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

Transforming Recycling and Solid Waste Management in Mexico

Executive Summary

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Acronyms and Abbreviations

ABS	Acrylonitrile, Butadiene and Styrene
AMEE	*Asociación Mexicana de Envase y Embalaje, A.C.* (Mexican Association of Containers and Packaging, A.C.)
AMIA	*Asociación Mexicana de la Industria Automotriz, A.C.* (Mexican Association of the Automotive Industry, A.C.)
AMIRPAC	*Asociación Mexicana de la Industria de Reciclaje de Plástico, A.C.* (Mexican Association of the Plastic Recycling Industry, A.C.)
AMRRE	*Asociación Mexicana de Recicladores de Residuos Electrónicos, A.C.* (Mexican Association of Electronic Waste Recyclers, A.C.)
ANIPAC	*Asociación Nacional de Industrias del Plástico, A.C.* (National Association of Plastics Industries, A.C.)
ANIQ	*Asociación Nacional de Industria Química, A.C.* (National Chemical Industry Association, AC)
CC	Collection Center
CE	Circular Economy
CEC	Commission for Environmental Cooperation
CNGM	*Censo Nacional de Gobiernos Municipales* (National Census of Municipal Governments)
CSys	Cleaning System
DBGIR	Basic Diagnosis of Integral Waste Management
DOF	*Diario Oficial de la Federación* (Official Journal of the Federation)
ECOCE	*Ecología y Compromiso Empresarial, A.C.* (Ecology and Business Commitment, AC)
EPR	Extended Producer Responsibility
HDPE	High Density Polyethylene
HIPS	High Impact Polystyrene
Inboplast	*Asociación de Industriales de Bolsas Plásticas de México, A.C.* (Association of Plastic Bag Industrialists of Mexico, AC)
INECC	*Instituto Nacional de Ecología y Cambio Climático* (National Institute of Ecology and Climate Change)
INEGI	*Instituto Nacional de Estadística y Geografía* (National Institute of Statistics and Geography)
kt	Kilotons
LDPE	Low Density Polyethylene
LDPE/LLDPE	Low Density/Linear Polyethylene

LGEEPA	*Ley General del Equilibrio Ecológico y la Protección al Ambiente* (General Law on Ecological Balance and Environmental Protection)
LGPGIR	General Law on Prevention and Integral Management of Waste
MEXBEB	*Asociación Mexicana de Bebidas* (Mexican Beverage Association)
MI	Manufacturing Industry
MSW	Municipal Solid Waste
Mt CO_2 eq	Millions of tons of CO_2 equivalent
Mt	Millions of tons
NGO	Nongovernmental Organization
NOM	Mexican Official Standards
PASA	Promotora Ambiental, S.A. de C.V.
PBAT	Polybutyrate
PBS	Polybutylene Succinate
PCR	Post-Consumption Resin
PE	Polyethylene
PET	Polyethylene Terephthalate
PHA	polyhydroxyalkanoates
PLA	Polylactic Acid
POE	Periódico Oficial Estatal (Official State Newspaper)
POM	Polyoxymethylene
PP	Polypropylene
PS	Polystyrene
PVC	Polyvinyl Chloride
Semarnat	*Secretaría de Medio Ambiente y Recursos Naturales* (Ministry of Environment and Natural Resources)
SHW	Special Handling Waste
SP	Selection Plant
SR	Shared Responsibility
TP	Thermoplastic Resins
UNEP	United Nations Environment Program

Definitions

Apparent consumption	The sum of domestic production plus imports minus exports
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
FDS	Final disposal site. Place for final disposal of municipal solid waste and special handling waste
Food grade plastic	Plastic used in the manufacture of a product or good that is in contact with food, regardless of the type of waste in question
GP	Garbage picker. Individuals who perform plastic 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
Monomers	Molecules of low molecular weight, which are the basic units or components of polymers
Other plastics	Plastic resins classified in category 7
PGP	Private garbage picker. Individual or legal entity that performs plastic waste recovery activities from large generators, industry, commerce or services. They provide invoices with fiscal value
Post-consumption	Waste generated by daily consumer use. Its origin is usually domestic or commercial
Post-industrial	Waste from a manufacturing process. It can be a defective finished product, scrap or waste, and does not fulfill its intended use or function
RDF	Refuse-derived Fuel
R&D	Research and Development
RI	Recycling Industry
SLF	Sanitary landfill. Infrastructure work that includes engineering methods and works; 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, formerly considered Mexican Standards
TS	Transfer Stations
UCSi	Uncontrolled site. Site unsuitable for final disposal that does not comply with any of the specifications indicated in NOM-083-Semarnat-2003, it is generally known as an “open dump”

1. Study Context and Scope

As part of the *Transforming Recycling and Solid Waste Management in North America* project of the 2021 Operating Plan, the Commission for Environmental Cooperation (CEC) commissioned studies on the recycling and management of paper and cardboard waste, 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 focuses on plastic waste. (Analyses of paper and cardboard waste and bioplastics are presented in separate studies.) A series of similar studies focused on Canada and the United States was recently published.[1] This publication for the case of Mexico provides information for decision-makers to know the current status of post-consumption plastic waste recycling in the country.

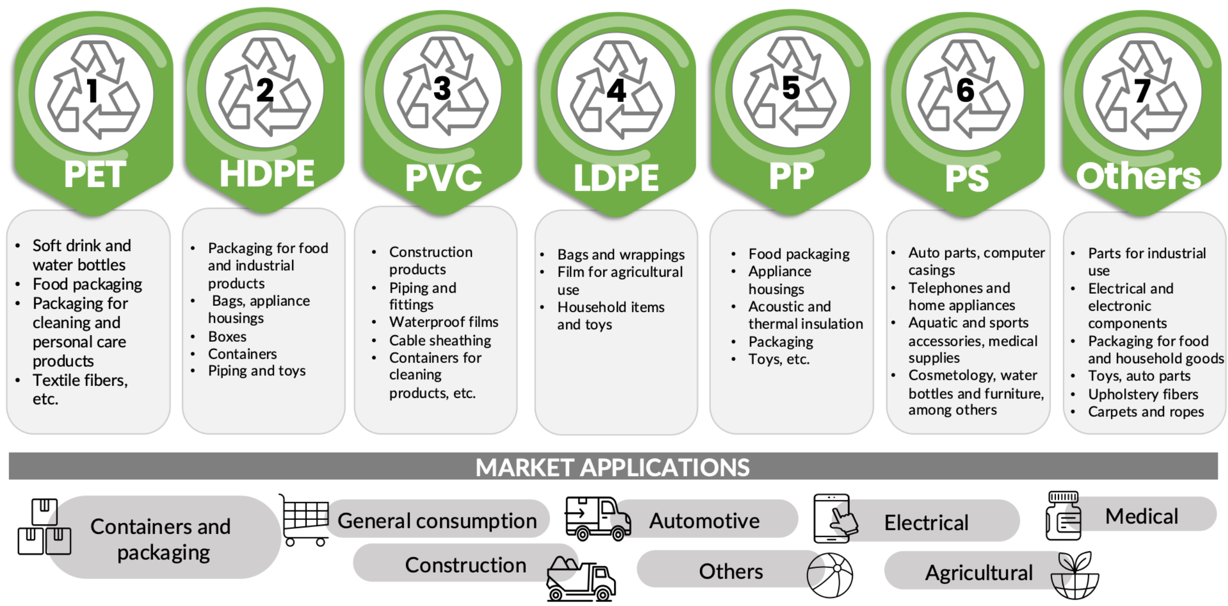
Resins produced in Mexico or imported by companies include polyethylene (PE), polypropylene (PP), polyvinyl chloride (PVC), polystyrene (PS/EPS), polyethylene terephthalate (PET) as well as engineering resins such as polyamides (PA), polycarbonate (PC), polybutylene terephthalate (PBT), polyoxymethylene (POM) and others. All are used in various applications.

Also on the market are resins for the manufacture of biodegradable or compostable products made from starches, biomass such as sugar cane and other organic materials produced by farmers or from organic product waste. These bioplastics include polylactic acid (PLA), polyhydroxyalkanoates (PHA), polybutyrate (PBAT), and polybutylene succinate (PBS), the latter two being biodegradable, but manufactured from non-renewable sources.

The plastics industrial chain supplies most branches of economic activity, such as food, automotive, construction, electrical and electronics, medical and agricultural, among others (see Figure 1).

[1] CEC (2025), *Transforming Recycling and Solid Waste Management in North America*, Commission for Environmental Cooperation.

Figure 1. Plastic resins and common applications



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

2. Research Method

This report is the result of a baseline study on plastic waste. It analyzes the value chain for recovery, handling and recycling of thermoplastic resins (TP) or commodities, describing in general terms its infrastructure, operational management and associated markets. The current state of recovery and recycling is also documented, and public policies and applicable regulations within the framework of the circular economy are examined. It also provides a description of good practices and recommendations to strengthen Mexico's system for managing these wastes.

The information in this study comes from the analysis of the information presented by ANIPAC in its 2023 Yearbook and the exchange of knowledge and experiences with ANIPAC, Inboplast, AMEE, AMIRPAC, AMIA, AMREE, the recyclers' section of Ecoce, ANIQ, MexBeb, and Braskem Idesa, as well as the analysis of information from official sources of INEGI and studies by the National Institute of Ecology, all of which provided the information that supports this document.

The information was organized and analyzed around the value chain, conventional products and their post-consumption waste, the social structure and its influence on recovery, infrastructure and public policy. The analysis was completed by recovering the positions, problems and expectations of business and social organizations, as well as those of government officials and academics.

The purpose of this study is to establish a baseline from the perspective of an international comparison that provides insights to governmental and private sector decision-makers who take short-, medium- and long-term actions aimed at development within the framework of a circular economy. The ultimate goals are to reduce consumption of virgin raw materials, to keep materials and their components within healthy circular economic systems by reducing waste of raw materials, and to provide insights for balanced and environmentally responsible development and strengthened social responsibility.

3. Key Findings

3.1 Material flow and waste management

The analysis of public policies, rates, infrastructure conditions and, above all, the formal and informal social structure in Mexico is key to explaining patterns of management, handling, recovery and recycling of post-consumption plastic waste which, by the way, in the study of paper and cardboard as well as in the management of solid waste exhibit very similar behavior.

Mexico is a country with a complex social structure and marked differences between urban and rural populations, including an Indigenous population with a significant presence and strong cultural components in some states.

Relevant information to identify market and public policy conditions was obtained from official sources. The development of the study includes the seven plastics identified as commodities or conventional, used mainly for the packaging and packing of products, as well as the use of plastics in the construction, automotive, electrical and electronics sectors, along with other applications in the agricultural and health sectors (see Table 1).

Table 1. Applications and uses of plastic in Mexico in 2022 (kilotons)

Industrial end uses	Abbreviation	Kt	Percentage
Conventional uses	CU	4,534	68
Electrical and electronics	EEU	903	13
Construction and demolition	CDU	690	10
Automotive sector	ASU	568	8
Total		**6,695**	**100**

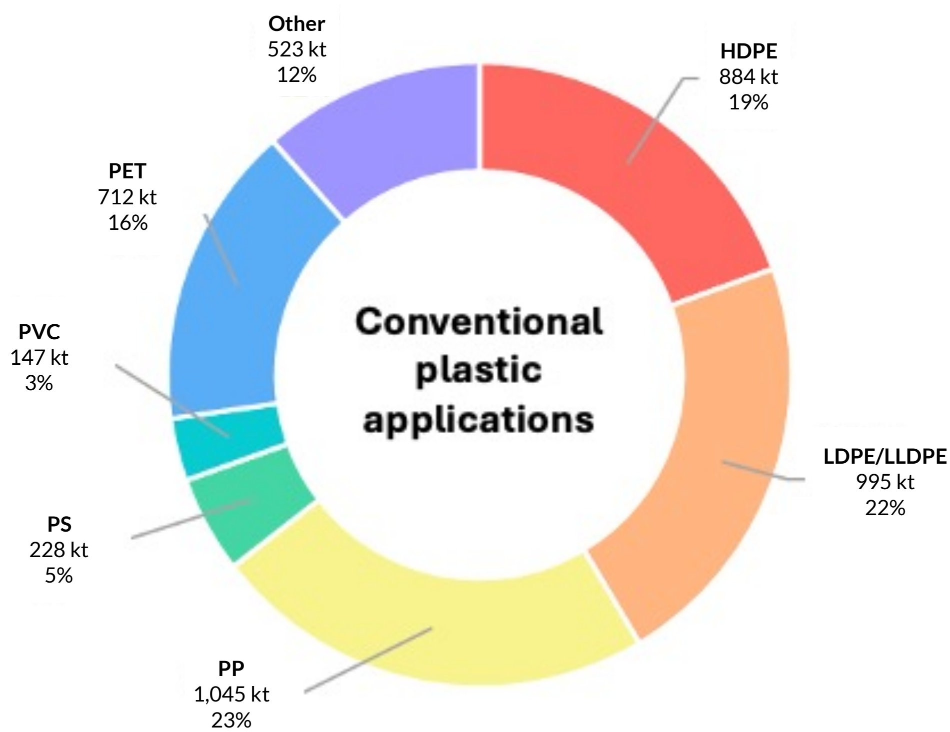
Source: Prepared by the authors with information from the ANIPAC *2023 Statistical Yearbook*.

In Mexico, the gross domestic product (GDP) of the plastics and rubber industry was equivalent to 2.52 percent of the GDP of the manufacturing industry in 2022. TP resin production accounts for

52 percent of apparent consumption in the country in industrial facilities with an installed capacity of 4,870 kt (72 percent). The country has a trade deficit of US$9,089 million in plastic products.

The most widely used resin for this purpose is PP, with 1,045 kt (23 percent of the total), followed by LDPE/LLDPE with 995 kt (22 percent of the total), HDPE with 884 kt (19 percent), PET with 712 kt (16 percent), others with 523 kt (12 percent), PS with 228 kt (5 percent) and, finally, PVC with 147 kt (3 percent of the total).

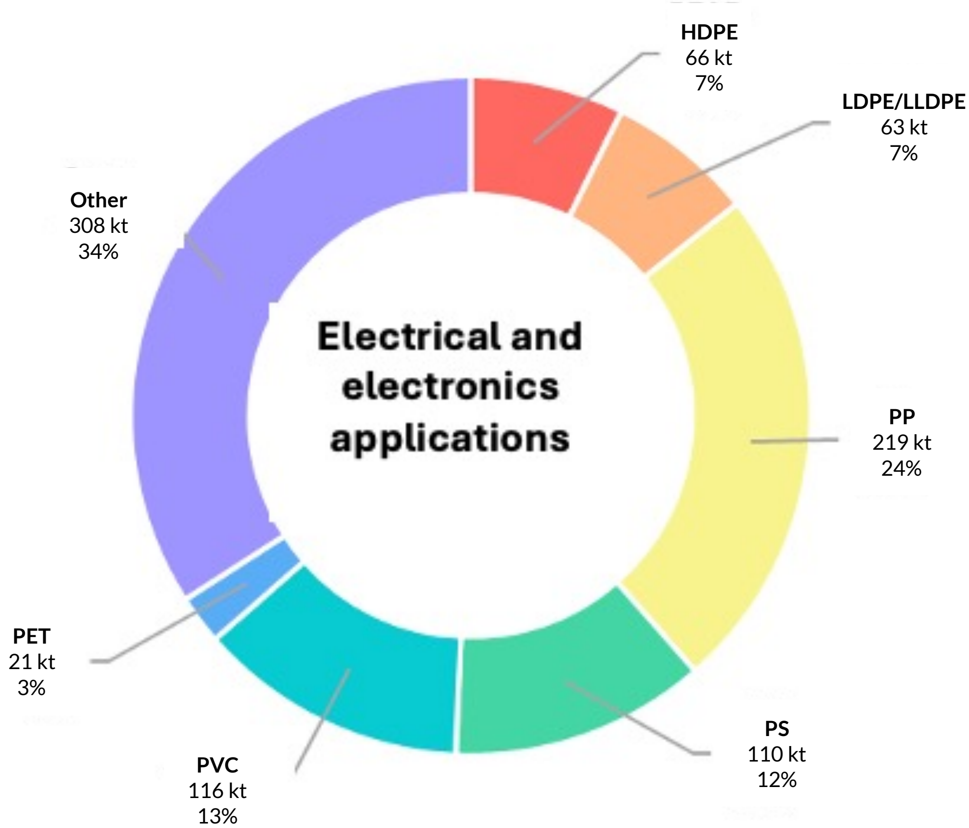
Figure 2. Resin types in conventional plastic uses, 2022



Source: Prepared by the authors with information from the ANIPAC *2023 Statistical Yearbook*.

Figure 3 shows the composition of resins used in electrical and electronic devices. The largest share is made up of other resins with 308 kt (34 percent of the total), mainly engineering resins, due to their flexibility and high resistance to high temperatures and chemical products, followed by PP with 219 kt (24 percent of the total), PVC with 116 kt (13 percent), PS with 110 kt (12 percent), HDPE with 66 kt (7 percent), LDPE/LLDPE with 63 kt (7 percent) and PET with 21 kt (3 percent of the total).

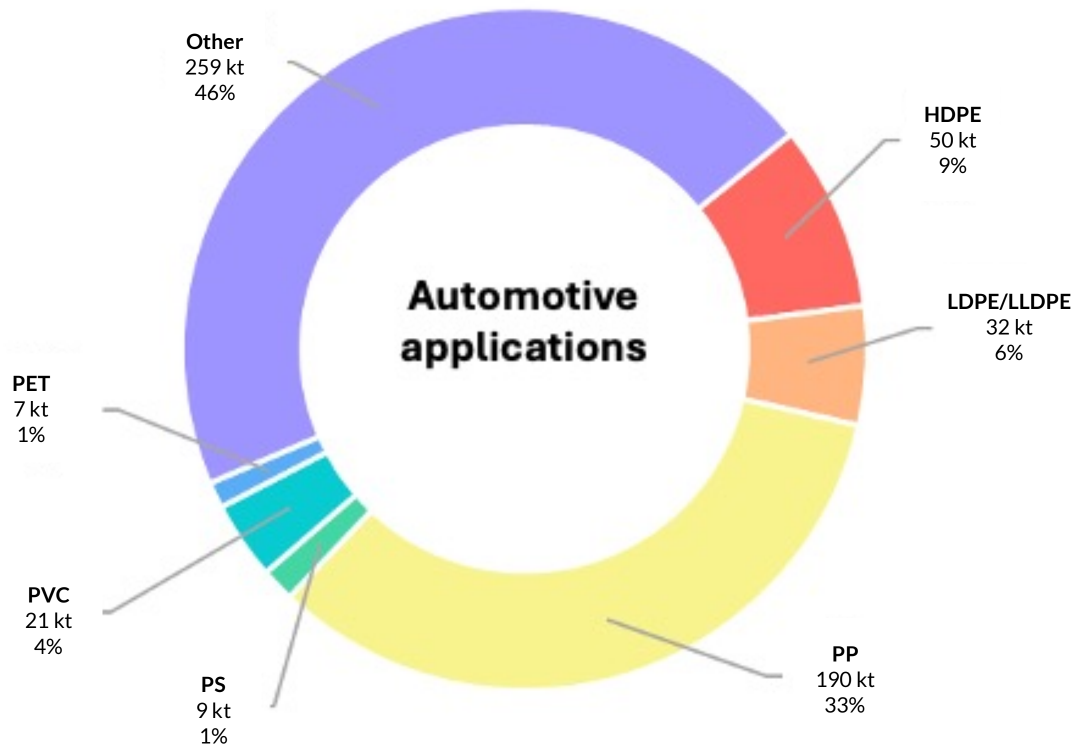
Figure 3. Types of resins in electrical and electronic applications, 2022



Source: Prepared by the authors with information from the ANIPAC *2023 Statistical Yearbook*.

Figure 4 shows the composition of resins used in the automotive sector, where the largest share consists of other resins with 259 kt (46 percent of the total), mainly engineering resins, followed by PP with 190 kt (33 percent of the total), HDPE with 50 kt (9 percent), LDPE/LLDPE with 32 kt (6 percent), PVC with 21 kt (4 percent), PS with 9 kt (1 percent) and, finally, PET with 7 kt (1 percent of the total).

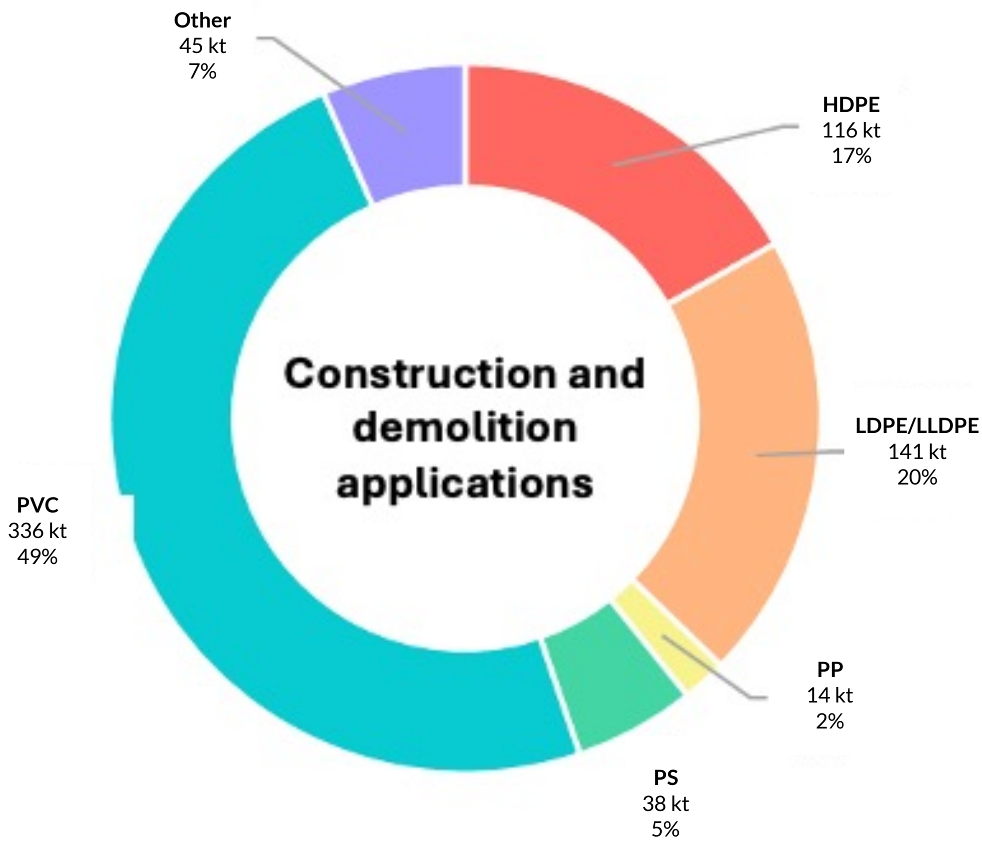
Figure 4. Types of resin in automotive sector uses, 2022



Source: Prepared by the authors with information from the ANIPAC *2023 Statistical Yearbook*.

Figure 5 shows the composition of resins in construction and demolition uses. The most used resin is PVC with 336 kt (49 percent of the total), low density linear polyethylene with 141 kt (20 percent of the total), HDPE with 116 kt (17 percent), other resins with 45 kt (7 percent), PS with 38 kt (5 percent) and, finally, PP with 14 kt (2 percent of the total).

Figure 5. Resin types in construction and demolition uses, 2022



Source: Prepared by the authors with information from the ANIPAC 2023 Statistical Yearbook.

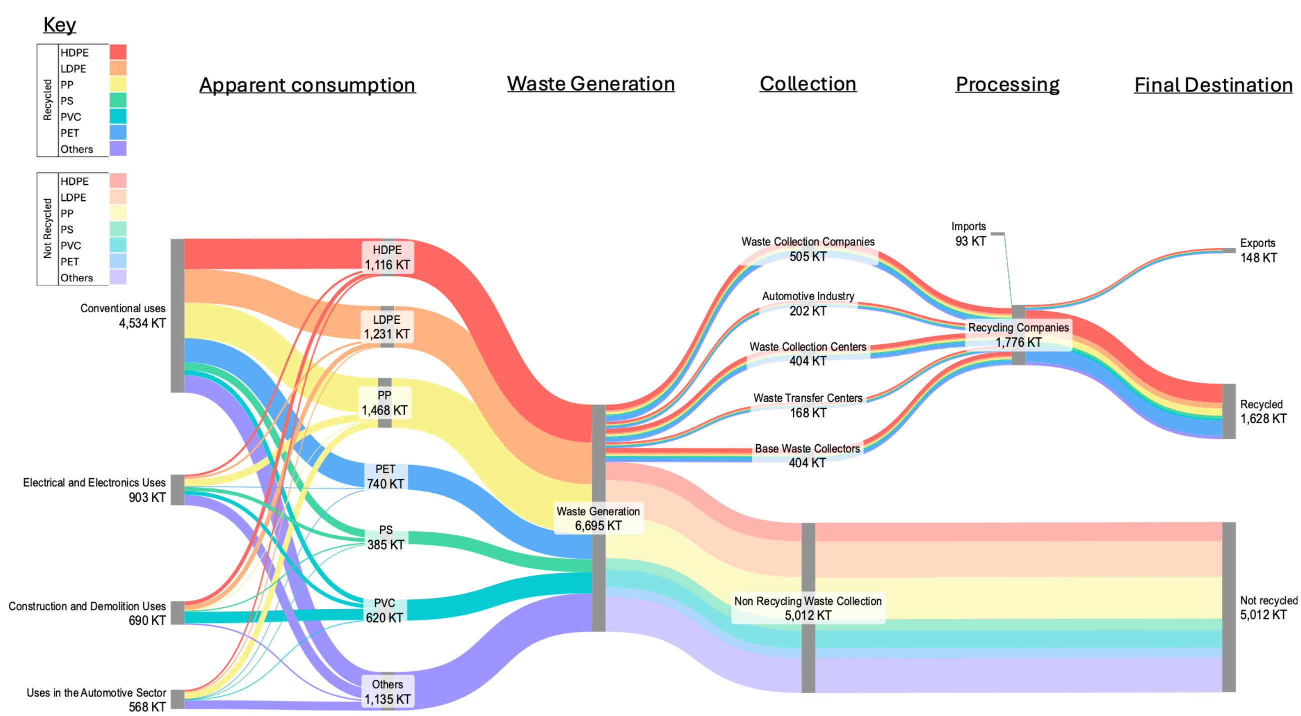
Total production of thermoplastic resins (TP) in Mexico in 2022 amounted to 3,508 kt. PET, the most produced TP resin in the country, totaled 978 kt (28 percent of domestic production). PVC came in second place, with 564 kt (16 percent of domestic production). In third place was HDPE, with 500 kt (14 percent). In fourth place was PP, with 468 kt (13 percent). In fifth place was PS, with 388 kt (11 percent). This was followed by LDPE/LLDPE, with 313 kt (9 percent). Finally, there were other TP resins, with 297 kt (8 percent of domestic production).

Table 2. TP resin production in Mexico in 2022 (kilotons)

Production	Abbreviation	Kt	Percentage
1. Polyethylene Terephthalate	PET	978	28
2. High Density Polyethylene	HDPE	500	14
3. Polyvinyl Chloride	PVC	564	16
4. Low Density/Linear Polyethylene	LDPE/LLDPE	313	9
5. Polypropylene	PP	468	13
6. Polystyrene	PS	388	11
7. Others	Others	297	8
Total		**3.508**	**100**

Source: Prepared by the authors with information from the ANIPAC *2023 Statistical Yearbook*.

Figure 6. Plastic waste streams by resin type and industrial application in Mexico, 2022 (kilotons)

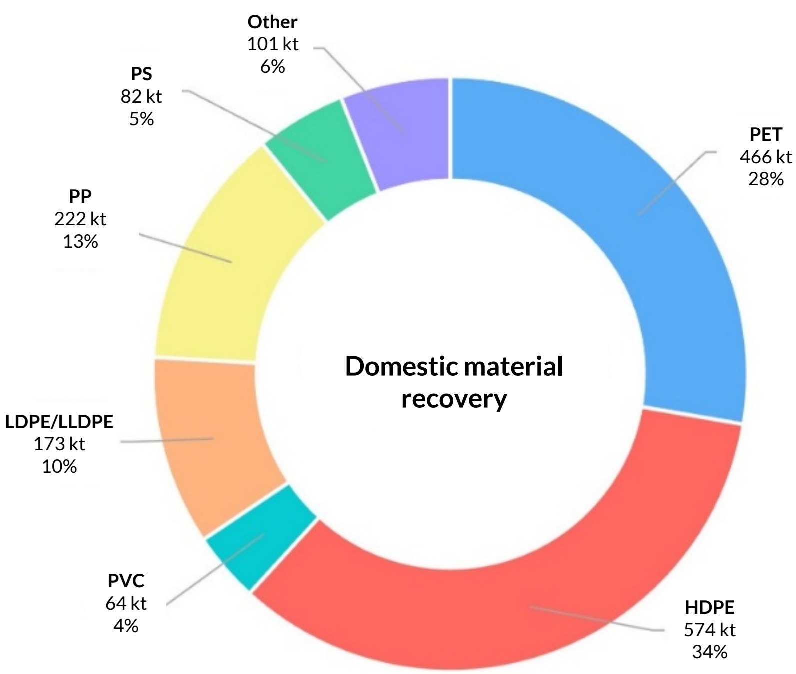


Source: Prepared by the authors with information from the ANIPAC *2023 Statistical Yearbook*, UN Comtrade and USITC DataWeb.

Packaging and packing, the most widespread applications, were grouped as conventional plastics, which used 4,534 kt (68 percent) of plastic materials. In second place, was the plastic contained in electrical and electronic products, which accounted for 903 kt (13 percent) of materials. In construction and demolition products, 690 kt (10 percent) of materials were used, and in the automotive sector, 568 kt (8 percent) of TP resins were used. Automotive materials data was for vehicle manufacturing, not waste generated by end-of-life vehicles. The reason for this is that, in Mexico, the disassembly of vehicles is not carried out in an orderly recycling scheme, but is rather a daily activity that lacks any focus on intensive recycling.

ANIPAC estimated that in 2022 the volume of plastic waste to be recovered for recycling in the country was 1,683 kt, implying a recovery rate of 25 percent. HDPE is the most recovered material, with 574 kt (34 percent of the total), followed by PET, with 466 kt (28 percent of the total), then PP, with 222 kt (13 percent), LDPE, with 173 kt (10 percent), other resins, with 101 kt (6 percent), PS, with 82 kt (5 percent), and finally PVC, with 64 kt (4 percent of the total), as shown in Figure 7.

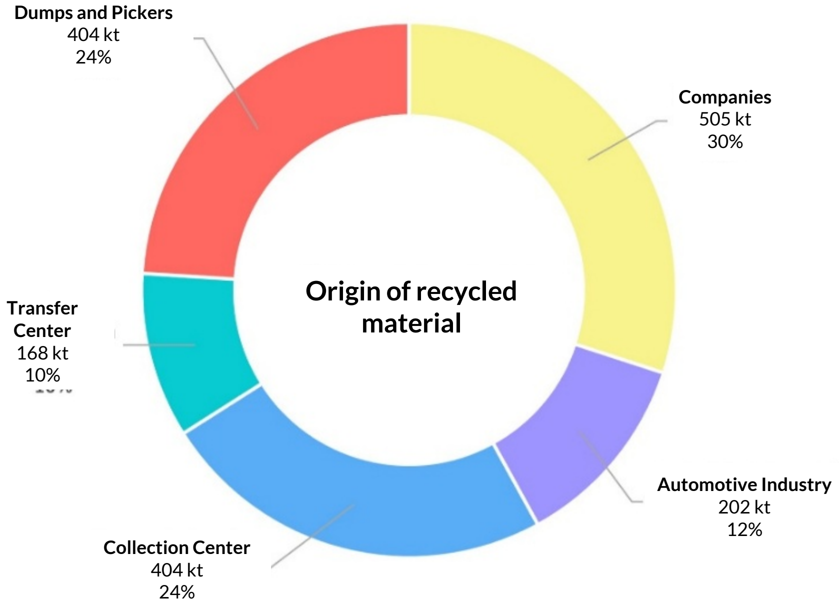
Figure 7. Domestic recovery of plastic materials, 2022



Source: Prepared by the authors with information from the ANIPAC 2023 Statistical Yearbook.

Certain applications, especially the food industry, restrict the use of recovered material, which means that any plastic impregnated with flame retardants or antistatics, among others, becomes useless for recycling in the food industry. Figure 8 shows the origin of plastic material used for recycling in Mexico, where 30 percent comes from companies, 24 percent from a collection center, the same percentage from open dumps, 12 percent from the automotive industry and, finally, 10 percent from a transfer center.

Figure 8. Origin of domestic material recycled, 2022



Source: Prepared by the authors with information from the ANIPAC 2023 Statistical Yearbook.

3.2 Legal and policy framework

The stances of state authorities on plastic waste in the country are varied, although three very clear ones can be identified: the imposition of taxes; a total or partial ban, which includes the mandatory substitution of plastics for environmentally friendly materials; and a mixed stance that encourages recycling rates and seeks circular rather than linear economies.

Formal certification processes in Mexico are still incomplete, particularly for recycled content in single-use post-consumption plastic products, especially when compared to international standards. The fact of not having standards makes it difficult to differentiate and provide transparency in the composition of plastic products, since some entities in the country, in response to the prohibitions, have issued their own technical regulation standards establishing minimum content indexes or their substitution by natural or compostable materials.

The Act for the Prevention and Integral Management of Waste (*Ley de Prevención y Gestión Integral de Residuos*) stipules shared responsibility as the way in which the governmental and private sectors interact, with management plans as the main instrument.

4. Barriers to Circularity

Differences in waste control and management capacities determine recycling efficiency in the various states of the country, and between countries. Mexico does not follow the solid waste control and management patterns used in Canada and the United States, and important differences are thus found in these patterns and, therefore, in the way in which actions for the recovery and recycling of this post-consumption waste are carried out.

In Mexico, in general, there are no fees for waste collection—a significant difference with respect to other countries—and the budget allocated to infrastructure and public services for waste management is very limited. This has led to inadequate operation and management of cleaning services by municipal governments, which has indirectly promoted the presence of an informal sector of workers, known as *pepenadores* or garbage pickers, who collect the materials on their own initiative, to sell or exchange them for small amounts of money.

These activities modify the waste management process, because these government-owned materials are extracted from cleaning system trucks, ostensibly for personal use, and the same situation occurs at final disposal sites run by the local government. This situation also affects the composition of the waste entering the few sorting plants in the country, which is where the waste should be extracted for recycling. This activity is classified as informal because these workers do not pay taxes, lack social security and the activity can generate health problems. Even so, it is a job whose usefulness is recognized for social reasons and thus ultimately, it is not illegal.

The garbage pickers sell their waste to other collectors who have greater financial capacity, and who have vehicles to transport it in larger quantities to collection centers. These centers do issue invoices and meet tax obligations, and thus they effectively formalize an informal activity. The materials thus recovered are cleaner than those extracted in a sorting plant, where mixed waste is received and processed. However, their integration into the formal economy is limited by the amount of waste that the first buyer can purchase without an invoice.

Generally speaking, Mexico does not have differentiated collection systems in the streets that enable it to recover plastic at the source, and it is only through the participation of the private sector, and its management plans, that strategies, goals and actions for post-consumption and post-industrial plastic recovery are defined.

Plastic recovery schemes by public, private, formal and informal actors reintegrate this material into the value chain. It operates only with waste that has economic value for the industry, such as PET, PP, PS, HDPE, LDPE bottles and other applications, such as packaging, trays, domes and hinges used in the food sector. Common practice in this sector is to use waste for the remanufacture of new products, although the use of plastics recovered from other applications is generally rejected because they can contain other chemicals in their molecular structure, such as antistatics or flame retardants.

In the joint analysis of the barriers identified in the CEC studies (2024) for Canada and the United States, there are some coincidences in the barriers, in addition to those presented, because of the management in Mexico. Table 4 presents a summary of the key barriers to circularity within the plastics value chain for Canada and the US, as identified by sector and value chain stage (production, collection, recycling and reuse). The red, amber, and green coloring (RAG rating) represent the degree of severity of the barrier to plastics circularity, with red representing the greatest barriers and green the least severe barriers. Barriers to circularity are grouped by plastic application: packaging, construction & demolition, automobiles, and electronics.

Table 3. Barriers to circularity (Shared conclusions for Mexico, Canada and the United States)

Sector	Country	RAG rating	Value chain stage	Barrier to circularity
Plastic packaging			Production	**Limited availability of recycled plastic**. Insufficient quality and quantity of recycled plastic for repackaging means that reliance on virgin plastic remains high. The demand for this material is greater than the supply. Insufficient quality and quantity of recyclable material and a volatile market can hamper the recycling industry and limit the production of recycled plastic. Problems with the collection of clean and recyclable plastics lead to insufficient quality and quantity.
			Production	**Limited use of recycled plastic in relation to the high use of virgin plastic**. Virgin plastics are relatively inexpensive and lightweight materials that are widely used in the manufacture of packaging. There are negative environmental and social impacts associated with the use of virgin material, which is used in increasing quantities for packaging. The use of recycled content is limited to a small number of applications and is used in relatively small quantities.
			Production	**Price volatility**. Recycled plastic prices are combined with volatile virgin plastic prices. The price volatility of recycled plastics discourages their use in manufacturing. Volatile markets make the recycling industry less attractive to potential investors. When oil prices are high, so are virgin plastic prices, and recycled plastic can be more competitive. But when virgin plastic prices drop, they can compete with recycled plastic. This, in turn, can drive down the price of secondary plastic material, making the recycling industry less profitable.
			Production	**Low recycled content in food grade packaging.** There is a challenge for the industry to increase the use of recycled content in food grade packaging. There is a lack of infrastructure that produces food grade recycled resin outside of PET bottles, as the quality of the material feeding these processors is not pure enough.

Sector	Country	RAG rating	Value chain stage	Barrier to circularity
			Collection	**Low reuse and collection for recycling**. In Canada and the United States, there are low recycling collection rates in places that lack systems that enable reuse. Some regions, often rural areas, have poor access to collection options for plastic recycling, which means that consumers are unable to recycle, even if they want to. In Canada and the United States, about 20.6 million tons of plastic packaging material is disposed of rather than recycled. In Mexico, this represents approximately 5,012 kt.
			Collection	**Plastics collected for recycling are of low quality** due to their contamination and the way in which recyclable materials are collected in Canada and the United States. Single-stream collection for households means that plastics are mixed with other recyclable materials (glass, paper) or general waste (organic, non-recyclable). These contaminants must be sorted for the plastic to be recycled, which requires investment in sorting infrastructure and, even then, generates losses when contaminants cannot be completely separated. In addition, inconsistent recycling requirements in different jurisdictions have resulted in confusion among consumers as to which items are recyclable. This inconsistency also poses challenges (e.g., creating uniform messages or labels on product packaging or waste containers) to educate consumers about proper disposal options and recycling practices.
			Recycling	**Limited data availability**. There is limited availability of data on the end-of-life treatment of plastics and the processing capabilities of facilities, which means that we lack detailed information on (a) the tonnages of different materials in circulation, whether entering the waste stream or escaping into the environment, and (b) the material flows within waste streams, including how they are ultimately processed. Without this information, knowing how and where to make improvements is a challenge.
			Recycling	**Recycling of multi-material flexible plastics is minimal**. There is a serious lack of infrastructure for sorting and processing multi-material flexible plastics, specifically infrastructure that is capable of processing plastics without causing contamination problems.

Sector	Country	RAG rating	Value chain stage	Barrier to circularity
			Recycling	**Unreliable comparisons between jurisdictions.** There is a lack of reliable data on how recycling rates compare across jurisdictions, and no consistent methodology for measuring recycling rates or recycled content in Canada, the United States and Mexico, which would be crucial for monitoring progress toward future circularity.
			Recycling	**Relatively low recycling rate of beverage containers.** The recycling rate of beverage containers is low in relation to other countries with DRS programs. DRS is not implemented in 40 of the 50 U.S. states, and DRS programs in the remaining ten states are not consistent, nor do they cover all beverage containers.
Construction and demolition			Production	Increased use of virgin plastic in construction with limited consideration of end-of-life reuse or recycling. Fossil fuel plastics, being a relatively inexpensive and lightweight material, are increasingly being used as building materials. However, there are negative environmental and social impacts associated with the use of virgin material, which is used in increasing quantities compared to recycled content plastics.
			Reuse	Low or minimal reuse of construction and demolition plastic waste. In relation to other types of plastic waste, there is difficulty in separating plastic in construction and demolition waste from other mixed materials. They also face challenges in storing used building materials for long periods of time due to their large size. It is difficult to access materials used from other construction projects due to size, project timelines and lack of knowledge about what materials are available. Finally, there are liability and material condition concerns regarding structural integrity that increase the friction regarding whether or not to reuse plastic materials in construction.
			Recycling	There is also a low recycling rate of plastics from construction and demolition waste compared to other categories of plastic waste. Plastic in construction and demolition waste is often difficult to separate from mixed materials, as noted above. In addition, such plastic is of low value compared to other materials, such as metals. The value of some plastics in construction is further reduced by the fact that they release dioxins or are deteriorated by use at the end of their useful life.

Sector	Country	RAG rating	Value chain stage	Barrier to circularity
End-of-life vehicles			Production	More and more virgin fossil fuel plastics are being used in the automotive sector. Using plastics instead of heavier materials, such as metal, can reduce the weight of vehicles and thus improve fuel efficiency and reduce emissions.
			Recycling	There is a low recycling rate of plastics in the automotive sector. It is difficult to separate some of the plastic inside the vehicles from the mixed materials. Not all vehicles are deconstructed before shredding, as it is often more cost-effective and less time-consuming to shred vehicles than to cut them up. In general, there is a minimum classification. Most of these plastics become automobile shredder waste.
Electrical and electronic equipment waste			Production	Increasingly, virgin fossil fuel plastics are being used in electronics because they are a relatively inexpensive and lightweight material.
			Production	Consumption of certain electronic products has been increasing. Some are not designed to last, but for replacement every two to three years. For some products, such as cell phones, companies provide incentives (discounts, promotions, etc.) for annual upgrades. In addition, there is limited accessibility to repair due to proprietary parts, tools, etc., which limit who or what companies can repair.
			Recycling and reuse	It is difficult to separate parts, including plastics, which would enable recycling of many electronic products. Many of these are not designed to enable easy and efficient disassembly, sorting and recycling or reuse of parts.

5. Recommendations to Increase Circularity

Table 3 presents recommendations corresponding to each barrier to circularity, resulting from the findings in the different stages and sections of the comprehensive study on plastics in Mexico. These recommendations enable it possible to point out areas of opportunity and improvement in the different components of the public and private sectors.

The identification of these barriers does not seek to issue opinions or qualifications on the facts found; its purpose is to describe those elements that provide relevant information or knowledge of the current conditions in the handling and management of plastic waste in the country.

Table 4. Summary of recommendations to increase circularity in plastic waste in Mexico

Value chain stage	Barrier to circularity	Recommendation
Handling and management of plastic waste	Inequality in cleaning systems, services offered for free and very low operating budget allocations do not enable waste management to have sufficient personnel, materials and infrastructure to achieve complete coverage in the country and fulfill its function of protecting the environment and public health.	Implement differentiated rates with application and destination in the same activity, which will provide sufficient resources for full coverage of the service, as well as maintain and update the equipment and infrastructure necessary for proper management and recovery of waste.
		Installation of collection centers by the government that bring the population closer to better disposal schemes for separated waste, including its sale to the recycling or manufacturing sector. This process will provide the government with additional financial resources for waste management (from the sale of separated waste to the private sector), offer more services to the population and free up financial resources.
		Evaluating the generation of energy from waste with thermal value will contribute to the energy matrix and will have an impact on final disposal by reducing waste, mineralizing the few waste products that are disposed of, and contributing useful materials to development.
		Implement, together with the private sector, autonomous waste management systems for municipalities with no cleaning services and with an Indigenous population, which provide the minimum infrastructure for the management of waste with potential for recovery.

Value chain stage	Barrier to circularity	Recommendation
		Enforcement of penalties for facilities that do not comply with regulations or that use improper waste disposal.
	Numerous facilities, such as sorting plants, transfer stations, final disposal sites or collection vehicles, practice good waste management, provided that such facilities comply with regulations and are properly operated and maintained. Otherwise, they are polluting and costly facilities that do not fulfill their social and environmental function.	Evaluate the disposal of waste in municipalities with sanitary landfills that comply with regulations.
		Evaluate complementary strategies, such as prohibiting the receipt of recoverable waste at the final disposal site, as well as the diversion of streams with high economic value, efficiency in collection and maintenance, and correction where there is leakage of money due to inadequate operations.
	There are municipalities with few collection centers and therefore with a saturation of recoverable plastic waste in their final disposal sites. This is the case for Mexicali, Baja California; Reynosa, Tamaulipas; Benito Juárez, Quintana Roo; Centro, Tabasco; Matamoros, Tamaulipas; Culiacán, Sinaloa, and Saltillo, Coahuila.	Call on the private sector to promote the creation of collection centers that ensure the purchase of recovered material, or that the private sector installs these collection centers. Here the government must assume the role of guarantor so that the activity is maintained in the long term.
		The installation of collection centers by the government is an alternative scheme, but the waste must be purchased by the private sector and the money reinvested in the same activity. This is a permanent strategy with no possibility of concession or loan to any private party.
		To have an updated list of individuals and companies that provide private collection services and waste collection centers. Here, close coordination between states and municipalities could create governance, complemented by schemes that inform the population of these sites and the services they offer.

Value chain stage	Barrier to circularity	Recommendation
		The medium- and long-term integration of garbage pickers into sorting plants would benefit them by receiving social security, adequate wages and better working conditions. It would provide the private sector with a labor force prepared for its work, which may even become qualified or certified. Public or private investors would be guaranteed a return on their investment, and the private sector would have better post-consumption materials. Society would benefit in terms of awareness of poverty and in social and environmental security.
	There is a partial or total lack of infrastructure for waste management in at least 150 municipalities, 86 of which have large Indigenous populations, in the states of Oaxaca, Puebla and Veracruz, with inorganic waste (plastics, glass and cardboard) as the main problem.	The implementation of strategies based on some type of containerization is valid as long as it is complemented by the periodic collection for shipment to a regional sanitary landfill, and only for the deposit of inorganic waste.
		Connectivity of the population is key to solving problems related to waste handling, waste management and waste utilization, among other things. It is essential to resolve access to remote locations or municipalities.
		Redesigned access to better recycling technologies and a domestic manufacturing industry for equipment and machinery specialized in plastics are necessary elements for the development of a sector focused on the return of waste to productive activity. Expanding the use of PS, PP and HDPE post-consumption waste is essential to address the presence of these materials in the environment. This is complemented by strategies for containerization and control of the negative effects of street food vending.

Value chain stage	Barrier to circularity	Recommendation
	Large quantities of PET bottles are recovered as post-consumption waste. However, the food sector uses other products, such as thermoformed and other injection forms with low post-consumption recovery rates; this is the case for trays, domes, cups, tableware and other disposable plastics such as HDPE, PS and PP. This occurs despite great opportunities to increase recycling rates and return of materials for the manufacture of new products.	The construction of a new sorting plant must consider the impact of garbage pickers in the value chain, since the risk of receiving waste without a high content of material for recycling makes it unfeasible. The by-products of this facility must guarantee its financial operability. This includes the production of RDF, where the greatest benefit is obtained in power generation.
		Establish the obligation for all private collection companies to carry out adequate waste management, so that materials that have material or energy value associated with plastics are extracted and the amount of waste sent to a sanitary landfill as the only valid final destination is reduced.
		E-commerce and related delivery are activities that should be regulated in the same way as those required by management plans, and with corporate responsibility schemes in accordance with current legislation.
Actors and post-consumption waste recovery	Apart from the benefits of their work, which results in cleaner waste, garbage pickers slow down the development of infrastructure and investment by the public and private sectors, such as the construction of sorting plants and sanitary landfills.	Resolving the fiscal aspects of first purchasers to garbage pickers will increase the amount of waste recovered and improve the quality of life of garbage pickers, as well as encourage waste recovery by the private sector.
		Implement social support schemes for garbage pickers to carry out their work activities, such as gloves, protective eyewear, and social security, among others.
	Collection centers, key facilities for recycling, present barriers by purchasing their raw materials without knowledge of prices and lacking either fiscal support or market support.	Establishing a generalized mechanism that shows the price of plastics in the market, as well as that of virgin or secondary raw materials, will help normalize the market and create healthy competition for materials.

Value chain stage	Barrier to circularity	Recommendation
		The installation of containers on public roads facilitates the collection of waste by garbage pickers, but they could also remain the responsibility of the collection centers or the industry concerned. Selecting the mechanism could be a matter for bidding, or it could be left to the municipal government to offer the recovered waste at a commercial price.
Market	Multi-material plastic waste is rarely recycled due to the complexity of its separation.	Promoting the use of APR guides will help identify the best recyclable plastics, thereby helping government, society and the private sector to make better decisions in the selection of raw materials.
		Addressing plastics for other applications, such as electrical and electronics, automotive or agricultural, requires evaluating the chemical compounds added to the plastics, such as antistatic, flame retardants or others, which impact recycling and reduce their potential applications.
	The private sector does not apply best practices in its operation, maintenance, raw materials, design and business activities, so its activities, although productive, are limited.	Encouraging business leaders to implement best practices, such as those identified in this study, will provide additional elements for the private sector to increase both its technical capacity and its social and environmental responsibility.
		Failure to encourage machinery production and technological development has promoted technological dependence on foreign countries and limited the industry's options.
Regulation	Management plans are the best instrument for coordination between the private sector and the government, but they are underutilized because they are unknown as an instrument for all actors (government and private). As they are voluntary, they lose their effectiveness and are limited in their scope.	The design and implementation of management plans should be done by waste stream (plastics, glass, metals, organic) or by plastic sector (agricultural, automotive, construction and demolition, health), which should have infrastructure, economic value and environmental and social interest. They should preferably be applicable across Mexico, to standardize strategies with the active participation of authorities. They are not applicable in solving environmental problems, but they can be used to improve management and promote circularity in the management of some types of waste, such as plastic.

Value chain stage	Barrier to circularity	Recommendation
		Give the sector the freedom to innovate in the actions identified in the management plans, but with conditions, such as a minimum percentage of waste recovery, or the creation of infrastructure, or product redesign activities and use of materials, among others.
		The government must show openness and support for other forms of recycling or waste recovery, such as thermal, with mandatory energy generation, raw material substitution, controlled remanufacturing and respect for intellectual property and trademarks.
		Establish a reliable, public and updated national registry of management plans and their degree of compliance as a key instrument to strengthen monitoring, oversight and transparency in waste management in Mexico. Currently, state and municipal registries are hampered by regulatory dispersion, duplications and compliance gaps, which limits traceability and hinders comprehensive evaluation of the environmental performance of obligated actors.
	The ban resulted in an obstacle for some due to their various applications, which causes inequality, inequity in the application and disaggregation of strategies. This reduces the effectiveness of environmental and social improvement actions and goals.	Transforming the sector from shared to extended responsibility requires a stronger regulatory structure and more policy instruments that enable incorporation of all actors. Micro, small, medium-sized and large generators, but also from society and government; not only the largest or most visible ones.
		The active participation of society is essential because citizens are the consumers, the holders of the waste, and the ones who have disposal options within their reach. However, this participation will only be effective if the government and the private sector guarantee access to adequate systems for the separation and differentiated disposal of plastic waste, either for recycling or for chemical or thermal recovery. It is also essential that the government apply the corresponding sanctions as established in applicable legislation or regulations.

Value chain stage	Barrier to circularity	Recommendation
	In response to local bans on single-use plastics, several states have issued their own environmental technical standards, establishing minimum recycled content rates or promoting the substitution of natural or compostable materials. This regulatory fragmentation, which generates regulatory inconsistencies and hinders harmonization with international frameworks, affects the sector's ability to demonstrate verifiable environmental compliance.	It is necessary to develop and implement a national environmental certification system that applies to plastic products, especially with post-consumption recycled content.

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

The CEC study, along with its executive summary (2024)[2], of this waste stream for Canada and the United States, include a section dedicated to barriers to plastic waste recycling. In Mexico, these barriers present significant similarities and are shared with those identified in the other two countries.

In particular, Mexico faces additional barriers, which are included in this document. Note that there are states, municipalities and large producers that can apply the recommendations proposed by Canada or the United States without neglecting the issues mentioned in the section on findings and recommendations.

The recommendations and barriers identified in the Canadian and U.S. study on plastic waste management (CEC, 2024) are presented in tables 5-8 below, preserving their original structure but adapting them to the issues that directly affect the Mexican context. In these studies, barriers to circularity are grouped by plastic use application: packaging, construction and demolition, automobiles and electronics.

The texts in the original English version of the Canada and U.S. study are presented in italics. When the content corresponds specifically to the wording applicable to Mexico as well, it is shown in italics

[2] The executive summary in English is available at: <https://www.cec.org/publications/milestone-study-on-plastics-waste-management-in-the-us-and-canada/>.

and bold type. When barriers, causes or solutions are relevant only to Mexico, the text is presented in normal font and bold.

For some barriers there are multiple possible causes, with their own suggested solutions and corresponding policy recommendations. In such cases, the following tables are structured with separate cells and color-coded for clarity. The color coding is simple: red for the two columns on the left, describing challenges and barriers to circularity, and green for the two columns on the right, describing suggested solutions.

Note that there is some repetition in the tables below because there are multiple reasons for barriers to circularity, and policy actions can serve as solutions to overcome more than one barrier. The most commonly presented policy recommendations include:

- **Extended producer responsibility (EPR).** This is an environmental policy approach in which producers assume financial responsibility for managing the packaging they place on the market at the end of its useful life. This can be used in a number of ways to promote circularity, including the introduction of collection and recycling targets, the modulation of EPR product fees to incentivize the inclusion of recycled content and design for recycling, as well as the use of EPR funds to finance investments in infrastructure, education and outreach.
- **A deposit return system (DRS).** Also called "container deposit system," "refund deposit" or "bottle bill," it charges a monetary deposit for a product, paid by the consumer at the time of purchase, which is refunded when the consumer returns the product to a designated location for reuse or recycling. Approving DRSs in jurisdictions that do not have them can help increase the volume of plastic bottles collected in the country and, therefore, improve the availability of high-quality recycling feedstock. DRS also tends to lead to better data due to better tracking of marketed products.
- **Recycled content targets** could help reorient the plastics value chain away from its historical reliance on virgin plastics and toward greater use of recycled material. They would provide a clear market signal for recyclers by creating demand and stable prices for recycled plastic. They can also be used to drive innovation aimed at overcoming the challenges presented by some difficult-to-recycle plastics, such as flexible films. A first step would be to assess the extent to which recycled content could be applied to different packaging materials and then develop ambitious but achievable targets with legislated minimum recycled content requirements to increase demand for recycled plastics.
- There are **other types of targets** beyond recycled content that can help move the plastic packaging industry toward circularity. This includes targets for plastic source reduction, reuse of single-use plastic packaging and reduction of virgin fossil-based plastics in packaging. Almost all of these objectives could be part of extended producer responsibility or introduced as separate policies, depending on the legislative context.

Table 5. Barriers to circularity and solutions in the three countries - Packaging

Barrier to circularity	Possible cause	Suggested solution	Actions for policymakers
High disposal rate of plastic packaging compared to recycling: *In Canada and the United States, due to low recycling rates, approximately 20.6 million tons of plastic packaging material is disposed of rather than recycled.* **In Mexico, approximately 5,012 kt are disposed of instead of being recycled.**	*Single-use design:* *Plastic containers, for the most part, are designed for single-use applications. The resulting plastic waste often ends up in linear pathways (i.e., not circular, not recycled or reused). This problem is aggravated by improper disposal by consumers and poor landfill management.*	*Replace single-use containers with reusable ones whenever possible. This would reduce the need for single-use packaging waste management.*	*Conduct a survey to identify where and in what contexts reuse is being used or tested (e.g., food and beverage, online shopping, delivery, packaging). Where appropriate, establish public-private partnerships to invest in reuse infrastructure (washing facilities, collection systems, etc.), zero waste packaging stores and pilot projects.*
			Investigate appropriate targets for plastic source reduction and reuse of single-use plastic containers and food service utensils. Where appropriate, establish these objectives.
			Integrate reuse requirements and funding into state EPR and deposit refund (DRS) legislation.
			Identify the types of packaging for which bans or taxes would be appropriate measures (making sure to consider the impact of substitute materials).
			Identify the types of packaging that would benefit from grant programs for reuse or refill projects.

Barrier to circularity	Possible cause	Suggested solution	Actions for policymakers
			Conduct a study to review and evaluate current reuse standards. Then, identify needs and recommend or develop standards where appropriate.
			Develop a regulation that encourages reuse while protecting liability.
Limited availability of recycled plastic: *Insufficient quality and quantity of recycled plastic for repackaging means that reliance on virgin plastic remains high. The demand for this material is greater than the supply.*	*Insufficient quality and quantity of recyclable material and a volatile market can hamper the recycling industry and limit the production of recycled plastic:* *Problems with the collection of clean and recyclable plastics lead to insufficient quality and quantity.* **In Mexico, the mixing of waste during collection results in a high loss of plastic waste with recycling potential.**	*Increase the volume and quality of recycled plastic to be turned back into packaging.*	*Consider investment and pilot projects to accelerate chemical recycling technology targeting plastic waste not suitable for physical recycling.*
			Assess where and to what extent recycled content could be applied to different packaging materials, then develop targets and legislate minimum recycled content requirements to increase demand for recycled plastics.
			Consider investment and pilot projects to accelerate chemical recycling technology targeting plastic waste not suitable for physical recycling.
		Decouple the price of recycled plastic from that of virgin plastic.	*Consider taxing virgin plastic. Review and evaluate the success of taxes on virgin plastic in other jurisdictions and assess the*

Barrier to circularity	Possible cause	Suggested solution	Actions for policymakers
			appropriateness of such taxes.
			Implement minimum recycled content requirements to increase demand for recycled plastics.
			Support proposed EPR bills that include recycled content targets and include recycled content targets in any new proposed EPR legislation.
			If possible, consider applying import tariffs to virgin fossil-based materials to improve the economic viability of domestic recycled materials.
Limited use of recycled plastic in relation to the high use of virgin plastic: *There are negative environmental and social impacts associated with the use of virgin material, which is used in increasing quantities for packaging. The use of recycled content is limited to a small number of applications and is used in relatively small quantities.*	*Recycled plastic poses more challenges compared to inexpensive virgin plastic:* *Virgin plastics are relatively inexpensive and lightweight materials that are widely used in packaging.*	*Optimize design to eliminate unnecessary volume in plastic packaging.*	*Pass legislation to reduce plastic wrap (the plastic film that covers products such as produce, meat or soft drinks, for example) by requiring that it be used only when "necessary" and reduced wherever possible.*
			Pass legislation to reduce plastic wrap (the plastic film that covers products such as produce, meat or soft drinks, for example) by requiring that it be used only when "necessary" and reduced wherever possible.
			Develop policies to encourage and enable

Barrier to circularity	Possible cause	Suggested solution	Actions for policymakers
	Volatile markets make the recycling industry less attractive to potential investors. When oil prices are high, so are virgin plastic prices, and recycled plastic can be more competitive. But when virgin plastic prices drop, they can compete with recycled plastic. This, in turn, can drive down the price of secondary plastic material and make the recycling industry less profitable.	*Increase the volume and quality of recycled plastics.*	*increased recycling activities, including improved collection and sorting.*
			Consider investment and pilot projects to accelerate chemical recycling technology to address plastic waste not suitable for physical recycling.
			Review and evaluate the success of taxes on virgin plastic in other jurisdictions and assess the appropriateness of such taxes.
			Assess where and to what extent recycled content could be applied to different packaging materials, then develop targets and legislate minimum recycled content requirements to increase demand for recycled plastics.
			Develop a Canadian, US and Mexican standard to enable cross-jurisdictional alignment in the measurement of recycled content.
			Establish targets and transitional packaging to increase the use of recycled content. This could be supported by industry standardization of recycling specifications (e.g., those

Barrier to circularity	Possible cause	Suggested solution	Actions for policymakers
			being developed by the Alliance to End Plastic Waste) and liaison with the European Committee for Standardization (ECS) on the standards they are reviewing and developing in Europe to support the European Strategy for Plastics in the Circular Economy.
		Decouple the price of recycled plastic from that of virgin plastic.	*Consider taxing virgin plastic. Review and evaluate the success of taxes on virgin plastic in other jurisdictions and assess the appropriateness of such taxes.*
			Implement minimum recycled content requirements to increase demand for recycled plastics.
			Support, in any new proposed legislation, EPR bills that include recycled content targets.
			If possible, consider applying import tariffs to virgin materials of fossil origin to improve the economic viability of domestic recycled materials.

Barrier to circularity	Possible cause	Suggested solution	Actions for policymakers
		Increase the use of sustainable, recyclable, bio-based and non-biodegradable packaging.	*Research and set targets for the reduction of virgin fossil plastics in packaging. This could be part of the EPR or separate legislation, as appropriate to the legislative context, and be done in conjunction with the recommendations of the CEC bioplastics waste and paper waste milestone studies.*
			Review and evaluate the success of taxes on virgin plastic in other jurisdictions and assess the appropriateness of such taxes.
Low quality of plastics collected for recycling due to contamination.	*Inconsistent recycling requirements in different jurisdictions:* *Inconsistent recycling requirements in different jurisdictions (even at the subnational level) have led to confusion among consumers about which items are recyclable. This inconsistency also poses challenges in creating uniform messages or labels, either on product packaging or waste containers, to educate consumers about disposal options and proper recycling practices.*	*Improve consumer recycling behavior through better education.* *Create accurate and consistent labeling.* *Harmonize or standardize the materials that can be recycled in a region or jurisdiction to mitigate consumer confusion.*	*Develop policies to encourage and improve collection rates and reduce pollution.*
			Conduct and invest in pilot projects to develop collection systems for flexible films and other plastic wastes that are historically not targeted by physical recyclers, but are a growing feedstock for chemical recycling.
			Initiate collaborative discussions on labeling consistency with stakeholders.
			Pass a federal law requiring accurate and transparent recyclability

Barrier to circularity	Possible cause	Suggested solution	Actions for policymakers
			claims on product labels (e.g., updates to the FTC Green Guides).
			Research and development to improve resin identification code (RIC) labeling to avoid confusion.
			Increase enforcement to incentivize proper recycling (e.g., fines for improper disposal).
Limited data availability: **In Mexico there is limited availability of data on the end-of-life treatment of plastics and the processing capacities of facilities, which means that we lack detailed information on the tonnages of different materials in circulation entering the waste stream versus escaping into the environment, and the material flows within waste streams, including how they are finally processed.**	*Lack of standardized waste reporting requirements:* ***Standardized and minimum waste reporting requirements are lacking in Canada, the United States and Mexico. In addition, there is a lack of incentives to report data.*** ***Also, there is often little data available on the informal sector, especially active in parts of the United States and Mexico.***	*Implement waste characterization standards in the three countries.*	*Develop guidance and potential incentives for waste reporting and guidance on conducting waste characterizations.*
		Implement extended producer responsibility.	*Encourage extended producer responsibility, whereby producers would be required to report sales and yield data.*
		Implement DRS in more areas.	*Support the enactment of DRS in more states or provinces, or nationwide. DRS generally leads to better data due to increased tracking of products placed on the market, along the waste value chain. In addition, it is necessary to ensure that DRS operates according to the same core bill of materials to increase standardization of waste management.*

Barrier to circularity	Possible cause	Suggested solution	Actions for policymakers
Minimal recycling of multi-material flexible plastics: *There is currently an almost negligible recycling rate of multi-material flexible plastics.*	***Lack of infrastructure for sorting and processing multi-material flexible plastics:*** *There is a serious lack of infrastructure to sort and process multi-material flexible plastics, specifically infrastructure that can process these materials without struggling with contamination issues.*	*Encourage source reduction through a ban on multi-material flexible plastics for packaging where a more circular alternative exists.*	*Conduct a study on which multi-material, flexible plastics are most problematic and what alternatives could be used if a ban were to be implemented.*
		Improve product design to facilitate recycling.	*Establish design requirements for flexible films that enable easier sorting and recycling (e.g., single-material flexibles).*
			Support and increase research and development grants for improved packaging design for recyclability.
		Increase infrastructure that can sort and process multi-material flexible plastics.	*Invest in technology, research and development and pilot facilities.*
			Encourage federal leadership to define chemical recycling to standardize the industry.
Low recycled content in food grade packaging: *Relative to other packaging, there is a particularly low use of recycled content in food grade packaging.*	***Lack of adequate raw materials:*** *There is a lack of infrastructure that can produce food grade recycled resin outside of PET bottles, as the quality of the material feeding these processors is not pure enough.*	*Provide guidance to industry on what technology or production methods can achieve food grade recycled content.*	*Work with industry to meet requirements for food-grade recycled content (along with bioplastics).*
		Increase the infrastructure that can create food-grade recycled resin.	*Encourage investment, pilot studies in food-grade recycling technologies.*

Barrier to circularity	Possible cause	Suggested solution	Actions for policymakers
Unreliable comparisons between jurisdictions: *Lack of clarity on how recycling rates compare between jurisdictions.*	***Lack of a consistent methodology for measuring recycling rates or recycled content:*** *There is no consistent methodology for measuring recycling rates or recycled content in Canada, the United States* ***and Mexico.***	*Publish standard guidance on how recycling rates and recycled content should be calculated in North America.*	*Initiate collaborative discussions on calculation methods for recycling rates and recycled content with actors.*

Table 6. Barriers to circularity and solutions in the three countries - Construction and demolition

Barrier to circularity	Possible cause	Suggested solution	Actions for policymakers
Increased use of virgin plastic in construction: *In Canada and the United States, increasing amounts of fossil fuel plastics are being used in building materials.* **In Mexico, all plastic used as construction material is of fossil origin.**	***Plastics are generally lower in cost than alternative building materials:*** *Plastics are a relatively inexpensive and lightweight material that is increasingly being used in construction.*	*Increase the use of plastics with recycled content instead of virgin fossil fuel plastics.*	*Invest in research and development and pilot projects focused on increasing the use of recycled content plastics in construction.*
		Increase the use of sustainable, recyclable, bio-based and non-biodegradable substitutes.	*Invest in research and development and pilot projects focused on increasing the use of bio-based plastics in construction.*
Minimal reuse of construction and demolition plastic waste: *There is low reuse of construction and demolition plastic waste relative to other types of plastic waste.*	***It is difficult to separate the plastic in construction and demolition waste from other mixed materials.***	*Encourage design for disassembly.*	*Incentivize (e.g., with tax exemptions) construction plans that incorporate end-of-life considerations into their plans.*
			Research and develop construction methods that enable easy end-of-life classification, including for plastic

Barrier to circularity	Possible cause	Suggested solution	Actions for policymakers
			components. Engage value chain stakeholders in pre-competitive collaboration to understand usage needs and end-of-life options.
		Require source separation on site.	*Establish requirements for separation at source of materials for reuse and recycling at construction and demolition sites.*
	***Difficult to store** building materials used for long periods of time due to their large size.*	*Increase storage of construction materials.*	*Provide grants for local building resource reuse centers, which store and sell used building materials, to enable storage and reuse.*
	***It is difficult to access used materials from other construction** projects due to size, project timelines and lack of knowledge about available materials.*	*Facilitate connection and accessibility to reusable plastic materials to encourage adaptive reuse.*	*Support and invest in reuse networks that provide a centralized online database of what materials are available, their status and location.* **In Mexico, consider construction industry management plans and local regulations for construction and demolition waste recycling.**
	***Potential liability or material condition concerns** in relation to structural integrity, which increases friction over reusing plastic materials in construction.*	*Create a standard or verification system that gives the industry confidence in the reuse of plastic material.* **In Mexico, consider construction and demolition waste, and local regulations for recycling of debris.**	*Clarify: 1) materials testing standards for reuse, and 2) accountability around the use of second-hand materials in construction.*

Barrier to circularity	Possible cause	Suggested solution	Actions for policymakers
Low recycling rate of plastics from construction and demolition waste *compared to other categories of plastic waste.*	***Difficult to separate for recycling:*** *Plastic in construction and demolition waste is often difficult to separate from mixed materials.*	*Encourage design that facilitates disassembly and, therefore, separation of waste into specific material streams.*	*Incentivize (e.g., with tax exemptions) construction plans that incorporate end-of-life considerations in their plans.*
			Provide grants for research and development of construction methods that enable easy end-of-life classification, including plastic components.
	Lower value of plastic materials: *Plastic has little value compared to other materials, such as metals. Some plastics further reduce their value in construction because they release dioxins or appear deteriorated by use at the end of their useful life.*	*It requires on-site source separation of materials, which reduces sorting loss rates and increases the quality of the waste stream, i.e., less material is lost to contamination.*	*Establish requirements for source separation of materials for reuse and recycling at construction and demolition sites.*
		Increase the demand and price of recycled plastic in the construction industry.	*Establish minimum recycled content requirements to increase demand for recycled plastics.*
			Conduct a study to examine alternatives to toxins used in construction that reduce the end-of-life value of plastic used in construction and demolition.
			Establish minimum recycled content requirements to increase demand for recycled plastics.

Table 7. Barriers to circularity and solutions in the three countries - Automotive

Barrier to circularity	Possible cause	Suggested solution	Actions for policymakers
Increased use of virgin fossil fuel plastics *in the automotive sector.*	***Plastics are lightweight, which improves fuel efficiency:*** *Heavy materials, such as metal, increase the weight of vehicles. Replacing them with plastics can improve fuel efficiency and reduce emissions.*	*Increase the use of plastics with recycled content instead of virgin fossil fuel plastics.*	*Incentivize (e.g., with tax exemptions) the design of automobiles that meet recycled content requirements.*
			Offer grants for research and development for designs that include recycled plastics in the manufacture of automobiles.
		Increase the use of sustainable, recyclable, bio-based and non-biodegradable substitutes.	*Incentivize (e.g., with tax exemptions) the design of automobiles that meet bio-based targets.*
			Offer grants for research and development in the use of bio-based plastics in automotive manufacturing.
	Increase in individual car ownership: *A secondary concern is the increasing number of vehicles in Canada, the United States and Mexico due to increasing private car ownership.*	*Improve public transportation to reduce dependence on private car production and ownership, which will reduce materials (including plastic) used in the automotive industry.*	*Invest in the expansion and improvement of public transportation systems.*
		Support the collaborative vehicle economy in order to reduce private car ownership and production, which will also reduce materials (including plastic) used in the automotive industry.	*Implement pass-through policies (e.g., with tax exemptions) that support carpooling, ridesharing, etc. (e.g., cabs, Uber, DiDi).*

Barrier to circularity	Possible cause	Suggested solution	Actions for policymakers
Low recycling rate *of plastics in the automotive sector.*	*It is difficult to separate some of the plastic inside the vehicles from the mixed materials.*	*Designing for deconstruction.*	*Incentivize (e.g., with tax exemptions) the design of automobiles that incorporate end-of-life considerations.*
			Offer grants for research and development in design for deconstruction improvements.
	Costs associated with deconstruction: *Not all vehicles are deconstructed prior to shredding, as it is often more cost effective and less labor intensive to shred vehicles instead of breaking them down.*	*Increase access to deconstruction locations prior to shredding.*	*Investigate capacity and needs for deconstruction facilities and infrastructure for end-of-life vehicles.*
	Sorting is minimal: *most of it becomes waste from car shredders.*	*Improving plastic recovery from automotive shredder waste.*	*Investigate (e.g., possible use of existing technology or development of new technologies and trials) how to improve the recovery of plastics from automotive shredder waste.*

Table 8. Barriers to circularity and solutions in the three countries - Electronics

Barrier to circularity	Possible cause	Suggested solution	Actions for policymakers
Increased use of virgin fossil fuel-based plastics *in electronics.*	***Plastics are relatively inexpensive and lightweight:***	*Increase the use of plastics with recycled content instead of virgin fossil fuel plastics.*	*Incentivize (e.g., with tax exemptions) electronic products that meet recycled content requirements.*

Barrier to circularity	Possible cause	Suggested solution	Actions for policymakers
	Plastics are a relatively inexpensive and lightweight material used in many types of electronic products.		*Offer grants for research and development in design using recycled plastics in the manufacture of electronic products.*
		Increase the use of sustainable, recyclable, bio-based and non-biodegradable substitutes.	*Incentivize (e.g., with tax exemptions) electronic products that meet bio-based objectives.*
			Offer grants for research and development in the use of bio-based plastics in electronics.
***Increased frequency of consumption** of certain electronic devices.*	***Short useful life of product:*** *Some electronic devices are not designed to last a long time, but to be replaced every two to three years.* *For some products, such as cellular phones, producers encourage annual upgrades (with, for example, discounts, promotions, etc.).*	*Design products with a longer service life that enables reuse and reconditioning.*	*Offer grants for research and development in electronic design for longer service life and repairability.*
			Prohibit designed obsolescence for certain products.
		Limit unnecessary upgrades and similar promotions.	*Conduct or commission a study on the impacts of promotions and incentives around unnecessary electronics upgrades.*
	Barriers to repair: *Inaccessible repair due to proprietary parts, tools, etc., that limit who or what organizations can make repairs.*	*Increase convenient and affordable access to repair.*	*Pass and support right-to-repair legislation (states that consumers and independent repair providers have the right to obtain manuals, diagrams, diagnostics and parts from OEMs for the repair of their own devices).*
***Difficult to separate parts,** including plastics, for many electronic products.*	***Not designed for recycling:***	*Increase the efficiency of electronic waste sorting.*	*Provide grants for research and development in sorting technology that improves sorting speed and efficiency and repairability or reusability.*

Barrier to circularity	Possible cause	Suggested solution	Actions for policymakers
	Many electronic products are not designed to enable easy and efficient disassembly, sorting and recycling or reuse of parts.		*Incentivize (e.g., with tax exemptions) electronic products that incorporate end-of-life considerations.*
			Conduct a study to identify incentives and policies to increase the reuse of second-hand material parts in reconditioned equipment.

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