PLASTIC LIFECYCLE ASSESSMENT CALCULATOR FOR THE ENVIRONMENT AND SOCIETY (PLACES) LATIN AMERICA AND THE CARIBBEAN

LIFE CYCLE ASSESSMENT METHODOLOGY AND RESULTS
OCTOBER 2025

Background

The Circulate Initiative, in collaboration with the Center for Life Cycle Analysis and Sustainable Design (CADIS), has evaluated the energy consumption, greenhouse gas (GHG) emissions, and water consumption of plastic waste management practices in the following Latin American and the Caribbean (LAC) countries:

- Brazil
- Colombia
- Dominican Republic
- Mexico

We selected these four countries to represent the region, given the diversity of contexts in each country, for example, the differing mix of plastic waste management methods. We may include other LAC countries in future iterations of the Plastic Lifecycle Assessment Calculator for the Environment and Society (PLACES).

This evaluation builds on previous analysis in PLACES, which covered various countries in South and Southeast Asia. PLACES addresses the end of life (EOL) of plastic waste (i.e., post-consumer waste) and does not cover the full life cycle of plastics.

This methodology and results document provides details on the research approach, assumptions, and results from the life cycle assessment (LCA) study that forms the basis for the calculator. In developing PLACES, The Circulate Initiative used an LCA methodology that adheres to ISO 140401/140442 guidelines.

This document is organized into the following sections:

- Goal and Scope
- Life Cycle Inventory Analysis
- Results
- Interpretation

Goal and Scope

The goal of PLACES is to quantify the environmental impacts of plastic waste EOL fates in Brazil, Colombia, the Dominican Republic, and Mexico. The results from the analysis can help stakeholders understand the relative environmental impacts of different EOL fates and make informed decisions on plastic waste management.

The plastic waste types covered in this study are:

- High-density polyethylene (HDPE)
- Low-density polyethylene (LDPE)

- Polypropylene (PP)
- Polyethylene terephthalate (PET)

These four types account for most of the plastic waste in each country. In addition, we use a “generic” plastic waste category to account for mixed plastic materials. As a result, all plastic waste materials are considered in this study. The scope of this study includes downstream plastic waste treatment, from plastic waste generation to disposal or processing. This includes the collection of plastic waste and processing of plastic waste.

We evaluated the following indicators as they represent key environmental impacts in the management of plastic waste:

- **Energy consumption:** the total amount of energy used for each EOL fate, for example, the electricity used to operate recycling machinery. This includes energy sourced from both renewable and non-renewable energy sources. Energy consumption is expressed in megajoules (MJ).
- **Greenhouse gas (GHG) emissions:** the GHG emissions resulting from each EOL fate, for example, emissions from the open burning of plastic waste and fugitive methane emissions from landfills. This includes emissions from energy consumption and transportation during processing activities. We include all GHG emissions, and express this indicator as carbon dioxide equivalent (CO_2e).
- **Water consumption:** the amount of water consumed, evaporated, incorporated in products, or otherwise removed from natural availability based on each EOL fate. Water consumption is expressed in cubic meters (m^3).

For recycling, we factor in displaced primary plastic production, and thus the energy, GHG emissions, and water results reflect the EOL impacts less the savings from displaced production.

The indicators for each EOL fate are derived from Ecoinvent (v3.11) based on the following models:

- **GHG emissions:** Intergovernmental Panel on Climate Change (IPCC) 2021 model (climate change, GWP100),
- **Energy consumption:** Cumulative Energy Demand model,
- **Water consumption:** midpoint impact category from ReCiPe 2016 V1.03 (water use).[1]

[1] Ecoinvent Association – *Ecoinvent Database v3.11*.

Assumptions

We made the following assumptions in our analysis:

Country	Plastic Waste End of Life	Transportation
Brazil	• Formal and informal collection[2] rates of total recycled plastic are assumed to be 20% and 80%, respectively. All informally collected plastic is recycled.[3] • Open burning of plastic waste does not result in any solid plastics being leaked into the environment.[4] • The EOL fates for recycling rejects are weighted to the three other EOL fates (sanitary landfills, open dumps, and open burning).	• Local transport distance between collection (formal and informal) and recycling plants is 5.75 kilometers (km). Estimated based on the average transport distances from the Colombia and Mexico models. • Local transport distance between collection and sanitary landfills is 50 km. Estimated based on waste transport routes in Brazil. • While import volumes are negligible relative to domestic plastic waste, the transport distance (3,647 km) between Brazil and the top eight plastic waste import partners, including Mexico and the Dominican Republic, is taken as the average distance traveled by plastic waste imports.[5] Plastic waste is shipped from the largest port in each country (based on the cargo volume handled) in the year of reference.[6] Sea transport is assumed. • No transport is involved for uncollected waste.
Colombia	• All informally collected plastic waste goes to recycling. • Open burning of plastic waste does not result in any solid plastics being leaked into the environment.[7]	• Local transport distances between collection by the formal sector and sanitary landfills, and between collection by the formal sector and open dumps, are both 53.5 km.[8]

[2] Formal collection typically refers to municipal waste collection and collection by waste collector associations and cooperatives, whereas informal collection typically refers to waste collected by informal waste sector workers.
[3] Gabriel Ruske, Ecocircle Brazil, interview *(2025)*.
[4] Associação Brasileira de Resíduos e Meio Ambiente (ABREMA) – *Panorama Dos Resíduos Sólidos No Brasil (2024).*
[5] HUB Residuos sólidos y Economía Circular – *Importaciones y exportaciones de residuos sólidos y materias primas secundarias (2021a).*
[6] World Shipping Council – *The Top 50 Container Ports (n.d.).*
[7] Gobierno de Colombia – *Hoy no se habla de basura, sino de residuos que son insumos para productos: Minambiente. Ambiente (2022a).*
[8] Tecorralco, B. A. L. – *Análisis de ciclo de vida de cubrebocas reutilizables y de un solo uso. UAM, Universidad Autónoma Metropolitana (2023).*

Country	Plastic Waste End of Life	Transportation
	• The EOL fates for recycling rejects are weighted to the three other EOL fates.	• The transport distance (3,162 km) between the top plastic waste import partner, Mexico, and Colombia is taken as the average distance traveled by plastic waste imports.[9] Plastic waste is shipped from the largest port in each country (based on the cargo volume handled) in the year of reference – Puerto de Manzanillo in Mexico and Puerto de Buenaventura in Colombia, respectively.[10] • No transport is involved for uncollected waste.
Dominican Republic	• All informally collected plastic waste goes to recycling.[11] • Open burning of plastic waste does not result in any solid plastics being leaked into the environment.[12] • The EOL fates for recycling rejects are weighted to the three other EOL fates.	• Local transport distance between collection (formal and informal) and recycling is 8.79 km. Estimated based on the weighted distance of main recycling companies in each region and the percentage of recycling companies in each region.[13] • Local transport distance between collection by the formal sector and sanitary landfills is 15.3 km. Estimated based on the average distance of disposal sites from main cities.[14] • Local transport distance between collection by formal sector and open dumps is 15.3 km.[15] • While import volumes are negligible relative to domestic plastic waste, the transport distance (8,562 km) between the top plastic waste import partner, USA (97% of imports), and the Dominican Republic is taken as the average distance traveled by plastic waste imports.[16] Plastic waste is

[9] HUB Residuos sólidos y Economía Circular – *Importaciones y exportaciones de residuos sólidos y materias primas secundarias (2021).*
[10] World Shipping Council – *The Top 50 Container Ports (n.d.).*
[11] Banco Interamericano de Desarrollo (BID) – *Mapa de Ruta Para Los Residuos de Envases y Embalajes de Plástico En La República Dominicana. ODS 9 (2020).*
[12] Yvelisse Pérez, Head of Solid Waste Management, Ministry of the Environment, Dominican Republic, interview *(2025).*
[13] Alegre, M., and Torrens, L. – *Diagnóstico nacional de residuos sólidos en la República Dominicana. Versión borrador final (2022).*
[14] Yvelisse Pérez, Head of Solid Waste Management, Ministry of the Environment, Dominican Republic, interview *(2025).*
[15] Ibid.
[16] HUB Residuos sólidos y Economía Circular – *Importaciones y exportaciones de residuos sólidos y materias primas secundarias (2021).*

Country	Plastic Waste End of Life	Transportation
		shipped from the largest port in each country (based on the cargo volume handled) in the year of reference – Los Angeles in the USA and Santo Domingo in the Dominican Republic, respectively.[17] Sea transport is assumed. ‣ No transport is involved for uncollected waste.
Mexico	‣ All informally collected plastic goes to recycling. ‣ 4.3% of plastic waste is sent to disposal sites without basic sanitary landfill characteristics. Thus, it is assumed that this proportion of plastics is sent to open dumps. ‣ Open burning of plastic waste does not result in any solid plastics being leaked into the environment. ‣ The EOL fates for recycling rejects are weighted to the three other EOL fates.	‣ Local transport distances between collection (formal and informal) and recycling and sanitary landfills are both 59 km.[18] ‣ No transport is involved for uncollected waste. ‣ There was no imported plastic waste in the reference year.

Recycling of plastic waste is assumed to displace the production of primary plastic in all four countries; that is, the recycled resin is used to make new plastic packaging, avoiding the need to use virgin material. We assumed the following replacement ratios:

- 95% for PET
- 91% for HDPE and LDPE
- 83% for PP[19]
- and 50% for other plastics.

[17] World Shipping Council – *The Top 50 Container Ports (n.d.).*
[18] Tecorralco, B. A. L. – *Análisis de ciclo de vida de cubrebocas reutilizables y de un solo uso. UAM, Universidad Autónoma Metropolitana (2023).*
[19] Faraca, G., Martinez-Sanchez, V., and Astrup, T. F. – *Environmental life cycle cost assessment: Recycling of hard plastic waste collected at Danish recycling centres (2019).*

System Boundaries

There are four EOL fates for each country:

- **Recycling:** plastic waste collected, processed, and reintroduced into the production cycle as raw material, displacing primary plastic production. PLACES covers mechanical recycling.
- **Sanitary landfill:** plastic waste disposed of in a dedicated location, lined with barriers to prevent contamination of the surrounding landscape.
- **Open dumps:** plastic waste that is discarded in unmanaged sites without environmental safeguards. This also includes unsanitary landfills.
- **Open burning:** plastic waste that is burned in uncontrolled conditions.

We classify open dumps and open burning as mismanaged plastic waste for the purposes of our analysis.

Below, we provide the system boundaries for each country. The system boundaries constructed were peer reviewed by local country experts in plastics, waste management, and the circular economy. Our analysis is limited by data availability on material flows, though this can be updated at a later date when more reliable data is available.

Figure 1. System boundary: Brazil

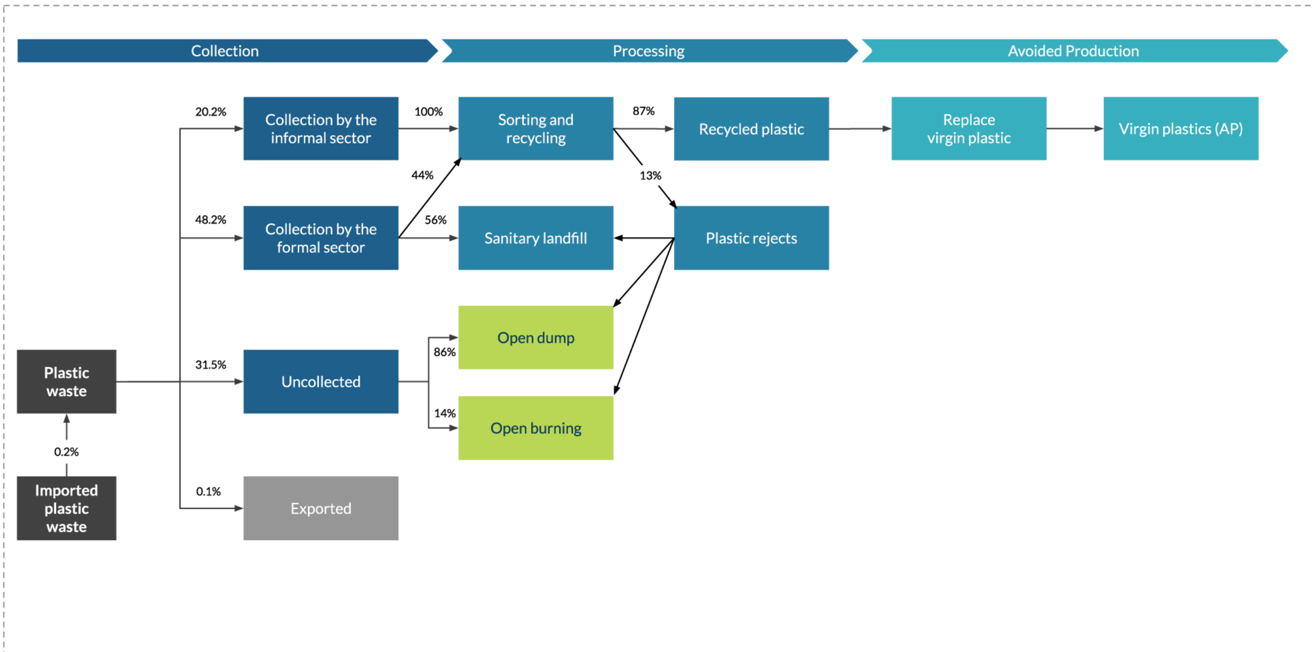


Figure 2. System boundary: Colombia

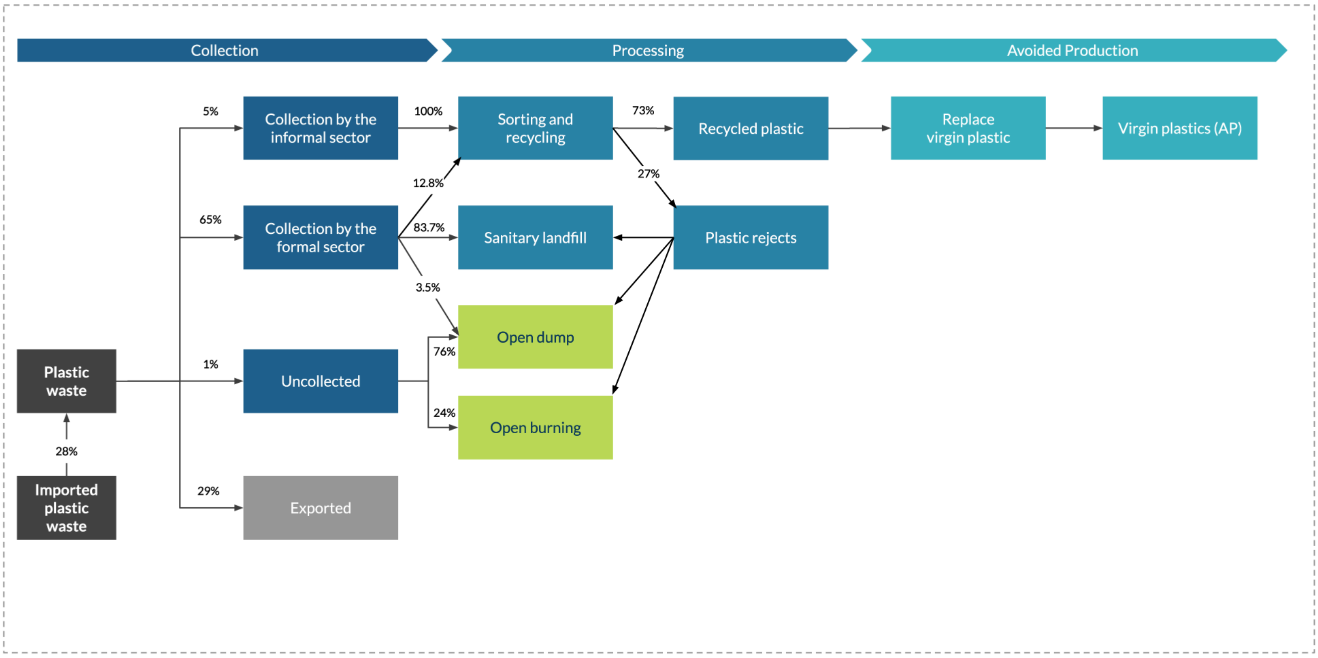


Figure 3. System boundary: Dominican Republic

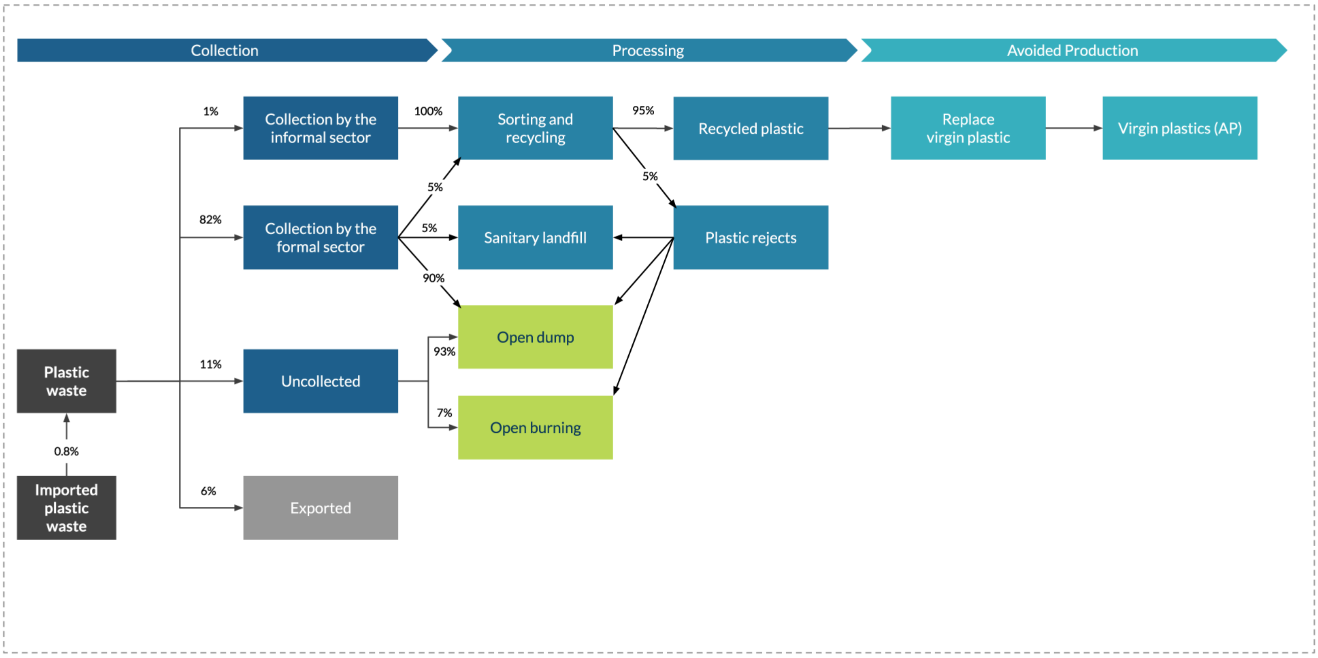
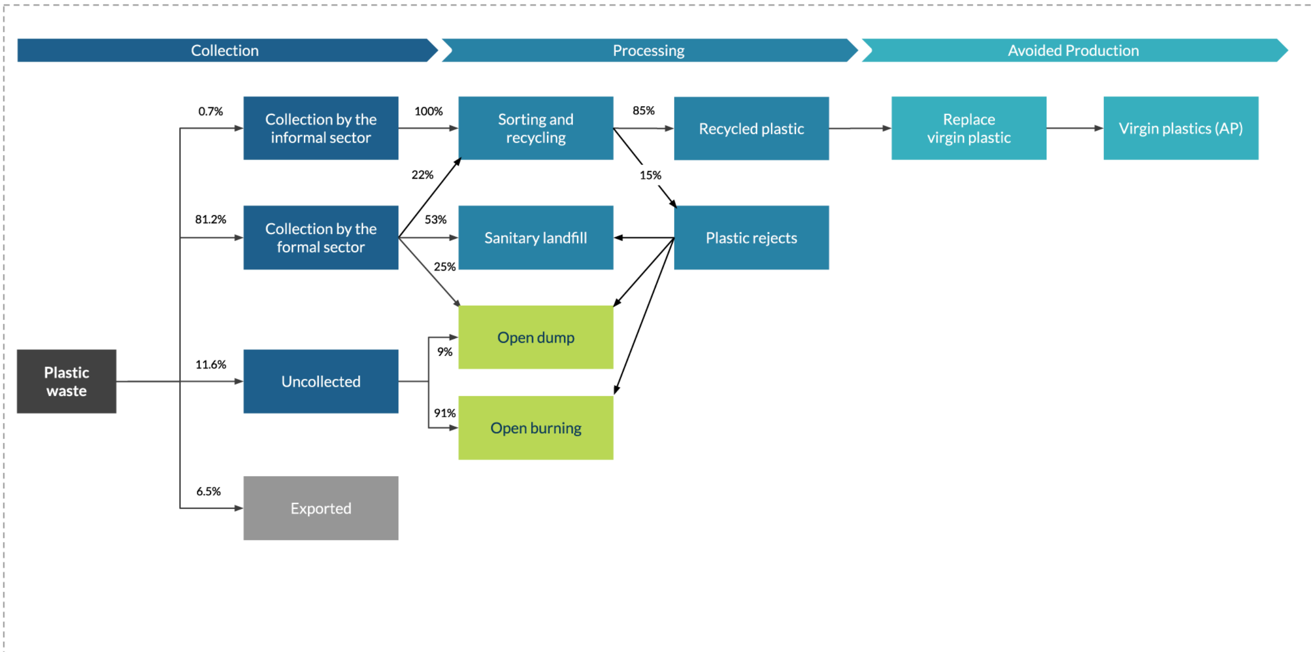


Figure 4. System boundary: Mexico



Life Cycle Inventory Analysis

We compiled data relating to plastic waste generation and EOL fates from what we deemed to be the best available sources, including governmental and non-governmental organizations and consultations with various industry experts.

In Table 1, we share the EOL fates for plastic waste in each of the four countries.

Table 1. EOL fates for plastic waste, by country

Country	Recycling	Sanitary Landfill	Open Dump	Open Burning
Brazil	21.0%	43.4%	30.7%	4.9%
Colombia	13.3%	70.9%	15.3%	0.5%
Dominican Republic	5.7%	4.1%	89.4%	0.8%
Mexico	15.7%	47.4%	25.2%	11.6%

In Tables 2 to 5 below, we share the total amount of plastic waste generated in each country, broken down by polymer type, and the amount of each polymer type that is recycled.

Table 2. Plastic waste generated and recycled, Brazil

Polymer type	Plastic waste (mn tonnes)[20]	% plastic waste recycled[21]
PP	0.86	16%
HDPE	0.86	18%

[20] Instituto Pragma - *Anuario Del Reciclagem (2022).*
[21] Associação Brasileira da Indústria do Plástico (ABIPLAST) - *As Indústrias de Transformação e Reciclagem de Plástico No Brasil (2023).*

Polymer type	Plastic waste (mn tonnes)[20]	% plastic waste recycled[21]
LDPE	1.18	13%
PET	1.35	34%
Other	0.08	6%
Total	**4.33**	

Table 3. Plastic waste generated and recycled, Colombia

Polymer type	Plastic waste (mn tonnes)[22]	% plastic waste recycled[23]
PP	0.46	6%
HDPE	0.34	15%
LDPE	0.48	6%
PET	0.27	25%
Other	0.87	6%
Total	**2.42**	

Table 4. Plastic waste generated and recycled, Dominican Republic

Polymer type	Plastic waste (mn tonnes)[24]	% plastic waste recycled[25]
PP	0.03	2%
HDPE	0.05	6%
LDPE	0.05	3%
PET	0.04	15%
Other	0.08	2%
Total	**0.26**	

Table 5. Plastic waste generated and recycled, Mexico

Polymer type	Plastic waste (mn tonnes)[26]	% plastic waste recycled[27]
PP	0.76	11%
HDPE	1.27	27%
LDPE	0.83	8%
PET	0.42	10%
Other	2.42	12%
Total	**5.70**	

[22] Brooks, A., Jambeck, J., and Mozo-Reyes, E - *Plastic Waste Management and Leakage in Latin America and the Caribbean (2020).*
[23] HUB, Residuos sólidos y Economía Circular - *Impulsando la transición hacia la digitalización y la economía circular en América Latina y el Caribe (2021b).*
[24] Banco Interamericano de Desarrollo (BID) - *Mapa de Ruta Para Los Residuos de Envases y Embalajes de Plástico En La República Dominicana. ODS 9 (2020).*
[25] Serviguide Dominicana - *Diagnóstico de las Cadenas de Producción, Importación y Comercialización de Envases y Embalajes y Materiales de la Construcción para Identificar Oportunidades hacia la Economía Circular (Extender, Reusar y/o Reintroducir Residuos) (2018).*
[26] Asociación Nacional de la Industria Química, A.C. (ANIQ) - *Perspectiva de Los Residuos Plásticos En Ciudad de México (2023)*; Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) - *Diagnóstico Básico Para La Gestión Integral de Los Residuos (2020).*
[27] Asociación Nacional de Industrias del Plástico, A.C. (ANIPAC) - *2° Estudio Cuantitativo de La Industria Del Reciclaje de Plásticos En México (2023).*

In Tables 6 to 8, we show the environmental impacts of each EOL fate on a per kilogram basis. These figures form the basis for calculating total energy consumption, GHG emissions, and water consumption for each EOL fate across the four countries. The recycling columns show two values: the number on the right (in parentheses) represents the amount of energy, GHG emissions, and water associated with transporting and processing plastic waste for recycling, while the number on the left represents the reduction in energy, GHG emissions, and water from displacing primary production of plastic. Adding these two figures together results in a net impact figure for recycling in each country. To illustrate, in Brazil, transporting and processing 1 kg of plastic emits 0.51 kg CO_2e, and recycling that same 1 kg reduces GHG emissions by 2.97 kg CO_2e through avoided production.

Table 6. Energy consumption for each EOL fate (MJ per kg plastic waste)

Country	Recycling	Sanitary Landfill	Open Dump	Open Burning
Brazil	-72.6 (6.81)	2.06	0.08	0.03
Colombia	-61.88 (6.1)	0.92	0.71	0.03
Dominican Republic	-65.09 (3.01)	1.05	0.82	0.02
Mexico	-62.79 (6.69)	0.93	0.69	0.00
Average[28]	-65.59 (5.65)	1.24	0.58	0.02

Table 7. GHG emissions for each EOL fate (kg CO_2e per kg plastic waste)

Country	Recycling	Sanitary Landfill	Open Dump	Open Burning
Brazil	-2.97 (0.51)	0.24	0.13	2.77
Colombia	-2.58 (0.49)	0.15	0.18	2.73
Dominican Republic	-2.87 (0.31)	0.16	0.19	2.75
Mexico	-2.88 (0.51)	0.15	0.18	2.74
Average[29]	-2.83 (0.46)	0.18	0.17	2.75

Table 8. Water consumption for each EOL fate (m^3 per kg plastic waste)

Country	Recycling	Sanitary Landfill	Open Dump	Open Burning
Brazil	-0.73 (0.08)	0.01	0.0001	0.00
Colombia	-1.15 (0.07)	0.01	0.001	0.00
Dominican Republic	-1.2 (0.01)	0.01	0.001	0.00
Mexico	-1.43 (0.07)	0.01	0.001	0.00
Average[30]	-1.13 (0.06)	0.01	0.001	0.00

To interpret the results from the LCA study, we consider two LCA system models: attributional LCA (ALCA)[31] and consequential LCA (CLCA). However, PLACES mainly focuses on results based on the CLCA model. CLCA allows users to understand the change in environmental impact as a consequence of the change in technology mix. For the four LAC countries, this primarily refers to the avoided emissions from displacing primary production of plastics.

[28] Linear average across the four countries.
[29] Ibid.
[30] Ibid.
[31] ALCA studies the portion of environmental impact that should be attributed to a specific technology and is aligned with the GHG Protocol.

Results

In Tables 9 through 12, we present the total environmental impacts of managing plastic waste in each country. We include the amount of plastic going to each EOL fate in parentheses.

Table 9. Brazil

EOL fate	Energy (million MJ)	GHG emissions (thousand tonnes CO_2e)	Water consumption (thousand m^3)
Recycling (21%)	-65,853 (6,179)	-2,694 (462)	-664,414 (72,388)
Sanitary Landfill (43%)	3,869	448	22,039
Open Dump (31%)	109	175	78
Open Burning (5%)	6	587	2.4
Total	**-55,690**	**-1,021**	**-569,906**

Table 10. Colombia

EOL fate	Energy (million MJ)	GHG emissions (thousand tonnes CO_2e)	Water consumption (thousand m^3)
Recycling (13%)	-14,172 (1,396)	-592 (112)	-262,900 (14,918)
Sanitary Landfill (71%)	1,120	186	13,032
Open Dump (15%)	186	46	163
Open Burning (<1%)	0.25	22	0.09
Total	**-11,470**	**-226**	**-234,787**

Table 11. Dominican Republic

EOL fate	Energy (million MJ)	GHG emissions (thousand tonnes CO_2e)	Water consumption (thousand m^3)
Recycling (6%)	-891 (41)	-39 (4)	-16,501 (115)
Sanitary Landfill (4%)	10	2	107
Open Dump (89%)	176	40	157
Open Burning (<1%)	0.04	5	0
Total	**-664**	**12**	**-16,123**

Table 12. Mexico

EOL fate	Energy (million MJ)	GHG emissions (thousand tonnes CO_2e)	Water consumption (thousand m^3)
Recycling (16%)	-52,740 (5,618)	-2,420 (432)	-1,198,021 (61,833)
Sanitary Landfill (47%)	2,357	390	27,257
Open Dump (25%)	936	237	846
Open Burning (12%)	0	1,698	0
Total	**-43,829**	**338**	**-1,108,086**

Interpretation

Open burning is a significant contributor to GHG emissions from managing plastic waste at end of life. It generates 15 times more GHG emissions per kg than sanitary landfills and open dumps, and is six times more GHG intensive than transportation and processing for recycling. Factoring in displaced primary production, open burning still results in more GHG emissions per kg than recycling, as shown in Table 13 below.

Table 13. GHG emissions, kg CO_2e per kg plastic managed[32]

	Sanitary Landfill	0.18
	Open Dump	0.17
	Open Burning	2.75
	Recycling	-2.37

Given the emissions intensity of open burning, this EOL pathway results in a disproportionate share of total GHG emissions for plastic waste management in each country. Considering the GHG emissions for the EOL processes alone (i.e., excluding the GHG emissions reductions from displaced primary production), the 5% of plastic that is subject to open burning in Brazil accounts for 42% of emissions, while in Mexico, the 12% subject to open burning accounts for 66% of emissions (Table 14).

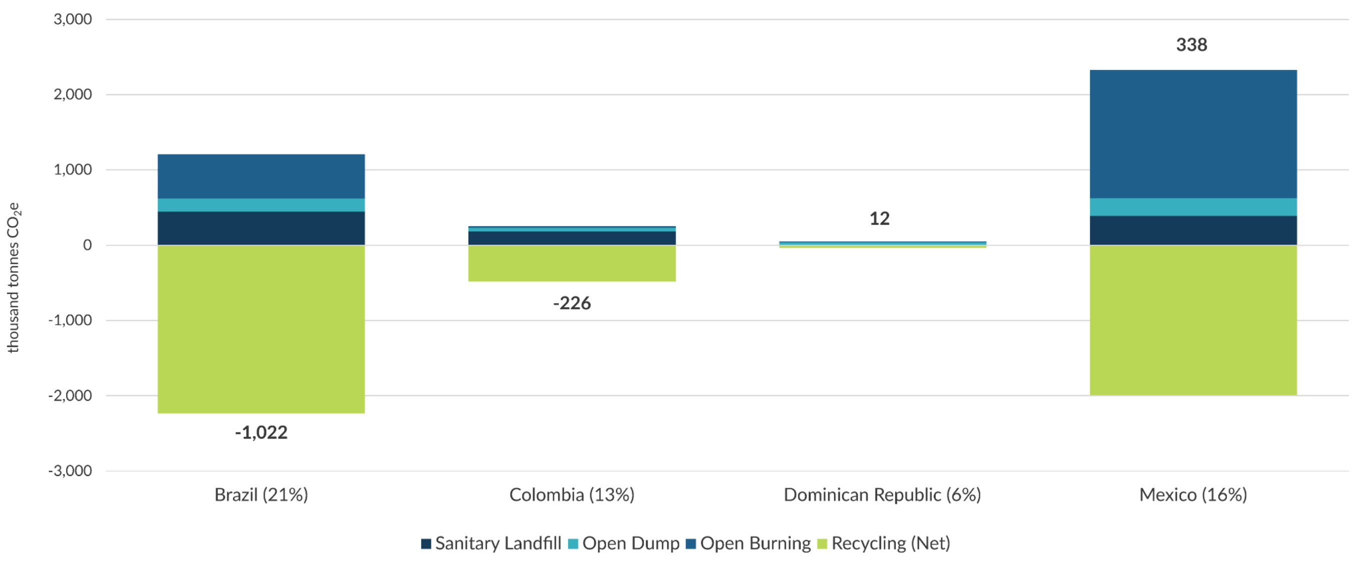
Table 14. Contribution of open burning to GHG emissions (not including displaced emissions)

Country	% of Plastic Waste, Open Burning	GHG Emissions from Open Burning, % of all EOL Emissions
	4.9%	41.6%
	0.5%	8.6%
	0.8%	14.6%
	11.6%	66%

[32] The figures shown are the linear average across the four countries. For recycling, 0.46 kg CO_2e represents emissions from transportation and processing of recyclables, while -2.83 kg CO_2e represents the reduced emissions from displaced primary plastic production.

In Brazil and Colombia, with recycling rates of 21% and 13% respectively, recycling contributes to a net reduction in GHG emissions on an absolute basis. GHG emissions are essentially flat in the Dominican Republic, while they are positive in Mexico, the latter driven by a relatively low recycling rate (16%) and relatively high open burning rate (12%). Figure 5 shows this breakdown.

Figure 5. Net GHG emissions per country



Recycling rates in parentheses
Data labels refer to the overall net emissions

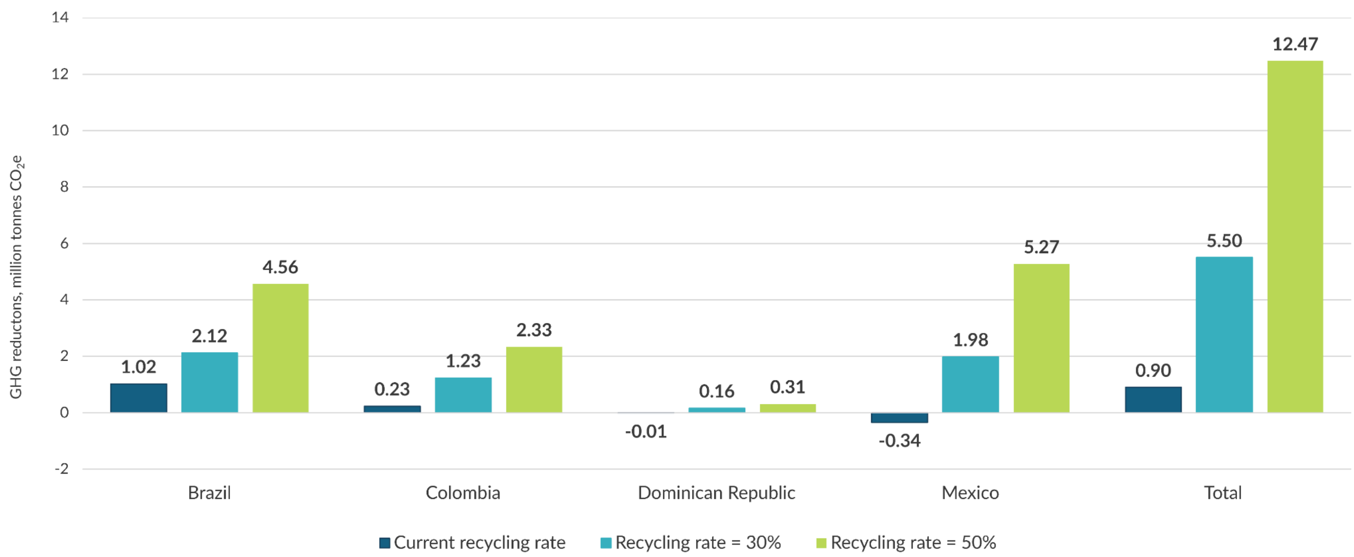
Increasing recycling rates, even modestly, would have significant environmental benefits. Currently, across the four countries, EOL management of plastic waste reduces GHG emissions by 0.9 million tonnes. Increasing the recycling rate to 30% in each country would reduce emissions by 5.5 million tonnes per year, and at 50% the reduction would be 12.5 million tonnes CO_2e. This assumes that the increase in recycling rates is offset equally by reductions in the other EOL fates.

Table 15. GHG emissions reductions from increasing recycling to 30% and 50%[33]

		Total GHG emissions, all EOL fates (million tonnes CO_2e)		
	Current recycling rate	Current recycling rate	Recycling rate = 30%	Recycling rate = 50%
Brazil	21.0%	-1.02	-2.12	-4.56
Colombia	13.3%	-0.23	-1.23	-2.33
Dominican Republic	5.7%	0.01	-0.16	-0.31
Mexico	15.7%	0.34	-1.98	-5.27
Total		**-0.9**	**-5.5**	**-12.5**

[33] In this table, reductions are expressed in negative numbers, for example, currently in Brazil, EOL management of plastic waste results in a reduction of 1.02 million tonnes CO_2e (due to recycling).

Figure 6. GHG emissions reductions from recycling, all countries[34]



For a full list of sources consulted for the LCA study, please click this link.

[34] In this chart, GHG reductions are framed as savings, thus positive numbers.