc.
- Clean and dry materials, i.e., without organic residues or wetted with any liquid

Contaminants include the following:

- Glues, adhesives and self-adhesive papers
- Waxes and pitches
- Fats and oils
- Tar
- Carbon and carbonless paper
- Inks
- Lacquers and varnishes
- Materials with high moisture resistance (waterproof)

The quality of recovered paper and cardboard for recycling is established in Mexican standard NMX-N-106-SCFI-2010, developed by the private sector. Its purpose is to determine the type of material to be recycled, its conditions and the methodologies for its evaluation. Table 2 describes the categories established by the standard.

Table 2. Paper and cardboard type characteristics and sources of material by category

Category	Types of waste	Source of material
Browns	Rolls, Short Fiber (SF) and Long Fiber (LF) Primary and secondary bags Corrugated, SF and LF trimmings SF corrugated box, in different presentations LF corrugated box, in different presentations Tube	Industry Collection centers Pre-consumption industry Pre-consumption imports Self-service stores Domestic Garbage pickers
Grays	Tissue or paperboard roll Used caple (i.e., high stiffness) paper or trimmings, from SF or LF Directory with or without spine Magazine Newspaper (selected, not printed)	Paper mills and converters Retail collection centers and pre- and post-consumption material Directory ads, print ads
Whites	Primary white (HWS) Continuous forms (CPO) Pre-consumption white file (MWL) Post-consumption white file (SWL) Primary white blend (80/20) Revoltura nacional (mixed paper) Color file (MCL) Yellow envelope and tissue waste	Printers Specialty paper manufacturing processes Collection centers Offices Factories Converters

Source: Prepared by the authors with information from CNICP (2023) and the NMX-N-106-SCFI-2010 standard.

The three types of paper or cardboard have different specifications for strength, stiffness or flexibility, smoothness, appearance, gloss, ink and glue absorption, and resistance to humidity and refrigeration, among others.

This classification of materials into browns, grays and whites is maintained from the time they are recovered and sent to collection centers until they are delivered to the manufacturing industry. The classifications are described below:

- **Brown materials.** Paper rolls (a post-industrial product of the paper industry itself), corrugated trimmings (leftover product from the manufacture of corrugated boxes), brown paper bags, corrugated boxes, cardboard tubes.
- **Gray materials.** Tissue rolls (a post-industrial product of the paper industry itself), paperboard rolls (a post-industrial product of the paper industry itself), paperboard trimmings (leftover or waste product from the manufacturing process of paperboard boxes), paperboard boxes and used paperboard in general, telephone directories, magazines, printed and unprinted newsprint.
- **White materials.** Unprinted bond paper sheets (a post-industrial product of the paper industry), continuous forms for printers with or without printing, soft files and shavings, bond paper with a large amount of printing or color, yellow envelopes, colored files, tissue waste (a leftover product or waste from the manufacturing process).

3.1.3 End-of-life management

As mentioned above, paper and cardboard in Mexico are manufactured mainly from secondary fiber. In its 2023 report, CNICP stated that apparent consumption is 8.98 million tons, of which 4.86 million tons were recovered. This was equivalent to 54 percent of secondary raw material for paper production. This means that the production, management and recovery of paper and cardboard can be seen as developed under the principles of the circular economy, since technical elements such as investment, redesign, recovery, reintegration into the production cycle, as well as a management plan that coordinates the efforts of all actors.

The recovery and recycling process is performed daily. However, fiber degrades with each cycle as it loses length and strength. Long fibers are always associated with little-recycled paper while short fibers with paper that has been recycled many times. This classification is done in the laboratory by observing the resistance of the residual paper to folding and tearing. Much-recycled paper is more brittle when pressure is exerted with the hands and, consequently, there is a high probability that it will become sludge in the pulper and lose its recycling capacity. It is estimated that paper can withstand up to seven recycling cycles without losing quality.²

Not all post-consumption or post-industrial paper and cardboard waste is recovered, partly because it is mixed with other waste or reused in other industries, such as handicrafts or window cleaning, or as fuel to generate heat energy. These activities do not enable recycling of all paper or cardboard, since paper impregnated with contaminants decreases in quality and is no longer of interest to the industry.

²CNICP, 2012, p. 9.

The useful life of paper is generally short although in some applications it can last into the medium or even long term. Long-term uses are, as mentioned above, those in which it is considered "permanent paper," such as that used for printing books and scientific or legal documents.

3.2 Value chain actors

Table 3 lists the actors in each stage shown in Figure 1 and describes their participation in the value chain. Note that some of them intervene in one or more stages, playing different roles.

Table 3. Key actors in the paper and cardboard value chain by stage and forms of organization

Stage	Actors, organization	Participation
Supply of domestic or imported virgin raw material. Supply of domestic or imported secondary raw materials	Importers of virgin and secondary fiber. Domestic producers of wood and virgin natural fiber. Collection centers run by the manufacturing industry or private actors.	Domestic producers work with certified timber forest plantations to use their products in cellulose production. Importers of virgin fiber bring in virgin and secondary pulp for paper production. Domestic secondary fiber is obtained through a network of industry collection centers or from other private actors that supply them with this material. In all cases, post-consumption and post-industrial paper and cardboard waste are recovered, sorted or compacted at the collection centers.
Production, transformation of cellulose, paper and cardboard products, including recycling	The industry is mostly affiliated with CNICP. It includes 36 companies in the paper sector and 5 cooperating companies. Some companies integrate the cellulose part. There are only two cellulose manufacturing companies.	They manufacture cellulose and, in some cases, integrate manufacturing and pulp production. They supply about 90 percent of apparent consumption. These same companies already include recycling activities, since the raw materials they use are mainly secondary in origin.
Marketing and consumption	Paper and cardboard are marketed through: 1. Large self-service chains 2. Department stores 3. Large distributors Consumption and use correspond to that of the population in general.	They have distribution centers and wholesale and retail operations. This sector produces post-industrial waste associated with packaging in its business activities. The population generates post-consumption waste from packaging of products of interest or foodstuffs. It is disposed of as mixed waste that is subsequently delivered to cleaning systems.

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Stage	Actors, organization	Participation
Paper and cardboard waste management	Garbage picker (GP) Private garbage picker (PGP) Cleaning system (CSys) Collection Centers (CC) Manufacturing Industry (MI) Recycling Industry (RI)	GP recover post-consumption waste directly from uncontrolled disposal sites (UDSi) or from local CSys collection vehicles. The waste is sold to collectors with greater financial or infrastructure capacity, or to collection centers. PGP mainly recover post-industrial waste from large generators (industry, business or services) and commercialize it with the CC. CC buy and sell recovered waste, sort it, compact it and send it to larger collection centers or to the manufacturing or recycling industry. These facilities receive material directly from the population. MI handle and reprocess post-consumption and post-industrial waste and manufactures paper and cardboard. RI handle and reprocess post-consumption or post-industrial waste to manufacture other products, such as soles for shoes or roofing sheets, and includes products from the handicraft sector (for piñatas, alebrijes), for cleaning or for use as fuel.
Collection and transportation	Municipal Government Cleaning Systems (CSys) Private businesses and individual services	CSys provide collection, transportation and delivery services of household waste to FDS, and in some cases includes large generators, industry, businesses or services. The CSys, in some cases, have transfer stations (TS) and even sorting plants (SP). Private services are companies or individuals with business activity that have their own collection vehicles and provide waste collection and shipment services to final disposal sites (FDS). Private services generally do not sort waste: they only collect and dispose it. On the other hand, some that collect separated waste send it to the CC and when they collect mixed waste from the population, they send it to an FDS.
	Garbage Pickers (GP)	GP are individuals or families who collect paper and cardboard waste at final disposal sites. Some work on foot, others with tricycles and some with pack animals.

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Stage	Actors, organization	Participation
		They sell to private collectors or pickers. They are informal labor and do not issue receipts or invoices with fiscal value. Theirs is subsistence labor. In large cities, GPs are hired by the driver of a collection vehicle and separate commercial waste, including paper and cardboard, en route.
	Private Garbage Pickers (PGP)	PGP are individuals or companies that recover paper and cardboard waste from large generators, industry, businesses or services. They can sign contracts and issue invoices. They recover waste and provide home collection services and services to micro- and small businesses, especially in poor areas or areas without infrastructure. They sell separated waste to larger collectors or directly to the CC. Some only transport and dispose of waste in the FDS and provide services to closed or open housing developments.
Recovery (sorting) and recycling	Individual private collection centers	These are facilities that have mobile scales and buy and sell clean waste. They aren't owned by a big company and they sell their materials to the highest bidder. They have minimal infrastructure and in some cases are located near uncontrolled sites (UCSi) or on vehicle routes to transfer stations (TS) or sorting plants (SP). They usually separate and temporarily store waste for shipment to other collectors, larger capacity collection centers or directly to the MI or RI.
	Business collection centers	These are facilities with infrastructure, such as a fixed scale for weighing vehicles, a sorting belt and compactor. Some CCs belong to the MI, which seeks to supply post-consumption or post-industrial waste that is better cleaned and of higher-quality material. The MI, and in some cases the RI, organize their own networks of collection centers. They buy and sell post-consumption and post-industrial waste on a wholesale basis.

Milestone Study on Post-Consumption Paper and Cardboard Waste Management and Secondary Markets in Mexico

Stage	Actors, organization	Participation
	Selection Plant	Some municipalities have such facilities to sort waste with commercial value, such as paper and cardboard, plastics, mainly PET, PP, HDPE, glass or metals. However, they are inefficient because they receive waste after it has been manually sorted by GPs in collection vehicles.
	Manufacturing Industry (MI) or Recycling Industry (RI)	MI is an industry, generally in the dominion of commercial brands, that has their own CC, or that operates them through associations, or forms a collection network that ensures that they receive clean and properly selected post-consumption or post-industrial materials. RI is an industry that is associated with CCs or PGP that mainly ensures they receive a supply of post-industrial waste, although they produce goods that differ from those for which the waste was originally destined.
	Management plan promoters	These are individuals or companies that recover waste and reintegrate it into the value chain. They promote joint, differentiated and coordinated participation of value chain actors to improve the handling, management and assessment of waste with high economic value for the generator or a third party. In 2011, CNICP prepared a management plan for the paper industry that is now in operation and produces annual reports. By 2023 it included at least 36 companies. Others can join if they meet the requirements.
Final disposal sites (FDS)	Sanitary landfill (SLF) owners	SLF is a site that complies with NOM-083-Semarnat-2003, where the entry of GPs and PGPs is not allowed and the waste is permanently disposed of. It can be private or public, generally under concession.
	Controlled Site (CSi) or Uncontrolled Site (UCSi)	CSi. A CSi is a site where waste is dumped, covered and compacted regularly and where GPs are allowed to enter. The recovery of paper and cardboard waste by GPs is low, as waste is commonly mixed and contaminated.

Stage	Actors, organization	Participation
		UCSi. A UCSi is a site where garbage is dumped without control and where GPs and PGPs and their leaders are allowed to enter.

Source: Prepared by the authors, 2025.

In general terms, authorities, and society generally, recognize the positive impact of garbage pickers, as they collect clean, high-quality materials close to the source of generation. However, when this work is carried out at an uncontrolled site (UCSi), the sanitary conditions can carry significant risks. Also, when the activity is carried out in urban collection vehicles, health risks may be lower, but the handling of mixed waste without proper protective equipment can still be dangerous.

The work of garbage pickers has secondary effects in the value chain, such as:

- It is an irregular business activity that does not issue receipts, much less contracts or invoices.
- It is usually carried out via public infrastructure, such as a collection vehicle, a roadside container or a final disposal site.
- It removes waste that has the highest market value. This affects the efficiency, financial balance and profitability of sorting plants.
- The activities of private companies, as individuals or legal entities, are carried out under better conditions.

4. Market overview

4.1 Population

Mexico, a country with great cultural, historical and natural diversity, consists of 31 states and Mexico City. Its demographic composition is varied, with quite different populations, which in this report are classified as urban, rural and Indigenous. At present, these three population types coexist in all states of the republic, and in none of them is there an absolute predominance of a single type.

Our study considers percentages by population type in each of the states, as shown in Table 4, where those with greater urban populations are listed. It shows that there are a few states with majority Indigenous populations, such as Oaxaca and Yucatán, where they make up more than 60 percent of the population. Note that Indigenous populations can be found in both urban and rural areas.

The information obtained at the municipal level does not enable us to observe the amount of infrastructure for waste management, or to determine detailed correlations between the coverage of services, environmental quality or access to financial and human resources.

The data from Semarnat's Basic Diagnosis for the Prevention and Integral Management of Waste (DBGIR) (2020) provide some details at the municipal level, but do not enable robust analysis based on indicators or relationships between waste management and the type of population, whether urban, rural or Indigenous.

Even if the table does not show this, it is evident that urban populations have more public and private infrastructure for waste management (mainly in state capitals) while rural populations have uneven infrastructure, depending on the states where they are located. Localities with high percentages of Indigenous populations have the least infrastructure, due to their remoteness and limited communication routes and access to technologies or resources.

Table 4. Percentage of population type by state in Mexico

State	Urban population (%)	Rural population (%)	Indigenous population (%)
Aguascalientes	84	16	6
Baja California	94	6	7
Baja California Sur	91	9	12
Campeche	75	25	47
Coahuila	92	8	2
Colima	90	10	13
Chiapas	49	51	37
Chihuahua	87	13	10
Mexico City	99	1	9
Durango	72	28	9
State of Mexico	87	13	16
Guanajuato	72	28	6
Guerrero	60	40	33
Hidalgo	57	43	37
Jalisco	88	12	7
Michoacán	71	29	21
Morelos	82	18	24
Nayarit	72	28	16
Nuevo León	96	4	6

State	Urban population (%)	Rural population (%)	Indigenous population (%)
Oaxaca	49	51	69
Puebla	73	27	33
Querétaro	79	21	13
Quintana Roo	90	10	33
San Luis Potosí	67	33	20
Sinaloa	76	24	9
Sonora	88	12	13
Tabasco	59	41	21
Tamaulipas	90	10	7
Tlaxcala	83	17	16
Veracruz	62	38	27
Yucatán	86	14	65
Zacatecas	63	37	5

Source: Prepared by the authors with data from INEGI (2023).

According to Table 4, while most states have urban populations above 50 percent, in Chiapas and Oaxaca this percentage is slightly lower (49 percent in each state).

The National Commission for the Development of Indigenous Peoples (CDI) created a methodology to classify a municipality as indigenous (Serrano *et al.*, 2002, and INPI, 2020) based on the identification of the household and the quantification of the population, considering the total of its members, with the following categories:

- Indigenous municipalities A, when their Indigenous population is equivalent to or greater than 70 percent of the total population.
- Indigenous municipalities B, when their Indigenous population is between 40 percent and 69.9 percent of the total population.

In 2022, a total of 615 municipalities considered as Indigenous responded to the National Census of Municipal Governments (CNGM) questionnaire. Type A municipalities numbered 440 (73 percent of the total) and Type B added up to 165 (27 percent). In sum, 9,588,871 people lived in municipalities considered Indigenous. In Type A municipalities there were 5,721,770 people, and in type B municipalities there were 3,867,101 people.

Regarding the recovery and recycling of paper and cardboard waste, the report is based on the volumes generated and separated at the source, which enables the development of local markets

to supply factories. Therefore, most of the paper that is discarded in small, rural or urban localities that do not have an adequate collection center ends up in final disposal sites.

4.2 Overview of material flows and performance

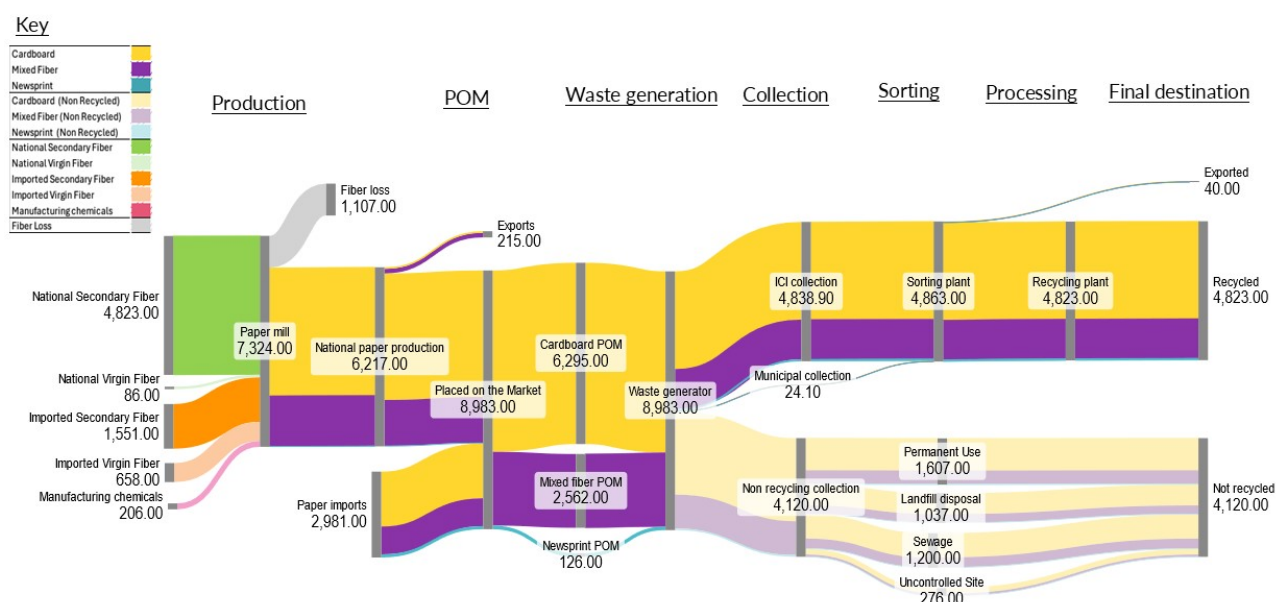
Based on CNICP statistics (2023), paper production between 2018 and 2023 reached an annual average of 6,107 kilotons (kt).

Last year, 6,126 kt of finished paper products were produced for the domestic market, 4.3 percent less than in 2022, when 6,497 kt were produced. In 2023, 215 kt of paper products were exported and 2,981 were imported, which shows that the country is a net importer of finished paper products. From 2018 to 2023, the paper sector's share of Mexico's gross domestic product (GDP) was 0.4 percent per year. However, in 2023, the sector's share of industrial GDP was 1.3 percent, and 2 percent of manufacturing GDP.

It is estimated that the Mexican paper industry generates 65,000 direct jobs and 235,000 indirect jobs. CNICP (2023) lists 41 pulp- and paper-producing companies that, taken together, operate 50 paper mills in 21 states and two pulp mills in two other states. Installed capacity capable of producing 7,877 kt of paper was reported, which implies that the industry operated at 78.9 percent of its capacity. The following sections analyze the flow of paper in Mexico and its performance.

Figure 2 presents a summary of the paper and cardboard flow in Mexico for 2023, according to CNICP statistics:

Figure 2. Sankey diagram for paper and cardboard in Mexico, 2023 (kilotons)



Source: Prepared by the authors with data from the CNICP Annual Report (2023).

Production

In its *2023 Annual Report*, the Chamber of Paper reported that domestic paper and cardboard production was 6,217 kt. The total consumption of fiber used for production (which includes virgin and secondary fiber) was 7,118 kt, of which 4,823 kt was domestic secondary fiber and 1,551 kt was imported secondary fiber. In sum, 6,374 kt of secondary fiber, 86 kt of domestic virgin fiber and 658 kt of imported virgin fiber were consumed. Recycled content makes up 89.5 percent of the total.

The 1,107 kt difference in fiber consumption is considered a loss due to poor-quality short fiber accumulating in the process sludge. The production of paper and cardboard also requires chemical inputs, which amounted to 206 kt in the year under review.

Apparent consumption

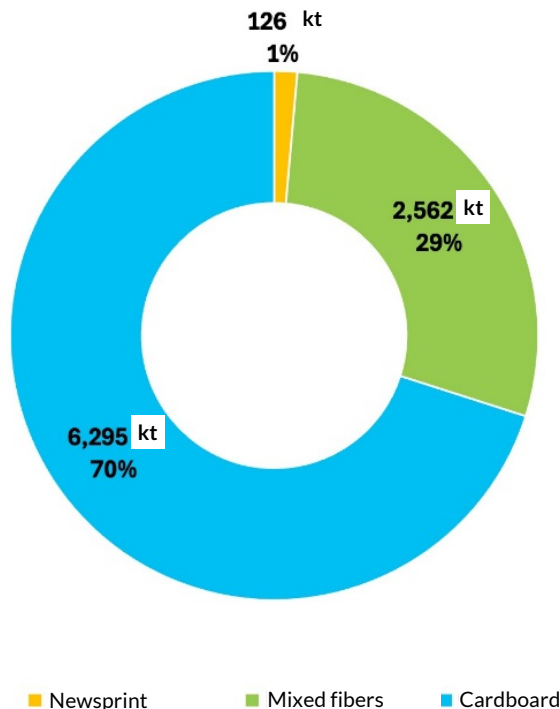
Apparent paper consumption is the total of domestic manufacturing of paper products (6,217 kt) plus imports of these materials (2,981 kt) minus exports (215 kt). Apparent consumption of paper in Mexico in 2023 was 8,983 kilotons.

Of this amount, 4,863 kt of raw material consisted of secondary fibers from domestic recycling. This figure yields a recovery rate for recycling of 54 percent. As in Canada and the United States, recovery of materials from the industrial, commercial and institutional (ICI) sector was predominant, representing 4,839 kt, or 99.5 percent of all materials recovered for recycling.

Based on information from INEGI's *National Census of Municipal Governments and Territorial Districts of Mexico City* (2023), the recovery of paper and cardboard for recycling at the local level was only 24 kt, or 0.5 percent.

Of the selected material, 4,823 kt were sent to recycling plants and 40 kt of secondary fiber were exported. Most of the paper products consumed were cardboard, at approximately 6,295 kt (70 percent). The remaining tonnage consisted of 2,562 kt of mixed fiber (29 percent) and 126 kt of newsprint (1 percent), as shown in Figure 3.

Figure 3. Apparent consumption of paper and cardboard products in Mexico, 2023

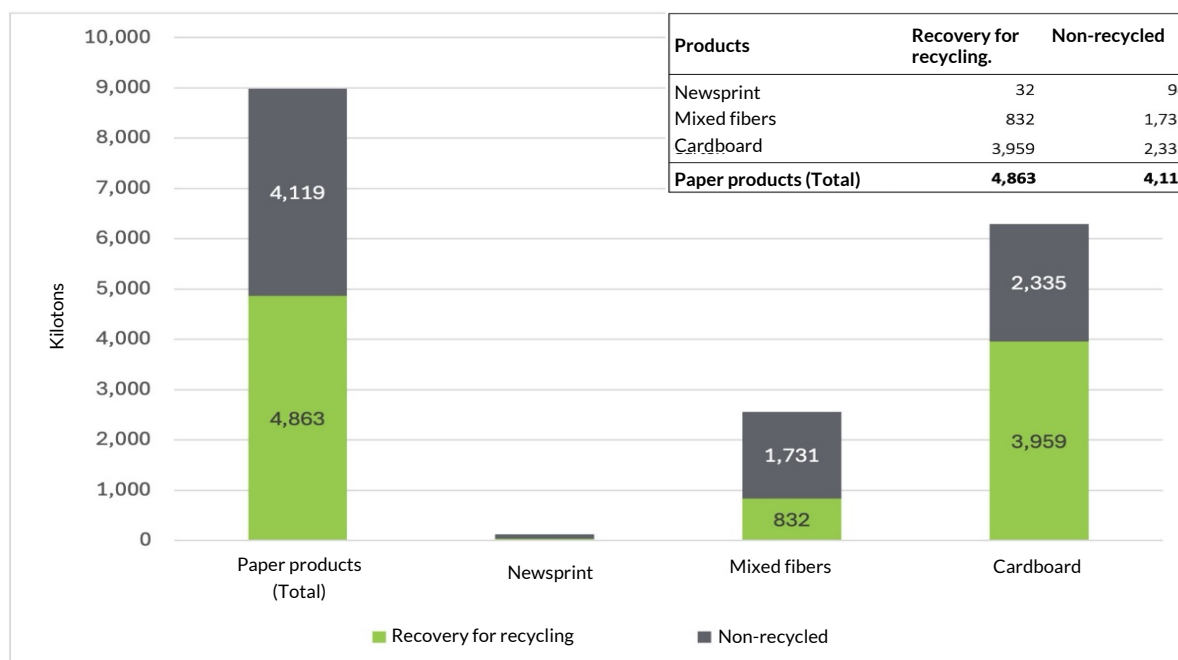


Source: Prepared by the authors with data from the CNICP *Annual Report* (2023).

Paper recovery for recycling

As mentioned above, in 2023 Mexico managed to recover 4,863 kt of material for recycling, achieving a recovery rate of 54 percent. Cardboard recorded the highest recycling rate (63 percent) with 3,959 kt recovered. Mixed fibers followed with 832 kt (32 percent), while newsprint saw a recovery of 32 kt (26 percent), as shown in Figure 4.

Figure 4. Post-consumption paper products recovered for recycling in Mexico, 2023



Source: Prepared by the authors with data from the CNICP Annual Report (2023).

Paper and cardboard collection without recycling

During 2023, 4,119 kt of paper waste was collected that was not destined for recycling. Of this amount, an estimated 1,037 kt ended up at a disposal site. However, 1,200 kt of sanitary paper waste ended up in drainage, 276 kt in uncontrolled sites, and 1,607 kt were permanent use paper, i.e., paper kept in libraries, universities, legal documents and government offices, among others.

4.3 Infrastructure of value chain actors

This section has two parts: public services provided by municipalities and those provided by the private sector. Each has its own infrastructure. They often do not interact with one another beyond the buying and selling activities they carry out amongst themselves. Operation and maintenance are the responsibility of each sector. Only the public sector provides publicly available information in the bibliography consulted. The private sector does not. Its costs, technologies and processes remain hidden. Only a few companies provide access.

4.3.1 Municipal solid waste collection services (MSW)

To analyze the coverage of MSW collection services, we used data from the *National Census of Municipal Governments and Territorial Districts of Mexico City* (2023). It showed that these services reached 99.5 percent of the country's population and were distributed among 2,276 municipalities that represent 94 percent of the total.

As for the population without MSW collection services, the census reports 150 municipalities (6 percent of the total). Based on information from Conapo (2023), these municipalities are home to 600,363 people, or 5 percent of the population, which lack these services. Oaxaca, with 387,247 inhabitants, is the state with the highest percentage of people without service (64.5 percent), followed by Veracruz, with 75,430 inhabitants (12.56 percent) and Puebla, with 44,473 inhabitants (7.41 percent).

Of the 614 Indigenous municipalities that responded to the census questionnaire, 86 (14 percent) do not have MSW collection services. However, of the 1,811 non-Indigenous municipalities that responded to the questionnaire, 64 (3.53 percent) lack municipal solid waste collection services.

In other words, of the 150 municipalities without access to MSW collection services, 86 (57 percent) are considered Indigenous municipalities (74 type A and 12 type B) and the remaining 64 (43 percent) are considered non-Indigenous municipalities. This means that if a municipality has no MSW collection services, it is 1.34 times more likely to be an Indigenous municipality.

According to the questionnaire answered by all municipalities in the country, an Indigenous municipality is 3.96 times more likely to have no access to MSW collection services than a non-Indigenous municipality.

Public infrastructure

In terms of infrastructure for municipal solid waste (MSW) and special handling waste (SHW), there is notable disparity between the states, with some having more efficient management than others. This inequality is caused by a combination of factors. Among the most important are public policies, access to infrastructure, citizen participation and financing.

Analyzing these factors makes it possible to identify the states with the best infrastructure for waste management and those where more attention is advised.

Public policies. Some states have more restrictive waste management regulations, especially for single-use plastics, while for paper and cardboard the regulation is based on the amount of waste generated in large volumes and the obligation to have management plans, a public policy instrument that enables the private sector to promote the installation of infrastructure, mainly for the recovery of paper and cardboard from all sources of waste. This policy leads to shared responsibility, as established by Mexican law, and as is the case between CNICP and Semarnat.

The municipalities with the best regulatory structures are Mexico City, Querétaro, Quintana Roo and Yucatán, while others, such as Jalisco and Guanajuato, regulation is more proactive in terms of recycling and the circular economy.

Generation and composition of waste. Variations in these parameters are closely linked to the region where the waste is generated: urban areas clearly generate a greater volume of organic waste and inorganic waste such as paper and cardboard, plastics and metals.

In rural or Indigenous areas, the composition of waste is different, since organic waste is generally used to fertilize the soil naturally or to feed farm animals. These regions face serious issues for the management of their inorganic waste, as the lack of infrastructure promotes inadequate disposal in uncontrolled sites (also known as open dumps) or in the natural environment, such as forests, ravines, rivers, hillsides, etc. They are also burned, a practice that leaves unconsumed material remains, mainly plastic, metals and glass.

Infrastructure. To analyze the coverage of collection and transportation services, it is necessary to consider not only the number of collection vehicles, which is crucial, but also the number of transfer stations, on-street containers and the frequency of collection, which must meet the needs of the population. In this regard, the broadest coverage is in urban areas, state capitals and metropolitan areas, such as Mexico City, Jalisco and Nuevo Leon. In Baja California, Nayarit and Quintana Roo, coverage is closely related to tourism activities.

Infrastructure for handling, treatment and disposal is built, operated and maintained by public agencies. Funds come mainly from federal government budget allocations to each state. These budgets do not meet actual waste management and handling needs. They are limited by available funds. Semarnat's Basic Diagnosis for Integrated Waste Management (2020) indicates that the cost of MSW collection reported by 167 municipalities in thirteen states for operation of the collection service, which includes salaries, fuel and in some cases the maintenance of the units, was \$434.03 per ton.

The cost of final disposal, reported by 84 municipalities in ten states, was \$121.58 per ton. This amount includes salaries and fuel for the machinery used. These costs affect the infrastructure conditions and the operation of the final disposal sites.

As mentioned above, infrastructure listed in the DBGIR (2020) includes 127 transfer stations, 26 sorting or recycling plants, 5 shredding facilities, 13 compaction facilities, 19 composting facilities and 5 for biodigestion. It is evident that this number of facilities is not sufficient to handle the total volume of waste currently generated in Mexico. As well, most of them operate below capacity, due to financial and technical limitations, which causes a large number to be in poor condition or even out of operation. This severely limits their efficiency in sorting and handling waste.

Some entities, in addition to sorting plants, transfer stations and collection centers, have more advanced facilities. For example, Mexico City has developed plants for biodigestion of nopal waste, and for the hydrothermal carbonization, treatment and recovery of construction waste, as well as for manufacturing biodiesel. Uncommon equipment like this is to be found also in Querétaro and Guanajuato, where there are facilities for biodigestion of organic waste. Querétaro, State of México, Jalisco and Coahuila also have facilities for recycling debris and composting. Morelos has

chemical recycling plants for plastics. In general, Mexico City, Nuevo León, Jalisco, Querétaro, Baja California and Guanajuato have achieved more efficient waste management thanks to their advanced infrastructure.

For the management of waste with high economic and recycling value, such as paper and cardboard, PET, metals and—to a lesser extent—glass, infrastructure has been built and is operated and maintained by the private sector, which has found recycling to be a way to reduce its costs of operation and cope with variations in prices of raw materials.

The distribution of these private facilities is mainly determined by the availability of paper and cardboard waste, as well as the location of pulp mills, the manufacturing or recycling industry, and the collection network that provides post-consumption or post-industrial waste. In addition, the cost at which waste is bought and sold determines access to waste, since garbage pickers and formal collectors always sell to whomever pays the highest price most promptly.

The following section describes the private infrastructure available for the recovery and recycling of paper and cardboard and, as well, analyzes public infrastructure for municipal solid waste management.

4.4 Paper and cardboard waste chain infrastructure

The value chain will be used as a basis for a description of infrastructure for post-consumption and post-industrial paper and cardboard waste. Infrastructure grouped by each of the stages will be described.

Raw materials

The producers of natural and secondary fibers, domestic or imported, are at this stage, which will describe only the infrastructure for domestic natural fibers. The other natural fibers used as raw material are brought into the country via customs brokers, whose infrastructure is simply an office or, as in the case of natural virgin fiber, comes from the cultivation of trees grown for that purpose.

Table 5 lists the Mexican states with cellulose production for paper and cardboard manufacturing, based on information for forest timber production, by product in m³ in rolls, reported in the National System of Environmental Information and Natural Resources of Semarnat.

Table 5. Entities with cellulose production in Mexico, 2021

States	Total cellulose (m ³)
Aguascalientes	0
Baja California	1,753
Baja California Sur	0
Campeche	0

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States	Total cellulose (m ³)
Chiapas	3,949
Chihuahua	33,774
Mexico City	173
Coahuila	0
Colima	0
Durango	376,563
State of Mexico	12,916
Guanajuato	3,053
Guerrero	16,021
Hidalgo	13,379
Jalisco	20,996
Michoacán	46,820
Morelos	0
National	573,644
Nayarit	0
Nuevo León	0
Oaxaca	26,620
Puebla	0
Querétaro	865
Quintana Roo	0
San Luis Potosí	53
Sinaloa	0
Sonora	0
Tabasco	140
Tamaulipas	0
Tlaxcala	0
Veracruz	7,524
Yucatán	0
Zacatecas	9,045
Grand total	1,147,288

Note: Cubic meters of wood in rolls.

Source: Conafor, 2021.

In the entities that record forest production for cellulose manufacturing, it is assumed that all production is destined for paper and cardboard manufacturing, and that forest plantations are authorized and have appropriate technology for long-term maintenance and operation, as well as sawmills and transportation necessary for handling wood. Appropriate data come from official

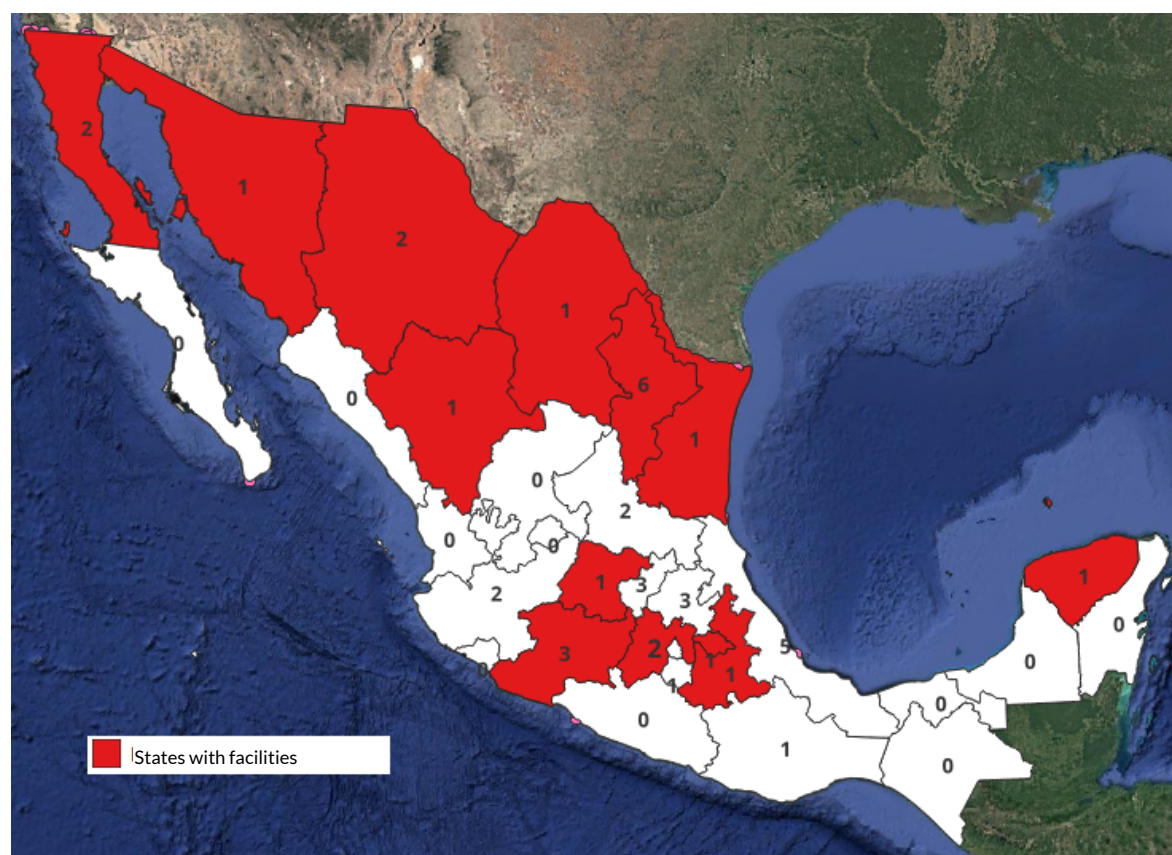
sources, such as Semarnat's National Environmental and Natural Resources Information System (SNIAR), whose information in turn comes from the National Forestry Commission (Conafor), the National Forestry Information System (SNIF) and Conafor's State of Timber and Non-Timber Forest Production Statistics (2024).

To identify where this infrastructure is located, the Chamber of Paper's 2023 *Annual Report*, the National Statistical Directory of Economic Units (DENUE, 2024), the *National Census of Municipal Governments and Territorial Districts of Mexico City* (INEGI, 2023), and the *Basic Diagnosis for Integrated Waste Management* (Semarnat, 2020) were consulted.

Cellulose production

The cellulose production industry has 19 facilities located in 13 Mexican states. The States of Guanajuato, México, Michoacán, Nuevo León and Puebla have more than one installation each. These plants produce pulp from wood cellulose and other plant fibers, as well as from recycled secondary fiber (see Figure 5).

Figure 5. Number of pulp mills by state

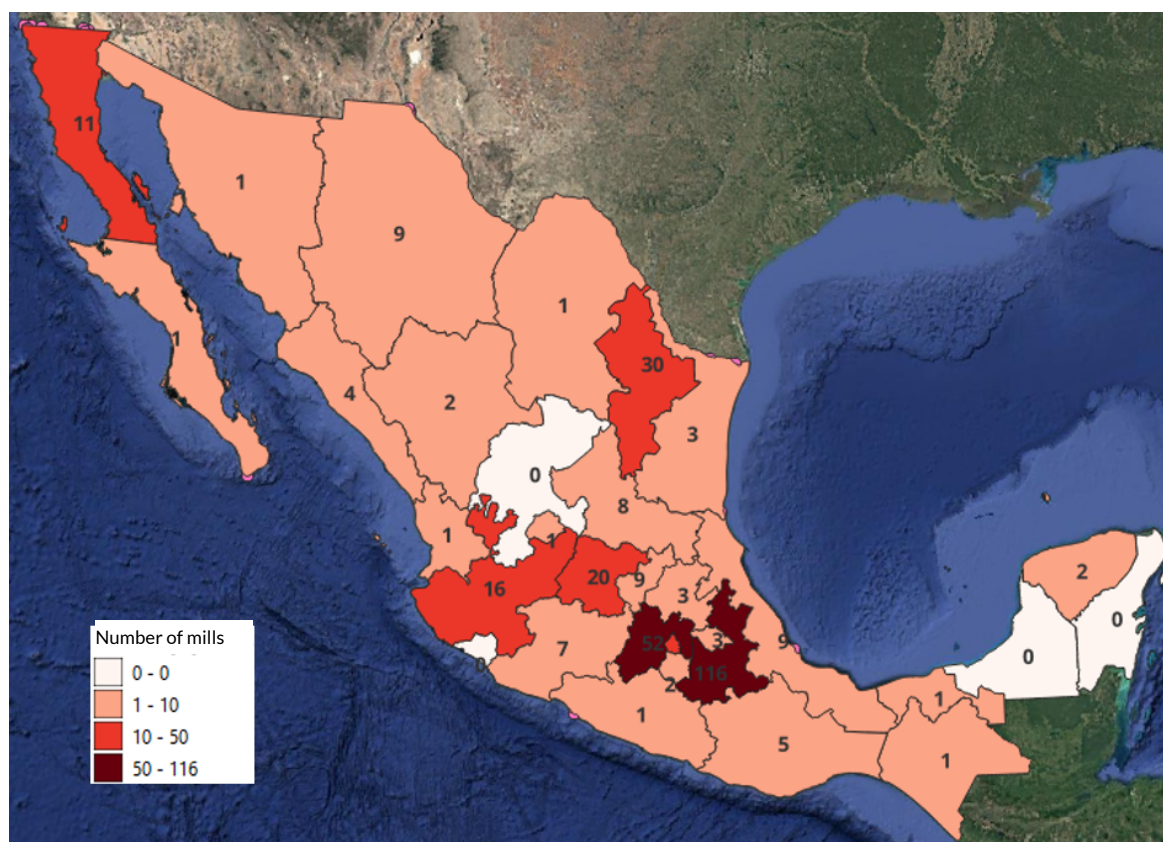


Paper and cardboard production

The Mexican paper and cardboard industry converts cellulose into a wide range of products, including printing and writing paper, cardboard used in packaging, and paperboard for consumer products. Based on information from DENUE (2024), it was found that the transformation of cellulose into paper is carried out in 340 industrial plants.

The State of Puebla has 118 paper production facilities, most of them family-owned, micro- or small companies, whose main production is artisanal. Next come the State of Mexico with 52; Nuevo Leon, 30; Mexico City, 21, and Guanajuato with 20 (see Figure 6).

Figure 6. Number of paper and cardboard production plants by state



Source: Prepared by the authors with information from DENUE (2024).

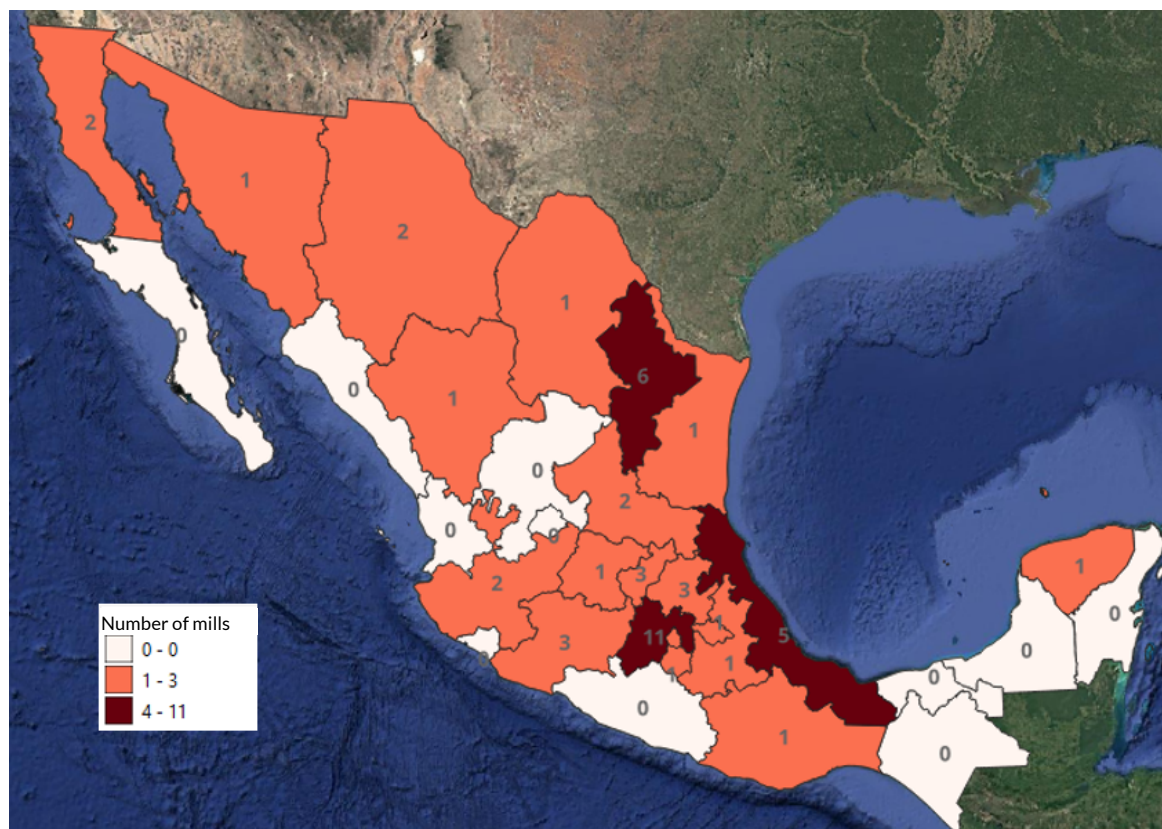
According to DENUE (2024), production is centered in 50 facilities that produce more than 90 percent of the paper and cardboard in Mexico. All of these facilities are members of the Chamber of Paper. According to its 2023 report, the Chamber comprises 36 companies. Taken together, they have two pulp mills in the States of Jalisco and Michoacán and 50 paper and cardboard production plants in 21 states in the country. The State of Mexico reports 11 facilities; Nuevo León, 6; Veracruz and Hidalgo, 5 each; and Michoacán and Querétaro, 3 each. The remaining are in other states (see Table 6 and Figure 7).

Table 6. Main paper and cardboard production facilities by state, 2023

State	Paper plants
Baja California North	2
Chiapas	2
Coahuila	1
Mexico City	1
Durango	1
State of Mexico	11
Guanajuato	1
Hidalgo	3
Jalisco	2
Michoacán	3
Morelos	1
Nuevo León	6
Oaxaca	1
Puebla	1
Querétaro	3
San Luis Potosí	2
Sonora	1
Tamaulipas	1
Tlaxcala	1
Veracruz	5
Yucatán	1
Total	50

Source: Prepared by the authors with information from CNICP (2023).

Figure 7. Distribution of the main paper and cardboard production plants by state



Source: Prepared by the authors with information from CNICP (2023).

The figure shows that paper and cardboard production companies are located in the central and northeastern states and are therefore identified as destinations for recovered waste.

Waste management, and in particular material or energy recovery, involves public and private infrastructures that collaborate, especially at the collection stage. However, collaboration in the selection and flow of waste to the industry is minor, as shown in Tables 7 and 8.

Table 7. Public and private infrastructure involved in waste management, by state

State	Population	Pulp mills (1)	Paper, cardboard and paperboard mills (1)	Paper, cardboard and paperboard mills (98 percent of production) (2)	Paper and cardboard collection centers (1)
Aguascalientes	1,425,607	0	1	0	24
Baja California	3,769,020	1	11	2	25
Baja California Sur	798,447	0	1	0	5
Campeche	928,363	0	0	0	3

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State	Population	Pulp mills (1)	Paper, cardboard and paperboard mills (1)	Paper, cardboard and paperboard mills (98 percent of production) (2)	Paper and cardboard collection centers (1)
Coahuila	3,146,771	1	1	1	56
Colima	731,391	0	0	0	7
Chiapas	5,543,828	0	1	0	12
Chihuahua	3,741,869	1	9	2	24
Mexico City	9,209,944	0	21	1	365
Durango	1,832,650	1	2	1	23
State of Mexico	16,992,418	2	52	11	494
Guanajuato	6,166,934	3	20	1	103
Guerrero	3,540,685	0	1	0	14
Hidalgo	3,082,841	0	3	3	42
Jalisco	8,348,151	0	16	2	137
Michoacán	4,748,846	2	7	3	40
Morelos	1,971,520	0	2	1	29
Nayarit	1,235,456	0	1	0	7
Nuevo León	5,784,442	2	30	6	113
Oaxaca	4,132,148	0	5	1	24
Puebla	6,583,278	2	116	1	140
Querétaro	2,368,467	0	9	3	39
Quintana Roo	1,857,985	0	0	0	12
San Luis Potosí	2,822,255	0	8	2	46
Sinaloa	3,026,943	0	4	0	25
Sonora	2,944,840	1	1	1	27
Tabasco	2,402,598	0	1	0	6
Tamaulipas	3,527,735	1	3	1	28
Tlaxcala	1,342,977	1	3	1	34
Veracruz	8,062,579	0	9	5	78
Yucatán	2,320,898	1	2	1	18
Zacatecas	1,622,138	0	0	0	8

Source: Prepared by the authors with information from: (1) DENUÉ (2024), and (2) CNICP (2023).

Table 8. Public and private infrastructure involved in waste management by state (*continued*)

State	Collection vehicles (1)	Transfer station (1)	Treatment plants (1)		Final disposal sites (1)	Sanitary landfills (2)
Aguascalientes	186	5	0		2	1
Baja California	529	6	0		20	2
Baja California Sur	186	0	0		32	0
Campeche	55	0	0		12	2
Coahuila	303	9	0		41	6
Colima	84	1	0		3	1
Chiapas	430	5	2		125	0
Chihuahua	457	3	1		164	2
Mexico City	2,740	12	2		0	0
Durango	182	1	0		61	1
State of Mexico	2,257	19	4	63	13	
Guanajuato	557	0	1		43	5
Guerrero	361	0	0		133	1
Hidalgo	361	7	3		52	4
Jalisco	1,287	11	13		123	12
Michoacán	867	2	4		112	4
Morelos	262	5	0		15	2
Nayarit	131	0	1		29	1
Nuevo León	456	5	2		42	3
Oaxaca	1,038	12	2		432	0
Puebla	560	2	2		95	10
Querétaro	237	2	1		12	5
Quintana Roo	199	2	1		28	3
San Luis Potosí	806	3	0		59	2
Sinaloa	291	0	0		48	1
Sonora	346	2	0		116	2
Tabasco	324	1	2		17	1
Tamaulipas	448	6	1		41	3
Tlaxcala	176	0	1		4	1
Veracruz	917	9	4		108	3
Yucatán	314	1	1		126	1
Zacatecas	246	1	0		92	1

Source: Prepared by the authors with information from (1): CNGM (2023), and (2): INECC (2022).

4.4.1 Marketing and consumption

Marketing is a complex stage of the value chain. It involves so many actors of different sizes and capacities that describing its infrastructure would be the subject of a separate study. Suffice it to say that the marketing of paper and cardboard products occurs through:

- Wholesalers and distributors, including distribution centers
- Specialty stores (stationery stores, packaging stores)
- Supermarkets and self-service stores
- Direct sales to industrial companies

Large actors buy varying volumes and resell to smaller ones, up to direct sales to retailers. Wholesalers and large distributors often rely on distribution centers to improve their marketing processes, reduce their costs and expand commercial coverage. This traditional structure has been extended in recent years by accelerated growth of e-commerce, which uses large quantities of paper and cardboard in its shipments. It doesn't distinguish the origin (domestic or international) of products purchased and the packaging involved.

The main groups of consumers are:

- Manufacturing industry (food, beverages, pharmaceuticals)
- Commercial sector (stores, supermarkets)
- Offices and homes

The manufacturing industry is a major consumer of *kraft* cardboard and paper packaging. This group includes cereal packaging, milk cartons, juice cartons and fruit and vegetable packaging. Electronics, appliances and auto parts require protective boxes for a wide variety of products. Pharmaceuticals require packaging for drugs and their distribution. E-commerce and logistics companies require packaging for shipments.

The publishing and printing industry uses large quantities of bond, newsprint and coated paper for the publication of books and magazines, advertising and newspapers. (Newspaper production is trending downward.)

Finally, huge volumes of bond and specialty paper for printing and photocopying, envelopes and stationery, are used in homes and offices. This consumption also includes toilet paper, napkins and paper towels.

Recycling corrugated cardboard is more important than ever, due to the growth in demand for packaging caused by the pandemic and changes in the food and healthcare industries. Mexico is a leader in paper and cardboard recycling. The packaging sector has experienced five percent annual growth. According to 2023 data from the Mexican Packaging Association (AMEE), paper and cardboard accounted for 37.7 percent of the materials in highest demand for this business activity.

The use of recycled cardboard in packaging is vital not only to satisfy market demand, but also to meet sustainability and efficiency standards required by global companies. This growth in the paper and cardboard packaging industry is driven by a trend toward innovation and flexibility, with high-quality materials and environmentally friendly solutions setting the pace.

Paper and cardboard waste management

This section includes all the activities of the actors involved in the collection and transportation of waste, whether from the private or public sector, as well as the infrastructure for recovery, sorting, recycling and disposal in a sanitary landfill or a controlled or open-air disposal site (for solid materials) and wastewater when paper is disposed of in the sanitation system.

Informal collectors or garbage pickers do not have facilities, so they are not included in this section.

The infrastructure for integrated waste management and recovery generally differs in each state, given the number of facilities, equipment, the size of the population served, infrastructure conditions and characteristics, the age of the equipment and the final disposal site. Disposal is important. A sanitary landfill will comply with regulations so that the environment impact of the waste it stores is minimal. This is not the case with other sites, where the impact on soil, water and air is greater, due to the lack of adequate sealing and waste control and management measures.

The most important facilities for the recovery of paper and cardboard are collection centers. Table 9 lists facilities in each state per 100,000 inhabitants and the percentage of collection coverage.

Table 9. Percentage coverage of solid waste collection and management facilities per 100,000 inhabitants in the states

State	Population	% collection coverage (1)	Solid waste management facilities per 100,000 inhabitants				
			CC for paper and cardboard (2)	Collection vehicles (1)	Transfer stations (1)	Treatment plants (1)	FDS (1)
Aguascalientes	1,425,607	71	1.71	13.29	0.36	0.00	0.14
Baja California	3,769,020	84	0.66	13.92	0.16	0.00	0.53
Baja California Sur	798,447	100	0.63	23.25	0.00	0.00	4.00
Campeche	928,363	89	0.33	6.11	0.00	0.00	1.33
Coahuila	3,146,771	75	1.81	9.77	0.29	0.00	1.32
Colima	731,391	100	1.00	12.00	0.14	0.00	0.43
Chiapas	5,543,828	58	0.22	7.82	0.09	0.04	2.27
Chihuahua	3,741,869	96	0.65	12.35	0.08	0.03	4.43
Mexico City	9,209,944	100	3.97	29.78	0.13	0.02	0.00
Durango	1,832,650	75	1.28	10.11	0.06	0.00	3.39

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State	Population	% collection coverage (1)	Solid waste management facilities per 100,000 inhabitants				
			CC for paper and cardboard (2)	Collection vehicles (1)	Transfer stations (1)	Treatment plants (1)	FDS (1)
State of Mexico	16,992,418	74	2.91	13.28	0.11	0.02	0.37
Guanajuato	6,166,934	69	1.66	8.98	0.00	0.02	0.69
Guerrero	3,540,685	78	0.40	10.31	0.00	0.00	3.80
Hidalgo	3,082,841	79	1.35	11.65	0.23	0.10	1.68
Jalisco	8,348,151	94	1.65	15.51	0.13	0.16	1.48
Michoacán	4,748,846	100	0.85	18.45	0.04	0.09	2.38
Morelos	1,971,520	78	1.45	13.10	0.25	0.00	0.75
Nayarit	1,235,456	100	0.58	10.92	0.00	0.08	2.42
Nuevo León	5,784,442	86	1.95	7.86	0.09	0.03	0.72
Oaxaca	4,132,148	56	0.59	25.32	0.29	0.05	10.54
Puebla	6,583,278	70	2.12	8.48	0.03	0.03	1.44
Querétaro	2,368,467	90	1.63	9.88	0.08	0.04	0.50
Quintana Roo	1,857,985	100	0.63	10.47	0.11	0.05	1.47
San Luis Potosí	2,822,255	71	1.64	28.79	0.11	0.00	2.11
Sinaloa	3,026,943	100	0.83	9.70	0.00	0.00	1.60
Sonora	2,944,840	85	0.93	11.93	0.07	0.00	4.00
Tabasco	2,402,598	81	0.25	13.50	0.04	0.08	0.71
Tamaulipas	3,527,735	85	0.80	12.80	0.00	0.03	1.17
Tlaxcala	1,342,977	94	2.62	13.54	0.00	0.08	0.31
Veracruz	8,062,579	78	0.96	11.32	0.11	0.05	1.33
Yucatán	2,320,898	74	0.78	13.65	0.04	0.04	5.48
Zacatecas	1,622,138	71	0.50	15.38	0.06	0.00	5.75

Note: The entities with the highest values for each parameter are shown in green and the lowest in red.

Source: Prepared by the authors with information from (1): CNGM (2023), and (2): DENUE (2024).

Table 9 shows states that, due to their population, require more infrastructure to handle, manage and recover the amount of waste generated, and that having numerous facilities does not always translate into better waste management. There are entities, such as Aguascalientes, where the lack of final disposal sites could be a limiting factor in the management of their waste. However, Aguascalientes has a sanitary landfill, uses biogas and generates energy. Other entities, such as Baja California Sur, despite the size of its territory and the dispersal of its population, lacks transfer stations that would connect its cleaning systems and avoid having so many FDS that do not comply with environmental regulations.

Mexico City is another example. There are no resources available for the creation of a final disposal site, but its strategy is based on transfer stations, sorting plants and sending waste to sanitary landfills in neighboring states, which complement its management system. States like Oaxaca and Zacatecas have many disposal sites suitable for effective waste management. However, the fact that none of these sites are sanitary landfills suggests that soil, water and air impacts are greater than one would expect, and exacerbate the problems caused by the dispersion of waste, odors and visual impacts on the environment.

Paper and cardboard waste recovery

In the context of paper and cardboard production, several key actors were identified in the value chain, from raw material producers to final recyclers. Treatment and manufacturing plants are mechanized, enabling them to produce large volumes of high quality, raw outputs from both virgin and recycled materials. In addition, a sustainability approach is becoming increasingly common, such that many companies are adopting eco-friendly production practices and are increasingly using recycled fibers in their processes.

Due to the growing demand for paper and cardboard products, businesses have increased investments in production capacities and technological improvements, enabling them not only to satisfy the domestic market, but also to compete in international markets. Collaboration between government institutions and industry associations has been crucial in developing regulations and standards to ensure product quality and sustainability. Details are provided in section 6.1: Overview of the federal, state and local regulatory and standards framework.

Recovery of paper and cardboard is more effective when the waste is clean and separated, free of organic residues and liquids. This makes it easier to recycle. However, in Mexico, the separation established in the General Law on Prevention and Integral Management of Waste (LGPGIR) is basic, stating that separation of waste into organic and inorganic material is voluntary. Other types of separation are at the state or municipal levels, according to their interests or issues and taking federal typology into consideration.

The installation of containers on public roads requires taking certain factors into account for proper use and operation, such as the following:

- Frequent container washing
- Adequate collection schedule that prevents waste accumulation
- Operation by public or concessioned cleaning system
- Definition of whether to intervene with garbage pickers

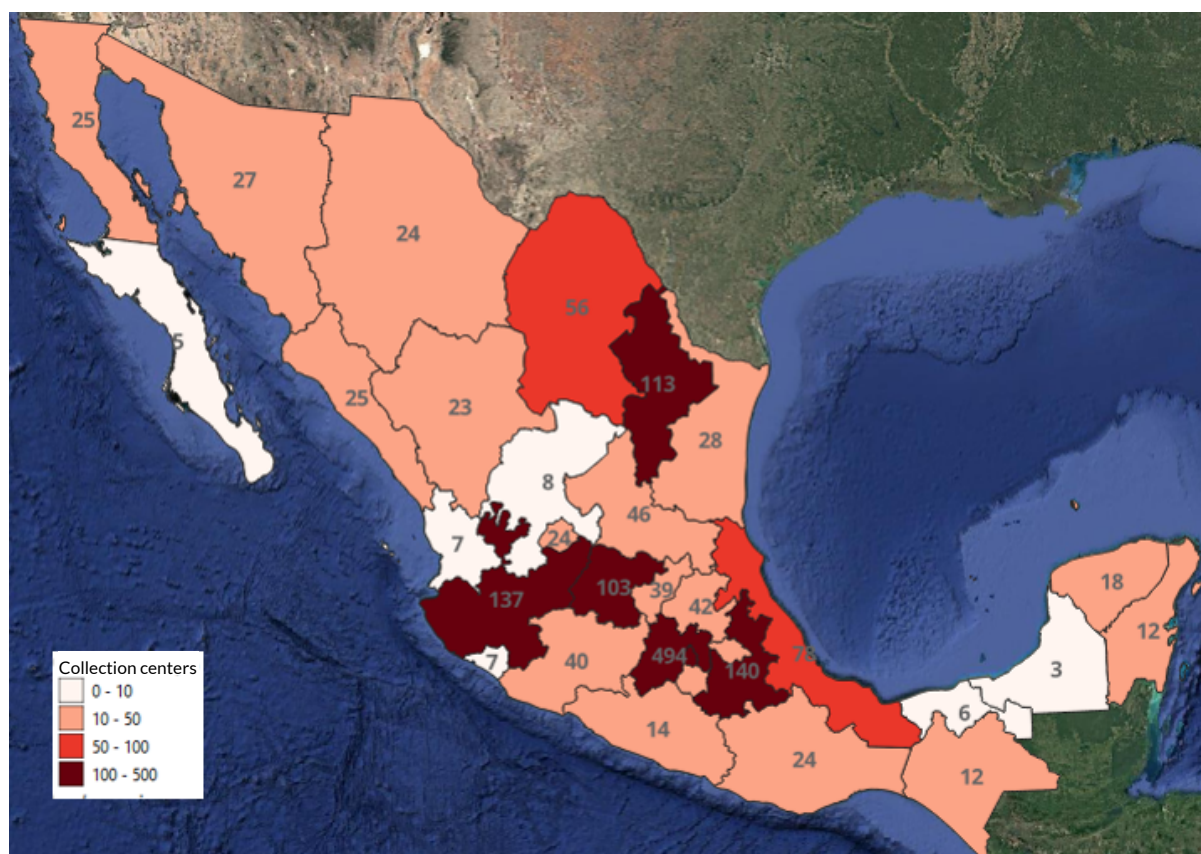
However, it is rare in the country to encounter containers on public roads that promote separation into more groups, such as paper and cardboard, PET and glass. A good example of the usefulness of on-street containers is Tapachula, Chiapas, where there has been a substantial increase in PET collection by garbage pickers, with positive effects, despite the sorting infrastructure. Puebla and

some areas of the states of Mexico, Jalisco, Nuevo León and even Mexico City also have containers for separating waste.

Successful recovery of paper and cardboard consists mainly in capturing the waste at source, so the key to success starts with its separation and temporary storage in households and businesses. This is usually done with private containers, while government efforts are focused on installing wastepaper and cardboard containers in public offices and schools.

DENUE (2024) states the existence of 2,008 paper and cardboard collection centers in Mexico. The states with the most centers are the State of Mexico, with 494; Mexico City, with 365; Puebla, 140; Jalisco, 137, and Nuevo Leon with 113 (see Figure 8).

Figure 8. Number and distribution of paper and cardboard collection centers by state



Source: Prepared by the authors with information from DENUE (2024).

Similarly to production of paper and cardboard, waste collection centers are located mainly in central and northeastern Mexico. The scarcity of these facilities in the rest of the country hinders the recovery and concentration of waste and, therefore, of its recycling.

Though part of the municipal solid waste management infrastructure, sorting plants, treatment plants and final disposal sites do not play an important role in recycling. Paper and cardboard are mixed with other waste in these facilities, making separation difficult to add them to the value chain. When there is contamination with other types of waste, the only possible types of recovery are composting or energy generation.

After the paper and cardboard collection centers, where selection and treatment processes occur, waste goes to secondary fiber production plants and, if it is sent to paper and cardboard manufacturing plants, the cycle is closed once again.

The management and handling of municipal solid waste is a municipal responsibility. Special handling of waste (SHW) is a state responsibility. However, collection and management of both types of waste from households is carried out by the municipal cleaning system. Private collectors are used in businesses, industry and offices. Taking the above into account, paper recycling would be strengthened by municipal infrastructure and economic and social policies.

Infrastructure for the production and recycling of paper and cardboard waste was only registered in 99 of the 2,475 municipalities (as of 2022). Of those, only 20 were home to 226 of the 340 plants that produce paper and cardboard in Mexico, according to DENUE (2024) (see Table 10).

Table 10. Municipalities with more than four paper and cardboard mills

State	Municipality	Number of mills	Population
Puebla	Pahuatlán	109	20,274
Guanajuato	León	14	1,721,215
Nuevo León	Apodaca	10	656,464
Mexico City	Cuauhtémoc	9	545,884
State of Mexico	Ecatepec	9	1,645,352
State of Mexico	Tlalnepantla	7	672,202
San Luis Potosí	San Luis Potosí	7	911,908
Baja California	Tijuana	6	1,922,523
Jalisco	San Pedro Tlaquepaque	6	687,127
State of Mexico	Ixtapaluca	6	542,211
Nuevo León	Guadalupe	6	643,143
State of Mexico	Atizapán	5	523,674
Baja California	Mexicali	4	1,049,792
Mexico City	Azcapotzalco	4	432,205
State of Mexico	Cuautitlán Izcalli	4	555,163

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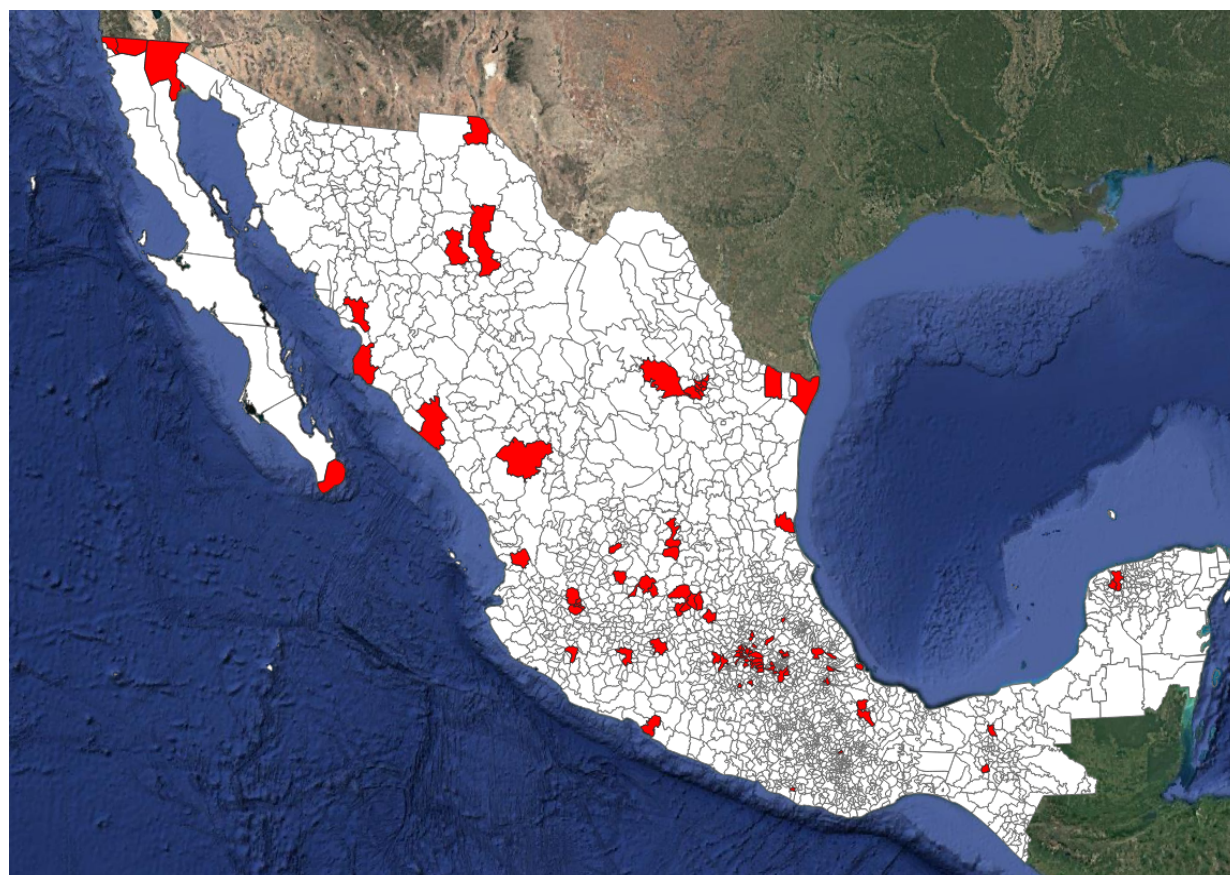
State	Municipality	Number of mills	Population
Michoacán	Uruapan	4	356,786
Nuevo León	Monterrey	4	1,142,994
Nuevo León	San Nicolas de los Garza	4	412,199
Querétaro	El Marqués	4	231,668
Querétaro	San Juan del Río	4	297,804

Source: Prepared by the authors with information from DENUE (2024).

Although only 41 companies affiliated with CNICP account for production of more than 90 percent of domestic paper and cardboard, there are small plants in various municipalities that use local natural fibers or paper waste to manufacture their products (see Figure 9). Notably, the municipality of Pahuatlán, Puebla, has 109 plants. These family establishments produce amate paper, an artisanal pre-Columbian activity that is one of the main sources of income for the area.³

³ Cruz Márquez, *et al.* (2014).

Figure 9. Location of paper and cardboard production plants in Mexican municipalities



Source: Prepared by the authors with information from DENUE (2024).

The location of private and public CCs makes it possible to identify areas of concentration, as well as areas of opportunity to build new facilities, so that the coverage for paper recovery is as wide as possible, with the best conditions, in places with potential for use.

Currently, collection centers are unevenly distributed. Only 369 municipalities have CCs. The municipality of Iztapalapa in Mexico City has the largest number of facilities (106), followed by the municipalities of Ecatepec, Puebla, Nezahualcóyotl, Toluca and Guadalajara with 89, 67, 63, 55 and 52 facilities, respectively (see Table 11).

Table 11. Municipalities with more than 20 paper and cardboard collection centers

State	Municipality	Number of collection centers	Population
Mexico City	Iztapalapa	106	1,835,486
State of Mexico	Ecatepec	89	1,645,352
Puebla	Puebla	67	1,692,181

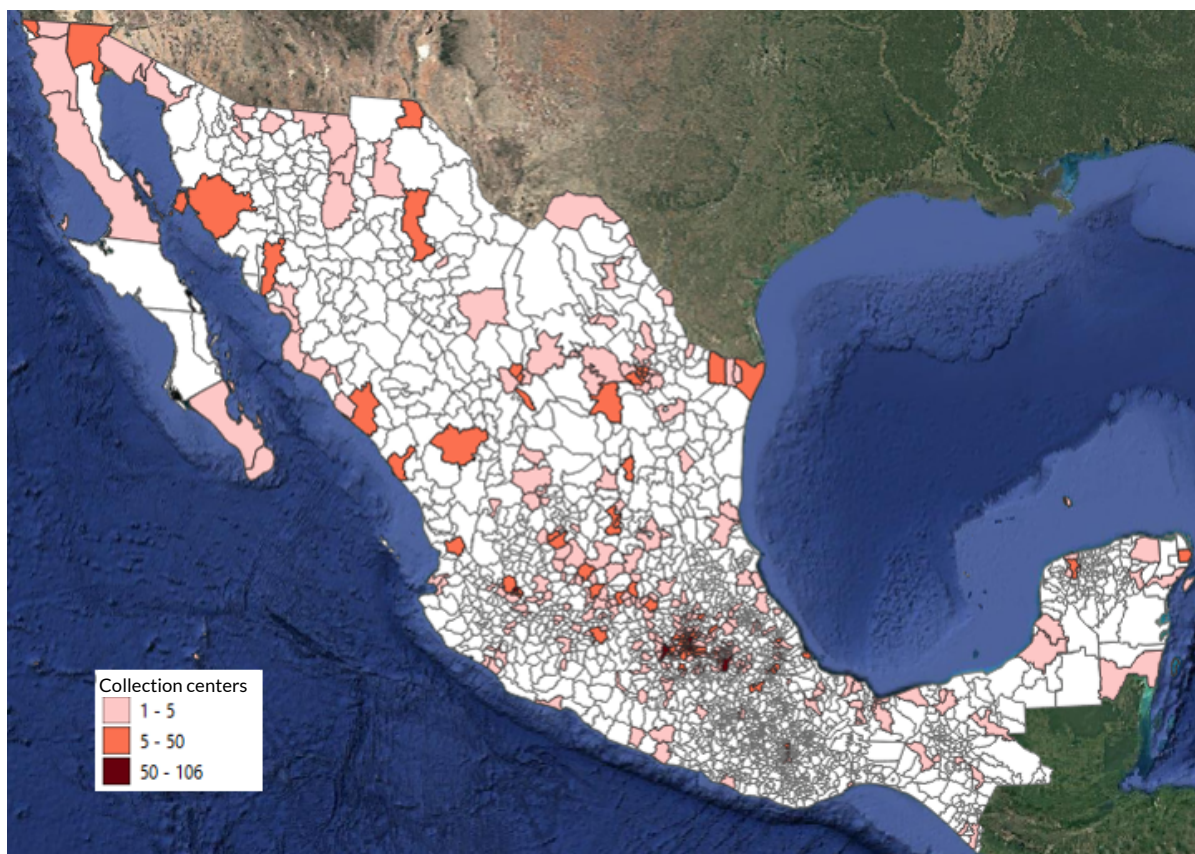
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State	Municipality	Number of collection centers	Population
State of Mexico	Nezahualcóyotl	63	1,077,208
State of Mexico	Toluca	55	910,608
Jalisco	Guadalajara	52	1,385,629
Guanajuato	León	46	1,721,215
Nuevo León	Monterrey	42	1,142,994
Mexico City	Gustavo A. Madero	40	1,173,351
Mexico City	Azcapotzalco	36	432,205
Mexico City	Cuauhtémoc	29	545,884
Mexico City	Venustiano Carranza	28	443,704
San Luis Potosí	San Luis Potosí	28	911,908
Mexico City	Tláhuac	25	392,313
State of Mexico	Chimalhuacán	24	705,193
Jalisco	Zapopan	23	1,476,491
Nuevo León	Guadalupe	23	643,143
State of Mexico	Naucalpan	22	834,434
Querétaro	Querétaro	21	1,049,777
Jalisco	San Pedro Tlaquepaque	20	687,127

Source: Prepared by the authors with information from DENUE (2024).

Geographically, collection centers (CCs) are concentrated in large cities. However, there are municipalities with more than one million inhabitants that do not have CCs, such as Tijuana in Baja California, Ciudad Juárez in Chihuahua, and Culiacán in Sinaloa. Acapulco, Guerrero, with 779,556 inhabitants, has only three such centers, despite its dynamic tourist activity with the potential for significant generation of packaging and containers (see Figure 10).

Figure 10. Location of paper and cardboard collection centers in Mexican municipalities



Source: Prepared by the authors, with information from DENUE (2024).

The distribution of the CCs is of course linked to paper and cardboard production areas and cities with high waste generation. However, there are also municipalities of more than 500,000 inhabitants with high potential for recovery, since they currently have few collection centers. These include:

- Tijuana, Baja California
- Ciudad Juárez, Chihuahua
- Mexicali, Baja California
- Culiacán, Sinaloa
- Mérida, Yucatán
- Chihuahua, Chihuahua
- Hermosillo, Sonora
- Benito Juárez, Quintana Roo
- Acapulco, Guerrero
- Tlajomulco, Jalisco

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- Reynosa, Tamaulipas
- Centro, Tabasco
- Apodaca, Nuevo Leon
- Tuxtla Gutiérrez, Chiapas

The private sector has numerous collection centers closely related to industry, or are part of a business network of centers, that ensure they receive a large quantity of high-quality supply of paper and cardboard waste. Their facilities have large yards for maneuvering and storage of post-consumption waste, delivered to them by their network of suppliers, and of products selected and compacted in bales weighing over 350 kg/m³.

These CCs enable the manufacturing industry to recover and process secondary fiber in 21 states to feed 52 industrial plants. They have wastewater treatment plants for water reuse in their processes, so they minimize the consumption of fresh water. They also generate 25 percent of their energy needs and process a total of 7.6 million tons of paper for recycling.

Table 12 shows installed capacity and machinery used by the main paper and cardboard manufacturing companies in Mexico.

Table 12. Key facts for the main paper and cardboard manufacturers in Mexico

Company	Paper plants	Collection centers	Installed capacity (tons)	Make or type of papermaking machinery
Absormex	3 in Mexico	ND (no data)	86,000 for paper 55,000 for regenerated fiber	ND
Biopappel	30 in Mexico 7 in the United States	14	1,700,000 for paper 280,000 for regenerated fiber	Beloit Voith Black Clawson Sandy Hill
Cartonera Ponderosa	1 in Mexico	12	240,000 for paper	Valmet
Copamex	1 in Mexico	14	166,000 for paper	Sandy Hill Dorries Fourdrinier Voith
Essity	4 in Mexico	ND	154,170 for paper 113,150 for regenerated fiber	Voith Recard Metso
Fábrica de Papel San Francisco	5 in Mexico	ND	231,000 for paper	Fourdrinier Crescent Former

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Company	Paper plants	Collection centers	Installed capacity (tons)	Make or type of papermaking machinery
	1 in the United States		219,000 for regenerated fiber	Ntt Metso
Gondi S. de R. L. de C.V. WestRock	18 in Mexico	ND	1,062,000 for paper	Voith Gorostidi ABK Beloit Black Clawson
Grupak	3 in Mexico	6	287,000 for paper	Gorostidi PJ Wolf Valmet
Grupo Corporativo Papelero	3 in Mexico	ND	97,550 for paper 12,500 regenerated fiber	Daniel Valmet Overmeccanica Acelli
Kimberly Clark de México	5 in Mexico	ND	842,000 for paper	Voith Beloit Valmet Metso
Manufacturas Sonoco	4 in Mexico	ND	FDS	Sonotube
Smurfit Kappa	26 in Mexico 1 recycling plant	ND	552,000 for paper	Fourdrinier Formadores

Note: ND = no data

Source: CNICP Membership Directory (2023); Copamex R. (2023); WestRock (2023); M. Sonoco (2023); Grupak (2023); and Smurfit K. (2023).

5. Secondary markets

The paper and cardboard market in Mexico is mainly secondary, as the manufacturing industry relies heavily on secondary fibers for raw material. Therefore, recovery data for these materials are key to assessing the stability and sustainability of the market.

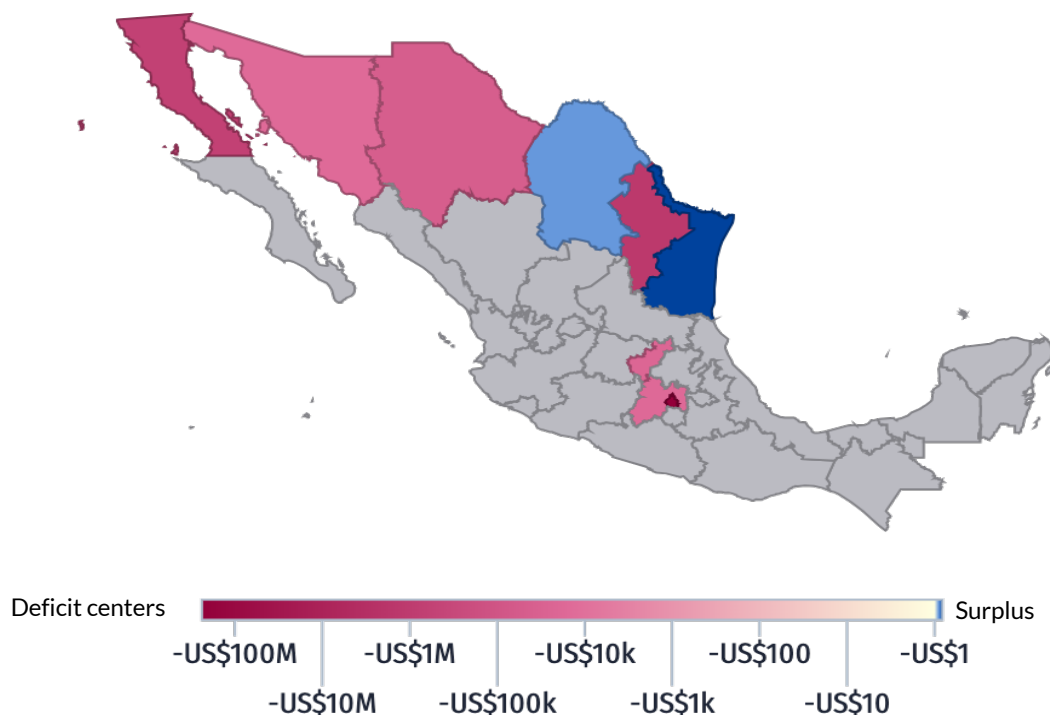
During 2023, 4,863 kt of secondary fiber was recovered for recycling. Cardboard made up most of this volume at 3,959 kt (82 percent of the total). The remainder consisted of 832 kt of mixed fibers (17 percent) and 32 kt of newsprint (1 percent). These figures indicate solid performance in Mexico's secondary market for recovery and recycling.

In terms of trade, 40 kt of secondary fiber were exported, of which 52 percent was cardboard (21 kt) and 48 percent mixed fibers (19 kt). As for materials entering the country, 1,551 kt of secondary fibers were imported: 45 percent was cardboard (705 kt); 53 percent mixed fiber (818 kt), and 2 percent newsprint (28 kt). These figures indicate that Mexico is a net importer (in terms of volume and monetary value) of secondary fiber.

The Ministry of the Economy reported that, during 2023, the total trade exchange of paper or cardboard for recycling (code 4707 in the four-digit 2012 Harmonized System) was 528 million U.S. dollars (\$US). The states with the highest foreign sales of paper or cardboard for recycling were Baja California (\$US5.78 million), Tamaulipas (\$US2.63 million), Chihuahua (\$US998,000), Sonora (\$US212,000) and Coahuila (\$US158,000). The regions with the most foreign purchases were Mexico City (\$US239 million), Nuevo León (\$US111 million), Baja California (\$US97.3 million), Chihuahua (\$US27.8 million) and Querétaro (\$US10.1 million).

Figure 11 shows the net trade balance of paper and cardboard for recycling by state. States shown in shades of blue had the highest levels of international sales. States shown in shades of red had a higher level of foreign purchases. The graphic shows that Baja California, Sonora, Chihuahua, Nuevo León, Querétaro, the State of Mexico and Mexico City are net importers of paper and cardboard for recycling, while Coahuila and Tamaulipas are net exporters.

Figure 11. Net commercial balance of paper and cardboard for recycling by state, 2023

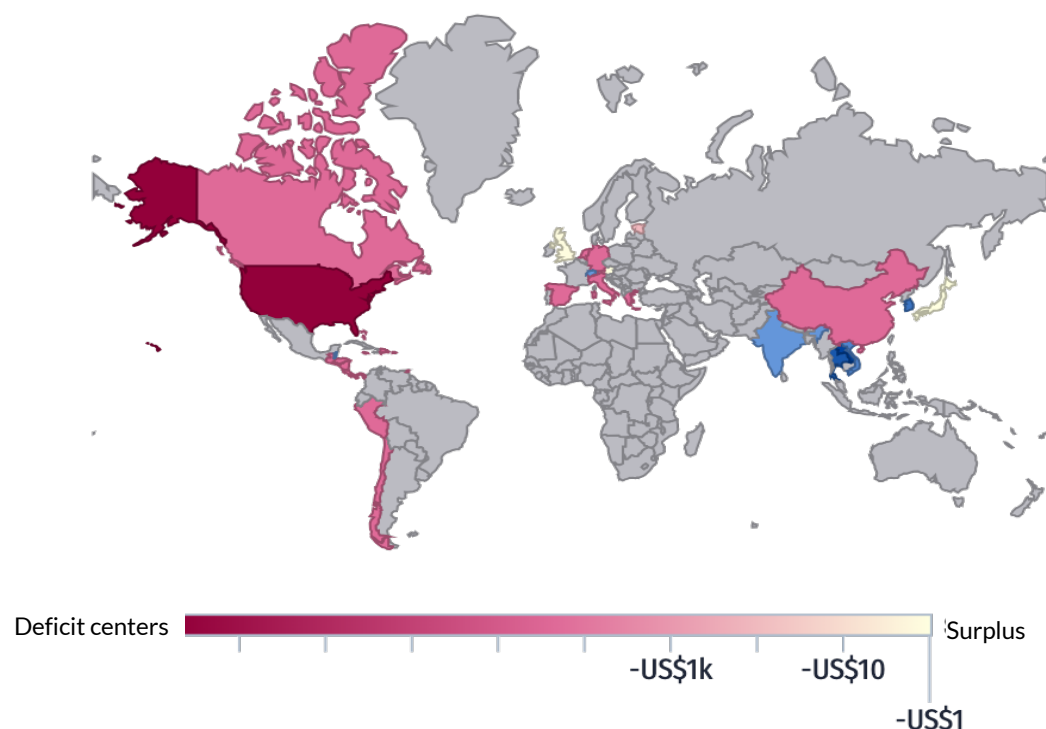


Source: Ministry of the Economy, *Mexico Data* (2023).

The countries that exported the most paper and cardboard for recycling to Mexico are the United States (US\$476 million), Guatemala (US\$3.02 million), the Dominican Republic (US\$2.5 million), Costa Rica (US\$1.96 million) and Puerto Rico (US\$1.48 million). Mexico's biggest buyers of paper or cardboard for recycling were the United States (US\$8.14 million), Laos (US\$1.19 million), Canada (US\$687,000) and Thailand (US\$568,000).

Figure 12 shows the net trade balance of paper or cardboard for recycling between Mexico and the rest of the world. Countries shown in shades of blue are net importers of material from Mexico. Countries shown in shades of red are net exporters of material to Mexico. The graph shows that the United States, Canada, Chile, China, among others, are net exporters of materials to Mexico, while India, Korea, Laos and Malaysia, among others, are net importers of paper and cardboard for recycling from Mexico.

Figure 12. Net trade balance of paper and cardboard to be recycled between Mexico and the rest of the world, 2023



Source: Ministry of the Economy, *Mexico Data* (2023).

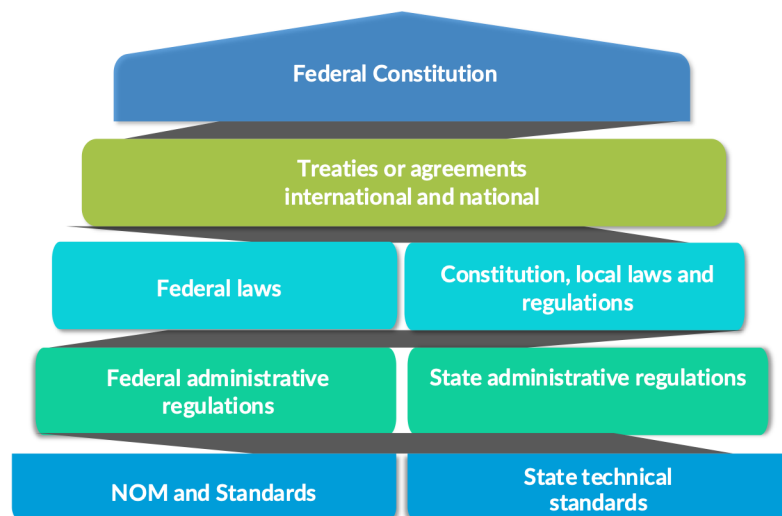
6. Regulatory framework

As mentioned, Mexico is a republic made up of 32 free and sovereign states and 2,475 municipalities (in 2022), all of which have a legal framework regulated by the Political Constitution of the United Mexican States, international treaties and agreements to which it is a party, general and federal laws, regulations, Mexican Official Standards (NOM), Standards (formerly called Mexican

Standards NMX, according to the new Quality Infrastructure Law), decrees and agreements, state constitutions and municipal ordinances (see Figure 13).

Federal and state governments have the authority to design, manage and publish laws, regulations and norms. Municipalities can only design, manage and publish regulations and ordinances, although they are responsible for cleaning systems and their management.

Figure 13. Hierarchy of the legal framework in Mexico



Source: Prepared by the authors, 2025.

There are several laws that seek to protect the environment. Some of the main federal such laws include the General Law of Ecological Balance and Environmental Protection (LGEEPA) and the Law of Prevention and Integral Waste Management (LPGIR), There are also state laws, regulations and agreements that determine the scope of competence and functions of the various entities related to waste management and handling in Mexico.

Semarnat sets national domestic environmental policy. Its responsibility is to establish guidelines through general laws and regulations, as well as to develop assessments and domestic plans for municipal solid waste and special handling. These guidelines must be followed by state legislatures, which harmonize local legislation with national legislation so that it responds in a similar way to issues and conditions specific to their territories such that each state has its own environmental law and regulations.

As part of the Municipal Solid Waste (MSW) and Special Handling Waste (SHW) environmental regulatory framework that applies to the paper and cardboard stream, Semarnat designs, manages and publishes Mexican Official Standards (NOM) and Standards (formerly NMX) to establish specifications and technical procedures that must be applied throughout the country.

6.1 Overview of the federal, state and local regulatory and standards framework

National waste regulations that apply to the paper and cardboard stream are based mainly on the General Law for the Prevention and Integral Management of Waste (LGPGIR), its regulations and the Mexican official standard *NOM-161-Semarnat-2011*, which sets criteria for classifying SHW and determines those that are subject to a management plan; its list, the procedure for its inclusion or exclusion to/from such list; as well as the elements and procedures for the formulation of such plans.

Standards, formerly known as Mexican Standards (NMX), are voluntary regulations. In the paper industry, four key standards (NMX-AA-144-SCFI-2008, NMX-N-100-SCFI-2009, NMX-N-106-SCFI-2010 and NMX-N-107-SCFI-2010) regulate the manufacturing and recycling of paper and cardboard. These standards were issued by the Ministry of the Economy with the participation of the Chamber of Paper and other agencies, laboratories, research institutions and companies in the Mexican paper industry. Details of each one are discussed in Table 8.

Environmental legislation classifies paper and cardboard waste produced by large generators (industry, commerce and services) as special handling waste (SHW), and it is the responsibility of the federal entities (the states and Mexico City) to set local public policy, as well as the procedures and obligations in their territory with which the private sector must comply.

Large generators, importers and exporters are required to comply with the provisions of NOM-161-Semarnat-2011, which mandate the preparation of management plans for post-consumption waste, derived from production and marketing activities directly or indirectly carried out in a state. These plans include an assessment of the situation in the country or the entity, as well as the strategies, goals and mechanisms for compliance with other obligated parties, to take advantage of the economic value of the waste and, if applicable, to increase its recovery, improve its management and optimize recycling, while providing the dissemination and communication mechanisms required to involve the population and the government in the effort.

Semarnat is responsible for preparing the *National Diagnosis of Prevention and Integral Waste Management*, on which the National Program for the Prevention and Integral Management of Urban Solid and Special Handling Waste is based. These documents determine domestic strategies, goals and actions to improve waste management and optimize waste recovery. They also outline public policy that applies to all waste generated in the country, assigning to Semarnat and its agencies the responsibility for hazardous metallurgical mining and oil waste. Management of special handling waste is the responsibility of the federal or state entity, while management of municipal solid waste is the responsibility of the local or municipal administration. Table 8 lists the main laws, regulations and standards for the paper and cardboard industry.

Semarnat's DBGIR (2020) states that Aguascalientes, Baja California Sur, Chiapas, Nayarit, Nuevo León, San Luis Potosí, Tamaulipas, Tlaxcala and the State of México do not have a specific state law

for waste, although the subject is covered by their environmental and ecological balance laws or codes.

Of the 23 entities that do have state waste regulations, Campeche and Tabasco have not made reforms that pertain to paper and cardboard. This indicates that regulatory update has been slower or that policies for these materials are considered less relevant.

The concept of a circular economy is relatively new to Mexico. Its development has been strengthened in conjunction with bans on single-use plastics, so that some states have their own laws on the matter. The federal government is even considering the possibility of issuing a General Law on Circular Economy to regulate the matter and harmonize concepts at the national level. Outstanding local regulations for this include the following laws:

- Mexico City Circular Economy Law.
- Law for the Prevention, Integral Management and Circular Economy of Waste of the State of Querétaro.
- Law for the Prevention, Integral Management and Circular Economy of Waste of the State of Quintana Roo.

Quintana Roo was the first state to publish (in 2019) its Law on the matter. In December 2021, it issued its Extended Producer Responsibility Regulation. Other state laws and even some municipal regulations have started to introduce these changes

In the area of paper and cardboard, 20 states include some obligation to manage this stream or establish a preventive measure or proposal to substitute paper or natural fiber products for plastic materials.

Table 13. Identification and general characteristics of federal and state regulations applicable to paper and cardboard waste

Instrument	Date of publication	Scope of application and general description	Impact on paper and cardboard
Federal			
LGPGIR	2003	National. Established public policy on waste, which includes municipal solid, special handling, hazardous, mining and oil waste.	Established the obligation to prepare management plans for paper and cardboard waste in different business activities and by different generators, including industry, business and services.
Regulations of the LGPGIR	2006	National. It regulates what was established in the LGPGIR.	It established the content and characteristics of the management plan and applies to paper and cardboard waste.

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Instrument	Date of publication	Scope of application and general description	Impact on paper and cardboard
Agreement of Semarnat-CNICP	2015	National. Established the Strategy for the Promotion of Forest Harvesting, as well as the promotion of sustainable production and consumption of paper and cardboard.	State recycling agreements have been signed with the states of Colima, Coahuila and Durango, as well as with the municipalities of Tecomán, Ixtlahuacán and Armería in Colima.
NOM-161-Semarnat-2011	2011	National. Established criteria for classifying special handling waste (SHW), determining which waste is subject to a handling plan and the list of these types of waste.	Paper and cardboard waste is included.
NOM-105 Semarnat-1996	1996	National. Established maximum permissible limits for atmospheric emissions of solid sulfur particles.	Pulp and paper industry in chemical recovery processes.
NOM-083-Semarnat-2003	2003	National. Environmental protection specifications for site selection, design, construction, operation, monitoring, decommissioning and complementary works of a municipal solid and special handling waste disposal site.	It established that a sanitary landfill does not allow collection or removal of recoverable materials, including paper and cardboard.
Mexican Standards (NMX)			
NMX-AA-015-1985	1985	National. Established the quartering method for municipal solid waste and the obtaining of specimens for laboratory analysis.	
NMX-AA-018-1984	1984	National. Established the test method for measuring ash in municipal solid waste.	
NMX-AA-022-1985	1985	National. Established the selection and method for quantifying by-products contained in solid waste.	The list of by-products to be identified includes the paper and cardboard stream.

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Instrument	Date of publication	Scope of application and general description	Impact on paper and cardboard
NMX-AA-061-1985	1985	National. Established the selection and method for determining solid waste generation.	
Standards in the paper and cardboard industry			
NMX-AA-144-SCFI-2008	2008	National. Pulp and paper industries, paper for printers and photocopiers, technical characteristics.	Technical characteristics of recyclable material and chlorine content for the manufacture of paper for printers and photocopiers of federal public administration agencies and entities were specified.
NMX-N-100-SCFI-2009	2009	National. Pulp and paper industries, determines moisture in slabs, bales, recovered raw material, cardboard, cartonboard, paper, files, shavings and related materials for paper manufacturing, test method.	Operating procedures technical standard
NMX-N-106-SCFI-2010	2010	National. Pulp and paper industries, list of fibrous material grades of recovered paper, cardboard, paperboard, paper, file, shavings and related materials.	For paper manufacturing. Classification and test methods.
NMX-N-107-SCFI-2010	2010	National. Pulp and paper industry, minimum recycled fiber content for newsprint, paper for bags, wrapping and sacks, cardboard, corrugated boxes and solid fiber boxes.	Specifications, conformity assessment and eco-labeling, as well as minimum recycled fiber content for manufacturing. 
State			
Aguascalientes Environmental Protection Act	2000	State. Established mechanisms to protect the environment, preserve natural heritage and promote sustainable development of the state.	This regulation applies to collection centers and paper and cardboard management plans.

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Instrument	Date of publication	Scope of application and general description	Impact on paper and cardboard
Baja California Law for Prevention, Integral Management and Circular Economy	2007	State. Established guidelines to regulate the integrated management of waste with a circular economy and life cycle approach in a programmed and gradual manner.	Applies to collection centers and paper and cardboard management plans, with particular focus on containers and packaging. In its last update, in 2021, it established the obligation to transition to reusable, recyclable, compostable, usable or recoverable models by 2030.
Baja California Sur Ecological Balance and Environmental Protection Act	1991	State. Established regulatory bases for the preservation and restoration of ecological balance and protection of the environment, including integrated waste management.	Applies to collection centers and paper and cardboard management plans.
Campeche Law for the Integral Management of Municipal, Special Handling and Hazardous Solid Waste	2019	State. Established guidelines for the prevention, generation, management and integral handling of municipal solid waste, special handling waste and hazardous waste.	Applies to collection centers and paper and cardboard management plans
Coahuila de Zaragoza Law for the Prevention and Integral Management of Waste	2005	State. Established guidelines for regulation of generation, recovery and integral management of municipal solid and special handling waste.	Applies to collection centers and paper and cardboard management plans. In its latest update, in 2020, it foresaw a program of substitution and the search for viable alternatives to replace plastic bags and straws with degradable or biodegradable items (could apply to bags made of paper).
Colima Solid Waste Act	2006	State. Established guidelines to regulate the integral management of non-hazardous solid waste, as well as the provision of public cleaning services.	

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Instrument	Date of publication	Scope of application and general description	Impact on paper and cardboard
Chiapas Solid Waste Act	2019	State. Established provisions to regulate prevention of the generation, use of the value and integral management of municipal solid and special handling waste.	It seeks to promote a short-term program to reduce the use of permanent paper in various procedures as well as the change to digitalization of information.
Chihuahua Law for the Prevention and Integral Management of Waste	2014	State. Established provisions to regulate the prevention, generation, recovery and integrated management of urban solid and special handling waste.	
Mexico City - Federal District Solid Waste Act - Circular Economy Act	Waste-2003 Circular economy-2023	State. Established provisions to regulate the integral management of non-hazardous solid waste, as well as the provision of public cleaning services. State. Established powers of encouragement and promotion, defined policy principles and instruments to promote the circular economy.	Promotes the purchase and use of disposable objects made from organic, biodegradable or low ecological impact materials.
Durango - Law for the Prevention and Integral Management of Waste - Sustainable Environmental Management Act	2007 2019	State. Established public policies and coordination mechanisms for the prevention, generation, recovery and integrated management of waste, as well as for sustainable environmental management.	In the latest update (2020), it allows for the use, delivery or marketing of eco-friendly or reusable <i>kraft</i> paper bags made from recyclable fibers.
Guanajuato Law for the Integral Management of Waste	2005	State. Established provisions to promote sustainable development through regulation of the generation, recovery and integrated management of municipal solid and special handling waste.	Seeks to propose actions or mechanisms to reduce the use of paper in invoices, receipts or vouchers.

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Instrument	Date of publication	Scope of application and general description	Impact on paper and cardboard
Guerrero - Law 593 for the Integral Management and Use of Solid Waste - Ecological Balance and Environmental Protection Act	2008 2009	State. Established and integrated public policies for the prevention and integrated management of waste, as well as to preserve ecological balance and environmental protection.	In the latest update (2019), it mandates that businesses and service establishments replace bags, containers and packaging made of plastic and non-recyclable materials with others that are reusable, recyclable or biodegradable (may apply to containers and packaging made of paper).
Hidalgo Law on Prevention and Integral Management of Waste	2011	State. Established guidelines for regulation of generation, recovery and integral management of municipal solid and special handling waste.	In the latest update (2019), it indicated that research and development of reusable materials and alternatives to single-use disposable plastics should be encouraged.
Jalisco Integral Waste Management Act	2007	State. Established public policies on waste management.	
State of Mexico Code for Biodiversity	2006	State. Established provisions to regulate five environmental matters. The third includes waste prevention and management.	
Michoacán - Law for the Prevention and Integral Management of Waste - Law for Environmental Conservation and Sustainability	2010 2021	State. Established public policies on prevention and integrated waste management.	They seek to eliminate the use of single-use plastics and expanded polystyrene derivatives, as well as to promote the use of raw materials from renewable natural resources and sustainable recyclables.
Morelos Solid Waste and Circular Economy Act	2007	State. Established public policies on prevention and integrated waste management.	Applies to generators and established mandatory separation at source (collection centers), as well as paper and cardboard management plans for the recovery, management and recycling of waste.
Nayarit Ecological Balance and Environmental Protection Act	2001	State. Established public policies on waste management based on the General Law.	

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Instrument	Date of publication	Scope of application and general description	Impact on paper and cardboard
Nuevo León Solid Waste Act	2019	State. Established public policies on waste management based on the General Law.	
Oaxaca Law for the Prevention and Integral Management of Waste	2019	State. Established guidelines for prevention and integrated waste management, based on the General Law.	Encourages state and municipal government agencies and entities to donate the wastepaper they discard to be recycled in the production of books or educational materials to public printing institutions.
Puebla Law for the Prevention and Integral Management of Municipal Solid and Special Handling Waste	2006	State. Established guidelines for prevention and integrated waste management, based on the General Law.	Applies to generators. Established mandatory separation at source (collection centers), paper and cardboard management plans for recovery, handling and recycling.
Querétaro Law for Prevention, Integral Management and Circular Economy for Waste	2021	State. Its purpose is to regulate the prevention and integrated management of waste using a circular economy approach.	Established guidelines to increase productivity of industrial materials, promote regeneration of natural resources, mitigate the release of GHGs and promote economic growth with social equity.
Quintana Roo Law for Prevention, Integral Management and Circular Economy for Waste	2019	State. Aims to regulate the prevention and integrated management of waste using a circular economy and lifecycle approach.	Applies to collection centers and paper and cardboard management plans for recovery, handling and recycling using a circular economy and lifecycle approach.
San Luis Potosí Environmental Law	1999	State. Established public policies for prevention and management of waste based on the General Law.	Established the promotion of collection and recovery centers for recyclable paper waste.
Sinaloa Waste Act	2018	State. Established public policies for prevention and management of waste based on the General Law.	
Sonora Ecological Balance and Environmental Protection Act	2008	State. Established public policies for prevention and management of waste based on the General Law.	

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Instrument	Date of publication	Scope of application and general description	Impact on paper and cardboard
Tabasco Law for the Prevention and Integral Management of Waste	2012	State. Established public policies for prevention and management of waste based on the General Law.	
Tamaulipas Sustainable Development Code	2008	State. Established the basis for regulating and promoting environmental compliance to protection and comprehensive management of waste.	
Tlaxcala Waste Act	ND	State. Established public policies for prevention and management of waste based on the General Law.	
Veracruz Law on Prevention and Integral Management of Municipal Solid and Special Handling Waste	2004	State. Established public policies for prevention and management of waste based on the General Law.	
Yucatán Law for Integral Waste Management	2011	State. Established public policies for prevention and management of waste based on the General Law.	In the latest update (2021), it established promoting the use of raw materials from renewable and recyclable natural resources.
Zacatecas Solid Waste Act	2010	State. Established public policies for prevention and management of waste based on the General Law.	Encourages those responsible for the production and distribution of products or packaging to persuade their customers to carry goods in paper bags, nets, baskets, boxes or other containers that can be reused.
Local			
Organics laws, environmental or waste regulations or municipal ordinances	Various dates	Established attributions in environmental and waste matters of municipalities to appoint and monitor public services commissions and cleaning service concessions.	

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Instrument	Date of publication	Scope of application and general description	Impact on paper and cardboard
Certifications			
Forest Stewardship Council (FSC) Chain of Custody	1994	International. Certification that aims to identify, purchase and use forest products obtained from well-managed forests.	For forest management and chain of custody. 
Clean Industry Certificate		National. Environmental certificate that recognizes the environmental performance of an industry based on its activity.	It is applicable to paper and cardboard manufacturing industries that use combustion processes. 

Source: Prepared by the authors using various official sources, DOF, Programas de Ordenamiento Ecológico and A. Flores *et al.* (2024).

Shared and differentiated responsibility

In Mexico, the LGPGIR views shared responsibility (SR) as the form of interaction between the public and private sectors for handling and management of municipal solid waste (MSW) and special handling waste (SHW) that has implicit economic value to foster collection, recovery and reintegration into the value chain. Its main instrument is the management plan.

Extended producer responsibility (EPR) is a form of international public policy that dates to the 1990s and requires producers to take financial and physical responsibility for the environmental impacts of their products throughout their life cycle. It is based on the "polluter pays" premise, as well as the internalization of the costs of recycling or disposal of the product at the end of its useful life, conditions that the final generator does not usually want to assume. In theory, this responsibility should lead to a model in which products are more durable and recyclable, use fewer natural resources, and have a lower environmental impact.

Various EPR schemes have been adopted around the world. In this study, the CEC mentions those followed by Canada and the United States. In Mexico, the scheme is based on SR, which promotes joint, differentiated and coordinated participation of actors in the value chain to improve handling, management and recovery of waste with high economic value for the generator or a third party.

The following is a list of the waste streams for which companies or associations address this responsibility:

- Paper and cardboard
- Various types of plastics, films, packaging, bags and other plastics, mainly made of PET, PP or PE

- Various electrical and electronic equipment
- Discarded used tires
- Construction and demolition waste

Mexico City, the State of Mexico, Querétaro, Jalisco and Nuevo León, have procedures and formalities for management plans that address some waste streams of local concern, particularly plastic and electronic waste, but do not include paper and cardboard as an issue to be solved.

When waste impacts environmental quality and conditions, its handling and management is governed by the principle of environmental protection (with the application of sanctions, prohibitions or restrictions) and does not form part of the scope of a management plan.

7. Identification of best practices applicable to the Mexican context

This section lists best practices that can be applied by the various actors in the value chain. We are confident that by adopting these practices, we will be able to promote circularity in paper and cardboard waste that is produced and imported, marketed, generated and recycled, with the aim of supporting more environmentally responsible industrial operations and increasing rates of reuse, recovery and recycling of products in Mexico. These practices are also usefully applied to any type of waste.

The identification of these practices was based on analysis of the activities and actors that make up the value chain, as well as research of documents and publications. The main source was the *Guide to Good Manufacturing Practices* (2010) of the Confederation of European Paper Industries (GMP CEPI), as well as findings obtained during consultations with CNICP and industries in the wastepaper management sector.

All these practices focus on improving operations, reducing losses and increasing control, taking into consideration human, material and economic resources at different stages of the value chain.

Applicable best practices were grouped according to the stages of the paper and cardboard value chain (see also Figure 1):

- Raw material
- Transformation, production and recycling
- Marketing and consumption
- Recovery and management of paper and cardboard waste

Based on this structure, the industry's best practices are listed under the following headings:

- Best practices in raw materials and manufacturing

- Best environmental practices in raw materials and manufacturing
- Best practices for marketing and distribution
- Best practices for consumption
- Best practices for recycling and circular economy

At the raw material and manufacturing stages, practices that ensure quality, health and hygiene and risk reduction are taken into consideration. They consider reduction in the generation of paper and cardboard waste, proper handling of raw materials by workers, procedures and technology used to limit losses and take advantage of materials in productive activities of any kind and, once waste is generated, its proper handling in order to achieve better disposal and benefits after use. These practices are shown in Table 14:

Table 14. Best practices at the raw material and manufacturing stages

Activity	Description	Result
Quality assurance system	The organized and documented provisions that are adopted to guarantee that materials and objects achieve quality levels required to comply with applicable norms and quality standards necessary for production.	They are intended to ensure the safety and quality of the products for their intended use. This implies that paper and cardboard must be manufactured in accordance with regulations such as: • NMX-AA-144-SCFI-2008 • NMX-N-100-SCFI-2009 • NMX-N-106-SCFI-2010 • NMX-N-107-SCFI-2010
Quality control system	Systematic application of measures established in the quality assurance system that ensure compliance with the specification defined for the quality of initial materials and intermediate and finished materials and objects.	The paper and cardboard industry already has technical norms and standards to ensure the quality of secondary raw material recovered: • NMX-AA-144-SCFI-2008 • NMX-N-100-SCFI-2009 • NMX-N-106-SCFI-2010 • NMX-N-107-SCFI-2010
Documentation	For proper documentation, it is not necessary to continuously compile and maintain a complete file. Paper and cardboard manufacturers should be able to make the relevant information available to competent authorities upon request and within a reasonable period. A minimum retention period of two years is recommended.	Maintain traceability of the origin and use of virgin or secondary raw materials.

Activity	Description	Result
Labeling	Labeling helps users handle and use materials and objects correctly. Labeling methods may vary depending on the intended user of the products. Information content is not the only aspect to be considered. The material used to make the product is also considered. Inks and adhesives must also be considered when they directly impact recyclability.	Helps ensure compliance with environmental standards. Labels may include, in addition to information specified by the authority, the type of materials, their processing and adhesives used.
Traceability	The manufacturing industry must have records from the supply chain through supply and distribution to the retail sale to the final consumer, as it facilitates recall of defective products. Traceability from the paper and cardboard mill to the container or packaging and the article itself must be guaranteed. Traceability in the recycling industry involves information from the collector, the origin of post-consumption or post-industrial waste and the collection centers to the manufacturing or recycling plant.	Paper mills must be able to track materials throughout the process, from the start to shipping of products. This is a step up to the next stage in the value chain.

Source: Prepared by the authors based on the Guide to Good Manufacturing Practices of the Confederation of European Paper Industries (GMP CEPI) (2010).

Quality assurance ensures that materials and objects are produced in a consistent manner, implemented and controlled so they meet applicable norms and quality standards for the intended use, so as not to endanger human health or cause a change in the generation of paper waste due to poor operating practices.

The application of these best practices must consider the size of the industry, its financial condition, personnel and the technologies it uses. These are practices that affect formal productive activities, not informal ones, such as those carried out by actors like garbage pickers.

Best environmental practices in manufacturing are described in Table 15.

Table 15. Best environmental practices at the raw material and manufacturing stages

Activity	Description
Use of sustainable raw materials	Deforestation and environmental impacts are reduced by ensuring that virgin raw material is sourced from sustainably managed forest plantations.

Activity	Description
Recycling	The need for new raw materials and the amount of waste and space in final disposal sites are all reduced when an effective recycling system that includes recovery at source of used paper and cardboard for use as secondary raw material is implemented.
Energy efficiency	It is advisable to use technologies and machinery that consume less energy. Implementation of renewable energy sources, such as solar or wind, can be beneficial.
Water reduction	Use of water is minimized when it is reused in the manufacturing process and technologies that reduce consumption are applied.
Emissions controls	The installation of filtration and gas treatment systems to reduce pollutant emissions during production helps comply with environmental regulations and protects public health.
Product innovation	The development of biodegradable, compostable or recyclable paper and cardboard products, as well as the use of environmentally friendly inks, contribute to a sustainable lifecycle.
Personnel training	Investing in training employees in sustainable and efficient production practices can contribute to continuous improvement, reduce raw material loss and increase yields.
Monitoring and continuous improvement	Implementing a monitoring system to assess the environmental impact and efficiency of the production process helps identify areas for improvement and adjust practices as necessary.

Source: Prepared by the authors based on the Guide to Good Manufacturing Practices of the Confederation of European Paper Industries (GMP CEPI) (2010).

The best practices for marketing and distributing paper and cardboard are listed in Table 16:

Table 16. Best practices for marketing and distribution activities

Activity	Description
Route optimization	Using logistics software to plan efficient distribution routes can help identify the shortest and fastest routes to minimize fuel consumption and the resulting carbon emissions.
Use of sustainable packaging	Opting for recycled or biodegradable cardboard packaging not only reduces the environmental impact but also can be attractive to consumers.
Load consolidation	Grouping shipments to maximize the use of space on transport vehicles reduces the number of trips required and the resulting expenditure of resources.
Eco-friendly transport	Using more sustainable means of transportation, such as electric or low-energy vehicles for paper and cardboard distribution, improves the company's environmental performance.

Activity	Description
Distributor training	Training distributors in sustainable practices raises awareness of the importance of handling paper and cardboard responsibly during storage and transportation.

Source: Prepared by the authors based on the Guide to Good Manufacturing Practices of the Confederation of European Paper Industries (GMP CEPI) (2010).

Table 17 lists activities related to paper and cardboard consumption.

Table 17. Best practices for consumption activities

Activity	Description
Responsible use	Encourage consumers to use paper and cardboard consciously. Promoting double-sided printing and using recycled paper will help reduce demand for new products.
Recycling	Adopting specific recovery systems (on public roads using containers and targeted collection in offices and institutions) helps capture paper and cardboard waste for recycling.
Digitization	Using digital tools for communication and information storage, as well as the digitization of documents, will help reduce dependence on paper.
Consumer education	Informing consumers about the importance of choosing sustainable and recyclable paper and cardboard products can influence their purchasing decisions.
Reuse	Encourage people to reuse paper and cardboard instead of discarding it, e.g., using cardboard boxes for storage or crafts.
Preference for sustainable products	It is important to create awareness among consumers so that they choose brands and products committed to sustainable practices in the production and distribution of paper and cardboard.

Source: Prepared by the authors based on the *Guide to Good Manufacturing Practices* of the Confederation of European Paper Industries (GMP CEPI) (2010).

Beyond just increasing recycling rates of wastepaper and cardboard, the regulation of this activity should take the existing value chain into account, with a view to market development. It is vital to promote sustainable, eco-friendly methods that are based on efficient and responsible resource management to benefit both the environment and industry.

Implementation of these best practices requires close collaboration between all actors in the value chain, from grassroots collectors to paper manufacturers, to ensure a holistic and efficient approach.

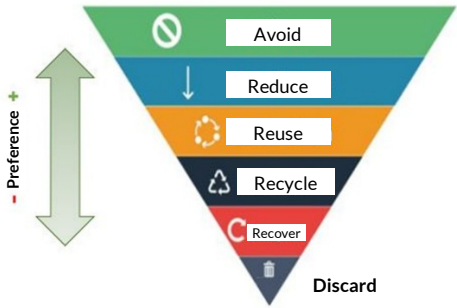
The list of best practices in Table 18 establishes the convenience of using secondary raw materials. Mexico's production of paper and cardboard, using secondary raw materials, is close to 90 percent.

The recovery of post-consumption waste is a very important environmental stewardship activity. Paper and cardboard waste is of enormous interest due to its economic value. As we shall see, it is possible to identify and promote best practices among value chain actors.

Table 18. Best practices for recycling and circular economy activities

Activity	Description
Diagnostic	A detailed diagnosis of waste generation points and the integrated public and private infrastructure will enable identification of suitable recovery areas to increase collection, as well as other types and quantities of paper and cardboard that can be recovered. Egg cartons are an example of this, for which CNICP estimates an additional recovery potential of 50 percent. The remaining 50 percent consists of publications (such as manuals) and miscellaneous files, bags of cement for falsework and garbage bags.
Implementation of containerization schemes	Containerization for separate recovery of waste from the source would directly impact the amount of waste obtained. We acknowledge that it would favor informal activity; however, schemes have been observed that demonstrate the net benefit of its use. Installations must occupy visible sites, as complementary schemes to cleaning services, and require location studies and development of recovery logistics. This activity includes the acquisition of vehicles with additional equipment and container washing.
Training	This activity should include the participation of large value chain actors. Training should be tailored to the characteristics of specific activities, always focused on sustainability, based on circularity schemes in raw materials, products and consumption.
Design and application of rates	This strategy provides necessary economic resources for the construction, operation and maintenance of cleaning systems. It considers dissemination, training, collection, transportation, recycling and final disposal, so that waste is reassigned to the same use that generated it. Compliance with the "polluter pays" principle requires designing and incorporating differentiated tariffs that acknowledge the requirements, efforts and social conditions of the actors.
Design and development of operating organizations	Public, private or mixed operating agencies must have financial independence, their own resources, and combined control schemes. Their operation requires technical expertise and long-term business models to ensure proper waste collection, management, recovery and recycling.
Performance indicators and assessments	To assess waste management, performance indicators must be established to measure compliance with objectives and milestones. Some indicators and assessments might consider the amount of paper and cardboard recycled, the reduction of non-recyclable waste, and the level of societal participation.

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Activity	Description
	Assessments should include periodic performance audits to assess service efficiency provided based on accurate and timely information, as well as follow-up and feedback to identify areas for improvement.
Inventory and information generation	Inventories with standardized information make possible the development of infrastructure programs and projects, public policies and national, state and municipal programs that define specific actions to regulate and solve issues. Information on recovery and recycling also provides a better understanding of infrastructure, the quantities and types of waste generated, the amount of waste consigned to sanitary landfills, and the waste recovered for recycling. It also contributes to assessing the results of local programs and projects to establish short-, medium- and long-term plans and strategies.
Application of the inverted triangle of integrated waste management	Applying the strategies defined in the hierarchical categorization of integrated waste management (IWM), as well as actions adapted to this hierarchy in the management of waste, not only of paper and cardboard but also of all types of waste, and provides structured elements that can be used in public policy development. 
Use of the best available technologies	The use of the best technologies fosters modernization of productive activities and new product development. To expand their use, economic, fiscal and market instruments that encourage their application in the private sector must be created and promoted. The operational manner of garbage pickers, as well as the various levels of activities in the collection centers, have boosted the recycling rate of paper and cardboard, even if the technologies in use are still inadequate. Recovery must be supported using fixed facilities, adequate collection vehicles, and modern sorting and compacting equipment that improves the quality of bales sent to wastepaper and cardboard remanufacturing or recycling plants. The use of optical sorters, ballistic separators and automated equipment is also desirable.
Strengthening regulations	National standards for management of paper and cardboard waste must be standardized, with circular economy criteria and strategies. This will foster adoption of comparable actions and goals throughout Mexico. The regulatory framework should include obligations for generators, with the objective of broadening the recovery collection for some types of paper and cardboard, such as: • Egg cartons • Publications of the <i>Official Gazette</i>

Activity	Description
	• Manuals and miscellaneous files • Cement sacks for falsework, garbage bags • Cardboard for corrugated dead file boxes and permanent packaging • Folders • Fast food containers Regulations should consider the application of fees and penalties for noncompliance with the law.

Source: Prepared by the authors, 2025.

8. Findings and recommendations

The findings of this study enable identification of areas of opportunity in public and private sector activities. They are listed below with the aim of providing information about the conditions for handling and management of paper and cardboard waste.

The identification of these findings is not meant to issue opinions or qualifications of the findings, but to describe elements that contribute information or knowledge concerning the handling and management of this waste stream in Mexico.

The section is organized as follows: description of a finding, ordered according to the topic where it appears in the study, followed by corresponding recommendations.

8.1 Relevant actors

Finding 1: Garbage pickers extract waste from mixed garbage and sell it in collection centers without issuing invoices or tax documents. This impacts the first buyers because they then lack an official registry that would enable them to prove how they acquired these materials.

Recommendation. Resolve the tax issue on the first acquisition so that the initial purchasers can recover any amount of waste, if they can demonstrate to the authority the value of said waste using balance sheets.

Strengthen the regulatory framework to cover the full life cycle of bioplastics produced in Mexico, for cases where the raw material is from crops. This is relevant because the production, imports and use of bioplastics are favored by regulatory frameworks rather than by sustainability purposes.

8.2 Economic and financial aspects

Finding 1: The low costs for cleaning system collection reported in the DBGIR (2020) (\$434.03 for collection and \$121.58 for final disposal) do not enable the acquisition of sufficient material resources and infrastructure for full coverage of the service in each entity.

Recommendation. Implement rates that are differentiated by application and destination, so that sufficient resources are available for the full coverage of the service, the maintenance, and for updating equipment and infrastructure (material and energy) for the correct handling and recovery of waste.

8.3 Technical and operational aspects

Finding 1: Shipping paper and cardboard to final disposal sites contributes to the emission of greenhouse gases and odors and to the dispersal of waste, since most of the facilities at these sites do not comply with NOM-083-Semarnat-2003.

Recommendation 1. Allocate sufficient resources to transform controlled and uncontrolled disposal sites into sanitary landfills, which will reduce atmospheric and soil emissions and protect the region where they are installed.

Recommendation 2. Apply effective supervision and the penalties set forth in the LGPGIR and NOM-083-Semarnat-2003 to final disposal sites, both controlled and uncontrolled.

Recommendation 3. Promote regionalization in the operation of sanitary landfills for the final disposal of waste, as Mexico City does. This is a convenient option since it only requires the implementation of service contracts and not association schemes.

Recommendation 4. Reduce dumping of paper and cardboard waste in final disposal sites via broader recovery at source by installing containers on public roads and ensuring that private collection service providers include waste management and not just transportation. Penalties for the disposal of recoverable waste could be considered.

8.4 Material flows and waste management

Finding 1: Recovered paper and cardboard waste comes mainly from economic and service activities, not households. This increases the volume of clean, quality material that can be recycled and incorporated back into the value chain.

Recommendation 1. Install containers for disposal of waste paper and cardboard from households to help obtain clean paper. The municipality can determine the control and destination of economic benefits generated by the sale of these materials to the recycling and manufacturing industry.

Recommendation 2. Apply multisectoral strategies focused on citizen awareness, environmental education and activation of community participation to maximize separation at source and facilitate waste recovery. This would help optimize waste management and align actions with circular economy principles.

Finding 2: The activity of garbage pickers, private waste collectors and collection centers has been a determining factor in the recycling of paper and cardboard waste of better quality. However, in some cases, recovery is carried out in an irregular manner, without social guarantees, at low salaries and affecting public investment that could result from the extraction of high-value materials.

Recommendation 1. Acknowledge that the paper and cardboard industry has a network of collection centers that concentrates the efforts of all the pickers and collectors who comprise the value chain.

Recommendation 2. Protect vulnerable garbage pickers, especially those working in controlled and uncontrolled disposal sites, using current government social support programs. Provide them with technical training and basic tools such as gloves, coveralls and glasses for their work.

Finding 3: Tables 7 and 8, which refer to infrastructure, show some states that, due to their population, require more and better infrastructure for waste management and utilization, such as Chiapas, State of Mexico, Guanajuato, Oaxaca and Puebla. Mexico City has made significant efforts to improve waste management through the construction of new infrastructure and concessioned waste management.

Recommendation 1. Conduct a study on the possibility of increasing the recovery of paper and cardboard waste in the entities identified in Finding 3. Indicate the amount of paper and cardboard available and accessible for recycling, as well as specific strategies that could be adopted, such as installing containers, improving collection services and coverage, and encouraging the creation of local value chains.

Recommendation 2. Before investing in a sorting plant, the potential for the total amount of waste to be used must be taken into account, so that potential income from its sale to recyclers can be estimated with certainty. If it is not sufficient to generate an adequate return on investment, other projects should be considered.

Recommendation 3. Consider, in final disposal sites, using energy-generating incineration plants as a viable alternative with waste of high thermal value (e.g., paper, cardboard, plastics, textiles)

Recommendation 4. Establish a National Commission for Waste Management that, at the outset, provides technical elements to municipalities which lack them so that they can design waste management projects. In the medium term, it should be a guarantor for access to financing or for loans from second-tier banks, so that they can develop investment projects with an effective return on capital. Finally, over the long term, the Commission would be set up as a national operator with a local presence for waste management and recovery via energy generation and the sale of materials.

Finding 4: There are 150 municipalities without waste collection services, 86 of them Indigenous, in the states of Oaxaca, Puebla and Veracruz. These localities, regardless of population type, require infrastructure that enables them to increase collection and properly manage their waste.

Recommendation 1. Install containers that function as transfer stations and schedule collection frequently enough to improve the environmental and social health of these municipalities.

Recommendation 2. The lack of infrastructure can be overcome by first installing collection centers or mechanisms for the return of waste (mainly packaging and containers) in charge of the sectors that market their products in these municipalities.

8.5 Secondary markets

Finding 1: Because of their design and application, management plans (as agreed upon by businesses) do not support economies of scale in recovery and recycling because they are only a formality for the government. This dilutes infrastructure efforts and eliminates the potential for the public sector to coordinate with the private sector and encourage recycling. It also reduces any efficiency and effectiveness of large-scale actions, which instead are broken down into small activities for each company.

Recommendation 1. Redesign the content and form of writing and implementing a management plan. Plan coverage should be national (or regional for metropolitan areas). Plans should be collective, with goals, milestones, strategies and actions that are reviewed and adjusted every two years. They should be clear in their purposes to establish infrastructure, integrate garbage pickers and a collection network with national coverage to create markets for the acquisition of waste and the sale of raw materials. Management plans should be considered tools of the circular economy and given extended responsibility.

8.6 Regulatory framework

Finding 1: The paper industry has taken important steps to recover post-consumption waste through shared responsibility, relying on garbage pickers and private collection centers to whom it pays market prices for its products. However, recovery remains an informal activity. It occurs on public roads or in unsuitable locations, which has various effects on the value chain in terms of fiscal, operational, environmental and social security conditions.

Recommendation 1. Foster a better-organized structure and content for management plans for national coverage with trackable goals over periods of two to four years and active participation of authorities and consumers.

Recommendation 2. The government can establish and promote economic participation schemes that enable value chain actors who do not have the financial, personnel or material capacity to design or implement management plans on their own to comply with their "polluter pays" responsibility and contribute to the solution of inadequate product and waste management issues.

Recommendation 3. Redesign tax schemes for initial waste purchases so that the private sector can increase its initial purchases without fiscal uncertainty and monitor them through material balances.

Recommendation 4. The government can offer financing schemes to entrepreneurs, micro and small businesses to improve and modernize their operations. The dissemination of market prices and conditions will make it possible to focus action on services and not just on prices.

Finding 2: There is homogeneity in the private sector for the recovery and recycling of paper and cardboard, largely thanks to the participation of CNIPC, which has made it possible to manufacture products with more than 90 percent recycled content and to recover 50 percent of post-consumption material from domestic waste.

Recommendation 1. The authorities and the private sector must coordinate more closely and frequently in order to monitor progress and define and accomplish new goals. This will make it possible to achieve a strategy with common goals for both sectors.

Recommendation 2. Diagnose and assess sales of cardboard to delivery services (which increased substantially after bans on single-use plastic and the introduction of products made of paper and cardboard to replace plastic) that would act to recover waste from the electronic market and delivery services.

9. Conclusions

9.1 Conclusions for Mexico

This section highlights conclusions for strengthening the paper and cardboard recycling chain in Mexico that delve into implications, limitations and key areas.

The mixing of paper and cardboard waste with organic and liquid debris during collection by cleaning system vehicles causes them to become contaminated, which makes them less recyclable.

In turn, garbage pickers extract a significant portion of the paper and cardboard in the general waste stream from collection vehicles and final disposal sites. However, their participation has been analyzed only as a social problem, without assessing fiscal aspects, links to the “first purchase” issue faced by industry actors, or the impact on sorting plants that receive waste with little value for recycling. These aspects must be analyzed together and in detail to determine how informal garbage pickers should participate.

Of the estimated 4,119 kt of paper waste not destined for recycling in 2023, 1,200 kt (29 percent of the total) ended up in the sewage system because it was mainly sanitary paper waste. In years to come, this amount of waste in the sewage system is expected to grow in proportion with increases in population.

On the other hand, 1,607 kt (39 percent) was paper for permanent use. It is believed that this amount will remain stable in the coming years and will gradually decrease as the digital transition reduces use of paper files. Finally, 1,037 kt (25 percent) end up in a sanitary landfill, and 276 kt (7 percent) in uncontrolled sites. A large portion of this waste is difficult to recycle because it is mixed with organic matter, so recovery efforts must begin with proper separation in homes and containers on public roads, in alignment with management plans.

With growing demand for paper and cardboard products, companies have increased their investments in production capacity and technological improvements, which has enabled them not only to satisfy the domestic market, but also to compete abroad. Collaboration between government institutions and industry associations has been crucial for the development of regulations and standards to ensure product quality and sustainability.

In the secondary market, cardboard is the most recovered material. In 2023, 3,959 kt (82 percent of the total) was recovered. With the growth of e-commerce, more cardboard will be used for packaging, so recovery of this material may potentially increase in the coming years.

Second place in the market goes to mixed fibers, of which 832 kt (17 percent) was recovered. These included special paper and white writing paper. Demand for these materials is expected to remain stable in the coming years.

The use and recovery of newsprint in Mexico have been decreasing. Only 32 kt (1 percent) of newsprint was recovered in 2023. With the transition from printed newspapers to digital media, it is believed that the number of newspapers will decrease further in the coming years. Newsprint will still be produced, mainly as an input for piñatas and other handicrafts (or another material will be substituted).

Regarding the trade balance of secondary fiber: in 2023, 1,551 kt was imported and 40 kt was exported. These figures indicate that Mexico is a net importer of secondary fiber. The states that imported most were Baja California, Mexico City, Chihuahua, State of México, Nuevo León, Querétaro and Sonora. Coahuila and Tamaulipas are mainly exporters.

Canada, Chile, China and the United States were identified as the main suppliers of the secondary fiber used in Mexico. Korea, India, Laos and Malaysia, among others, are net importers of Mexican paper or cardboard for recycling.

A key indicator of the efficiency of the measures applied in paper and cardboard collection and recycling is the amount of waste that is no longer sent to final disposal, where it would be transformed until it decomposes as carbon dioxide (CO₂) or methane (CH₄). According to CNICP, each year the disposal of around 6 Mt of paper and cardboard products is avoided. This reduces GHG emissions associated with the degradation of paper and cardboard at disposal sites by about 15.2 Mt of CO₂/year (CADIS, 2014, p. 15).

The financial, economic, material and human resources provided by the government are insufficient to have a cleaning system that meets the population's needs; nor does it enable us to achieve the necessary infrastructure for integrated waste management, much less to promote a circular economy. The responsibility to provide this service (as a constitutional right) is shared by the three levels of government: municipal, state and federal. However, the participation and coordination of the public, private and social sectors is essential to resolve the negative environmental impact of inadequate waste management, as well as its insufficient integration into the country's development.

The following table retains the original structure used in the Canadian and US studies, and published by the CEC, to facilitate correlation of the barriers and actions indicated, mainly in terms of human, material and financial resources.

Table 19. Summary of recommendations to increase circularity in paper and cardboard waste management in Mexico concerning human, material, and financial resources

			
Barrier to circularity	Possible cause	Suggested solution	Action for policymakers
There are not enough funds for comprehensive management of waste that covers recovery, management, operation, recovery and final disposal.	Unsustainable financing practices without the system generating its own financial resources. Local governments apply available resources using the budget allocated and funds they manage to obtain from domestic or international financing programs. A vision of public infrastructure with no return on investment, which does not have sufficient resources for operation and maintenance, and which does not recover the economic value of the waste.	Develop and apply differentiated rates for collection and cleaning services that enable the system to achieve financial balance and take socio-cultural differences into account. Implement schemes to recover the economic value of waste projects with federal government or international investment, for the benefit of the system itself. Use integrated generator control and monitoring systems.	Work with local governments to manage application of unified rates throughout Mexico that take local needs into account and respond to the socio-cultural conditions of each state or municipality. Ensure that investment projects that already include capital return studies are viable and are executed using control and monitoring mechanisms, as well as penalties for non-compliance.

			
Barrier to circularity	Possible cause	Suggested solution	Action for policymakers
Infrastructure is irregular and insufficient in most municipalities.	Technical and economic capacities are uneven across municipalities and do not enable construction of the minimum infrastructure required for waste management.	A National Waste Commission could help to standardize waste management infrastructure. At the outset, it would provide technical elements to support municipalities that have not developed this capacity.	The design and creation of a National Waste Commission that performs technical support functions at the outset. In the medium term, it will serve as a guarantor for investment projects with total control. In the long term, it will be an operator with a presence in each entity. This agency would reduce inequality and ensure sufficient resources and infrastructure for waste management.
	There is no infrastructure that enables waste recovery and management in rural areas with large populations of Indigenous people.	When there are sufficient communication routes, install collection centers or containers that function as transfer stations. Schedule frequent collection. This could provide enough technical elements to maintain environmental and social health in rural municipalities.	Design and support measures for the implementation of each project in areas with no infrastructure. Analyze material elements required to implement the project based on communication routes.

9.2 Shared conclusions on paper and cardboard waste management in Canada and the United States

In December 2024, the CEC published two studies (with executive summaries) of this waste stream for Canada and the United States.⁴ Both documents include sections dedicated to barriers to recycling waste paper and cardboard. As for Mexico, these barriers share similarities with those identified in Canada and the US.

There are additional barriers here, which are included in this document. Note that there are states, municipalities and large producers that can adopt the recommendations proposed for Canada or the United States in addition to those of this study.

⁴ The executive summary in Spanish and the full technical study in English are available at the following links: [Paper: executive summary in English](#) and [Paper: full study: Canada and the United States \(English only\)](#).

Recommendations and barriers identified in the Canadian and US studies are listed in tables 19-21 below, adapted to issues that directly affect the Mexican context.

In the studies of those countries, the barriers to circularity are grouped in the final stages of the paper value chain: collection, sorting, recycling and export of waste paper. However, for our analysis, only collection and recycling are considered because they have strong similarities with the Mexican context.

For some barriers, the table lists multiple possible causes and corresponding, suggested solutions and policy recommendations. In these cases, separate cells and color codes are used for clarity.

The two red columns on the left distinguish between challenges and barriers to circularity. The two green columns on the right list suggested solutions. The flags of Canada, the United States and Mexico are shown at the top to indicate that the table corresponds to the three countries. Note that there is some repetition in the content of the tables because barriers to circularity coincide and public policy actions can help overcome more than one barrier. The tables list recommendations that have an impact on the three countries. Barriers, causes and solutions from the original English version of the Canada and United States study are presented in italics, and those that are only relevant to Mexico are indicated in normal font and bold.

Common public policy recommendations include:

- Introduce multi-flow collection services in which paper is collected separately (or at least separately from glass) as a way of overcoming barriers to circularity in both collection and sorting.
- Leverage extended producer responsibility (EPR) to promote circularity in a number of ways, including the introduction of collection requirements for the industrial, commercial and institutional sectors and multifamily buildings.
- Measures to increase recycled content in paper products.

Table 20. Summary of recommendations to increase circularity in paper and cardboard waste in Canada, the United States and Mexico at the collection stage

			
Barrier to circularity	Possible cause	Suggested solution	Action for policymakers
<i>Material recovered from the residential sector were not recovered to same extent as the industrial, commercial and institutional (ICI) sectors:</i>	<i>The residential sector lacks the economic incentives of the ICI sectors:</i>	<i>Increase the amount of residential paper waste collected for recycling.</i>	<i>Local governments should require selective paper collection. Extended producer responsibility could help cover the costs of this collection, through either existing or new programs.</i>

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Barrier to circularity	Possible cause	Suggested solution	Action for policymakers
Recovery in this sector in Mexico is 4,838.9 kt, while municipal recovery is 24.1 kilotons. However, a significant tonnage of ICI fibers are not collected.	Most of Mexico's recycled paper comes from the ICI sectors because the largest tonnages are obtained from commercial activities via packaging. Mixed collection in the residential sector in Mexico causes large losses of material with recycling potential. There are no public collection systems in place to enable a cleaning system to capture paper and cardboard from residences.		<i>Modify or introduce extended producer responsibility (EPR) with collection and recycling targets for residential and ICI paper. Advocate for states to adopt EPR programs to cover the cost of residential collection and provide more investment to modernize and improve collection and recycling infrastructure.</i> <i>Municipalities should introduce pay-as-you-throw to encourage recycling behavior.</i> <i>Implement educational and outreach programs on paper recycling to clear up consumer confusion, including providing clear instructions on how to recycle correctly, as well as harmonizing or standardizing materials that can be recycled in a region or jurisdiction.</i>
<i>Inconsistent recycling requirements among various jurisdictions have confused consumers with respect to recyclable items. This inconsistency also poses challenges in creating uniform messages and labels to help educate consumers about recycling practices.</i>	<i>Lack of policies to harmonize collection practices.</i>	<i>Options for improving consistency in fiber collection include standardized landfill bans in the region, which would be particularly effective in boosting collection of industrial, commercial and institutional (ICI) fibers, that account for 84 percent of the fibers currently collected in the US market.</i> In the Mexican market, ICI fibers represent just over 99 percent of the material recovered for recycling. <i>Standardize multifamily recycling programs for residential buildings.</i>	<i>Research industrial best practices to develop and implement general recyclability labeling requirements, including a uniform color for recycling containers.</i> <i>Harmonize or standardize materials that can be recycled in a locality, a jurisdiction, and (on a national level) to reduce consumer confusion.</i> <i>Establish or improve educational programs for residential, industrial, commercial and institutional sectors.</i> <i>Institute consistent landfill bans for cardboard in all jurisdictions and establish appropriate enforcement.</i> <i>Analyze best practices for waste diversion from the multifamily residential sector in each country. Provide financial support through grants to standardize these best practices.</i>

			
Barrier to circularity	Possible cause	Suggested solution	Action for policymakers
		Increase consumer understanding to improve recycling behavior. Improvements are needed in educational programs in the residential, industrial, commercial and institutional sectors.	

Table 21. Summary of recommendations to increase the circularity of paper and cardboard waste in Canada, the United States and Mexico at the recycling stage

			
Barrier to circularity	Possible cause	Suggested solution	Action for policymakers
<i>Challenges of molded pulp recycling:</i> <i>Increased awareness of the problems associated with plastic pollution has led to a trend toward less plastic packaging, which in turn has led to an increase in demand for paper packaging made from molded pulp, i.e., packaging material made from paper and water. However, not all recyclers can process molded pulp and there is no mature end-use recycling market for it.</i>	<i>Lack of access to technology and contamination issues:</i> <i>The technology to recycle molded pulp is new and most recyclers do not have access to it.</i> <i>The ability of molded pulp to be recycled also depends on its level of contamination. When contaminated with organic waste from food packaging, it is particularly difficult to recycle.</i>	<i>Support investments in research and development of scalable technology and infrastructure for recycling molded pulp.</i> <i>Establish recycled content targets that stimulate innovation to recycle molded pulp.</i>	<i>Encourage partnerships between government and industry to provide funding for pilot projects aimed at developing technologies to recycle molded pulp, so that these technologies can be made available to all mills.</i> <i>Establish recycled content targets for packaging, including molded pulp, to drive industry investment and action to find ways to meet the targets, including the development and expansion of new technologies.</i>

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Barrier to circularity	Possible cause	Suggested solution	Action for policymakers
			That government at federal, state and territorial levels update existing (or pass new) legislation requiring a certain percentage of recycled content in packaging and paper products, as in the state of California, USA, where the Public Procurement Code set a threshold of 30 percent recycled content for printing and writing paper and other paper products, with some exceptions. This percentage may increase over time to enable the industry to gradually expand the use of recycled fiber. In Mexico, percentages of recycled material content and labeling were established in NMX-N-107-SCFI-2010. In jurisdictions with EPR, producer fees can also be modified to provide a bonus for those who integrate a certain percentage of recycled fiber.
Challenges of fiber-based packaging recycling: There are challenges to recycle fiber-based packaging that limit the potential for switching from plastic to fiber-based packaging.	Inclusion of non-fiber elements in fiber-based packaging: Some fiber-based applications, such as multi-material and multi-layer packaging, still include plastic elements as a moisture barrier. This can create difficulties in recycling, with substantial differences in mills' capabilities to handle non-fiber elements.	Design for recycling. Possible design solutions include switching to single-material packaging, e.g., replacing aluminum or plastic layers in cardboard with fiber-based alternatives--or making non-fiber elements easily removable and recyclable to minimize fiber loss (e.g., replacing tapes with fiber-based interlocking tabs).	Incentivize design for recycling through EPR rate modulation. Provide financial incentives for design competitions, both in industry and the academic community.

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Barrier to circularity	Possible cause	Suggested solution	Action for policymakers
	The challenge of manufacturing high moisture-resistance pulp fiber-based packaging: For the performance of paper packaging to compare with that of plastic, the fiber must retain high strength when wet. This strength can make pulping (and thus recycling) difficult, and lead to a low yield of usable fiber. High moisture resistance in paper packaging applications must thus be pulped using processes specifically designed for them.	Incorporate pulp manufacturing processes designed for high moisture resistance.	Through EPR funds or other financing structures, provide financial incentives for mills to invest in pulp manufacturing technologies that can treat high moisture resistance paper products. This includes both refurbishing old mills and ensuring that new mills are equipped with required technologies. Fund life cycle assessments (LCAs) to discern the true cost of recycling coated paper packaging, such as alternative food utensils. The challenge for mills, when it comes to polyethylene-coated paper packaging, is the time and energy required in the pressure washer to remove paper fiber from the polyethylene layer.
	Re: Imported packaging imbalances in relation to domestic production: More packaging is imported from abroad than is manufactured domestically, and domestic manufacturing capacity limits the demand for recycled fiber. Mexico imports a large amount of recycled fiber, which limits the procurement of domestic recycled fiber.	Promote domestic paper manufacturing. Encourage the construction or modernization of paper mills capable of 100 percent recycled content. Invest in recycling infrastructure. Increase domestic secondary fiber recovery.	Through EPR funds or other financing structures, provide financial incentives to install mills handling 100 percent recycled content, or retrofit existing mills to accept more recycled fiber. Invest in paper mills to improve their capacity to handle lower quality fibers and effectively remove contaminants. This may also include cleaning equipment to remove contaminants. Provide incentives to the mills through tax exemptions and other financial supports, to change the composition of the paper being fed to them and incorporate more recycled fiber.

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Barrier to circularity	Possible cause	Suggested solution	Action for policymakers
			Mexico should free up unused government files and simplify administrative paper and cardboard management. <i>Support creation of an average "Price Index" for paper and cardboard.</i> <i>Design and support fiscal mechanisms that simplify the incorporation of paper waste into the productive sector.</i>
		<i>Establish recycled content requirements for paper packaging to drive demand and encourage producers to increase domestic capacity to incorporate recycled fiber in their products.</i>	<i>That the government, at the federal, state and territorial levels, update existing (or approve new) laws requiring a percentage of recycled content in packaging and paper products. This percentage may increase over time to enable the industry to gradually expand the use of recycled fiber. In jurisdictions with EPR, producer fees can also be modulated to provide a bonus to those who integrate a certain percentage of recycled fiber.</i>

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