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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

Executive Summary



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*Photo credit – Cover: Little boxes made of recycled corrugated cardboard by Elizabeth Romo-Rabago from Ciclomanias. <https://www.ciclomanias.com>

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Acronyms and Abbreviations

CEC	Commission for Environmental Cooperation
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)
DBGIR	<i>Diagnóstico Básico para la Gestión Integral de los Residuos</i> (Basic Diagnosis of Integral Waste Management)
INECC	<i>Instituto Nacional de Ecología y Cambio Climático, México</i> (National Institute of Ecology and Climate Change, Mexico)
INEGI	<i>Instituto Nacional de Estadística y Geografía, México</i> (National Institute of Statistics and Geography, Mexico)
INPI	<i>Instituto Nacional de los Pueblos Indígenas</i> (National Institute of Indigenous Peoples)
LGPGIR	<i>Ley General para la Prevención y Gestión Integral de los Residuos</i> (General Law on Prevention and Integral Management of Waste, Mexico)
NOM	Mexican Official Standards
Semarnat	<i>Secretaría de Medio Ambiente y Recursos Naturales</i> (Secretariat of Environment and Natural Resources, Mexico)
UNEP	United Nations Environment Programme

Definitions

CC	Collection Center
CE	Circular Economy
CSi	Controlled site. Site unsuitable for final disposal that meets the specifications of a landfill, but does not meet the waterproofing specifications in accordance with NOM-083-SEMARNAT-2003
EPR	Extended Producer Responsibility
FDS	Final disposal site. Place for final disposal of municipal solid waste and special handling waste
GDP	Gross Domestic Product
GP	Garbage picker. Individuals who perform paper waste recovery activities at final disposal sites other than sanitary landfills. These pickers do not provide any type of receipt or invoice with a fiscal value
ICI	Recovery from the Industrial, Commercial and Institutional Sector
kt	Kilotons
Mt	Millions of tons
Mt CO ₂ eq	Millions of tons of CO ₂ equivalent
MSW	Municipal Solid Waste
NGO	Nongovernmental Organization
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
SHW	Special Handling Waste
SLF	Sanitary landfill. Infrastructure project that involves engineering methods and works. These final disposal sites comply with NOM-083-Semarnat-2003
SR	Shared Responsibility
Standard(s)	Technical document that establishes rules, characteristics or test methods for products, processes or services, including terms, symbols, packaging, labeling and other specifications, formerly considered Mexican Standards
UCSi	Uncontrolled site. Inadequate final disposal site because it does not comply with the requirements of NOM-083-Semarnat-2003

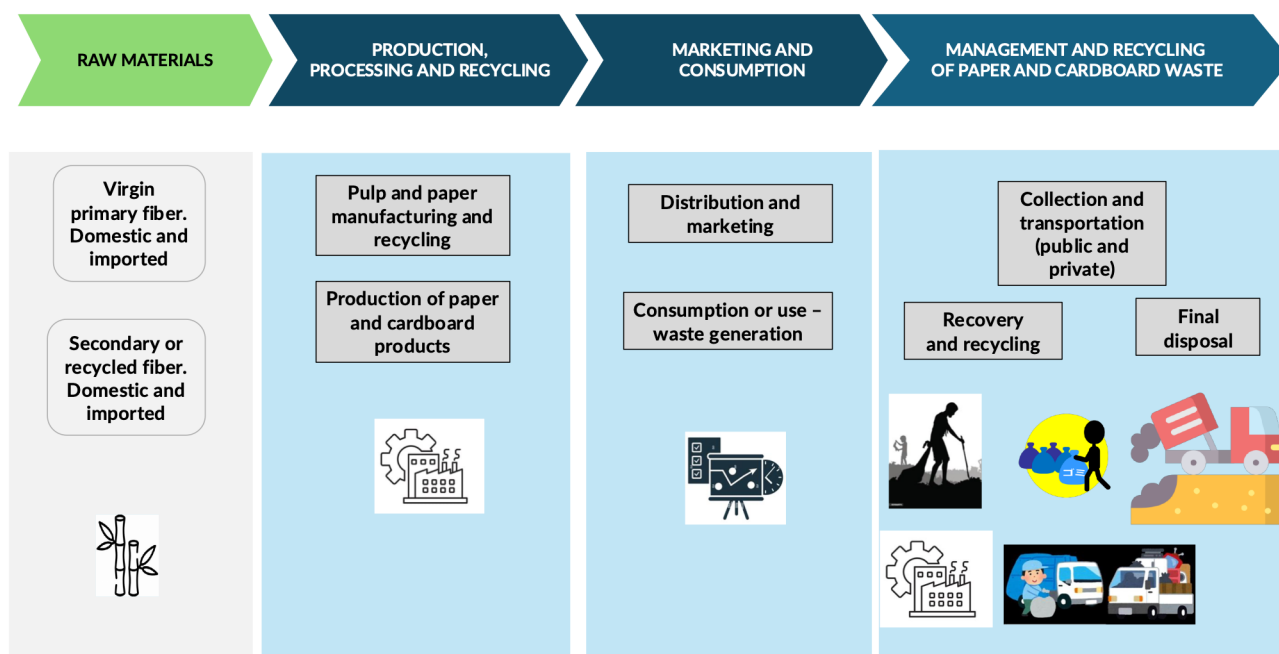
1. Study Context and Scope

As part of the Commission for Environmental Cooperation's 2021 Operational Plan project on *Transforming Recycling and Solid Waste Management in North America* studies were commissioned on the recycling and management of paper and cardboard waste, plastics and bioplastics for Canada, the United States and Mexico. The objective of these studies was to accelerate the adoption of circular economy (CE) practices that would promote strategies for the sustainable management of these materials and generate economic and environmental benefits for the region.

The present study focuses on the treatment of paper and cardboard post-consumption waste recycling in Mexico (the analyses of plastics and bioplastics waste are presented in separate studies) and a series of similar studies focused on Canada and the United States were recently published.¹

Various waste management strategies determine the recycling efficiency in the states of Mexico and in many other countries. However, the same solid waste management patterns are not followed here as in Canada and the United States, and these generate significant contrasts in the recovery and recycling of post-consumption waste.

Figure 1. Paper and cardboard value chain in Mexico



Source: Prepared by the authors with information from CNICP (2012) and CEC (2024).

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

2. Research Method

This study describes the value chain, installed infrastructure, waste management sector and the primary and secondary paper and cardboard markets in Mexico, which show the current state of recovery and recycling for these materials by the population in the country. It also includes a summary of the public policies and regulations applicable within the framework of the circular economy. Best practices in waste management that could be implemented, based on the recommendations and findings of the report, are also specified.

The data come mainly from the 2023 Annual Report of the National Chamber of the Pulp and Paper Industries (CNICP) and from the knowledge and experience of key players in the Chamber itself. The information was validated by comparing it with official sources, such as the National Institute of Statistics and Geography (INEGI) and the National Institute of Ecology and Climate Change (INECC) of Semarnat.

It was also organized around the value chain, conventional paper products and their post-consumption waste, the social structure of the population and its influence on recovery, infrastructure and public policies, and incorporated the points of view, problems and expectations expressed by businesses and nongovernmental organizations, public servants and academic researchers.

The study seeks to contribute to the definition and implementation of shared strategies in North America that will enable the public and private sectors to undertake short-, medium- and long-term actions to base the paper and cardboard sector on circular economy criteria that will reduce raw material consumption and waste, retain materials and components in healthy economic circuits and contribute to balanced, sustainable regional development with social and environmental responsibility.

3. Key Findings

3.1 Material flow and waste management

In Mexico in 2023, the paper sector made up 0.4 percent of national GDP, 1.3 percent of industrial GDP, and 2 percent of manufacturing GDP. In terms of employment, the industry generated 65,000 direct jobs and 235,000 indirect jobs.

CNICP lists 41 pulp- and paper-producing companies that together operate 50 paper mills in 21 states and two pulp mills in two other states. Domestic production of paper and cardboard was 6,217 kilotons (kt), while installed capacity was 7,877 kt, which implies that the industry operated at 78.9 percent of its capacity.

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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 total, 6,374 kt of secondary fiber, 86 kt of domestic virgin fiber and 658 kt of imported virgin fiber were consumed. Therefore, recycled content made up 89.5 percent of the total.

At the state level, Baja California, Chihuahua, Mexico City, Estado de México, Nuevo León, Querétaro and Sonora are net importers of paper or cardboard for recycling, while Coahuila and Tamaulipas are net exporters.

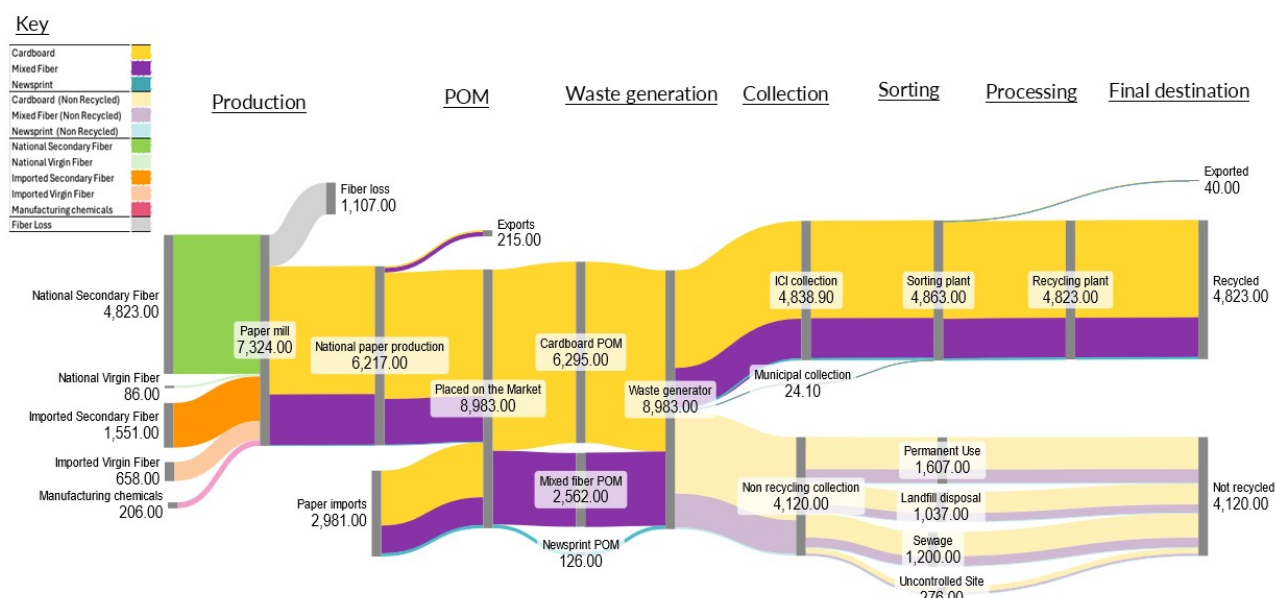
The United States, Canada, Chile and China, among others, are net exporters of these materials to Mexico, while Korea, India, Laos and Malaysia, among others, are net importers of paper or cardboard for recycling from Mexico.

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 being studied.

In 2023, 215 kt of finished paper products were exported and 2,981 kt were imported, making Mexico a net importer of these products.

Apparent paper consumption is the result of domestic manufacture 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 amounted to 8,983 kilotons.

Figure 2. Paper and cardboard flows in Mexico for 2023 (kilotons)



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

Around 4,863 kt of paper and cardboard were collected and recycled in the country, equivalent to 54.14 percent of all apparent consumption of this material, which places Mexico 27th in the world in the recovery of domestic secondary fiber.

However, this recovery was not sufficient to supply the secondary fiber requirements of the pulp and paper companies that are affiliated with 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, and a recycled content rate of 89.53 percent in final products.

Recovery and recycling of paper and cardboard waste are carried out through the infrastructure and actions of the private sector, complemented by the import of secondary fiber. The percentage recovery achieved in Mexico (54 percent) is nearly equivalent to those of Canada (59 percent) and the United States (55 percent). However, the percentage of recycled material differs substantially in Mexican products in terms of content, as well as in pricing, infrastructure and involvement of garbage pickers and collection centers.

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 (2024).

An important indicator for measuring the efficiency of paper and cardboard collection and recycling is the amount of waste no longer sent to final disposal, where it would be transformed until it decomposes into carbon dioxide (CO₂) or methane (CH₄). According to CNICP, each year the

disposal of 6,374 kt of paper and cardboard products is avoided, which reduces GHG emissions, associated with the degradation of paper and cardboard at final disposal sites, by the equivalent of 1,600 kt CO₂ eq/year.

Of the 4,119 kt of paper waste that was not destined for recycling in 2023, 1,200 kt (29 percent of the total) ended up in sewers (this was mainly sanitary paper). It is estimated that in the coming years the amount of waste in the sewage system will increase in proportion to population growth.

Paper for permanent use amounted to 1,607 kt (39 percent of the total). It is estimated that this amount will remain stable in coming years and even gradually decrease as digital transition replaces paper archives.

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 the growing demand for paper and cardboard products, companies have increased their investments in production capacity and technological improvements, which has allowed 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 stands out as the most important material. In 2023, 3,959 kt (82 percent of the total) were recovered. With the growth of online commerce, increasing use of paperboard for packaging can be expected, along with a potential increase in the recovery of this material in the coming years.

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

Finally, the use and recovery of newsprint in Mexico have been decreasing over time. Only 32 kt (1 percent) of this paper was recovered in 2023. With the transition from printed newspapers to digital media, it is estimated that newspaper circulation will decrease further in the coming years, and its production will contribute mainly as input for piñatas and other handicrafts, or a substitute will be used.

3.2 Regulatory and public policy frameworks

National waste regulations applicable to the paper and cardboard stream are based mainly on Mexico's General Law for the Prevention and Integral Management of Waste (LGPGIR) and its regulations, as well as on the official Mexican standard "NOM-161-Semarnat-2011," which

establishes the criteria for classifying special management waste and determining which are subject to a management plan; its list and the procedure for its inclusion or exclusion; as well as the elements and procedures for the formulation of such plans.”

Standards, formerly known as Mexican Standards (NMX), are voluntary regulations. There are four key standards in the paper industry: NMX-AA-144-SCFI-2008, NMX-N-100-SCFI-2009, NMX-N-106-SCFI-2010 and NMX-N-107-SCFI-2010, which regulate the manufacture and recycling of paper and cardboard, and were issued by the Ministry of Economy with the participation of the Chamber of Paper and other agencies: laboratories, research institutions and companies in the Mexican paper industry.

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 establish local public policy, as well as the procedures and obligations for compliance by the private sector in their territory.

Nine Mexican states lack a specific law pertaining to waste: Aguascalientes, Baja California Sur, Chiapas, Estado de México, Nayarit, Nuevo León, San Luis Potosí, Tamaulipas and Tlaxcala, 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 relevant reforms concerning paper and cardboard. This implies that either their regulatory update has been slower or that the relevance of these materials in their policies has been lower.

As for paper and cardboard, 20 states provide some obligation in the management of this stream or establish some preventive measure or proposal for the substitution of plastic materials for paper or natural fiber products.

4. Barriers to Circularity

Differences in waste control and management capacities determine recycling efficiency in the various Mexican states, and between countries. Mexico does not follow the solid waste management and handling patterns used in Canada and the United States. There are important differences, for example, in the way post-consumption waste is recovered and recycled.

Mexico does not charge fees for waste collection, which marks a significant difference with respect to the other two countries and the budget allocated to infrastructure and public services for waste management.

Limited infrastructure and poor operation and handling of the cleaning services provided by municipal governments have indirectly promoted the presence of an informal sector known as *pepenadores* or garbage pickers who, voluntarily and 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 (government-owned materials are extracted for personal use) or at local government final disposal sites. This has consequences on the composition of the waste sent to sorting plants. This is an informal activity, but it is not illegal as its social usefulness is recognized.

Garbage pickers do not issue invoices but sell their waste to other collectors with greater financial capacity and the vehicles to transport it in large quantities to collection centers. These centers 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. Their integration into the formal sector, however, is limited by the volume of waste that can be purchased without an invoice from the first buyer.

Mexico has very few differentiated street collection systems that enable the recovery of paper and cardboard, mainly from households. Management plans and strategies, actions and goals for the recovery of post-consumption and post-industrial paper and cardboard waste are the responsibility of the private sector.

The mixing of waste in the waste collection vehicles of cleaning systems increases the loss of paper and cardboard waste because they are contaminated with organic or liquid waste from municipal solid waste or special handling waste.

Also, garbage pickers extract a significant portion of the paper and cardboard from the general waste stream of collection vehicles and final disposal sites. However, their participation has been analyzed only as a social problem, without evaluating its fiscal aspects, its relationship with the problems of industries at initial purchase, or the impact on sorting plants that receive waste with little value for recycling. These issues must be analyzed together and in detail, to determine the net impact of informal garbage pickers.

The financial, economic, material and human resources provided by the government are insufficient for a cleaning system that meets all 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.

5. Recommendations to Increase Circularity

Table 2 summarizes recommendations for overcoming obstacles to circularity, based on the findings of the full document on paper and cardboard in Mexico. It identifies areas of opportunity and improvements that can be addressed by the public and private sectors, based on the conditions of handling and management of paper and cardboard waste in the country.

Table 2. Summary of recommendations to increase the circularity of paper and cardboard waste in Mexico

Stage in the value chain	Barrier to circularity	Recommendation
Relevant actors	Informal garbage pickers extract waste from mixed garbage and sell it to collection centers without an invoice or tax document, which affects the first buyers because they do not have a formal mechanism to prove the acquisition of these materials.	Redesign tax schemes for the first purchase so that initial purchasers can recover any volume of waste that they can access, if they demonstrate such values using balance sheets for the corresponding authority.
Economic and financial aspects	Low costs for collection by the cleaning system 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-service coverage in each entity.	Implement tariffs differentiated by application and destination, so that sufficient resources are available for full coverage of the service, maintenance and updating of equipment and infrastructure (material or energy) for the correct handling and recovery of waste.
Technical and operational aspects	The shipment of paper and cardboard to final disposal sites contributes to the emission of greenhouse gases, the generation of odors and the dispersion of waste, since most of the facilities at these sites do not comply with NOM-083-Semarnat-2003.	Allocate sufficient resources to transform controlled and uncontrolled final disposal sites into sanitary landfills, which will reduce atmospheric and soil emissions and protect the region where they are located.
		Transform controlled and uncontrolled final disposal sites into sanitary landfills, with effective supervision and the penalties set forth in the LGPGIR and NOM-083-Semarnat-2003.
		A convenient option is to promote regionalization in the operation of sanitary landfills for the final disposal of waste, as Mexico City does, since it does not require association schemes, just service contracts.

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Stage in the value chain	Barrier to circularity	Recommendation
		Reduce the disposal of paper and cardboard waste in final disposal sites via greater recovery at the source by installing containers on public roads and ensuring that private collection service providers manage waste and not just separate it during transportation. A complementary recommendation is to apply penalties for the disposal of recoverable waste.
Material flows and waste management	Recovered paper and cardboard waste come mainly from economic and service activities, not from households, which limits the volume of clean, quality material that could be recycled to be incorporated back into the value chain.	Install containers for disposal of wastepaper and cardboard from households to help obtain clean paper. The municipality will decide on the control and destination of the economic benefits generated by the sale of these materials to the recycling and manufacturing industry.
		Applying multisectoral strategies focused on citizen awareness, environmental education and community participation to maximize separation at the source and facilitate waste recovery would help optimize waste management and align actions with circular economy principles.
	The activity of garbage pickers, private waste collectors and collection centers has been a determining factor in the recycling of clean and better quality paper and cardboard waste. However, in some cases, recovery is carried out in an irregular manner, without social guarantees, with low salaries and affecting public investment that could result from the extraction of high-value materials.	Note that the paper and cardboard industry has a network of collection centers that concentrate the efforts of practically the entire network of collectors of all types and the economic activities of the collectors and collection centers that make up the value chain.
		Protect vulnerable garbage pickers, mainly those working in controlled and uncontrolled final disposal sites, through social support programs, social security, technical training and basic tools such as gloves, overalls and glasses for the development of their activity.
		Conduct a study on the possibility of increasing the recovery of paper and cardboard waste in the entities identified, indicating the amount of paper and cardboard available and accessible for recycling, as well as the specific strategy that could be adopted, such as installing containers, improving collection services and coverage, or encouraging the creation of local value chains.

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Stage in the value chain	Barrier to circularity	Recommendation
	Regarding public infrastructure, there are some states that, due to their population, require more and better facilities for waste management and utilization, such as Chiapas, Estado de México, Guanajuato, Oaxaca and Puebla. Mexico City has made significant efforts to improve its waste management through the construction of new infrastructure and concessioned waste management.	Before investing in a sorting plant, the potential for the total amount of waste to be used must be determined so that potential income from its sale to recyclers can be estimated with certainty. If the amount is not sufficient to have an adequate return on investment, then a change of project should be considered.
		It is very important to consider recovery in energy-generating incineration plants as a viable alternative for waste with high thermal value, such as paper and cardboard, plastics and textiles, present in final disposal sites.
	There are 150 municipalities without waste collection services, 86 of them Indigenous, in the states of Oaxaca, Puebla and Veracruz. These localities, regardless of their population type, require infrastructure that allows them to initiate or increase collection and properly manage their waste.	The installation of containers that function as transfer stations and an adequate frequency of collection could contribute to the environmental and social health of these municipalities.
		The lack of infrastructure can begin to be resolved by installing collection centers or mechanisms for the return of waste, mainly for packaging and containers, run by the sectors that market their products in these municipalities.
Secondary markets	Because of their design and application, management plans do not support recovery and recycling in economies of scale, as they are considered by companies to be simply a government formality. This dilutes infrastructure efforts and eliminates the potential for the public sector to coordinate with the private sector and encourage recycling. It also reduces the efficiency and effectiveness of large-scale actions, breaking them down into small activities for each company.	Redesign the content and form of registering 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 and national coverage to create markets for the acquisition of waste and sale of raw materials. Management plans should be considered instruments of the circular economy and extended responsibility.

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Stage in the value chain	Barrier to circularity	Recommendation
	There is homogeneity in the private sector for the recovery and recycling of paper and cardboard, largely thanks to the participation of CNICP, 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.	The monitoring of progress and the definition and fulfillment of new goals require closer and more frequent coordination between authorities and the private sector. This will make it possible to achieve a strategy with common goals for both sectors.
		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) in order to establish actions to recover waste from the electronic market and delivery services.
Regulatory Framework	The paper industry has carried out important actions to recover post-consumption waste through shared responsibility, relying on garbage pickers and private collection centers to whom it pays a competitive price for products. However, recovery remains informal, with activities on public roads or in unsuitable locations, which has varying impacts on the value chain in terms of fiscal, operational, environmental and social security conditions.	Promote a better organized structure and content in the management plans for domestic coverage, with measurable goals in spans of two to four years and a clear definition of the participation of authorities and consumers.
		Establishment and promotion by the government of economic participation schemes that include actors in the value chain who do not have the financial, personnel or material capacity to design or implement management plans on their own, but who collaborate with the authority, cover their “polluter pays” responsibility, and contribute to the solution of inadequate product and waste management.
		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.
		The government should cover the financing schemes that the private sector does not provide to entrepreneurs and 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 only on prices.

Stage in the value chain	Barrier to circularity	Recommendation
	The technical and economic capacities of the municipalities are unequal and do not allow for the construction of the minimum infrastructure necessary 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. In the medium term, it would serve as a guarantor for investment projects with total control, and in the long term it would take over waste management in the country.

6. Shared Conclusions on Paper and Cardboard Waste Management in Canada and the United States

In the CEC (2024) study of this waste stream for Canada and the United States, and its respective executive summary,² include a section dedicated to barriers to recycling wastepaper 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.

Tables 3 and 4 group the recommendations and barriers identified in the Canadian and US studies, adapting them to the 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 wastepaper. However, for our analysis, only collection and recycling are considered because they are much more like the domestic context.

For some barriers, the table lists multiple possible causes with corresponding suggested solutions and policy recommendations. In these cases, the tables are presented in separate cells and color-coded for clarity.

The red in the two columns on the left is for the challenges and barriers to circularity. The green in the two columns on the right is for suggested solutions. The flags of Canada, the United States and

² 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 \(English only\)](#).

Mexico are placed at the top of each table to indicate that this information pertains to all three countries. Note that some table content is repeated because barriers to circularity overlap, and public policy actions can serve as solutions to 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:

- Introduction of 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.
- Use 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 3. 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> 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.	<i>The residential sector lacks the economic incentives of the ICI sectors:</i> 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.	<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> <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>

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Barrier to circularity	Possible cause	Suggested solution	Action for policymakers
	There are no public collection systems in place to enable a cleaning system to capture paper and cardboard from residences.		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.
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.	Lack of policies to harmonize collection practices.	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. In the Mexican market, ICI fibers represent just over 99 percent of the material recovered for recycling. Standardize multifamily recycling programs for residential buildings. Increase consumer understanding to improve recycling behavior. Improvements are needed in educational programs in the residential, industrial, commercial and institutional sectors.	Research industrial best practices to develop and implement general recyclability labeling requirements, including a uniform color for recycling containers. Harmonize or standardize materials that can be recycled in a locality, a jurisdiction, and (on a national level) to reduce consumer confusion. Establish or improve educational programs for residential, industrial, commercial and institutional sectors. Institute consistent landfill bans for cardboard in all jurisdictions and establish appropriate enforcement. Analyze best practices for waste diversion from the multifamily residential sector in each country. Provide financial support through grants to standardize these best practices.

Table 4. 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> <i>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.</i> In Mexico, percentages of recycled material content and labeling were established in NMX-N-107-SCFI-2010. <i>In jurisdictions with EPR, producer fees can also be modified to provide a bonus for those who integrate a certain percentage of recycled fiber.</i>

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Barrier to circularity	Possible cause	Suggested solution	Action for policymakers
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.
	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.	Promote domestic paper manufacturing. Encourage the construction or modernization of paper mills capable of 100 percent recycled content. Invest in recycling infrastructure.	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.

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Barrier to circularity	Possible cause	Suggested solution	Action for policymakers
	Mexico imports a large amount of recycled fiber, which limits the procurement of domestic recycled fiber.	Increase domestic secondary fiber recovery.	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. Mexico should free up unused government files and simplify administrative paper and cardboard management. Support creation of an average "Price Index" for paper and cardboard. Design and support fiscal mechanisms that simplify the incorporation of paper waste into the productive sector.
		Establish recycled content requirements for paper packaging to drive demand and encourage producers to increase domestic capacity to incorporate recycled fiber in their products.	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.

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