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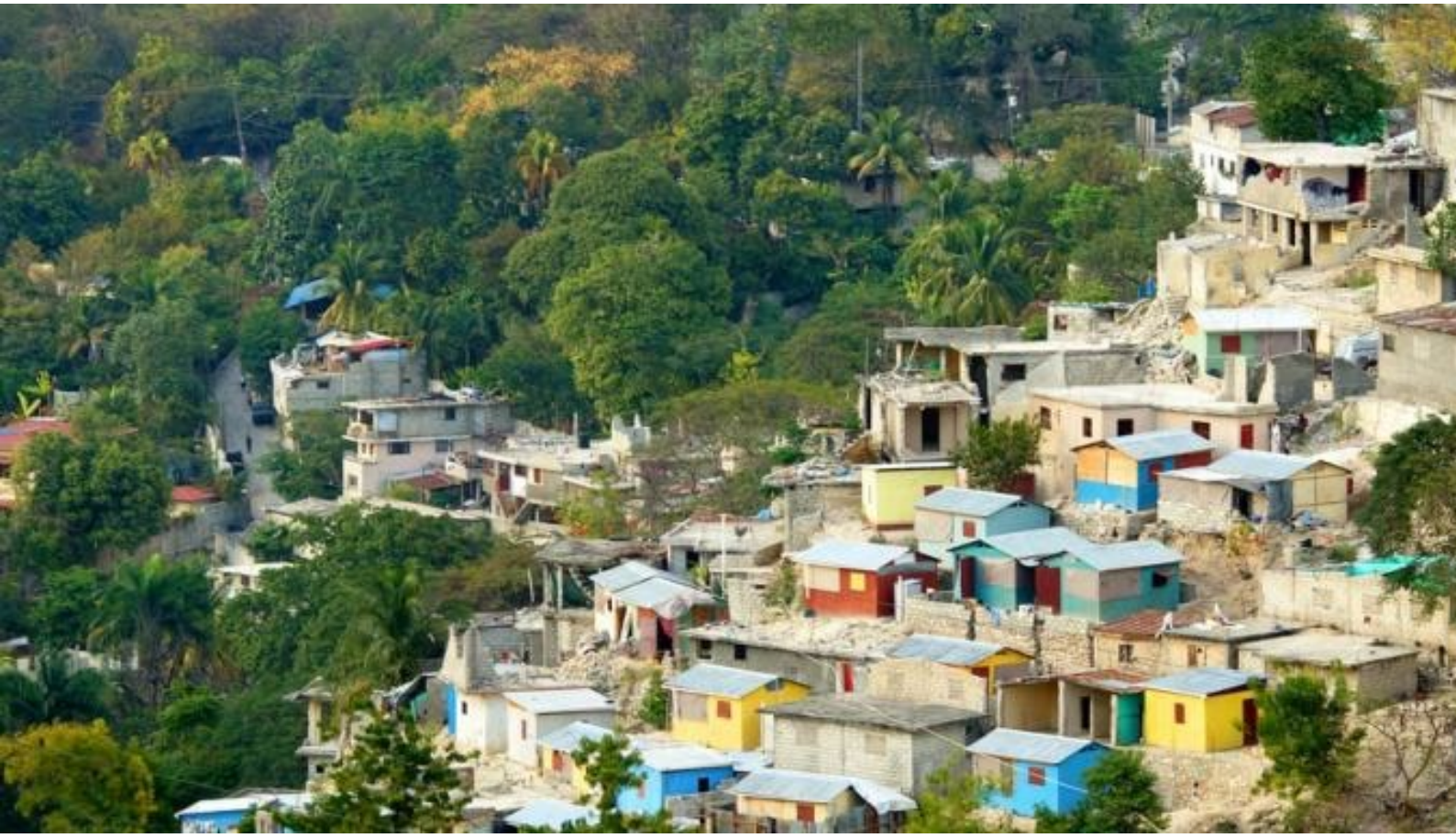

Program for Local and Urban Sustainability

PERU COASTAL CORRIDORS ASSESSMENT

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ACRONYMS

Acronym	Definition
3Rs	Reduce, Reuse, Recycle
ARFUMM	Asociación de Recicladores Forjando un Mundo Mejor
CCBO	Clean Cities, Blue Ocean
EOR	Solid waste operating companies
EPR	Extended Producer Responsibility
GOP	Government of Peru
HDPE	High-Density Polyethylene
ISO	International Organization for Standardization
IWC	Informal waste collector
Kg	kilogram
Km	Kilometer
LATAM	Latin America
MINAM	Ministry of Environment
MSW	Municipal solid waste
MT	Metric Tons = 1,000 kg = 2,204.62 lb.
PET	Polyethylene Terephthalate, a type of plastic
PLUS	Program for Local and Urban Sustainability
PP	Polypropylene
PSF	Source Segregation Program
SIGERSOL	MINAM's Information System for Solid Waste Management
SWM	Solid Waste Management
USAID	U.S. Agency for International Development
USD	U.S. Dollars

I. EXECUTIVE SUMMARY

This assessment evaluates the feasibility of increasing recycling aggregation and transportation to Lima from municipalities in northern and southern coastal cities in Peru. At present, Lima is the only city in Peru with an existing large-scale recycling industry; therefore, coastal cities must send all of their recovered recycled material to Lima for processing. More than 60 percent of the population in Peru lives within 30-40 kilometers (km) of the coast, making it the area with the most waste generation in Peru; therefore, promoting a clear pathway for recyclable materials from these coastal cities to Lima would serve to promote recycling in the Peru and potentially reduce the volume of plastic waste discarded in the ocean.

The U.S. Agency for International Development (USAID) Peru has several programs that have engage both the Government of Peru (GOP) and several of its provinces and districts on programs that help mitigate plastics pollution and promote a more sustainable and cleaner Peru. USAID Peru has engaged the Program for Local and Urban Sustainability (PLUS) to help advance its understanding on how to further advance solid waste management (SWM) and plastics reduction efforts throughout the country. PLUS focuses on specific areas (i.e., the Loreto Department and coastal corridors) to further support improvements in the SWM value chain, enhance recycling capacity, and reduce plastics pollution. This Report examines cities along the coastal corridor from Tumbes in the north to Tacna in the south to determine which cities could be the focus of economic recycling corridors.

To determine the preliminary economic and environmental feasibility of the Northern and Southern Recycling Corridors, the PLUS team assessed the current municipal solid waste (MSW) generation and collection in Peru's corridor cities, the logistics for aggregation (i.e., transportation between cities) and the recycling market demand. This Report also explores potential incentives to attract increased private sector engagement in the recycling sector along the corridors.

The absence of a formalized and economically viable MSW recycling system along the coast is an opportunity to address growing plastic pollution in Peru's coastal ecosystems, particularly in the populous coastal cities. Recycling along the coastal corridors remains relatively nascent and largely informal. The implementation and expansion of the recycling value chain (i.e., a supply chain where value is added along each step of the process) along the corridor could provide many economic, social, and environmental benefits throughout the country and will be critical to Peru achieving its recycling goals.

Under the Ministry of Environment's (MINAM's) direction through the *National Plan for Comprehensive Solid Waste Management 2016-2024* and other legislation (discussed in the PLUS team's *Peru National Assessment on Solid Waste Management*), coastal city municipalities would like to transition toward a circular economy model where the implementation of the principles of reducing, reusing, and recycling (3R) play a pivotal role in achieving plastic circularity and curbing plastic pollution. Following the COVID-19 pandemic, coastal municipalities resumed their source segregation programs with a strong emphasis on promoting the 3R principles. Despite this renewed commitment, Peru's coastal recycling sector faces the endemic challenges described in the *Peru National Assessment on Solid Waste Management*. These challenges included rapid and disorderly urbanization, insufficient public participation, poor enforcement of source segregation practices, limited stakeholder engagement across the recycling value chain, and lack of effective price signals and slim profit margins which make it difficult to increase SWM/recycling and to stop the environmental damage from waste pollution.

USAID and GOP should continue to support and promote the improvement of SWM in the coastal cities in Peru, and work to support the development of recycling coastal corridors in the North and South. The GOP should seek to expand the existing recycling corridor in the North between Trujillo and Lima to establish a circular economy and enhance the corridor's capacity to move more plastics and promote new business opportunities through increased private sector participation and formalization. In the medium to long term, the GOP should look at decentralization by supporting

the construction of waste processing/manufacturing facilities in Trujillo which will expand the recycling potential of the area north of Trujillo, where it is not currently economical to transport recyclable materials to Lima. In the South, the GOP, in coordination with USAID, should continue to support the corridor between Ica and Lima through technical assistance and the analysis of opportunities to expand the corridor area further south or southeast.

To support the recycling corridor development, it is critically important for the GOP and MINAM to provide support to municipalities and their partners to improve municipal SWM, including improvements in source segregation, recycling practices, circular economy initiatives, and effective waste segregation where source segregation fails. It is also important to explore incentives and support to the private sector across the recycling value chain to increase participation and improve infrastructure for recycling along the coastal corridors and in Trujillo for the Northern Coastal Corridor. The GOP should look at piloting recycling and plastic manufacturing decentralization in Trujillo, which will help to open a market for certain cities along the Northern Coastal Corridor that are not currently economically viable to transport waste to Lima for recycling transformation.

II. INTRODUCTION

Purpose and Objective

This Report complements the PLUS *Peru National Assessment on Solid Waste Management* by providing specific analysis on the potential for MSW recycling and reuse in the corridors[1] along Peru's coast. The term "corridor" is used in this Report to describe the route(s) along which recyclables are transported, and which links different territories (in this case municipalities) together along Peru's coast. The GOP has made significant improvements in environmental management and SWM in the last decade; however, there are still challenges facing SWM services and SWM infrastructure that have resulted in waste leakage along the coast. Challenges with source separation, collection, aggregation processes, varying value chains, and a lack of capacity of processors to create post-consumer materials hinder business models for plastic recycling and slow the country's shift towards a circular economy.

This Report also builds on previous work carried out by the USAID Clean Cities, Blue Ocean (CCBO) Program in Peru. CCBO conducted a market study on usable organic and inorganic MSW and in addition to waste produced in artisanal fishing towns in the districts of Máncora, Paita (both in the Piura Department), and Pisco (Ica Department) to identify the local supply and national demand for usable waste.[2] Learnings from that report and program point to the need to create plans for recycling and processing of collected waste and link the dispersed geographies of CCBO technical assistance to recycling processing and plastic manufacturing centers along the coast.

This Report expands on the initial CCBO study and explores the possibility of developing coastal recycling corridors for aggregation and transportation across municipalities. Corridors could potentially make recycling more economically sound and sustainable along the coast of Peru. At present, the only location along the coastal corridor with a complete recycling value chain (i.e., inorganic materials are consumed, conditioned, and transformed into new material) is Lima. This limits the potential for municipalities to recycle, as presently all cities in Peru must ship their recyclable material to Lima for processing. This Report explores the possibility of improving transportation to Lima in the short-term and in the long-term establishing the full value chain in additional cities along the coastal corridor. Currently, there is no real corridor along the North or South. Together with USAID, the PLUS team established that Trujillo would be the most viable northern endpoint to investigate first because of the concentration of industry and its population size. To the south, USAID and PLUS decided that Ica would be the most viable southern city to focus on due to transportation distances and USAID's interest to build off its current programming in the area.

This Report explores SWM opportunities and provides recommendations for how to further advance formalized corridors by expanding the existing infrastructure that supports recyclable material transportation, improving financial incentives for recycling, and engaging and formalizing stakeholder roles in this process.

The objective of the Coastal Corridors Assessment is to:

- Assess the recycling sector, potential business models, and conditions needed to attract private sector investment in recycling along the coast of Peru, including the potential for Northern and Southern corridor/s and specific city involvement.
- Outline and evaluate the economic and environmental criteria to determine the feasibility of local recycling and transportation of promising circular materials such as metals, glass, and polyethylene terephthalate (PET) along the coastal corridors.

[1] Corridor is mainly defined as a route along which goods and people move and which links different territories or areas together.
[2] Note: Within Peru the regions were previously referred to as "Departments." MINAM's database (SIGERSOL) still uses the term "Departments" within its database to refer to regions.

- Provide recommendations for next steps to advance the recycling corridor concept and enhance local recycling and reuse capabilities along the coast.

This Coastal Corridors Assessment should be read in tandem with the PLUS team's *Peru National Assessment on Solid Waste Management*, as there is relevant information that helps support the analysis of this Report.

Report Organization

This Report is organized into five sections and three appendices:

- **Section 1** is an executive summary of the Report
- **Section 2** is an introduction of the topics covered in this Report and an explanation of the methodology used to undertake the analysis
- **Section 3** defines the proposed coastal corridors and describes the overarching landscape (e.g., value chain, stakeholders, laws/regulations)
- **Section 4** describes the key factors which GOP will need to address as it develops the coastal corridors in addition to potential opportunities for the GOP to address challenges
- **Section 5** provides the Report's conclusions
- **Appendix A** provides additional detail on SWM data in Ica and Trujillo
- **Appendix B** provides an analysis of transportation costs
- **Appendix C** provides waste collection number estimations

Methodology

To determine the preliminary economic and environmental feasibility of the Northern and Southern Recycling Corridors, the PLUS team assessed:

- The current MSW generation and collection in Peru's Coastal Corridor cities,[3] with a focus on Trujillo and Ica
- Logistics for aggregation, transportation, and disposal
- Recycling market demand and prices for recycled materials (primarily plastics)
- Potential incentives for private sector engagement

This Report focuses on the plastic recycling value chain, and includes some data on paper, glass, and metal recycling. When looking at plastic recycling, this Report focuses on the plastics with the highest recycling resale value: PET, a plastic that can be 100 percent recyclable/remade and is the material choice for beverage bottles; Polypropylene (PP), used in most plastic packaging; and High-Density Polyethylene (HDPE), used in packaging for heavy liquids given its strength to density capabilities.

The PLUS team analyzed which cities the GOP and USAID could most effectively incorporate into these corridors based on economic and environmental viability of recycling and opportunities for the creation of adequate financial incentives for the stakeholders involved in the process.

The PLUS team completed a desktop analysis of USAID CCBO data and held discussions with the CCBO Peru team, including follow up check-ins with the CCBO team to clarify data or existing processes and activities where required. Additionally, the team conducted interviews in person in Lima and Trujillo and virtually for Ica and held several follow-up discussions with recycling companies and enterprises active throughout Peru. The following types of interviews were conducted:

- Three-day, field-based, in-person stakeholder interviews in Trujillo. Trujillo was selected as a field site given it is the largest producer of waste in the Northern Coastal Corridor.

[3] The PLUS team considered and looked at the following provinces to different degrees: Lima, Chimbote, Trujillo, Chiclayo, Piura (including Mancora), Ica, Pisco. Tumbes in the North and southern cities of Nazca, Ayacucho, Arequipa, and Cusco were considered during the transportation analysis.

Additionally, the PLUS team visited the coastal region surrounding Trujillo City, covering a radius of approximately 40 km, situated in the La Libertad Department

- Virtual interviews with Ica municipal officials[4]
- In-person interviews in Lima and observation of SWM activities in Lima's districts to understand the SWM and recycling landscape
- Virtual interviews with transportation companies, PET consultants, and small and medium size entrepreneurs in the plastic recycling value chain in Peru. Three specific companies to highlight include:
  - Ecoladrillos SAC, a company that fabricates specialized machinery that converts recycled PET (rPET) and plastics into to sustainable construction materials; their sales and service operations are nation-wide in Peru and is highly dependent on understanding pricing and availability of PET in Peru recyclable supply chain;
  - Perpal SAC, a registered and authorized waste operating company (EOR) that specializes in the commercialization of solid waste, the sale and purchase of recyclable plastics and construction materials, hauling and warehousing, and recuperation and reconditioning of waste; in Peru, Perpal offers services similar to an *acopiadores* (i.e., waste agreggation facilities); and
  - Bioambiental SAC, a registered environmental and SWM waste site and landfill remediation consulting firm that works with companies across the SWM spectrum from recycling associations to purchasing, as well as hauling and repurposing.

Figure 1. Coastal Corridor Cities of Peru

Following the interviews, the team conducted desktop research and analyzed datasets in addition to data which the interviewees provided pertaining to the coastal corridors to identify:

- Economically viable corridors for recycling for the potential Northern and Southern Coastal Corridors
- The enabling environment for municipalities, the private sector, and other stakeholders to enhance SWM and achieve higher levels of aggregation and recovery rates for recyclables
- Opportunities and constraints to improve recycling, including the current recycling aggregation and processing centers, transportation, and economically feasible distances of cities in the corridor
- The current recycling sector, potential business models, and financial incentives needed to attract the private sector
- Potential locations for decentralized recycling (outside of Lima) to attract private sector recycling

Analysis on Viable Corridors

In order to acquire data for the analysis, much of which is not available publicly, the PLUS team conducted interviews with recognized experts from the private sector focused on critical phases of the recycling supply chain, commercialization and valuation, hauling and transport, critical community and private sector stakeholders. The PLUS team additionally obtained information on pricing relative

[4] Due to health and safety concerns, it was not possible for the team to conduct interviews in Ica and USAID advised the team to conduct the interviews virtually.

to each phase of the recycling value chain. Given the lack of a comprehensive database on recyclable material values and transportation costs, these interviews provided key illustrative data which the PLUS team used in concert with SIGERSOL data to develop analyses on the costs of transportation, costs of rPET, and the supply and demand of the recyclable material market. The PLUS team then used these findings to establish which cities could serve as the economically viable endpoints along the Northern and Southern Coastal Corridors.

III. COASTAL CORRIDOR LANDSCAPE

This section describes the key elements in determining the feasibility of the coastal corridors: value chains, key stakeholders, and local laws and regulations which impact SWM along the coastal corridors.

Defining the Coastal Corridors

For the coastal corridor assessment, the PLUS team examined two primary potential SWM corridors, I) the Northern Coastal Corridor: starting from Tumbes through Piura, Chiclayo, Trujillo, Chimbote and ending in Lima; II) the Southern Coastal Corridor starting in Tacna, through Ilo to Ica and Pisco and ending in Lima (with an optional stop in Arequipa) and another route from Cusco through Ica to Lima. These corridors are based on the main transportation roads between these cities.[5] In Peru, the cities[6] fall within districts, which are aligned to provinces and then regional departments. As the *Peru National Assessment on Solid Waste Management* lays out, municipal districts are responsible for SWM and provinces oversee when there are issues or opportunities for shared infrastructure across those district municipalities. The PLUS team analyzed volumes at both the district and provincial level, given there are opportunities to build recycling infrastructure across the provinces for the required quantities of recyclable material. Additional information about the department is shared for comparison and potential expansion opportunities for the coastal corridors in the long term.

The Northern Coastal Corridor is split into two main areas, from Tumbes to north of Trujillo, and from Trujillo to Lima along the Panamericana highway. The Southern Coastal Corridor encompasses several roadways and is divided into two segments: one running along the northeast route from Ica to Cusco, and the other extending southeast from Ica to Tacna (with an optional stop in Arequipa). Section 4 discusses the economic viability of portions of theses corridors. Due to collection constraints and time limitations, the focus of the interviews for this report were in Trujillo and Ica and thus the data collection was focused on these cities as well.

Lima is where most recycling centers and users of recycled materials (e.g., bottling manufacturing plants) are located, as a result Lima is the proposed endpoint of the recycling corridors.[7] The transportation infrastructure for these coastal corridors is already in place as there is a system of highways that extend down Peru's coastline; however, currently the value chain for recyclables along the coastline requires improvement.

At present, Lima is the only area in Peru with a full recycling value chain as it is the only location with recycling transformation facilities to convert used recyclable materials into new material. The aim of the coastal corridors, in the long-term, is to develop regional provinces/municipal cities, such as Trujillo, into areas with fully-fledged value chains as well; however, in the near term, the aim is to create value by transporting recyclable materials from Trujillo and Ica (in addition to other municipalities along the coastline between those cities) to Lima.

Given the large volume of MSW generated along the coastal corridors in addition to limited local government resources, development of the coastal corridors will require both municipal and public sector buy-in. The following sections describe the key steps in the recycling value chain and the gaps which both the Northern and Southern Coastal Corridors face.

The Recycling Value Chain in Coastal Corridors

At present, Peru does not have a fully built out recycling value chain, except in Lima. The end goal is for Peru to build out a recycling value chain along the coastal corridor (north and south) so that stakeholders in the value chain are motivated to increase both the collection and use of recycled materials and thereby mitigate broader plastics pollution. Ideally, the entire value chain would exist

[5] In some cases, these cities have a province that surrounds them with the same name, and will be considered for SWM potential
[6] Cities in Peru are also called municipalities or districts. They are labeled as districts in SIGERSOL.
[7] Lima is the most populous city in Peru with approximately 7 million residents.[7]

entirely within each city, but that is not economically feasible due the capital cost of waste transformation facilities. While Lima has all the components of the recycling value chain, there exists an opportunity for the GOP to promote cities along the coastal corridors joining together to establish a more built out recycling value chain by economically aligning cities outside Lima with recycling in Lima. Figure 2 provides a flow chart of what a recycling value chain would look like in Peru according to the *CCBO's Initial SWM Assessment Report.*[8] While some of these components exist in pockets across the country, they are not linked into fully functioning value chain along the coastal corridor in Peru. The following sections provide a brief definition of each phase within the recycling value chain and the status of that phase along the coastal corridors.

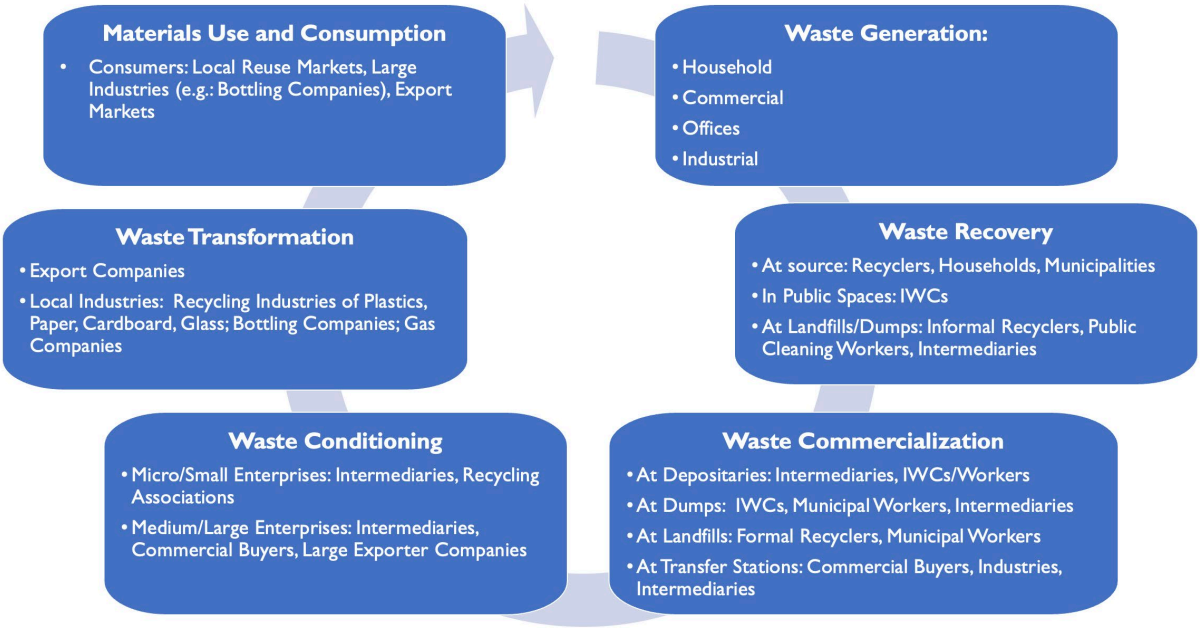

Figure 2. Flow chart of Peru recycling value chain (adapted from Ciudad Saludable and Global Fairness Initiative, 2018) and adapted by the USAID CCBO Program[9]

Note: Waste conditioning and transformation are both included under MINAM's Information System for Solid Waste Management's (SIGERSOL's) definition of "valorization."

Some specialized recycling streams may have additional or fewer processors. For example, in the PET waste value chain, there is an additional processor that specializes in polymers to break down the plastic into a reusable material.

Waste Generation

Waste generation comprises the amount of waste produced by homes, commercial businesses, industrial companies, office buildings, and other waste producers. This represents the overall potential plastics waste which can be segregated to generate profits in the recycling value chain. Waste generation stakeholders either use a product and then discard the waste in the appropriate recycling location or in a general waste stream. Consumers not properly disposing of their waste is the largest loss of recycled materials in the recycling value chain. Waste generation on the household side varies heavily depending on the population of the municipality, while within the commercial and industrial segments it varies primarily on industry and operational size. Section 4 provides an analysis of the levels of waste production in Trujillo and Ica.

[8] Ciudad Saludable and Global Fairness Institute. "Inclusive Waste Management in Peru: Enabling the Business of Recycling." 2018. https://www.mastercardcenter.org/content/dam/public/mc-cig/uploads/Inclusive-Waste-Mgmt-in-Peru-March-2018.pdf

[9] Ciudad Saludable and Global Fairness Initiative, "Inclusive Waste Management in Peru: Enabling the Business of Recycling"

Waste Recovery

In the recycling value chain, the volume of recyclables separated by households and commercial entities heavily impacts the supply of recyclable materials for other stakeholders further down the value chain. While it is technically the law in Peru that recyclables must be separated from waste, this is not enforced by the municipalities and MINAM noted that separation rates remain low except in areas with concerted programs to support separation. As a result, the supply of recyclable materials in Peru consists of materials which the general public and commercial businesses have separated, and those which recyclers can gather from general waste streams. As a result of limited waste separation, the amount of recyclable material which recycler associations and EORs can acquire through door-to-door pick-up is limited. Consequently, there are higher volumes of recyclable materials disposed of in dumps; these recyclable materials are more labor intensive to collect as they require informal waste collectors (IWCs) to physically dig through general waste. This limited volume of segregated recyclable material entering the value chain creates challenges for stakeholders down the value chain who rely on there being large quantities to derive a profit.

Recycler associations, formal recyclers and IWCs (i.e., recyclers), and EORs[10] are the primary stakeholders that conduct waste recovery (specifically recyclable material recovery).[11] Waste recovery in Peruvian municipalities remains largely informal and consequently there are various methods by which waste recovery of recyclable materials occurs, including:

- Municipal workers collect litter in public spaces;
- Recycler associations, and in some cases EORs, collect recyclables from green plastic bags or waste bins in front of homes and commercial businesses;
- IWCs and formalized recyclers sort through general waste bins in front of homes and collect high value recyclables;
- EORs or municipalities themselves collect general waste from homes and separate high value recyclables out prior to depositing the remainder of the waste in a dump or landfill;
- IWCs that reside at dumps separate the general waste to identify high value recyclables.

In this step of the value chain, companies that have trucks become critically important to be able to haul the MSW. Trucking companies (some of which are EORs) that haul different types of solid waste (e.g., hazardous materials, recycling, construction waste) must first acquire a certification from the MINAM.

Municipalities and private companies will not load their solid waste on to trucks until they receive proof of certification for hauling the waste. MINAM and the respective industry ministry (e.g., for the mining industry the Ministry of Energy and Mines) require municipalities and private companies to provide data in their annual reports on who collects their waste, or they may face a fine.[12] The municipalities and private companies pay the hauling firms to remain compliant with SWM laws and to remove their waste. Typically, solid waste hauling firms start their journey with a commercial load, driving under their standard commercial hauling certificate, and then pick up additional MSW that falls under their MINAM hauling license/certificate to avoid losses from an empty trailer.[13]

Northern Coastal Corridor

As the second most populous city on the coast (other than Lima), Trujillo produces the most usable inorganic waste (e.g., plastics) by volume and is home to some critical industrial companies (discussed further in the Materials Use and Consumption section below). The Trujillo District is also at the mouth of the Moche river, a source of considerable run off and plastic waste into the ocean. Trujillo province produces 89,217 metric tons (MT)/year of inorganic waste, with a 3.18 percent

[10] EORs are solid waste management companies that have contracts with municipalities or directly with commercial entities to collect waste. They collect waste directly from homes and/or commercial clients and sometimes also have other municipal waste collection responsibilities.
[11] For additional detail on these stakeholders please refer to the PLUS team's *Peru National Assessment on Solid Waste Management.*
[12] PLUS interview, 2023
[13] PLUS interview, 2023

recovery (e.g., recycling, composting) rate, which is below the national recovery rate of 4 percent.[14] Currently, nine of the ten Trujillo district municipalities in the Trujillo Province carry out recovery of inorganic (e.g., recyclables) and/or organic waste.[15] Table 1 below provides a summary of the waste collected in La Libertad Department, Trujillo Province and Trujillo District.

Table 1. Total generation and recovery of organic and inorganic MSW for Trujillo (2022)[16]

Geography	Inorganics generation (MT/year)	Inorganics recovered (MT/year)	Inorganics recovered (%)
La Libertad Department	**124,733.84**	**4,084.00**	**3.27%**
Trujillo Province	90,407.95	2871.74	3.18%
Trujillo District	23,726.08	894.91	3.77%

In 2023, the EOR Registry reported that the Trujillo province has 63 registered EORs.[17] In 2023, the SIGERSOL database reported that there are approximately 26 active EOR registrations which specialize in the transport of recyclable materials within the Trujillo District.[18] In addition to hauling services, many of these companies operate as *acopiadores* or offer similar waste aggregation services.

Given the scale of the city, there are opportunities to expand the number and size of the recycling associations; while IWCs can collect recyclable materials, recycling associations are capable of collecting a higher volume of recyclable material through access to waste collection vehicles as a result of their scale and size compared to IWCs. Registered waste collectors can either join associations or be independent. In 2022, Trujillo District had 149 registered waste collectors and one association, but it is unclear if this data includes municipal staff.[19] The formal recycling association Recicladora Manualita SAC is the only one working with the Trujillo District. Most of the other recyclable collectors are informal. The PLUS team estimated that for Trujillo District alone, based on the volume of inorganic waste that is produced, if 60 percent can be recycled and each individual recycler collects about 220 kilograms (kg) a day, approximately 300 recyclers are needed at a minimum (See Appendix C for the full calculation).[20]

In October 2023, MINAM issued Executing Unit 003: Integral Management of Environmental Quality, which provided the Trujillo Province with the first batch of machinery and vehicles to improve SWM in the La Libertad Department. These vehicles correspond to the first stage of the project: "Improvement and expansion of the public cleaning service in the City of Trujillo and final disposition of 9 districts of the Province of Trujillo, department of La Libertad of the Punche Peru Plan." This project has been supported by the GOP with an investment of approximately 89 million soles.[21]

Despite being one of the cities with the highest rate of waste generation, Trujillo does not have a municipal sanitary landfill for the final disposal of waste. Municipalities in the area typically use the nearby El Milagro dumpsite, an illegal dumpsite. At the El Milagro dump, there are many IWCs who separate the recyclable waste and sell it to formal and informal recycling companies (who then sell the material in Lima). There is however, one sanitary landfill, Cumbre Sanitary Landfill, that is close

[14] MINAM, "SIGERSOL." https://sistemas.minam.gob.pe/SigersolMunicipal/#/accesoLibre/valorizacion
[15] These nine district municipalities achieve a recovery of 3,486 MT/year of organic waste and 2,931 MT/year of inorganic waste based on municipal data for segregation programs. Refer to Appendix A for more information about the recovery of organic and inorganic waste in Trujillo.
[16] MINAM, "SIGERSOL." https://sistemas.minam.gob.pe/SigersolMunicipal/#/accesoLibre/valorizacion
[17] MINAM, "SIGERSOL." 2023
[18] MINAM "Listado de Empresas Operadoras." https://www.gob.pe/institucion/minam/informes-publicaciones/274465-listado-de-empresas-operadoras-de-residuos-solidos-autorizadas-por-el-minam
[19] MINAM, "SIGERSOL,"
[20] MINAM, "SIGERSOL," 2023; Trujillo women's association PLUS interview June 2023
[21] Andina, "Minam entrega vehículos para mejorar la gestión de residuos sólidos en Trujillo," https://andina.pe/agencia/noticia-minam-entrega-vehiculos-para-mejorar-gestation-residuos-solidos-trujillo-958052.aspx

to Trujillo and now services some of Trujillo; it could potentially be a location to separate and sort plastic waste that has not been source separated. The SWM company Innova Ambiental SA, that has operated for 25 years and has International Organization for Standardization (ISO) certifications on its SWM processes, has one of its two Peru bases in Trujillo. Innova Ambiental has refuse vehicles, landfill tractors, treatment facilities and sanitary landfills that it uses in Cumbre which could help to collect recycled material as part of circular economy efforts.[22] A coastal corridor for recyclables could serve to redirect recyclable materials away from dumps near Trujillo.

Southern Coastal Corridor

The Ica Province produces 29,218 MT of inorganic waste, with a 3.29 percent recovery (e.g., recycling, composting) rate, below the national recycling rate of 4 percent.[23] In Ica Province, 10 of the 13 district municipalities carry out the recovery of inorganic and/or organic waste. Table 2 provides a summary of the waste collected in the Ica Department.

Table 2. Total generation and recovery of organic and inorganic MSW (2022)[24]

Geography	Inorganics generation (MT/year)	Inorganics recovered (MT/year)	Inorganics recovered (%)
Ica Department	**61,115.05**	**2,361.41**	**3.86%**
Ica Province	29,218.31	961.73	3.29%
Ica District	14,587.29	528.71	3.70%
Pisco Province	11,447.44	340.01	2.97%

The Ica Province promotes segregation at source through a municipal source separation program (PSF), where recycler associations collect organic and inorganic waste from homes. For segregation at the source of inorganic waste, approximately 10,000 households participate.[25] Four recycler associations service Ica: Medalla Milagrosa, Nueva Juventud, Nuevo Horizonte, and San Cristóbal. Each association has different collection routes, and they go through each zone once a week to collect recyclable waste from homes and to leave new green bags for waste separation.[26] The recyclers collect recyclable waste such as glass, plastic, metal, paper, and cardboard. They do not collect tetra pak packages because it is not economically attractive.[27] Recycler associations serve a role like EORs but for recyclable material, where they can collect the recyclable material in some instances, but not frequently, through a municipal contract.

The municipality provides vehicles, a driver, and fuel to each of the four associations to support their collection activities. The municipality also provides support to the recycler associations with the purchase and donation of green bags that the recyclers deliver to residents for the segregation of waste. They also can use a municipal collection center[28] where they can store the recyclable material collected.

Waste Commercialization

Commercialization is the buying and selling of recyclable materials. The sellers are the recycling associations, EORs, and recyclers who have collected recyclable materials as part of the waste

[22] MINAM, "SIGERSOL."
[23] MINAM, "SIGERSOL." https://sistemas.minam.gob.pe/SigersolMunicipal/#/accesoLibre/valorizacion
[24] MINAM, "SIGERSOL."
[25] PLUS interview with Ica municipality June 2023
[26] Based on interviews with the Ica Municipality.
[27] Tetra pak is the material typically used for packaging cartons of milk and juice, it consists of multiple layers of paper, polyethylene, and aluminum. These multiple layers make tetra pak a particularly challenging material to recycle, as it requires specialized facilities to process the layers. To the PLUS team's knowledge, there are presently no facilities within Peru capable of recycling tetra pak.
[28] This may be a municipal piece of land or building they allow the association to use or may be a formal acopiadores that the association uses. The associations benefit from having a place to physically store their material, and donations from municipalities can be critically important

recovery phase. Buyers are typically microenterprises or waste marketers able to accumulate recyclable materials (i.e., aggregation centers) until it is profitable to transport it. Here, waste collection facilities or *acopiadores* play a critical role in the commercialization process. *Acopiadores*, whether formal or informal business entities (along the coast they are mostly formal), act as an intermediary commodity exchange. Buyers from industries whose production depends on certain plastics can purchase them as raw materials. More technologically advanced *acopiadores* have the capacity to clean, condition, and shred waste and process it further to support material reuse companies. Buyers and sellers determine the price per metric ton of waste through negotiation. *Acopiadores,* both formal and informal, exist in virtually every city and department of the country and thereby preclude longer time consuming and costly transport to processing facilities further afield help to decrease the costs for waste transportation prior to commercialization.

In more rural parts of the country, *acopiadores* may be more informal, acting as open markets spaces. In these instances, local government offers rent-free spaces to associations and indigenous communities to earn money by exchanging their recycled plastics with other semi-formal buyers of plastics. This often represents the first step along the commercialization chain for recyclable PET and plastics, whereby indigenous populations receive either monetary payment or materials recycled from their plastics such as bricks made from plastics or *ecoladrillos*.

Buyers typically purchase multiple types of recyclable material (e.g., PET and plastics) in order to lessen the impact of changes in market prices of the material on their profitability. The buyers are often also involved in waste conditioning, and serve as processors which is further described in the following sections.

In Peru, this phase of the value chain has many informal entities. While some data on the number of *acopiadores* is reflected in SIGERSOL, it likely does not reflect the total amount of active entities. When the PLUS team shared the number of *acopiadores* in SIGEROL with Peruvian transportation companies and plastics consultants, they indicated the number of *acopiadores* was in fact much higher than the formally reported GOP number from their experience in the industry.

Northern Coastal Corridor

Discussions with formal private recycling companies in Trujillo revealed that IWCs gather the most valuable plastic waste types (i.e., PET, HDPE, PP, cardboard, and white paper) and sell them to private recyclers who store the material in *acopiadores*, and wait until the waste transformation companies in Lima raise their prices which allows them to cover their transportation costs.[29]

Table 3 provides an overview of the number of registered aggregation centers in the Ancash and La Libertad Departments.

Table 3. Number of Acopiadores/Aggregation Centers (2022)[30]

Geography	Aggregation Centers
Ancash Department	**15**
La Libertad Department	**16**
Trujillo Province	4
Trujillo District	0

Southern Coastal Corridor

In Ica, the four recycler associations sell most of their recyclable material to Bioreciclar and Ecoliap (i.e., intermediaries).[31] At present, the sale of glass to these entities is not profitable in small amounts

[29] Based on interviews in Peru.
[30] MINAM, "SIGERSOL."
[31] PLUS interview with Ica municipality June 2023

for the recycler associations, as they only receive 10 sole cents per kg from the intermediaries.[32] The prices the intermediaries pay for PET plastic are dependent on the color; transparent PET has a better price than colored PET. Table 4 provides an overview of the number of registered aggregation centers in the Ica Department.

Table 4. Number of Acopiadores/Aggregation Centers (2022)[33]

Geography	Aggregation Centers
Ica Department	**18**
Ica Province	9
Ica District	3
Pisco Province	3

Waste Conditioning

As part of this phase, the secondary processor (often the same entity as those involved in the waste commercialization phase including the *acopiadores* mentioned above) continues to sort and clean the recyclables to make them ready for the end market users. The methods used to prepare the waste are dependent on the type of material but include washing, compacting, and packaging. The intermediaries conduct these processes at solid waste valorization plants, where both municipal and non-municipal waste is taken to be treated via processes that allow for reuse and recycling as part of a circular economy.[34] The plants have areas for selection, classification, maturation, and decomposition as well as a hydraulic press to compact the recyclable materials into bundles. The term "valorization plants" includes facilities that specialize in the treatment of either organic (i.e., composting facilities) or inorganic materials.

The large intermediaries which typically own these *acopiadores* facilities acquire waste from informal intermediaries (i.e., microenterprises), which include recyclers and small intermediaries. Some of the larger intermediaries also are involved in the transport of waste to Lima while others sell to marketing companies that have contracts with the material processing industries in Lima.

Northern Coastal Corridor

Table 5 shows the number of valorization plants in the Ancash and La Libertad Departments. Currently, SIGEROL does not designate which products the valorization plants include, and many will work to collect and sort multiple recyclable products.

Table 5. Number of Valorization Plants in the Northern Coastal Corridor (2022)[35]

Geography	Valorization Plants
Ancash Department	**27**
La Libertad Department	**26**
Trujillo Province	6
Trujillo District	1

[32] PLUS interviews in Peru June 2023
[33] MINAM, "SIGERSOL."
[34] Andina, "Solid waste: learn what recovery plants are, how they operate and their importance." https://andina.pe/agencia/noticia-residuos-solidos-conoce-son-las-plantas-valorizacion-como-operan-y-su-importancia-891035.aspx
[35] MINAM, "SIGERSOL."

Southern Coastal Corridor

Table 6 shows the number of valorization plants located along the Southern Coastal Corridor.

Table 6. Number of Valorization Plants (2022)[36]

Geography	Valorization Plants
Ica Department	**22**
Ica Province	10
Ica District	4
Pisco Province	4

Waste Transformation

Waste transformation is the process of converting the recyclable materials into materials that are ready for reuse by manufacturers (e.g., rPET). This process is carried out by recycling transformation facilities which are registered with the GOP. Almost all the country's transformation facilities are centralized in Lima because of its large population (and associated waste production) and the presence of plastics producers and manufacturers near Lima. The PLUS team is aware of one recycling transformation facility in Cusco which takes waste from Macchu Pichu and some production of small products such as olive barrels in Tacna (this facility has its own pelletizer).[37]

While there is no regulation explicitly prohibiting decentralized recycling processing in the provinces, it is not currently practiced due to the high operational costs of developing recycling centers away from the eventual plastics producers and the absence of legal requirements for recycling.[38]

Materials Use and Consumption

While almost all the formal processing and manufacturing of plastic occurs in Lima, there is some use of recycled plastic that occurs in a circular fashion in the Departments, including along the coast. Plastic waste is brought to the *acopiadores,* and small and medium size enterprises buy the material and reuse it. Due to the high transportation costs to ship the recycled plastic to Lima, the material is reused locally.[39] While it is difficult to identify all industries using the decentralized plastic waste material, some examples include reuse of materials in fishing and PET brick manufacturing.

The larger end market users are typically manufacturing plants that take in the recycled plastic material as a substitute for virgin materials. These companies turn the recycled materials into products that can then be put back on the market (e.g., recycled bottles). Although this section is focused on the plastics industry, similar trends are found in the metal and paper recycling sectors. The key plastics use industries in Peru include packaging for food and agriculture and fishing nets/ropes. Other key industries that rely on rPET and plastics include: furniture production, construction materials, electronics and electrical parts, as well as automotive manufacturing (e.g., motorcycles, trikes, trailers). Large factories that produce plastic goods are primarily located in Lima due to the proximity to the airport for transport and other factories which provide supplies. Additionally, plastics consumption is higher due to the higher population of Lima (7 million), which results in a higher volume of recyclable materials which the factories are reliant upon.

Peru does not produce virgin plastics due to the lack of a petrochemical industry. Instead, two companies import 97 percent of virgin plastics (e.g., chip film, sheet film, and plastic resin) into Peru including San Miguel Industrias PET S.A. (81.7 percent) and Amcor Rigid Packaging del Perú S.A.

[36] MINAM, "SIGERSOL."
[37] Wenco, "Envases del Sur." Envases del Sur recycles 900-2,000 tonnes of plastic per year. https://evsperu.com/
[38] Currently there is no EPR for containers and packaging in Peru; however, EPRs do exist for ewaste and end-of-life tires.
[39] PLUS interview, 2023

(15.3 percent).[40] These companies manufacture and supply millions of plastic products to the domestic market by leveraging these imported materials.

The legal requirement for inclusion of recycled plastic in PET products[41] has spurred demand for the recycled plastic industry to begin processing rPET into new products.[42] This has increased the need to transport PET recyclable materials from the provinces back to Lima for recycling.

Northern Coastal Corridor

Of the 2,425 plastic companies in Peru in 2021, 1,976 were located in Metropolitan Lima (Lima Province and Callao), 51 were in La Libertad Department, where Trujillo is located.[43] In Trujillo there are limited companies which manufacture plastics, the primary manufacturer being the Arca Continental Lindley (Arca) bottling facility. While Arca does use rPET, involvement from Arca to promote recycling in the province has been minimal.[44]

The largest manufacturer and marketer of plastic containers in the northern coastal region is San Miguel Industrias PET S.A., it has a competitive advantage in the value chain over other plastic manufacturing companies by having the only "bottle to bottle" recycling plant in Peru, in addition to having the knowledge and ability to produce recycled resin (e.g., rPET). San Miguel Industrias PET S.A. has production processes and warehouses in cities in northern coastal Peru such as Trujillo, Motupe (northeast of Chiclayo) and Moche (just south of Trujillo) among others. [45]

Unión de Cervecerías Peruanas Backus & Johnston S.A.C. is the largest beer producer in Peru, whose product portfolio includes the sale of alcoholic beverages in glass containers and has a program promoting the reuse of glass containers, which can be reused up to 25 times. This program allows for the potential recovery of more than 2 million bottles, which represents 98.6 percent of the current returnable bottles market currently sold in Peru. The company is located and has returnable bottle programs in the following cities in northern Peru: Huaral, Chocope, Huacho, Barranca, La Esperanza, Salaverry (just south of Moche and Trujillo), Trujillo, and Piura.[46]

Additionally, Norsac (a plastic textiles manufacturer) and Maquiplast (a producer of mechanical components for heating/cooling) are located in Trujillo; however, the PLUS team was unable to find information on either of these industries using recycled plastics currently.

In the future, as recycled plastics requirements increase in line with national goals and the recycling value chain improves along the coastal corridor, these companies may become more involved in the acquisition of recycled materials.

Southern Coastal Corridor

The PLUS team is not aware of any large plastics manufacturers located in Ica. As the recycling value chain continues to improve along the coastal corridors, there could be opportunities for Ica to also have plastic manufacturing given the largely agricultural sector along the Ica River in Ica province.

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[40] Roxana Díaz, Gabriela Velarde, Gladys Lino, LA SAETA UNIVERSITARIA: ANÁLISIS DE FLUJO DE MATERIALES DE PLÁSTICOS PARA LA PRODUCCIÓN, CONSUMO Y COMERCIO DE ENVASES RÍGIDOS DEL POLIETILENO DE TEREFTALATO (PET) EN PERÚ DURANTE 2018, Vol. 9 Num. 2. (Perú: 2021), https://www.unae.edu.py/ojs/index.php/saetauniversitaria/article/view/238.

[41] The Act No. 30884 establishes that manufacturers of PET bottles for beverages for human consumption, personal hygiene and other similar products must include post-consumer rPET material as input in at least 15 percent of its composition.

[42] Two examples of this are San Miguel Industrias PET and Pamolsa, both are container and packaging companies based in Lima.

[43] INEI, May 2021, "INEI PARTICIPÓ EN EL III CONGRESO INTERNACIONAL DE LA INDUSTRIA PLÁSTICA," https://m.inei.gob.pe/media/MenuRecursivo/noticias/nota-de-prensa-no-078-2021-inei.pdf

[44] Arca has worked with the provincial and district municipalities of Trujillo on actions such as planting trees in arid areas and collecting electrical and electronic waste.

[45] Silvia Elizabeth Gutierrez Martinez, *SUSTENTACIÓN DE CASO: ANÁLISIS Y DIAGNÓSTICO DE SAN MIGUEL INDUSTRIAS PET EN EL SECTOR MANUFACTURERO DE PLASTICO PERUANO, PROPUESTA DE UN PLAN ESTRATÉGICO. July 2022,* https://repositorio.ulima.edu.pe/bitstream/handle/20.500.12724/17176/T018_72534627_T.pdf?sequence=1&isAllowed=y

[46] El Comercio, "Se debe incentivar el reciclaje de botellas de vidrio a través de la reutilización," April 2022, https://elcomercio.pe/tecnologia/ciencias/webinar-backus-se-debe-incentivar-el-reciclaje-de-botellas-de-vidrio-a-traves-de-la-reutilizacion-noticia/

Laws and Regulations Impacting Coastal Corridors

The current recycling system along the Peruvian coast is governed by national laws and regulations.[47] Local SWM collection and disposal services in Peru are administered by municipalities (or contracted through EORs) and funded through municipal budgets (described in detail in the *Peru National Assessment on Solid Waste Management*). This section provides a brief overview of the local laws related to SWM along the coastal corridor (particularly in Trujillo and Ica).

Lima

Within Lima, a key law which impacts SWM within Lima is its single-use plastic law designed to promote the adoption of reusable, recyclable, or biodegradable plastic products within the circular economy.[48] This law includes a requirement to incorporate rPET in the production of new containers and prohibits the consumption of non-reusable polymer-based plastic bags, plates, and other non-recyclable utensils.[49] This law helps to drive the need for recycled material in Lima.

Northern Coastal Corridor

Trujillo Province adopted its most recent provincial SWM plan in 2016 for the years 2016 to 2020, the province approved this under Municipal Ordinance No. 025-2016-MPT. There does not appear to be an updated municipal ordinance for more recent years.

Southern Coastal Corridor

Municipal Ordinance N° 009-2021-MPI

This Ica ordinance approved the formalization of recyclers and regulated the selective collection of solid waste in the province. The ordinance sought to provide protection, training, and promotion of social and labor development by establishing the obligations, functions, and responsibilities to promote segregation at the source and selective collection of solid waste.

Municipal Ordinance N° 009-2012-MPI

This Ica ordinance approved the provincial SWM plan in 2012 for the years 2012 to 2022. The purpose of this plan is to help decrease the negative environmental impacts that occur because of inadequate SWM.

Mayoral Resolution N° 456-2022-AMPI

Under this resolution, the Province of Ica formed a team to update the provincial SWM plan for the years 2023 to 2027. As of the date of this Report, the province has yet to complete and publish this new SWM plan.

[47] Law No. 30884 "Law that Regulates Single-Use Plastic and Disposable Containers," approved in 2018 by the Peruvian President.
[48] Law No. 30884 "Law that Regulates Single-Use Plastic and Disposable Containers," approved in 2018 by the Peruvian President.
[49] Baker & McKenzie, "Peru: New prohibitions come into force with regard to single-use plastics and disposable containers or packaging"

IV. ANALYSIS

When evaluating whether the corridors will be financially feasible, and what cities Peru can include in the corridor to Lima, it is critical to look at the transportation costs and amount (measured by weight) of recoverable waste. Other key variables to consider include: the cost of acquiring recyclables, the volumes, and transportation costs for shipments (e.g., tolls, driver fees, trailer usage, fuel), the total distance, and the sale price per unit weight to recyclers and manufacturers in Lima. There is also a need to consider the appropriate financial return each participant in the value chain will need to receive for the material for it to ultimately be recycled.

This analysis lays out the three key factors which impact the recycling value chain, these include:

- **Transportation** – The cost of transportation varies significantly dependent on the travel distance and consequently is a core factor in determining the potential profitability of recycling;
- **Purchase Price** – The ultimate purchase price of recycled materials impacts the level of profitability within each step of the value chain; and
- **Recyclable material supply and demand** – Improving recycling value chains along the coastal corridors hinges on there being both a stable and sufficient supply of recyclable material and demand from manufacturers for recyclable materials.

At present, no comprehensive datasets exist for transportation and purchase prices within Peru; consequently, the data provided within this section was obtained through interviews with Peruvian stakeholders and is intended to be illustrative. The PLUS team used the data obtained through interviews in addition to data from SIGERSOL to derive estimates for transportation, purchase price, and recyclable material supply and demand.

Based on the findings of these analyses, this section concludes with recommendations for the end points of the recycling Northern and Southern Coastal Corridors that will be best served to promote the recycling value chain.

Transportation

Given that almost all processing and manufacturing of plastic occurs in Lima, recyclable waste collected outside of Lima must ultimately be transported to Lima for processing or must find a reuse industry along the coast. The further away the waste is collected from Lima, the higher the transportation time and associated costs (e.g., fuel costs and labor); therefore, transportation distance costs for recyclables sourced from remote coastal cities are a significant factor in the overall profitability of recyclable waste in Peru. Longer transport distances to Lima often render such long-haul delivery as cost-prohibitive especially when some recycled waste can be brought to *acopiadores* for sale and re-sale as raw materials. As a result, waste haulers are incentivized to sell their products at the closest *acopiadores* that receive, condition, and sell their products. In a typical SWM value chain, the waste pick-up and transportation costs greatly outweigh the waste disposal and treatment costs.[50] As such, transportation cost is a key factor in the economic viability of the corridors.

As described above, the first step for waste microenterprises and recycler associations is to sell their waste by the kilogram to local formal or informal buyers. This represents the first point of commercializing recyclable waste as an initial price per weight is determined. Using smaller vehicles, these buyers usually transport these much smaller quantities to local *acopiadores*, which exist throughout Peru. Transporting across longer distances, for example to facilities that are more technologically advanced, is not always financially feasible. By virtue of their ubiquity and accessibility, local *acopiadores* are a critical step along the transportation chain. Waste transporters (including

[50] Gobierno de Mexico, "Medio Ambiente," *SEMARNAT 2023* https://www.gob.mx/semarnat. In Mexico, the pickup and transportation costs are more than double the cost of waste disposal and treatment costs (434 pesos/ton compared to 122 pesos/ton) across 167 municipalities including rural and urban areas.

EORs with hauling capacity or independent logistics and trucking companies) then work to transport the waste to Lima.

These companies commonly accumulate recyclable waste in warehouses until the volume is sufficient to justify transport to Lima and often wait to sell until they receive a market price that meets their profitability requirements to justify transport. PET, for example, is not typically transported until there is a full truck of 30 MT.[51] Since waste transportation is effectively a fixed cost (i.e., the transporter will face similar costs independent of the amount of recyclable waste transported), the higher the weight of the recyclable waste the more profitable the transaction is for the waste transporter because the plastic is also sold by weight.[52] For example, transporting polystyrene, while lighter, does not have the same value on the market from producers as PET for each truck load as it weighs significantly less than PET.

Along the coastal corridors, there is one primary mode of transportation, namely by truck.[53] The key factor which impacts overall transportation costs is the fuel costs and distances/travel times, which include fuel and labor hours/accommodation costs. Because of these costs, routes 500 km or less tend to be the preferred hauling distance. As a general rule, EORs that also have MINAM certificates to haul solid waste prefer the more profitable shorter distances within a department, or even municipality and are rarely involved in the long-haul shipment to Lima.

In Peru, transportation costs are largely determined by distance. As such, EORs with hauling capacity and trucking companies prefer shorter distances of approximately nine hours to ten hours (or approximately 500 km) or less versus more expensive long hauls.[54] Stakeholders noted this could be due the country's rugged terrain and poor road conditions, which can make transportation by truck difficult and cause unexpected delays for transportation and thus create additional costs. It merits further examination however, since transit is typically along the coastal Panamericana Highway, which is well-maintained and the best transportation road in Peru.

Table 7 shows the minimum travel time for a recycling truck to travel by road/truck from a given location (*i.e.*, corridor city) to Lima or Guayaquil, Ecuador for final recycling.

Table 7. Average travel time during the night for trucks to haul recyclables[55]

Districts North of Lima	Hours to Lima	Distance (km)	Hours to Guayaquil	Distance (km)
Chimbote	6	430	N/A	N/A
Trujillo	9	550	N/A	N/A
Chiclayo	13	770	11	690
Piura	15	990	8	480
Mancora	18	1,180	6	370
Tumbes	20	1,270	4	260
Districts South of Lima	**Hours to Lima**	**Distance (km)**		
Ica	4	300		
Nazca	7	450		
Ayacucho	10	560		

[51] PLUS interview, 2023
[52] While heavier loads use more fuel, this is not as big of a factor given the material is valued in weight. All financial calculations were done based on a truck with 30 metric tons of PET.
[53] The opportunity to transport waste by ship along the coast is not possible due to a lack of appropriate infrastructure in the local ports.
[54] 9 hrs was confirmed by multiple transportation companies as the farthest distance reasonable for transporting recycled plastic. One mentioned the same distance existed for plastic transport to Lima.
[55] Interview; distance information obtained through Google maps.

Ilo	21	1,072		
Tacna	23	1,220		
Arequipa	16	1,010		
Cusco	19	1,140		

Stakeholders confirmed that Trujillo, at 550 km and nine hours, is just at the limit of the maximum distance where the profitability is worth the level of effort required for the transportation. For the Southern Coastal Corridor, Ica and Nazca are within the nine to ten hour range for profitable transportation. Ica District (at 305 km and 4 hours from Lima) and large parts of Ica Province are close enough to the capital to make the transport economically feasible for three of the plastic waste types (PET, PP, HDPE) and some other recyclables like white paper and cardboard.

For some coastal cities in the North, from a distance perspective, it would appear as though Guayaquil, Ecuador is within a viable distance. However, based on the stakeholder interviews, there are security concerns in southern Ecuador, consequently transporting waste (e.g., PET from Northern Peru to Guayaquil) is not a regular practice.[56] There are also long lines at the border for the trucks which adds to the transport time. Despite these challenges, based on interviews with the transportation company Manuelita in Trujillo, some amount of plastic products are still exported to Ecuador. Ecuador currently has a PET return tax where 1 kg of PET receives approximately 1.8 Peruvian soles ($0.46 USD).[57]

Transportation costs include truck leasing/purchase, fuel, maintenance, staff costs (hourly fees/salaries, number of personnel, and food/hotel costs), associated risks (e.g., accidents), and insurance which is included in the 15-20 percent administrative fee.[58] The costs associated for the transportation of recycled material (in this example 1 kg of PET) are in the Table 8 below with details on the assumptions in Appendix B.

PET plastic is transported in Peru via trucks in 30 MT dual axel trucks, which is used to calculate the average cost to transport 1 kg of PET. The transportation cost of 1 kg of PET is under .20 soles for cities less than 10 hours from Lima. Transportation costs however increase significantly when the round trip exceeds one day of travel, as the drivers then require hotels, further emphasizing the need for transportation times below the nine to ten hour maximum.

The following tables approximate the costs at each step of the value chain from the cities in the Northern and Southern corridors based on data gathered and discussions with Peruvian recycling and waste transportation companies as part of the PLUS team's primary research. This data provides a baseline cost assessment, which this Report uses to assess economic feasibility for the coastal recycling value chains. As USAID Peru continues its analysis, it should continue to collect data on costs throughout the value chain, expanding the sample of available data.

[56] PLUS interview, 2023; San Diego Union Tribune, "Security in Ecuador has come undone as drug cartels exploit the banana industry to ship cocaine," September 2023 https://www.sandiegouniontribune.com/business/nation/story/2023-09-03/security-in-ecuador-has-come-undone-as-drug-cartels-exploit-the-banana-industry-to-ship-cocaine

[57] Primicias, "Las botellas de plástico PET se reciclan para ser transformadas en materia prima, ropa y hasta juguetes para mascotas," https://www.primicias.ec/noticias/economia/botellas-plastico-sri-precio-reciclaje/

[58] SEMARNAT 2023; Interviews with Trujillo transportation company Manuelita.

Table 8. Northern Coastal Corridor Transportation Costs to Lima via Truck[59]

Note: Costs in Peruvian soles

City	Hours	# of days	Cost of vehicle / day	Total cost of vehicle	Labor cost / day	Total cost labor	Distance (km)	Total fuel costs	Tolls	Trailer Fee	Total costs before admin cost	Admin cost (20%)	Total Cost	Transport cost 1 kg PET	Estimated GHG emissions (kg CO_2)
Chimbote	6	1	66	66	180	180	430	572	113	2,773	3,704	741	4,445	0.15	45
Trujillo	9	1	66	66	180	180	550	732	134	3,547	4,659	932	5,591	0.19	58
Chiclayo	13	2	66	132	180	360	770	960	174	4,966	6,592	1,318	7,910	0.26	101
Piura	15	2	66	132	180	360	990	1,200	238	6,386	8,316	1,663	9,979	0.33	126
Mancora	18	2	66	132	180	360	1,180	1,440	271	7,611	9.814	1,963	11,777	0.39	151
Tumbes	20	2	66	132	180	360	1,270	1,524	284	8,192	10,492	2,098	12,590	0.42	133

Table 9 Southern Coastal Corridor Transportation Costs to Lima via Truck[60]

City	Hours	# of days	Cost of vehicle / day	Total cost of vehicle	Labor cost / day	Total cost labor	Distance (km)	Total fuel costs	Tolls	Trailer Fee	Total costs before admin cost	Admin cost (20%)	Total Cost	Transport cost 1 kg PET	Estimated GHG emissions (kg CO_2)
Ica	4	1	66	66	180	180	300	360	48	1,950	2,604	521	3,125	0.10	32
Nazca	7	1	66	66	180	180	450	540	61	2,580	3,427	685	4,112	0.14	48
Ayacucho	10	1	66	66	180	180	560	672	87	3,612	4,617	923	5,540	0.18	59
Ilo	21	2	66	132	180	360	1,072	1,290	87	6,914	8,783	1,757	10,540	0.35	113
Tacna	23	2	66	132	180	360	1,220	1,464	100	7,869	9,925	1,985	11,910	0.40	128
Arequipa	16	2	66	132	180	360	1,010	1,220	110	6,514	8,336	1,667	10,003	0.33	106
Cusco	19	2	66	132	180	360	1,140	1,360	92	7,353	9,297	1,859	11,156	0.37	120

[59] PLUS interview, 2023

[60] PLUS interview, 2023

Purchase Price

There is a lot of variability in recyclable material prices, both across recyclable material categories (e.g., paper and plastic) and within each category during the year and from year to year. In an interview with a recycler association in Trujillo, the association noted that last year they did not yield sufficient revenues to cover costs because of market prices and the fact that the municipality did not provide subsidized vehicles that year.

It is difficult to get independent financial data across the value chain, but several Peruvian recycling industry stakeholders shared their cost figures with the PLUS team help to provide visibility into the slim margins for recycling and the constraints that transportation across long distances causes for the economic feasibility of recycling across the Northern and Southern corridors. Further analysis for each waste stream will be necessary as part of an economic feasibility study for decentralizing recycling infrastructure in Trujillo.

The following sections arrive at an estimate for the manufacturing purchase price of rPET and compare this price to the cost of virgin PET in Table 10. The cost of virgin PET is effectively the maximum price which rPET can be before it is no longer economically feasible to recycle PET.

Revenues Generated Across the Value Chain

The waste collectors/recyclers at the bottom of the value chain are currently making very little money – on average they can sell PET for 0.50 soles per kg. The first *acopiadores* sorts and compacts the plastic and sells to either a second *acopiadore* or to a transportation company for 0.80 soles per kg. Using the Manuelita example (based in Trujillo), Manuelita functions as the first *acopiadore* and transporter for PET from Trujillo to Lima. There is a second *acopiadores* in Lima that processes and conditions the PET, further chopping and transforming it into pellets, and finally selling it to manufacturers of bottles and other plastic products including PET bricks. The second *acopiadores* sells it for approximately 1.50-1.80 soles per kg.[61]

Given this, the manufacturer purchase price ("Manufacturing purchase price" in Table 10 below) is between 1.9 and 2.22 soles depending on which city it is being transported from across the corridors. The manufacturer purchase price is the sum of the costs across the value chain (recycler costs, first *acopiadores* cost, the cost to transport and the second acopiadores cost) and is the purchase price at which the manufacturers of rPET in Lima would have to buy the recycled raw material inputs so average returns are achieved at each step. This manufacturer purchasing price will then have an added cost for the final processing of the PET into rPET ("Cost to manufacture into rPET" in Table 10). This cost to manufacture the rPET in Peru is unknown at this time.

Virgin PET

One key challenge in the recycling value chain is making the business case for the acquisition of rPET over importing virgin PET. Several factors impact the choice to import virgin PET or to use rPET; these include but are not limited to: 1) The cost of competing raw materials and virgin PET import prices (as Peru imports all PET currently); 2) the quality, quantity, and yield of the recyclable material collected; 3) costs associated with collection, transportation, sorting, cleaning, and washing; and 4) the diversity of end uses for the materials.[62]

It appears that there could be a natural price-based incentive to promote the use rPET instead of virgin PET, but without information on the specific costs to process or manufacture rPET in Peru it is not feasible to formally establish what the total cost is to produce rPET in Peru compared to imported virgin PET. The global price of virgin PET is based on market conditions that drive PET supply and demand in addition to input costs that come mostly from oil. It is therefore beyond the control of the GOP or private sector in Peru to some extent. If there is an increased legal

[61] PLUS interview with PET brick manufacturer, Ecoladrillo.pe
[62] "The Bausano world, to always stay in touch." https://www.bausano.com/en/press-and-news/the-economics-of-pet-recycling

requirement on the amount of rPET required in certain materials, that would increase demand and drive the need to increase collection/supply of rPET.

Other global trends point toward possible shifts away from virgin PET. Currently, globally, the cost of virgin PET is cheaper than rPET. As the costs of rPET decrease below those of virgin PET, the economics of the raw material will help to encourage shifts away from virgin PET. A 40-cent U.S. spread between the tow has remained consistent since 2016 despite shocks to the market, such as the global pandemic, supply chain disruptions, and fluctuations in petrochemicals. Market data suggests that an 'indifference point' for buyers might be reached at a per pound cost of 50 cents, assuming processing, conditioning, and other costs remain unchanged.[63] Controlling for other non-market factors like corporate sustainability and achieving recycling goals, buyers' preferences for virgin over rPET begin to soften at this price. Translated into the Peruvian market, the PLUS Team estimates that 5.67 soles/kg for rPET could begin to discourage buyers from using virgin PET. Currently, the LATM market price of 4.56 soles/kg for virgin PET means that it is still attractive to use virgin PET over rPET in Peru.

Table 10 below includes the Latin American (LATAM) PET price, which is the average regional virgin PET price that PET trades on the open regional market. This is not the Peruvian average landed virgin PET price, but serves as a regional example. The last column shows the difference between the LATAM average PET price and the manufacturer purchasing price ("Difference in LATAM price & manufacturing price" in Table 10). This illustrates the maximum price that the cost to manufacture can be before it is no longer economically feasible to transport the PET raw material to be recycled. When looking at decentralization strategies to bring plastic manufacturing to Trujillo or other cities outside of Lima, understanding this price and whether plastic materials can be manufactured for less than currently in Lima (minus the cost to transport) is critical.

[63] Recycling today, "The economics of PET recycling." February 2017 https://www.recyclingtoday.com/article/the-economics-of-pet-recycling/

Table 10. Value chain costs (soles) for PET (1 kg) for coastal cities

City	Recyclers cost (a)	First acopiadores cost (b)	Transport cost (c)	Second acopiadores cost (d)	Illustrative Manufacturing purchase price (a+b+c+d)	Cost to manufacturing into rPET	LATAM PET price[64]	Difference in LATAM price & manufacturing price
Tumbes	0.50	0.30	0.42	1.00	2.22	N/A	4.56	2.34
Mancora	0.50	0.30	0.39	1.00	2.19	N/A	4.56	2.37
Piura	0.50	0.30	0.33	1.00	2.13	N/A	4.56	2.43
Chiclayo	0.50	0.30	0.26	1.00	2.06	N/A	4.56	2.50
Trujillo	0.50	0.30	0.19	1.00	1.99	N/A	4.56	2.57
Chimbote	0.50	0.30	0.15	1.00	1.95	N/A	4.56	2.61
Ica	0.50	0.30	0.10	1.00	1.90	N/A	4.56	2.66
Nazca	0.50	0.30	0.14	1.00	1.94	N/A	4.56	2.62
Ayacucho	0.50	0.30	0.18	1.00	1.98	N/A	4.56	2.58
Ilo	0.50	0.30	0.35	1.00	2.15	N/A	4.56	2.41
Tacna	0.50	0.30	0.40	1.00	2.20	N/A	4.56	2.36
Arequipa	0.50	0.30	0.33	1.00	2.13	N/A	4.56	2.43
Cusco	0.50	0.30	0.10	1.00	1.90	N/A	4.56	2.66

[64] Mike price indices, PET (Polyethylene Terephthalate) price index, https://businessanalytiq.com/procurementanalytics/index/pet-price-index/

The required manufacturer purchase price for recovery of the costs of the value chain are 1.99 soles/kg from Trujillo, 1.95 soles/kg from Chimbote, 1.90 soles/kg from Ica, and 1.94 soles/kg from Nazca, which is not that much higher than that 1.84 Peruvian soles benchmark in Ecuador. As a comparison to these value chain costs, there is a highly effective PET bottle return program in Ecuador where companies/individuals receive of 1.84 Peruvian soles ($0.46 USD) per kg of PET.

Environmental viability

For environmental viability, the PLUS team included information on the long-haul transportation GHG emissions based on estimates of grams of GHG (i.e., carbon dioxide equivalent) generated per km driven by heavy trucks (per Table 10). Other environmental viability considerations related to air pollution from the manufacture of the plastics should also be considered, but would exist no matter where the plastic production facility is located. On the other hand, if GHG emissions considerations drive GOP and USAID programming decisions, they should focus more on decentralized reuse production processes to both decrease transportation emissions and plastic production emissions.

Recyclable material supply and demand

Quantity of recyclable material

Recycling companies (*acopiadores* and intermediaries), especially those that are formalized, exist along the coastal corridors in the cities that have large enough volumes of inorganic waste to generate an economic return. Large quantities of recyclable material are especially critical for long haul shipping to Lima as trucks will not drive to Lima without a full load (i.e., 30 MT of PET). As such, this analysis is focused on the bigger cities along the coast that can act as hubs for larger quantities of waste.

Acopiadores can also invest in better equipment the larger the quantities of recyclable materials and the greater number of transactions occurring in the marketplace. This equipment is critical to help to increase the value of the product and thus increase the revenue and margins for the *acopiadores* and recycling companies which helps them to expand operations. Manuelita shared that even adding washing capabilities at their facility in Trujillo will help to increase margins and economic viability by reducing the number of value chain participants their product must go through before it reaches the manufacturer. Adding additional value add steps, such as washing, is becoming an increasingly attractive investment because of the larger amounts of recyclable material being collected in Trujillo by the increase in associations and increased market demand due to the law requiring recycled plastic in new products.

Table 11 shows the inorganic waste generated and recovered (through recycling or reuse) across the northern and southern potential corridors. Inorganic waste is used as a proxy to highlight the waste that can be potentially recycled and thus the potential market size along the corridor for recyclables and reuse. The volume of recyclable waste produced within these cities is a significant factor for USAID to consider as it begins to prioritize SWM assistances along the coastal corridors.

Table 11. Corridor inorganic waste and recovery[65]

Geography	Inorganics generation (MT/year)	Inorganics recovered (MT/year)	Inorganics recovered (%)
Lima Department	835,512	39,342	4.71%
Lima Province	785,155	37363	4.76%
Lima District	19,742	1,031	5.22%
Callao District	64,346	3460	5.38%
La Libertad Department	124,734	4,084	3.27%
Trujillo Province	90,408	2871	3.18%
Trujillo District	23,726	894	3.77%
Tumbes Province	13,963	245	1.75%
Mancora District	774	0	0%
Piura Province	83,728	3,114	3.72%
Chiclayo Province	57,542	2,058	3.58%
Chimbote District	22,003	800	3.64%
Cajamarca Province	30,684	1,036	3.38%
Ica Department	61,115	2,361	3.86%
Ica Province	29,218	961	3.29%
Ica District	14,287	428	3.70%
Nazca Province	4,320	210	4.88%
Ayacucho District	5,783	285	4.93%
Ilo Province	3,669	203	5.54%
Tacna Province	19,219	755	3.93%
Arequipa Province	64,961	3,244	4.99%
Cusco Province	22,375	2,060	9.21%

Trujillo is a compelling city to look at from a potential recyclable material perspective given it is the second largest city by population along the coastal corridor after Lima. Lima Province produced 785,155 MT/year of municipal inorganic waste and recovered 4.76 percent (37,373 MT/year). Trujillo Province is the second largest producer of waste along the coast at 90,407 MT/year. The next largest region along the corridor is Piura Province and then Chiclayo Province for the north. For the south, Arequipa has the largest volumes after Ica Province.

Inorganic material makes up 26.8 percent of the waste stream at the La Libertad Department level, 28.14 at the Trujillo Province level, and 27.66 at the Trujillo District level. These percentages exceed the national estimated average of 20.94 percent, further emphasizing the need to address recyclable SWM in Trujillo. In addition, Trujillo has large quantities of industrial and other commercial waste. The province, however, does not track non-municipal waste data, therefore no official data is available for the generation of commercial/industrial waste. The SIGERSOL database does contain, however, information on the volume of waste from some large contributors of non-household waste in Trujillo as shown below. These can function as a proxy for non-municipal waste volumes. Given the large industrial center of Trujillo, commercial waste and partnerships with commercial waste producers will be important for recycling solutions in Trujillo.

[65] MINAM, "SIGEROL," October 2023

Table 12. Origins of non-household waste for Trujillo Province (2022) [66]

Origin of non-household waste	Amount (kg/day)	MT/year	Potential Recyclable material (25%) MT/year
Street Sweeping	230,945	84,295	21,074
Commercial Establishments	17,868	6,52	1,630
Restaurants	12,412	4,530	1,133
Hotels	1,809	660	165
Educational Institutions	19,477	7,109	1,777
Public and Private Institutions	4,351	1,588	397
Markets	25,684	9,375	2,344
Total	**312,546**	**114,079**	**28,520**

More than 7,000 MT/year of waste comes from non-residential and non-street sweeping that is measured as part of MSW. This does not include the individual commercial contracts companies in Trujillo have with EORs. Given that the level of inorganic consumption exceeds the average in Peru and the quantities of potential recyclable material are large in comparison to other cities, Trujillo will be an important city for the Northern Coastal Corridor.

More challenging to quantify but important for future action is political will. Political will for improving SWM and recycling is an important factor for achieving the recyclable collection rates. In this way, in underpins the quantities required for recycling operations and circular economy.

Market size

In estimating the market size, the PLUS team developed estimates of both demand and supply below.

Supply: Using the national average of 9.3 percent of municipal waste coming from plastic,[67] then Trujillo Province's municipal plastic waste is approximately 8,400 MT/year. This is a small percentage (3.5 percent of 236,750 MT/year) of the quantities needed to meet the national plastic demand. Collection of municipal recyclable waste with industrial waste will be important to meet the demand and create a steady market for recyclable material reuse.

Demand: In 2019, industries in Peru used approximately 947,000 MT of plastic each year.[68] The PLUS team here assumes an extreme example that all of this plastic is manufactured locally and thus needs imported virgin plastics or recycled plastics. If producers have to include 50 percent recycled plastic in all new production, the market need for plastic resin (e.g., rPET) would be 473,000 MT/year; if 25 percent, then 236,750 MT/year. The main PET manufacturer in Peru, Pamolsa, already includes 50 percent rPET in all new bottles produced at its recycling plant (See the *PLUS Peru National Assessment on Solid Waste Management* for more details).

Recommended Corridors

Northern Coastal Corridor

Based on primary interviews and the initial analysis above, the PLUS team found that Trujillo is the most northern city for the northern recycling waste corridor connecting formal and informal

[66] MINAM, "SIGERSOL."
[67] CCBO Initial Solid Waste Management Assessment Peru, 2021, https://pdf.usaid.gov/pdf_docs/PA00XWPM.pdf; This includes PET and hard plastic and bags.
[68] The Borden Project, "Peru passes law to cut use of single-use plastics," October 2019, https://borgenproject.org/peru-passes-law-to-cut-use-of-single-use-plastics/; Given this is a 2019 number, the PLUS team assumed that the plastic demand has increased, except potentially for 2020 and 2021 due to COVID. APIPLAST, "La Industria Plastica Peruana Camino Al Modelo De Economia Circular" , 2023 shared that Peru produced approximately 1.4 million MT of plastic (using 2019 - 2021 numbers).

recyclable collectors in coastal hubs to the recycling processors in Lima. The value chain of the most profitable plastic waste types (i.e., PET, PP, and HDPE) does not support transportation from north of Trujillo to Lima as supported by the transportation cost analysis included in this Report.[69] For example, while Chiclayo, Piura and Tumbes have higher rates of waste separation and thus are attractive markets for recycling collection, but they are north of Trujillo. As such, it is challenging for companies located there to cover the transportation costs to Lima, as that transportation typically takes two days. There could be export opportunities for the northern cities to Ecuador, should political and security conditions change.

Southern Coastal Corridor

The proposed Southern Coastal Corridor is recommended to end in Ica Province, with the Nazca District as the last economically viable municipality. The volume of inorganic waste generated in Nazca District is considerably less than Ica District (7,831 MT/year) and the PLUS team does not have any details on the waste collection infrastructure, which USAID would have to explore further. Given the limited amount of waste in Nazca, it might make sense for recyclable waste to be transported to Ica District *acopiadores* for conditioning without an emphasis on infrastructure advancement in Nazca, but rather focus in Ica instead.

The cost to transport recyclables to Lima from other southern cities does not allow for cost recovery because the distances are too long. Unfortunately, there are no opportunities to potentially export product from southern cities into neighboring countries (Chile and Bolivia) as they do not have recycling and plastic processing capabilities in the cities near the southern border.

The three other large cities in the Southern Coastal Corridor, Arequipa in the lowland zone (at 1,020 km or 17 hours by truck from Lima), Ilo (at 1,080 km and over 18 hours from Lima), and Tacna (at 1,225 km and over 20 hours from Lima) are too far from Lima to make the transportation of recyclable plastics economically feasible since the collection and transportation costs per MT are higher than what the recyclers in Lima are willing to pay per MT (demonstrated with PET example in Table 10 above).

There may be potential for an economic recycling solution for the cities south of Ica and Nazca; however, this would require either 1) subsidization of the transportation costs to cover the distances to haul the material or 2) a decentralization approach to plastic processing.

The tourist city of Cusco in the southern Andes (at 1,100 km and over 20 hours), even with high quantities of valuable plastic waste (22,375 MT inorganic waste), is too far away (more than 9 hours) from the recyclers in Lima to make the transportation feasible. The municipal government of Cusco is exploring the development of recycling infrastructure in Cusco to manage tourist waste volumes.

[69] There is some recyclable material from Chiclayo and cities north of Trujillo that arrives in Trujillo for transport to Lima, but this is not delivered on a consistent basis, and is considered by the recycling company in Trujillo, Manuelita, as one-off occurrences due to the cost for transport north of Trujillo to Lima.

V. Opportunities for Advancement of the Corridors

This Report provides a list of measures to address a lack of recoverable MSW recycling in the coastal corridors using various national and local levers. The Report focuses on the recycling elements of the coastal corridor, not the national recommendations that could have large impacts on the country as a whole. Applying all or a subset of these recommendations could contribute to strengthening of the Northern and Southern Coastal Corridors and contribute to an increase in recycling in the coastal cities.

There are multiple opportunities/levers to advance development and increase recycling along the coastal corridors. Some of these opportunities could be quick wins, introduced with relatively low effort through replicating other initiatives that have proven to be successful through existing programs. These have the potential to create a tangible impact in a relatively short timeframe. Other opportunities should be part of a longer-term vision for waste management in Peru and will require coordinated effort across various stakeholder groups to introduce an effective waste management system along the coast.

Both Corridors Opportunities

The PLUS team recommends that overall, the focus on developing the corridors should be on the North starting with Trujillo and then working south to Lima based on the cities with the greatest quantities of potential recyclable material. The focus should be on supporting Trujillo to improve collection and intermediary processing for transport to Lima and then transitioning to a decentralized model where additional plastics processing is added in Trujillo. In the South, the corridor can include the southern city of Ica province, Nazca. Expanded work in Ica, where USAID is already working in Pisco district, can provide important recycling quantities for transport to Lima. A focus on decentralization of recycling processing in Ica is less urgent, given the transportation costs are lower than for Trujillo.

Coordinate municipal SWM planning activities across coastal corridors (short-medium term)

Currently the planning for SWM is done by district and province. However, it is critical for there to be planning that occurs at the corridor level, looking for opportunities to bring together districts, provinces and departments (where applicable) to design a circular economy SWM system that is more economical and supports the GOP goals for decreased waste along the coast. **MINAM should establish a mandate to integrate corridor planning into the municipal planning requirements.** Through this planning process, municipalities can assess information around current infrastructure and make it available to the private sector and public sector for investment decisions. Additionally, MINAM may want to consider promoting the development of EOR or recycling concession agreements which cross municipal lines.

Improve technologies at *acopiadores*/aggregation facilities to increase quantity of recyclable materials along corridors (short-medium term)

Municipalities and the private sector should promote the creation of larger facilities that enable stacking, storage, and conditioning of recyclable material in the provinces to accumulate a greater quantity of recyclables to transport to Lima. To achieve more efficiency, the waste should be conditioned (e.g., pressed, washed, chopped) before transportation. This approach could enhance direct sales with the industry, improving the sales price and giving security to recyclers with longer-term contracts. This, in turn, could help with consolidating and obtaining loans to improve recycling association and *acopiadores* (aggregation center) processes. It will be important for the *acopiadores* to allow for storage of recyclable material until the volumes reach levels where collection becomes feasible and price for collection is economical. The more steps that can be completed with the least number of entities that the product must change hands

through, the more cost effective it is to get the recyclable material to the manufacturer. Any opportunities to increase capabilities of the *acopiadores* will help to reduce the cost for recycling.

Work to organize and adopt new technologies to decrease transportation costs (medium term)

Despite the challenges and high transportation costs to transport materials from cities in the north to Lima, the private sector has been working to improve transportation opportunities for recyclable material. Plastic recovery organizations in Lima and transportation companies in Trujillo noted that waste recovery companies have been traveling to the provinces to find material suppliers using direct marketing to obtain a better price from intermediaries. In addition, intermediaries are looking to optimize recyclables transport costs by carrying more than one type of recyclable material in each truck. **As the demand for recycled plastic in new production increases, based on the law requiring 15 percent recycled plastic in new products, the cities within the Northern and Southern Coastal Corridors need to organize to establish contracts, schedules, and plans for the supply of recyclable materials to the larger plastic manufacturers.** Currently, the intermediary/transportation companies are not interested in greater organization or greater transparency in supply to the industrial companies as it would remove direct negotiation control. Longer term contracts however can potentially provide some price security, motivating collection and continued investment in recycling equipment.

Additionally, some *acopiadores* interviewed in Trujillo and Lima are **investing in new technologies and equipment** that can help to improve the efficiency of the recycling and transportation process, such as **investing in the purchase of larger balers** that allow more material to be compacted and transported in each trip. Investment in this equipment will be critical to improving the economics to motivate more organizations to transport waste to Lima. Similar to *acopiadores* interviewed in Lima, additional investments can be made in **machines to condition waste such as mincers and other innovative machines to process waste** which would reduce the quantity of unusable materials shipped to Lima.

Support to formalize and increase the number of waste collectors and recycling associations in Trujillo and Ica (short-medium term)

To successfully scale and increase volumes of recovered inorganic waste for recycling, a larger number of waste collectors and recyclers is required. In Ica and Trujillo, inorganic waste recovery rates are around 3-4.5 percent, much lower than market potential and closer to developed country levels of 20-30 percent (current U.S. levels).[70] There is a need to build out the waste collector infrastructure, with an emphasis on women's organizations and formal associations. In many provinces (e.g., Ica and Piura) women comprise the majority of IWCs, this trend is likely also present across the corridor cities.[71] In Trujillo, the PLUS team interviewed the Asociación de Recicladores Forjando un Mundo Mejor (ARFUMM), the women's association that works in the broader area around the El Milagro dumpsite.[72] Membership in ARFUMM is down from 23 members in 2016 to only three members when PLUS conducted fieldwork in April 2023. The decline in membership can be attributed to several factors including the economic instability of the recycling market, safety concerns from working in the dumpsites, and a lack of vehicles to transport waste. One of the main limitations for ARFUMM members is the lack of land and vehicles for waste collection, as the municipality no longer provides vehicles they previously loaned to the Association. Due to the subsequent reduction in membership, ARFUMM can only collect a third of a truck full of waste per day (i.e., approximately 1.5 MT of PET plastic, other hard plastics, cans, glass, cardboard, film, and paper). When ARFUMM had 23 members, they were able to collect 5 MT per day. In an August 2023 registration drive to formalize recyclers at the El Milagro dump in Trujillo they found 26 waste

[70] US EPA, "America recycles Day, November 2022, https://www.epa.gov/circulareconomy/america-recycles-day#:~:text=The%20recycling%20rate%20has%20increased,and%20%2437.8%20billion%20in%20wages.
[71] Tetra Tech,"Clean Cities Blue Ocean Initial Solid Waste Management Assessment," USAID.gov, 2021, https://pdf.usaid.gov/pdf_docs/PA00XWPM.pdf.
[72] The recycler associations are formalized when they are registered in the local municipalities; however, there is no national database that consolidates this information, nor is there a database of informal recyclers. There are other similar women's associations such as well-known "Mujeres Ecosolidarias" in Arequipa.

collectors already in the process of formalization and registered 116 informal waste collectors.[73] These types of municipality initiatives to formalize more waste collectors should continue.

Trujillo and Ica provinces should consider the development of a program to formalize IWCs into associations and support associations to build out their transportation and safety equipment which would help to increase recyclable material collection volumes and be the first step in an important value chain for recycling processing along the corridors. There may also be opportunities to increase the women led associations involvement up the value chain, where they also manage and/or own equipment for cleaning and baling waste, own the transportation companies, and/or own the recycling processing. The further down the value chain the more financial capital is required, and more capacity building and financing would be necessary to support the association advancement. USAID has successfully run programs in other countries providing equipment for women-led associations (e.g., in Indonesia and the Philippines). USAID has yet not supported these associations to buy more large-scale recycling equipment or plastic manufacturing plants (likely due to the scale of capital required), but the opportunity exists to do so.

Introduce more private sector or public-private partnerships for waste collection (short-medium term)

Waste services along the Northern and Southern Coastal Corridors are predominately owned and operated by the municipality and depend on municipalities to finance their own operations.[74] In Trujillo and Ica, there are private EORs, and other private entities in the collection value chain, but further planning and then contracting using results-based contracts should be instituted with improved separation of waste and recycling as the goal. Currently, many of the EORs are less focused on material recovery, and do not have incentives for higher recycled material recovery. As is recommended above, working to formalize the associations is the first step, but then working to expand their operations beyond collection to be registered EORs will be critical for the build out of the value chain along the corridors. **Municipalities along the coastal corridors should consider establishing results-based contracts with EORs which incentivize them to increase recycling rates through partnerships with recycling associations. Municipalities can also work with recycling associations and waste collection associations to formalize them as EORs and expand their capabilities through equipment increases and expansion of responsibilities.** The privatization of the SWM services could create more cost-effective and efficient programs since it was identified that success is directly correlated to the ability to generate enough capital to finance the activities.[75] The public sector can be used to share information and help with behavior change programs, and the private sector can focus on improving performance and efficiency.[76]

Engage with Transportation Companies (medium term)

The GOP has signed several public private partnerships with private companies to operate certain sections of the coastal corridor roads. The GOP should explore the possibility of working with the operating companies to provide toll-free passage to recyclable material transporters to make transport costs cheaper. These private companies must generate income to recoup their costs and

[73] Servicio de Gestión Ambiental de Trujillo, "Primer Encuentro de Recicladores Hacia la Formalización - 27/08/23" https://www.youtube.com/watch?v=Ipm5BTohR8g

[74] Research studies from Debnath's research on Resources, Conservation, and Recycling (Somnath Debnath, "Exploring full cost accounting approach to evaluate cost of MSW services in India." February 2014, https://www.sciencedirect.com/science/article/abs/pii/S0921344913002735?fr=RR-2&ref=pdf_download&rr=818d624318194587) determined that in developing countries Bangladesh, Greece, India, Malaysia, South Africa, and Taiwan have similar approaches to handling their waste, and therefore similar barriers to success. These developing countries utilized a conventional approach to handling their waste, had limited financial partnerships with private companies, and increased negative social externalities due to their inefficient waste management systems (Mei Gechlik, "Making Transfer of Clean Technology Work: Lessons of the Clean Development Mechanism." 2009, https://heinonline.org/HOL/LandingPage?handle=hein.journals/sdintl11&div=10&id=&page=)

[75] S. Davies, "UK Municipal Waste Management: From Public Service to a Globalised Industry." Volume 11, Issue 1, 2007.

[76] Benjamin Bolaane, "Privatization of solid waste collection services: Lessons from Gaborone." March 2015, https://www.researchgate.net/publication/274260621_Privatization_of_solid_waste_collection_services_Lessons_from_Gaborone

make a return for investors and have little incentive to support such an initiative. However, the **GOP could include clauses in concession contracts that require private companies to be an active part of coastal recycling corridor transportation initiatives and support reduced toll costs for recycling sector participants including transporters. In return for this participation, they could receive stability incentives or some other fiscal incentive from the municipal or national government.**

Northern Coastal Corridor Opportunities

Improve SWM collection in Trujillo, adopting similar practices by CCBO (short term)

To support the increase in the collection of inorganic waste that can be recycled, there will need to be improved SWM in Trujillo. The program that USAID CCBO has implemented in Piura around citizen awareness and behavior change campaigns, improved collection and support to municipal authorities as well as support to IWCs to transition to formalized associations. These will all be important components of a comprehensive SWM program that should be undertaken in Trujillo**.** In addition, improvements in waste collection infrastructure are required to decrease leakage until the comprehensive SWM program can be established. Currently in Trujillo, the El Milagro dump is a large source of leakage, which the GOP should be working to upgrade. There is another sanitary landfill called Cumbre, which the GOP should be working to expand. While the GOP has started to take steps to improve the landfill challenges in Trujillo, the Trujillo province needs to accelerate this transition as it is a leakage point for recyclable material.[77]

Expand recycling processing and support facilities outside Lima – pilot in Trujillo (long term)

At present, there are scarce recycling facilities beyond Lima and there are no large-scale plastic processing and manufacturing facilities along the corridors outside of Lima. **MINAM should conduct further studies to gauge private sector interest and required government support to establish plastic processing and manufacturing capabilities in the Northern Coastal Corridor's economic hub of Trujillo.** Specific consultations with the largest industry players in Trujillo and APIPLAST (the Peruvian Association of the Plastics Industry) Circular Economy Commission should engage members to consider operations outside of Lima. Given the large role that Pamolsa is playing in recycled packaging, they should also be consulted about their interest to expand to Trujillo.

The PLUS team selected the economic hub of Trujillo as a pilot for decentralized recycling because it produces large quantities of inorganic waste and has industries that could provide circular economy opportunities. Trujillo has a large volume of industry, including food and beverage production, which makes it an ideal locale to examine opportunities for packaging manufacturing. At an industrial level, Trujillo has many companies that produce leather and footwear products, and it is an important agro-industrial hub. Trujillo is also within economic transportation distances for other inorganic waste production cities of Chiclayo (211 km, 4 hours) and Piura (429km, 6.5 hours), which could provide additional quantities for recycling in Trujillo. In addition, it already has some recycling collection and transportation capabilities, which USAID and GOP can use to build on and expand the recycling capabilities of the city.

This decentralized approach will also require the expansion of material recovery/washing/sorting enterprises to support the supply of materials for processing. While there are some of those types of companies discussed in this Report, there is limited infrastructure in Trujillo for supporting large-scale increases in plastics recycling volumes.

If plastics and other recyclable material manufacturers were established in Trujillo, it will be important for recyclable material to be transported to Trujillo to augment the quantities produced there. Trujillo could function as a recycling hub for the surrounding cities, including Chiclayo, the

[77] Price Waterhouse Coopers, "Concept Note, Trujillo, Perú." October 2018, https://cdkn.org/sites/default/files/files/Concept-Note-Trujillo.pdf

fourth largest city in Peru; Piura, which has a dedicated USAID CCBO program; and Chimbote, another major city south of Trujillo. All these cities could contribute greater recyclable waste quantities to the sector, which would make the pilot more attractive. Mancora could potentially also provide material to Trujillo, as it is a little more than 9 hours north of Trujillo. The PLUS team's analysis on transportation costs indicates that Tumbes is too far north to economically transport recyclable waste to Trujillo.

Table 13. Average travel time during the night for trucks to haul recyclables to Trujillo[78]

Districts North of Lima	Hours to Trujillo	Distance (km)
Tumbes	11.5	713
Mancora	9.25	607
Piura	6.5	429
Chiclayo	3.75	211
Chimbote	2	130
Cajamarca	5.75	300

To increase recyclable material recovery and supply to Trujillo, the GOP may want to prioritize capacity building for the Trujillo district and province, and also Chiclayo as one of the largest closest cites. It has been noted in a few studies that there are numerous challenges and that local government buy-in has not been as consistently focused on improved SWM in Chiclayo.[79] Given Chiclayo is too far north for recycled material to be transported to Lima, there is limited incentive for recyclable collection currently. A recycling facility in Trujillo could help to provide motivation to improve waste collection in Chiclayo.

While Trujillo is the largest city outside of Lima in the Northern Coastal Corridor and opportunities exist to decentralize recycling infrastructure and recycled material manufacturing, Lima Province's inorganic waste is almost 8.5 times larger than Trujillo province's waste volumes. Given this, a decentralized recycling market in Trujillo, if pursued, would be much smaller than the market in Lima and would need to be directed at the industries in Trujillo that need the recycled materials and where the best circular market potential lies.

Government incentives to private companies to decentralize business models (long term)

To support the pilot in Trujillo mentioned above, the municipal government will need to work closely with the private sector to identify the incentives required to open a processing facility in Trujillo. The private sector will need to have confidence that the collection rates in Trujillo and surrounding cities will improve, and that the waste streams for their processing will be easy to manage. This will take considerable work and will need to occur as part of a phased approach, where the first step includes improved municipal recycling rates where recyclable material is transported to Lima, and then eventually to establish new processing facilities in Trujillo. In addition, **the GOP will need to work with private industry to understand what tax or other subsidy incentives they will need to provide to support the movement of some of the plastic production industry to Trujillo.**

Explore opportunities for Trujillo reuse pilots (long term)

Some companies in Peru are starting to look at reuse business models. Most of them have been started in Lima where the largest population is, and the distance between collection and production is closest. Reuse business models need a decentralized system to be successful, given the

[78] Interview; distance information obtained through Google maps.
[79] Carlos Arteaga et al, "Solid waste management and urban environmental quality of public space in Chiclayo, Peru." https://www.sciencedirect.com/science/article/pii/S259025202300014 4

transportation costs are even greater given the material cannot be compacted for transport. As such, for reuse business models to be encouraged and successful outside of Lima, there should be more cleaning and reuse processing facilities outside of Lima as well. The increase in recycling infrastructure, and commitments by companies in Trujillo for recycling should help to introduce reuse options and be a good city to pilot such approaches outside of Lima. **The GOP should conduct a market study on potential reuse pilots in Trujillo including potential reuse market size and discuss, with companies, potential commitments they would be willing to make to recycling and reuse in Trujillo**.

Determine short term circular economy and recycling export for farthest north cities (short term)

Given the cities north of Trujillo do not have economically viable transportation options to bring their recyclable material to Lima, there are should be a study to explore exporting waste to Ecuador, even though market players shared that it is not currently the desired market and there is very little regular transport there given recent safety concerns. Ecuador is a large importer of recycled plastic from locations further away than Peru. If Peru sold materials to Ecuador at a lower prices than the United States, Mexico, and Dominican Republic, then it would incentivize Ecuador to purchase those from closer markets. Especially if oil prices are high, having closer and more diversified sources of waste would be beneficial for Ecuador.[80] Thus, **northern cities such as Tumbes and Piura should look at immediate opportunities for export of recoverable waste to Ecuador until recycling infrastructure can be established in Trujillo.** In addition, the cities should look at **supporting potential less capital-intensive circular economy business models such as the manufacture of PET bricks** or manufacture of bricks with other plastic inputs. This allows for the reuse of materials directly from the *acopiadores* and does not require the transport of the recyclable material to Lima. The CCBO report discusses circular economy opportunities, and these should be supported to build the markets for reuse until decentralized recycling facilities are built in Trujillo.

Southern Coastal Corridor Opportunities

Continue technical assistance support to Southern Coastal Corridor (short-medium term)

According to Lima recyclers, the Southern Coastal Corridor through Ica provides larger quantities of recyclables than the stream from the North where Chimbote, Trujillo, and Chiclayo send limited shipments.[81] The PLUS team determined that the Ica-Lima Corridor is economically feasible given the transportation analysis above and confirmed this analysis through discussions with key stakeholders in Ica, including municipal officials. The Southern Coastal Corridor is shorter, and therefore cheaper, and more feasible to haul recyclables within the Ica Department.

As such, **USAID and the GOP should continue to support the development of SWM programs in the Ica Department expanding out from the current work in Pisco.** As evidenced in the CCBO *Initial SWM Assessment* report, there is a growing volume of inorganic waste in the Ica Department and opportunities for continued recycling and transport along the corridor to Lima for processing.

Ica City is four hours from Lima by truck, within the distance of economic feasibility allowing recyclables collected in Ica to be transported to Lima for processing. Currently, the value chain and profit for plastics (i.e., PET, HDPE and PP) is greater than for glass and tetra pak, and **thus there is a need to work to increase the market uptake of other recyclables in Lima to sustain recycling across all products collected in Ica.** Even though it is a short distance between Lima and Ica, glass and tetra pak are not currently attractive financially to be transported at current volumes (according to recycling processors in Lima). The GOP needs to work with manufacturing

[80] Ecuador Times.net, "Ecuador imported $ 3.6 million in plastic recycling." June 2019, https://www.ecuadortimes.net/ecuador-imported-3-6-million-in-plastic-recycling/#:~:text=Ecuador%E2%80%99s%20imports%20of%20plastic%20waste%20were%20equivalent%20to,US%2C%20Mexico%2C%20the%20Dominican%20Republic%2C%20Colombia%20and%20Panama.

[81] Based on PLUS interviews with Lima plastic processors.

companies to either modify their packaging to not use tetra pak or glass if it cannot be recycled or provide incentives or subsidies to encourage the recycling.

Larger and more remote population centers (e.g., Cusco, Arequipa) and economic hubs with existing recycling activities (e.g., City of Ilo) could contribute MSW quantities to the Southern Coastal Corridor; however, these distances are beyond the currently economically feasible distances based on transportation cost data analyzed. The private sector in Cusco and Arequipa would need government incentives to overcome the non-economic feasibility of transporting recyclables to Lima. Currently, there are also initiatives in Cusco to build recycling infrastructure in the city which need to be considered when building out a transportation route that includes Cusco.

Explore glass and tetra pak reuse business models for Ica (medium term)

There is a need to either ban the use of glass and tetra pak materials in Ica or improve the economics for a circular economy of these products to be successful. As such, there may be an opportunity to work with the private sector that uses glass and tetra pak and develop reuse product lines. Given the shorter distances between Ica and Lima, there are opportunities to transport these slightly higher price materials if they are being transported to Lima less times given reuse occurring in a decentralized fashion in Lima. Another item that is discussed below that could be successful for glass for Ica is a bottle return incentive which is discussed further below.

Financial Incentives to Attract Private Companies to Participate in the Coastal Corridors

Beyond the extended producer responsibility (EPR) mechanism discussed in the *Peru National Assessment on Solid Waste Management*, there are other initiatives that the GOP could adopt to support the development of the coastal corridors and involve the private sector to achieve the SWM goals.

Analyze and select incentive schemes and structures (medium-long term)

There are a few incentive schemes and structures for various groups of stakeholders to encourage responsible SWM practices at both the national and local levels. These structures range from putting nearly all the cost and responsibility on the consumer to holding the upstream company responsible for the product causing waste. The *Peru National Assessment on Solid Waste Management* discusses the proposal for an EPR scheme, which is not discussed in detail here. The following are additional incentives that MINAM could use as part of an EPR or before the EPR is fully functional across Peru. Common incentives include tax breaks and subsidies to encourage investment and production of low-waste products. However, several specific examples show that tax incentives combined with penalties tend to be the most impactful approach to reducing waste. Examples of incentive schemes tested in other developing economies include:

- **Plastic credits** - plastic credits, like carbon credits, are financial incentives for companies to invest in downstream plastic waste collection or recycling infrastructure focused in developing nations.[82] This is not an overly extensive market, so there may be limited opportunities for this solution depending on interest from buyers for the plastic credits. They are sold to companies as a credit towards their reduction in plastic goals and can be used globally. The goal of these credits is to have them be an addition to another business practice to support the growth and development of waste management systems.[83] A business receives a plastic credit based on the amount of projected plastic they can recycle and is usually received after they have recycled material. A recycling processing facility recovers a certain amount of plastic that is reused and can sell a credit for the amount they

[82] Verra, "Five Things you Should Know About Plastics." April 2023,
[83] The waste management facility recovers a certain number of tons of plastic that is reused. Then the waste management facility can sell that so it can say they reduced plastic waste by said quantity. The main difference is plastic credits can be sold before the project starts based on the anticipated plastics recovered to fund the waste infrastructure.

reused. One of the benefits of the credit system is that it is often set up so that the credits can be sold before the plastic waste is recovered based on the anticipated recovered plastic to fund the waste collection infrastructure. In this case, the company will estimate the amount of future plastic to for example run through their recycling plant, and then receives the plastic credits up front. Plastic credits can help to create new private investment opportunities in recycling technology to improve revenue and returns for waste management systems. As a method of initial funding, plastic credits can be pre-sold with the expectation of future collection and recycling activities.[84] This could help Peru get the initial capital they need to develop the waste management infrastructure along the Northern and Southern Coastal Corridors.

- **Take back schemes and bottle returns**. These programs provide financial incentives to individuals or companies to pay for the collection of bottles. At the corporate scale, it is an incentive for manufacturers and transporters that deliver goods to collect bottles or other packaging and drive it back to the central recycling facilities. Given the centralized recycling infrastructure in Peru, this could be an effective mechanism. An agreement can be negotiated with those companies to take back the recyclable waste on their empty leg back towards the plant, thereby maximizing the use of space in their vehicles. In addition, through this practice, participating plants have easy access to the recycled materials that can go directly into their facility and bypass the material recovery facilities and save costs.[85] These programs have been especially successful with glass bottles in some countries, such as South Africa, where there is financial incentive to return the glass bottle successfully. Long term, it makes sense to support decentralized recycling in Peru (especially to reduce GHG emissions from transportation), but in the interim, take back schemes and bottle returns could be very important especially for products such as glass.
- **Price incentives at collection level**. This is an amount of money that is provided for individuals or waste collectors to return recycled material to a central location. This can be at a recycling center or other collection points. The price is set at the national or regional level (in the US some states do this). These points are paid by the government to administer these collection programs. There has been success in Mexico and South Africa in using price incentives to encourage bottle collection.[86] This voluntary subsidy scheme has proven to increase collection rates and spur investment in underdeveloped municipalities as shown in Figure 3 below.[87]

[84] Ocean Conservancy, "Financing Waste Management and Recycling Infrastructure to Prevent Ocean Plastic Pollution." 2021, https://oceanconservancy.org/wp-content/uploads/2021/04/Ocean-Conservancy-White-Paper-Full_20210426.pdf
[85] American Beverage, "Plastic." https://www.innovationnaturally.org/plastic/
[86] Ocean Conservancy, "Financing Waste Management and Recycling Infrastructure to Prevent Ocean Plastic Pollution."
[87] Ocean Conservancy, "Financing Waste Management and Recycling Infrastructure to Prevent Ocean Plastic Pollution."

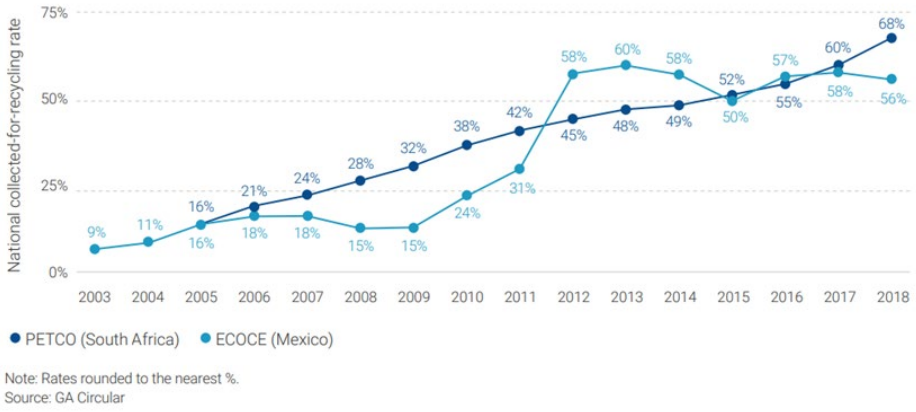

Figure 3. rPET Bottle Collection Rate in Mexico and South Africa[88]

The Mexico initiative was founded in 2002 and the South Africa initiative was founded in 2004. As shown in Figure 3, after 10 years of the collection incentive scheme, the recycling rates increased from 9 percent to 60 percent in Mexico and from 16 percent to 52 percent in South Africa. The estimated cost of running each of these systems was approximately 6 - 7 million USD (in 2017).[89] This is a program that could be adopted in specific geographies, or nationally, in Peru. **As the country is working to establish the EPR, these specific price incentive programs could be implemented to increase recycling and spur investment in the corridors.**

Pricing transparency and platforms

If any of the above schemes are adopted or piloted, it will be critically important for information to be made publicly available and shared down to the waste collectors. Sales to *acopiadores* are usually based on contracts and not disclosed publicly (at either the national or local level). In general, prices between intermediaries and buyers of recyclable products are not published.[90] It is unlikely this information will be made available publicly/transparently unless there is a price set, or a subsidy publicly announced by the government. **If the GOP works to create some transparency, or to support a subsidy to pay for price stabilization of certain recyclable materials it could help to increase participation across the value chain, in particular an increase in waste collection.** It is critical that information on any of the proposed schemes is available publicly for formal and informal collectors and that they can see the flat rates for either specific streams of waste or mixed waste can receive.

Increase targets for recyclable materials to boost demand for recyclables (short and medium-term)

The GOP has passed a law to require 15 percent recycled material in new plastic production. The GOP should continue to work to increase this target to increase the collection of recycled material by the end-use companies. As companies try to increase the amount of recycled material in their products, the price they are willing to pay for recycled material increases, improving the collection rates of the recycled material in Peru. There can also be greater private investment in creating the supply (e.g., the Coca-Cola Foundation funding initiatives to improve collections). Companies trying to increase their recycled content may even be more willing to pay directly for collection and/or delivery. In collaboration with the private sector, **the GOP should continue to increase the required percentage for recycled material in new products** as it is a supporter of improved

[88] Ocean Conservancy, "Financing Waste Management and Recycling Infrastructure to Prevent Ocean Plastic Pollution."
[89] Ocean Conservancy, "Financing Waste Management and Recycling Infrastructure to Prevent Ocean Plastic Pollution."
[90] Based on the interviews with U.S. intermediaries, there is little price transparency for what the end market is willing to pay because one end market may pay different secondary processors, different prices based on relationships and contracts. This is the same for intermediaries and secondary processors; if another intermediary will offer a hauler more money for the same recycled material, then they will lose business. As a result, price transparency is not likely to happen in the waste value chain.

recycling across the corridors and should continue to support increases in advancing recycling infrastructure outside of Lima.

Tax on Virgin Plastics (short and medium- term)

After the GOP adopts recovered plastic mandates, it should consider taxing the import of virgin plastics in Peru (in pellets or as ready products). This would likely boost demand for recycled plastics and potentially increase transported volumes along the coastal corridors. The tax on the import of virgin plastics could provide revenue to:

- Provide the GOP with funding to support the growth of Peru's waste management system for plastics
- Enable municipalities to finance separate collection of recyclables, through increased demand and municipal income
- Incentivize the separation of plastic from other materials for recycling
- Provide the opportunity for funds to subsidize transportation costs, to expand the corridor for recycling recovery

A tax will result in the price increase being passed on to consumers on end products, but the companies will either innovate such that they do not need to use virgin plastics, or they will build out return systems for products. To implement this return system, it may be necessary to transfer funding from the private sector companies to municipal entities and their contracted private collection companies if the producers do not want to be responsible operationally for the collection of material.

GOP incentive for building plastic processing facilities (medium-long term)

To attract decentralization of plastic processing and production in Trujillo, or other cities outside of Lima, the **GOP in collaboration with municipal governments should consider public private partnerships or a financial incentive for the companies that look to build recycling facilities and plastic processing outside of Lima.** This will have to be planned carefully as to size the facility appropriately to match the supply of the plastic feedstock (for example). The GOP can help to attract lower interest and development credit for such an initiative and support the permitting and other processing to support the development of such a facility in Trujillo. It will also help to signal the seriousness the government is taking recycling in the country.

Establish Policies that Encourage Higher Levels of Waste Collection and Separation

Promote behavioral change to increase waste separation (short term)

The GOP should continue to scale successful programs that build public awareness and introduce a clear set of rules for waste separation and recycling by leveraging cross-municipality programmatic approaches to educational programs.[91] Public information campaigns are critically important as an increase in knowledge increases the supply of recycled material.[92] To support the development of the Northern Coastal Corridor, the GOP should start this in Trujillo province and then expand to the cities along the Northern Coastal Corridor around Trujillo if decentralized recycling is

[91] Leverage existing programs, such as *I recycle at Home* (known in Spanish as "En casa yo reciclo"), which highlights the importance of recycling and provides a link to a phone application which helps users locate recycling points in Peru. MINAM, "En casa yo reciclo" https://www.gob.pe/institucion/minam/campa%C3%B1as/3011-en-casa-yo-reciclo

[92] A case study in Sarasota, FL was conducted on the outcomes and success of increasing community awareness through The Recycling Partnership, utilizing private donations from the Coca-Cola Foundation. They implemented 95-gallon recycling carts and focus on educating the community. This included community events, clean-ups to raise awareness, and education about improving the waterways and natural resources to increase tourism. After one year of implementation, 75 percent of households (15,000 households including 57,000 residents) were participating, and recycling rates increased 71 percent year over year. Source: The Recycling Partnership, *State of Curbside Recycling Report, 2020.* February 2020, https://recyclingpartnership.org/wp-content/uploads/dlm_uploads/2020/02/2020-State-of-Curbside-Recycling.pdf.

established in Trujillo. For the Southern Coastal Corridor, the GOP with USAID assistance should continue programming on behavior change in Ica Province expanding beyond Pisco district.

In Trujillo and Ica provinces, the GOP and USAID can leverage social media, influencers, national and local media catering to diverse groups to increase public awareness and support. The program can also use various high influence groups, structures and institutions for different age and social groups to raise public awareness including churches, schools, or football clubs to mobilize citizens and businesses.

In addition, the local municipalities can consider the parallel introduction of a system of obligatory fees for waste collection and sanctions to penalize citizens, businesses, and public institutions for non-compliance with SWM regulations.[93] Execution of fees and penalties will be key to its effectiveness. Adding municipality sanctions, including taxes on the discharge of municipal waste and on the rates of payment for waste generations have shown to encourage waste reduction and selective collection. This would be as a substitute to the current waste collection payment, *arbitrios,* which have low payment rates currently. One way is to change the *arbitrios municipales* (i.e., local fees which funds part of SWM) to be similar to other municipal service payments and to enable the municipality to be able cease services in the event of non-payment, similar to electricity or water sectors.

If source separation programs do not seem to be changing behavior, the municipality can consider pay-as-you-throw schemes, where payment is made for the weight of waste disposed of to help to reduce the overall *arbitrios* that some residents think is higher than their consumption warrants. This would encourage people to generate less waste and would help to reduce the payment costs for those who are economically less fortunate and produce less waste. There are also reward programs examples, in which residents are paid for successful separation and waste disposal. These can be instituted in individual districts along the coastal corridor as needed but can be expensive to implement and often make more sense on a small scale where behavior change efforts have failed.

[93] Jayashree Mahajan et al, "Waste Management: A Reverse Supply Chain Perspective." September 2016, https://journals.sagepub.com/doi/10.1177/0256090916659029

VI. CONCLUSION

This Report evaluates the feasibility of increasing recycling aggregation and transportation to Lima from municipalities in northern and southern coastal cities in Peru. The "coastal corridors" are economically and environmentally feasible for portions of the coast. Unfortunately, due to high transportation costs and the limited profitability for the recyclable material, there are some cities that are too far from Lima to make transporting recycled waste economically viable. The Northern Coastal Corridor can extend from Trujillo Province south to Lima and the Southern Coastal Corridor from Ica Province north to Lima. Given some sections of the coast cannot transport waste to Lima economically, the PLUS team recommends the GOP explore building decentralized recycling transformation infrastructure in Trujillo for the Northern Coastal Corridor. The first step includes bringing together multiple provinces for collaborative planning to build out the departmental recycling infrastructure planning. The Trujillo province and district will also need to work to develop an individual plan to strengthen solid waste management and increase recycling collection for supply to Lima, and eventual supply to a decentralized recycling center in Trujillo. Trujillo provincial and district governments will need to work closely with the private SWM informal and formal companies working along the SWM and recycling value chain and support them to become formalized. It will also be important for the Trujillo province and district to get buy-in from Trujillo's Chamber of Commerce and its members for successful adoption and supply and demand volumes for the recycling sector to thrive. Before the decentralized recycling transformation infrastructure is built in Trujillo, it should continue to be transported to Lima.

Decentralized infrastructure can be explored for the Southern Coastal Corridor but a combination of inland cities will need to be explored further to select the location for decentralization. This should be explored with financial incentives programs to support the build out of recycling infrastructure, from recycling associations through to conditioning equipment and transformation. In the meantime, Ica Province should explore expanding recycling associations and other recycling collection programs for transport to Lima with improved price transparency and more formalized stakeholders.

Critical to the advancement of the coastal corridors and increased recycling throughout Peru, is the role that recycling transformation companies will play for the decentralization of the recycling sector. Fiscal incentives and support from the GOP will be important to support the movement of recycling transformation technologies outside of Lima. The PLUS team's *Peru National Assessment on Solid Waste Management* shares more details on these recommendations, which are important for the full development of recycling along Peru's coastal cities and eventual high demand that will warrant the decentralization of recycling processing outside of Lima.

VII. APPENDIX A. ADDITIONAL BACKGROUND INFORMATION ON SWM IN TRUJILLO AND ICA

Trujillo, Department of La Libertad

The Department of La Libertad is the third most populous department with 2.048 million people after Lima (10.814 million) and Piura (2.077 million).[94] La Libertad is located north of Lima, situated on the coast between the USAID CCBO engagement sites in Piura (to the north) and Ica (to the south) and is home to Salaverry, one of Peru's largest ports. La Libertad is the only Peruvian department that contains coastal, highland, and rainforest ecosystems.

Figure 4. Provinces in the Department of La Libertad.

Trujillo is one of 12 provinces located in the Department of La Libertad. The population of Trujillo province is 1.141 million people, comprising nearly 55 percent of the total population of La Libertad. The province of Trujillo is divided into ten districts, including Trujillo district. Trujillo is the capital city in the Department of La Libertad and is located on the Moche River near the river's ending in the Pacific Ocean.

Table 14. Population in La Libertad and Trujillo[95]

Geography	Population (2022)
La Libertad Department	2,077,345
Trujillo Province	1,162,870
Trujillo District	350,915

Trujillo was selected as a field study site due to geographic distance to Lima and waste generation potential to contribute to aggregation of recyclables in the Northern Coastal Corridor.

Regulatory framework

It has different municipal ordinances that seek to create the conditions for improving waste management, including:

- Municipal Ordinance No. 0173-2014 creates the Municipal Recycling Program of the Trujillo district in 2014;
- Municipal Ordinance No. 017-2021 that prohibits the dumping of garbage and other waste in parks and streets; and
- Municipal Ordinance No. 051-2020 establishes the validity of the excise amounts for street sweeping and waste collection.

These ordinances and other governance actions seek to reduce the amount of waste disposed of in the municipal dumpsite, El Milagro, one of the largest dumpsites in the region. However, regardless of the ordinances in place, the SWM recovery and dump status has not improved. Currently, the municipal recycling program has stopped, and the recovery of organic waste is incipient due to lack of resources and limited citizen participation.

[94] MINAM, "SIGERSOL Sistema de información para la gestión de los residuos sólidos para el ámbito municipal," gob.pe, 2021, https://www.gob.pe/institucion/minam/noticias/78307-plataforma-sigersol-se-actualiza-para-brindar-informacion-sobre-la-gestion-de-residuos-solidos-de-municipalidades-a-nivel-nacional.
[95] MINAM, "SIGERSOL Sistema de información para la gestión de los residuos sólidos para el ámbito municipal."

The Chamber of Commerce of La Libertad, which has offices in the city of Trujillo, has a technical arm "*Centro de Desarrollo Sostenible y Responsabilidad Social*" in charge of an environmental technical support program for companies to comply with their obligations. This program is not only designed for companies that are members of the Chamber of Commerce, but also a service that they offer to any interested company. Chamber also has environmental commissions; these regional environmental commissions enjoy participation from the public, private, and academic sectors. The technical arm works hand in hand with the provincial municipality (environmental area – *SEGAT*) in collection programs and campaigns such as electronic waste.

At an industrial level, Trujillo is a center to produce leather and footwear, as well as an important agro-industrial hub, which is why there are several industries in the area. Innova Ambiental SA is an international SWM company with two main locations in Peru: Lima and Trujillo. For 25 years, Innova has been active in SWM with international ISO certificates, mainly for these industries.

Waste generation and composition

According to SIGERSOL data for 2021, household waste represented 87 percent of the composition of municipal waste in the department of La Libertad. compares the SIGERSOL MSW generation by household and non-household sources.

Table 15. Annual MSW Generation in La Libertad at various government levels (2021) [96]

Geography	Household waste generated (MT/year)	Non-household waste (MT/year)	Total MSW (MT/year)
La Libertad Department	396,281	57,331	453,612
Trujillo Province	224,967	88,784	313,751
Trujillo District	71,076	30,404	101,481

 compares the SIGERSOL MSW generation (from both household and non-household waste), composition data for the Department of La Libertad, and the Trujillo province and districts. Trujillo province is responsible for 71 percent of the total waste generated in the Department of La Libertad. In 2022, the province of Trujillo generated 321,281.97 MT of MSW, or 0.78 kg per person per day. The other waste streams in the same regions that do not fall under the municipal waste streams are significant, like industrial and medical waste that do not fall under the municipality.

Most of the MSW generated across the geographies was organic waste: 59.9 percent at the department level, 61.21 percent at the province level, and 70.65 percent at the district level. These exceed the national estimate of 56.7 percent organics in the waste stream. Inorganics made up 26.48 percent of the waste stream at the department level, 28.44 at the province level, and 23.38 at the district level. These percentages exceed the national total estimation of 20.94 percent of the national waste stream being inorganic.

Table 16. Annual MSW generation by material type (2022)

Geography	Organics (MT/year)	Inorganics (MT/year)	Not usable (MT/year)	Hazardous (MT/year)	Total MSW (MT/year)
La Libertad Department	262,049	124734	50,800	27,849	465,432
Trujillo Province	180,238	90,408	31,324	19,312	321,282
Trujillo District	52,957	28,330	12,293	8,825	102,406

[96] MINAM, "SIGERSOL Sistema de información para la gestión de los residuos sólidos para el ámbito municipal."

Regarding the specific composition of inorganic waste, as shown in the table, plastic is the most generated waste in the 3 levels, representing 26 and 29 percent for La Libertad and Trujillo province respectively, and 41 percent for the Trujillo district.[97]

Table 17. Composition of inorganic waste[98]

Geography	Plastic (MT/year)	Paper and cardboard (MT/year)	Glass (MT/year)	Tetra pak (MT/year)
La Libertad Department	46,506	40,848	18,932	1,402
Trujillo Province	35,082	30,542	14,845	895
Trujillo District	9,082	10,493	2,852	0

Separation, collection, and transportation

Until recently, the Trujillo municipality (district) promoted the separation and recovery of organic waste. For segregation at the source of organic waste, waste from markets and green areas is collected; the processes is completely manual. They value 480 MT/year of organic waste and with this they manufacture 100 MT/year of compost that they use for the organic garden. The collection of organic waste is carried out by the municipality with trucks and municipal workers. This collection is carried out every other day from the different registered markets and homes.

Before the COVID-19 pandemic, the municipality worked on the home segregation of inorganic waste, for which it had three recycler associations. As of June 2022, only one recycler association remains: the "ARFUMM" association made up of three women. Some recyclables (e.g., plastics, metals, paper and cardboard) are sent to Lima for recycling via individual efforts. Large scale efforts to aggregate and transport recyclables do not yet exist.

Table 18. Total generation and recovery of organic and inorganic MSW (2022) [99]

Geography	Organics generation (MT/year)	Organics recovered (MT/year)	Organics recovered (%)	Inorganics generation (MT/year)	Inorganics recovered (MT/year)	Inorganics recovered (%)
La Libertad Department	262,048	2,549	0.97%	124,734	4,084	3.27%
Trujillo Province	180,238	1,131	0.63%	90,408	2,872	3.18%
Trujillo District	52,957	383	0.72%	28,330	926	3.77%

Only one formal recyclers association works with the municipality of Trujillo. However, there are many informal recyclers who are located near the El Milagro dump who work informally inside the dump. When the recyclers see a truck coming, they separate the recyclable waste to sell and the organic waste to feed the pigs of the nearby pig farms, an activity which is not allowed according to national regulations. The details of the sale pertaining to all the collected waste is unknown due to informal character of transactions between the recyclers and intermediaries. Informal recyclers sell unprocessed waste due to lack of appropriate machinery. However, the recycling company Manuelita mentions that they sell the waste they buy with the final industry located in Lima. Data on

[97] MINAM, "SIGERSOL Sistema de información para la gestión de los residuos sólidos para el ámbito municipal."
[98] MINAM, "SIGERSOL Sistema de información para la gestión de los residuos sólidos para el ámbito municipal."
[99] MINAM, "SIGERSOL Sistema de información para la gestión de los residuos sólidos para el ámbito municipal."

informal sector workers (collectors, recyclers, and processors) is not available from MINAM or other data sources. According to the Agency for Environmental Assessment and Control (OEFA), at the El Milagro dump most informal waste collectors are men, while there were few women and there was no information provided on children present at the dump site when asked.

Final disposal

In La Libertad Department there is only one sanitary landfill for adequate final disposal, which is managed by the company Innova Ambiental SA. Trujillo's waste is disposed of in the private sanitary landfill or in the El Milagro dump. The El Milagro dump covers an area of 50 hectares (ha), and is considered one of the 50 largest dumps in the world, and one of the worst in Latin America due to daily open burning of more than 1,000 t/day of waste disposed of in the open air, without soil covering by end of day. The dump does not have any protection measures against (often toxic) smoke, sharps, hazardous waste dumping, and wind and rain leakage of ocean plastics in neighboring streams. Additionally, the El Milagro dump has no control or enforcement mechanisms to stop illegal dumping of liquid or hazardous waste. These conditions lead to environmental degradation in the form of air pollution, leachate, and percolate contamination of local ground water and other river ecosystems. As such, people living and working downstream from the dumpsite are exposed to immediate danger.

The provincial municipality has a project to have a sanitary landfill next year. This space would also have an area for the recovery of organic and recyclable waste. They already have a technical file and an approved budget.

Table 19. Landfills for waste disposal in La Libertad[100]

Geography	Number of landfills	Location	Operator
La Libertad Department	1	Ascope Province, Chiclama District; Trujilllo (Cumbre Sanatary Landfill)	Innova Ambiental SA
Trujillo Province	0	N/A	N/A

Of the ten districts of the province of Trujillo, seven dispose of their waste in the El Milagro dump. The other three districts dispose of waste in smaller dumps. Non-municipal waste is disposed of in the Innova Ambiental AS landfill because the government supervises this activity.

The PLUS team visited the El Milagro dump but was not permitted to come close to the dumping and burning area. The municipality showed the PLUS team the border, from where many smoke columns from burning waste were visible, behind a ridge 200 yards away.

Figure 5. USAID PLUS team at the ARFUMM recyclers association

The provincial municipality approved budget for a new sanitary landfill to be set up in 2024. The new landfill will include a facility for the recovery of organic and recyclable waste.

[100] REVISAR

Leakage of plastic waste

Due to insufficient waste infrastructure (e.g., sanitary landfills), many areas in La Libertad are considered degraded areas from waste pollution. Table 2021 details the areas degraded by waste for each level of government. El Milagro dumpsite is in La Cumbre, outside Trujillo district and province.

Table 20. Areas degraded by waste in La Libertad (2022) [101]

Geography	Number of areas degraded by waste	Extension of degraded areas (ha)
La Libertad Department	76	144.62
Trujillo Province	6	96.3
Trujillo District	0	0

Current capacity of SWM service providers

The OEFA team did accommodate the PLUS team's interest in visiting environmental hotspots and organic treatment area. The main streets were litter free, refuse compacting trucks were collecting waste, and there were signs of active informal recyclable waste collection. As such, the PLUS team visited formal and informal waste recyclers, a plastic bottling plant of Coca Cola, beaches, and riverbanks. The firms interviewed expressed a high interest in investing in expanding recycling activities, including in playing a key role in the corridor to the recycling hubs in Lima. Recycling corridors would require collection in the northern parts of the coastal corridor and require decentralizing recycling activities in Trujillo.

The Chamber of Commerce is ready to provide technical assistance with training and capacity building of private sector or public sector professionals working in SWM. After the pandemic, the municipalities show signs of picking up their MSWM in line with MINAM's guidelines to work on the circular aspects aspired by GOP and (re)starting waste segregation at source and 3R principles by households, shops, and organizations. The municipalities in Trujillo were hesitant to receive the PLUS team.

Ica

Ica Department is in the south-central coast of Peru. The Department of Ica is part of the CCBO Peru program. CCBO is engaged in Ica, working in the city of Pisco (population 282,500 in census of 2017) to strengthen local government capacity on SWM services, including through improved and expanded waste collection services.[102]

For this Assessment, the PLUS team analyzed data from other municipalities in the Ica province and district as potentially important contributors to a "Southern Coastal Corridor" for aggregation and transportation of recyclables to Lima. COVID-19 and political issues hindered CCBO's plans to work in Ica Department in the last year. Rains, dengue, and following unrest hindered the planned PLUS fieldwork in Ica. The PLUS team conducted a desktop study and virtual engagement (e.g., virtual interviews) of Ica's potential in the southern coastal corridor.

[101] MINAM, OEFA, "National Inventory of Areas Degraded by Solid Waste 2022."

[102] Urban Links, "CCBO in Peru." https://urban-links.org/ccbo-in-peru/.

Table 21. Population in Ica (2022) [103]

Geography	Population (2022)
Ica Department	1,020,050
Ica Province	467,131
Ica District	177,538

Regulatory framework and government priorities for SWM in Ica

Municipal ordinances and resolutions on SWM and recycling can vary depending on the specific municipality and its priorities. Whether it is to promote citizen participation, regulate waste generation or facilitate management processes, these local regulations are often aligned with national regulations such as the Solid Waste Comprehensive Management Law. The main Ica ordinances on waste management are mentioned below:

- Municipal Ordinance No. 409-2012- MPI, which approves the update of the "Comprehensive Plan for Environmental Management of Solid Waste (2012-2022)
- Municipal Ordinance No. 017-2014-MPI, which Approves the Formalization of Recyclers and the Selective Collection of Solid Waste in the Area of the Province of Ica
- Municipal Ordinance No. 009-2021-MPI, which regulates the formalization of recyclers and the activity of selective collection of solid waste in the province of Ica.

One of the main problems related to waste management is the contamination of important natural bodies for the department, such as the Ica River, which not only affects biodiversity but also economic activities such as export agriculture. In addition, Ica has seven protected natural areas of national importance, highlighting the importance of pollution and environment degradation from waste.

The concerted development plan of the province of Ica 2011-202 incorporates a pillar of Environmental Sustainability, where natural preservation and responsible consumption of resources are prioritized, with objectives and strategies to achieve sustainable development and reduce the environmental impact of region activities.

Likewise, MINAM has an institutional presence in Ica through its affiliated agencies, depending on the environmental aspects of the region. The presence of Protected Natural Areas, and the agro-export and tourism potential of the department make it a key place for investments in environmental improvement. Ica is one of the prioritized departments for MINAM waste investment projects. The ex-Minister of the Environment, Modesto Montoya, stated in 2022 that his sector is investing around 65,000,000 soles for the improvement of the integral management of solid waste in the Ica department, through different development projects.[104]

Waste generation and composition

In municipal waste, the largest amount generated is household waste, which represents 70 percent of the composition of municipal waste in the department of Ica.

[103] MINAM, "SIGERSOL Sistema de información para la gestión de los residuos sólidos para el ámbito municipal."
[104] MINAM, "Minam invests around S/65,000,000 to improve solid waste management in Ica." May 2022, https://www.gob.pe/institucion/minam/noticias/604929-minam-invierte-alrededor-de-s-65-000-000-para-mejorar-la-gestion-de-residuos-solidos-en-ica

Table 22. Annual MSW generation in Ica at various levels of government (2021) [105]

Geography	Household waste generated (MT/year)	Non-household waste (MT/year)	Total MSW (MT/year)
Ica Department	189,448	80,151	249,251
Ica Province	90,011	38,338	120,873
Ica District	36,047	14,970	51,256

The province of Ica in 2021 generated 120,872 MT of MSW (generation per person of 0.77 kg/person/day). This waste was mainly organic (57.3 percent), followed by inorganic waste (18.5 percent), unusable waste (11.9 percent), and hazardous waste (12.2 percent).

Table 23. Annual MSW generation by material type (2022) [106]

Geography	Organics (MT/year)	Inorganics (MT/year)	Not usable (MT/year)	Hazardous (MT/year)	Total MSW (MT/year)
Ica Department	143,581	31,115	44,278	26,868	275,842
Ica Province	73,447	29,218	19,402	13,362	135,430
Ica District	35,895	14,287	8,714	6,522	65,418
Pisco Province	23,636	11,447	4,450	48,014	4,8014

Regarding the specific composition of municipal inorganic waste, as shown in the table, plastic is the most generated waste in the 3 levels, representing 25 percent for Ica department, 26 percent for Ica province, and 19 and for the Ica district.

Table 24. Composition of municipal inorganic waste in MT/year from MINAM SIGERSOL in MT/year and % of waste stream[107]

Geography	Plastic (MT/year)	Paper and cardboard (MT/year)	Glass (MT/year)	Tetra pak (MT/year)
Ica Department	17,608.	19,613	5,925	881
Ica Province	8,047	8,239	2,381	411
Ica District	2,558	2,773	1,148	113

Using a slightly different data source that covers all waste in Ica department, not simply municipal waste, plastic is the material that is the most generated, representing 24 percent of total inorganic waste, followed by paper and cardboard (15 percent). The percentages obtained from the waste characterization are very similar to the SIGERSOLs data, which shows that in waste generation, the information flow may be reliable.

[105] MINAM, "SIGERSOL Sistema de información para la gestión de los residuos sólidos para el ámbito municipal."
[106] MINAM, "SIGERSOL Sistema de información para la gestión de los residuos sólidos para el ámbito municipal."
[107] MINAM, "SIGERSOL Sistema de información para la gestión de los residuos sólidos para el ámbito municipal."

Table 25. Composition of inorganic waste (% of waste stream) from Ica's waste characterization[108]

Geography	Plastic (% of waste stream)	Paper and cardboard (% of waste stream)	Glass (% of waste stream)	Tetra pak (% of waste stream)
Ica Province	36%	37%	11%	2%

Separation, collection, and transportation

The municipality of Ica promotes segregation at source through the municipal PSF, which collects organic and inorganic waste. The municipality provides support to the recycler associations with the purchase and donation of green bags that the recyclers deliver to the neighbors for the segregation of waste, the municipal collection center, vehicles (two motorcycle vans and one truck), driver, and fuel.

For the segregation at the source of organic waste, markets, green areas of the district, and 100 homes participate. Households are given a bucket to collect organic waste, markets are also given containers for collection, and waste from green areas is collected by municipal workers through their care activities for the green areas of the community zone. Organic waste is collected daily from registered markets and homes by the municipality with trucks and municipal workers.

For the segregation at source of inorganic waste, 10,000 households participate in Ica. The recyclers deliver green bags once a week to each home so that they can collect usable waste such as glass, plastic, metal, paper, and cardboard. They do not collect Tetra Pak packages because it is not economically attractive. The collection and transport of inorganic waste is carried out through 4 recyclers associations formalized and registered in the district: Medalla Milagrosa, Nueva Juventud, Nuevo Horizonte and San Cristóbal. Each association has different collection routes, and they go through each zone once a week to collect usable waste from homes and to leave new bags.

3Rs: commercialization and recovery of usable organic and inorganic wastes

Regarding the recovery of waste, 79 percent of the 13 district municipalities carry out the recovery of inorganic and/or organic waste, achieving a recovery of 362 MT/year of organic waste and 1,192 MT/year of inorganic waste. These amounts have been valued thanks to the segregation program at the municipal source. In Ica (province), 1.68 percent of the total annual waste is recycled, in Ice (district) 1.79 percent of total waste is recycled.

Most of the recycled waste is inorganic waste: 5.3 percent of inorganics are recycled each year (province) and 6.98 percent (district), which is above the national recycling rate average of 4 percent.

The associations of recyclers in the area collect 45 to 50 MT/month to sell the waste they collect from homes and small businesses to two micro-recycling companies Bioreciclar and Ecoliap. These sales provide the recyclers with enough income to support their families.

[108] MINAM, "SIGERSOL Sistema de información para la gestión de los residuos sólidos para el ámbito municipal."

Table 26. Total generation and recovery of organic and inorganic MSW (2022) [109]

Geography	Organics generation (MT/year)	Organics recovered (MT/year)	Organics recovered (%)	Inorganics generation (MT/year)	Inorganics recovered (MT/year)	Inorganics recovered (%)
Ica Department	143,581	1,057	0.74%	661,115	2,361	3.86%
Ica Province	73,447	445	0.61%	29,218	962	3.29%
Ica District	35,895	208	0.58%	14287	529	3.70%
Pisco Province	23,636	214	0.90%	11,447	340	2.70%

With respect to organic waste, the recovery of waste is carried out by the municipality through composting and vermiculture. The municipality has a composting center that allows this activity to be carried out, which has allowed the recovery of 50 MT/month of compost that is later used for the green areas of the area. Many small business recyclers closed due to COVID-19 challenges, including the health issues and the national quarantine that restricted recycling activities for months. This forced many recyclers to change jobs to continue earning income, a dynamic that is becoming increasingly evident and makes it difficult to establish a profile as a recycler as their main job with growth projections.

Final disposal

Ica has a municipal sanitary landfill located at12.5 km, which is used for the final disposal of waste. However, this landfill is in a critical state due to its remaining useful life, which is why the municipality has started a process to implement an additional cell of 2.6 hectares and thereby extend its useful life.

Table 27. Landfills for waste disposal in Ica Department [110]

Geography	Number of landfills	Location	Operator
Ica Department	1	Santiago District	Ica Provincial Municipality

Leakage of plastic waste

Plastic waste leakage is a significant environmental issue in many regions of Peru. Due to the great tourist activity in Ica, as well as the different commercial activities, the risk of contamination by waste increases, including plastics. This greatly affects the biodiversity of the area, as Ica is a department that is home to several protected natural areas. In 2022, it was evidenced that plastic pollution was directly affecting the species in the area, when microplastics were found in the condors of the San Fernando de Ica National Reserve.[111].

Environmental degradation due to poor waste disposal is intensified by insufficient waste infrastructure or waste recovery service that people throw their waste into the environment, especially on water flows or land extensions, generating dumps that end up degrading areas. Below is the detail of areas degraded by waste for each level of government.

[109] MINAM, "SIGERSOL Sistema de información para la gestión de los residuos sólidos para el ámbito municipal."
[110] REVISAR
[111] El Comercio, "Study reveals that Andean condors are contaminated with plastic: specialists make a worrying discovery in Peru."

Table 28. Areas degraded by waste in Ica (2022) [112]

Geography	Number of areas degraded by waste	Extension of degraded areas (ha)
Ica Department	35	279
Ica Province	10	33
Ica District	0	0

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Table 29: Total generation and recovery of organic and inorganic MSW (2022) [113]

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[112] MINAM, OEFA, "National Inventory of Areas Degraded by Solid Waste 2022." https://www.gob.pe/institucion/oefa/normas-legales/3156088-00018-2022-oefa-dsis
[113] MINAM, "SIGERSOL."

pollution was directly affecting the species in the area, when microplastics were found in the condors of the San Fernando de Ica National Reserve.[114].

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Assumptions

- Hours
  - Average travel time between the two cities at night
  - Times were calculated using google maps and verified through conversations with Peruvian transportation companies
- Number of days
  - 1 day of travel is assumed to be up to 12 hours of travel which is the Peruvian regulation for the number of hours a truck driver can drive without required rest time
- Cost of vehicle per day
  - Cost of vehicle per day is determined by the purchase price of a truck cab considering a standard lifetime of approximately five service years
  - Assuming a semi-tractor trailer truck hauling a standard 30-ton load.
  - On average, trucks cost 120,000 soles
- Total cost of vehicle
  - Number of days multiplied by the cost of vehicle per day
- Labor cost per day
  - For daily labor costs, the PLUS team assumed a two-person team consisting of a driver and an assistant.
  - Based on a standard monthly salary of approximately 2200 soles per month, driving six days per weeks results in roughly 90 soles per day for each team member.[115]
- Total cost labor
  - Labor cost per day multiplied by the number of days
- Distance (km)
  - Google maps distance between the two cities rounded
- Total fuel costs
  - Fuel costs are based on an average per liter cost for one liter of diesel derived from July 17 to the October 23, 2023, resulting in 4 soles per liter.[116] A vehicle carrying a 30-ton load assumes an average of 30 liters consumed per 100/km.[117]
- Tolls
  - Toll fees are obligatory on all national motorways, which are the preferred routes for hauling heavy payloads. Multi-axle heavy vehicles are charged higher fees. Interviews with local experts confirmed that most solid waste transport takes place on dual-axle semi-trailers
  - The fees are those calculated from the estimated tolls
- Trailer Fee
  - A standard transportation cost is associated with the daily usage of the 30-ton capacity semi-trailer. Most solid waste is transported at this 30 MT level of gross

[114] El Comercio, "Study reveals that Andean condors are contaminated with plastic: specialists make a worrying discovery in Peru." November 2022, https://elcomercio.pe/peru/arequipa-estudio-revela-que-condores-andinos-estan-contaminados-con-plastico-especialistas-hacen-preocupante-hallazgo-en-peru-video-contaminacion-ambiental-ica-ayacucho-rmmn-noticia/

[115] PLUS interview, 2023; Additional interview shared that their truck drivers make 1,700 soles/month. The PLUS team used the higher of the two salaries for calculations

[116] Peru diesel prices, 23-Oct-2023 | GlobalPetrolPrices.com

[117] What is the diesel consumption per mile of trucks? (webfleet.com) and Society of Motor Manufacturers and Traders, "Heavy Vehicle Fuel Efficiency," Diapositiva 1 (smmt.co.uk), 25 October 2023.

vehicle weight or total weight of the vehicle and the payload. A trailer fee, typically determined by transport companies, averages roughly 6.45/soles per km driven.

- Total costs before fees
    - Sum of the total cost of the vehicle, total cost labor, total fuel costs, tolls, and trailer fee
- Administrative cost (20 percent)
    - Administrative costs in Peru typically include a markup of 15-20 percent used to cover minor material costs, insurance, repairs and service and other incidentals. For the table above, the PLUS team assumed a 20 percent administrative cost as a more comprehensive figure.
- Total Cost
    - Total costs before fees plus administrative costs
- Transport cost 1 kg PET
    - The total cost for the transportation company to transport on average, a PET of plastic from the cities along the corridors to Lima
- Estimated GHG emissions (kg CO_2)
    - For GHG emissions, our calculations are based on a 105g/km driven for heavy trucks.[118] The metric is calculated kg.

[118] 8 Billion Trees, "Truck CO2 Emissions Per Km Calculator: Find semi truck carbon footprint," July 2023,https://8billiontrees.com/carbon-offsets-credits/carbon-ecological-footprint-calculators/truck-co2-emissions-per-km-calculator/#ref-8

VIII. APPENDIX B: WASTE COLLECTION ESTIMATIONS

Trujillo women's association collection rates

Number	Description
5.00	MT collected by association per day
23.00	number of IWCs
0.22	MT per person collected per day
217.39	kgs a day per person collected of mixed waste

During interviews with the Trujillo women's association, they shared that when they had 23 members, they were able to collect 5 MT of mixed recyclable material including PET plastic, hard plastic, cans, glass, cardboard, film, and paper. These are all materials that can be sold for a price. While glass is collected, it can only be sold for 10 soles cents per kg and thus it is not a priority for the association.[119] This helps us to calculate a per person collection rate of 0.22 MT/day.

Trujillo district number of waste collectors needed

Number	Description
23,726	MT per year inorganic waste
14,236	MT per year recycled
60%	percentage recycled of inorganic waste
220	days in year
65	MT per day recycled material available for collection
298	number of waste collectors needed

[119] PLUS interview with Trujillo Women's Association