URBAN OCEAN

PROJECT STATEMENT

Santa Fe

Pioneering Circular Plastics Recovery in Santa Fe

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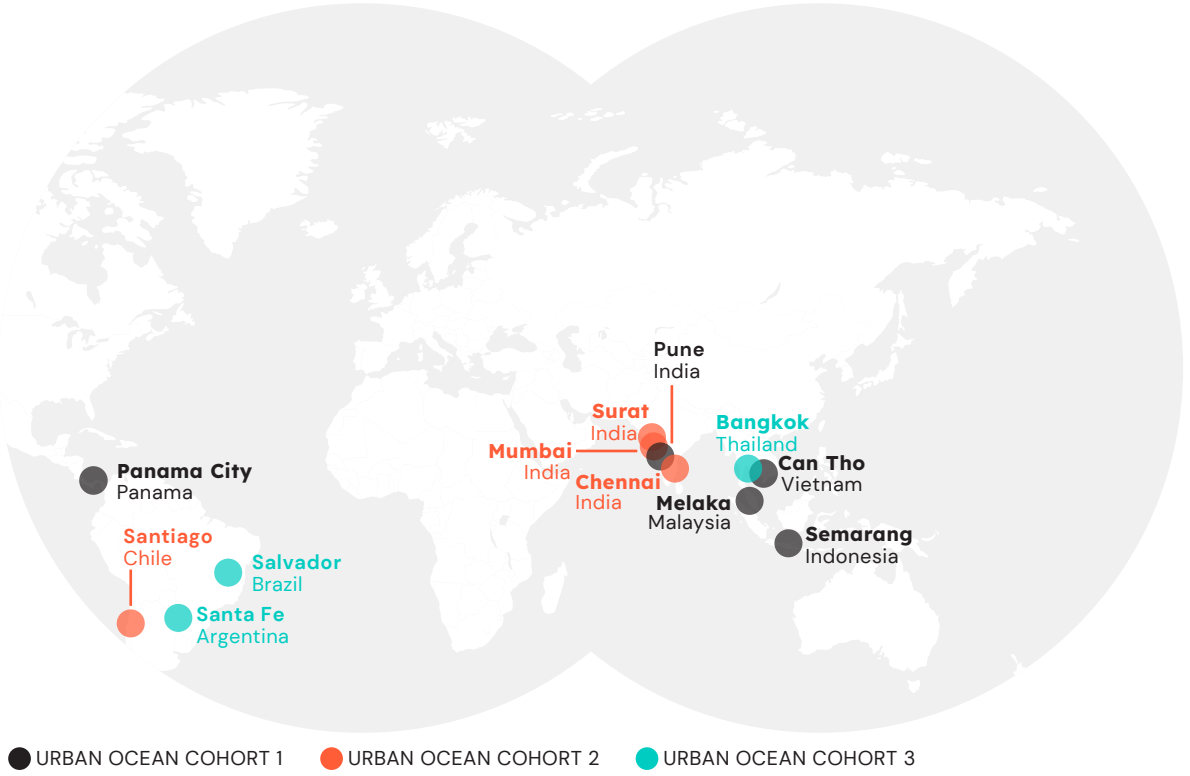
1. Introduction

Urban Ocean is a capacity-building and accelerator program for cities that champions circular economy principles, builds awareness of ocean plastic pollution, and assesses waste management systems. The program works with city leaders to bring new ideas, partners, and resources together to solve interrelated resilience challenges associated with waste management, reduce plastic waste leakage, and protect water bodies and the ocean. It demonstrates how actions to improve waste management and recycling can provide resilient and sustainable solutions that reduce ocean plastic pollution while addressing key city priorities such as improving public health, supporting economic development, and reducing greenhouse gas emissions. Furthermore, Urban Ocean provides cities with the opportunity to showcase leadership and share knowledge and experience across the Resilient Cities Network community and beyond.

The program is jointly led by Resilient Cities Network, Ocean Conservancy, and The Circulate Initiative, in partnership with the Municipality of Santa Fe and Universidad Nacional del Litoral.

FIGURE 1
Urban Ocean Cities



Overview of the Urban Ocean Challenge

Cities are home to over half of the global population and account for nearly three-quarters of global greenhouse gas emissions. Neither climate nor social targets will be met without a deep transformation of urban centers towards a more inclusive, sustainable and, ultimately,

resilient path. Approaching urban waste management systems through a resilience lens reveals complex, interrelated ramifications for social, economic, and environmental systems. The International Labor Organization estimates that the waste management sector alone has the potential to create 45 million jobs globally by 2030 while reducing greenhouse gas emissions by 15 to 20 percent. Additionally, within the same time frame, circular economies offer a $4.5 trillion USD economic opportunity by reducing waste, stimulating innovation, and creating employment. Currently, plastic usage continues to grow, remaining a threat to public and environmental health in the ocean and in cities. City governments have a unique opportunity to implement policies and projects that promote a more resilient and circular waste sector in their cities. Now is the time to set out on the path towards a more resilient urban–ocean relationship that highlights the importance of preventing marine plastic debris.

Urban Ocean Cities

Urban Ocean works closely with cities to demonstrate tangible solutions and highlight progress in addressing waste management challenges. The first cohort of Urban Ocean cities, launched in 2020, included Pune (India), Can Tho (Vietnam), Panama City (Panama), Semarang (Indonesia) and Melaka (Malaysia). In 2022, the program expanded to four additional cities in Cohort 2 – Chennai, Surat, and Mumbai (all in India) and Santiago (Chile), and then in 2024 to Cohort 3 – Salvador (Brazil), Bangkok (Thailand), and Santa Fe (Argentina). This expansion aimed to broaden the program's geographic scope, strengthen waste management, circular economy, and resilience ecosystems, increase collaboration with local governments, and establish effective waste management systems that generate environmental, social and economic co-benefits for cities.

Program Objective

Urban Ocean provides a platform for ocean advocates, city leaders and allies to join forces with other collaborators in developing comprehensive solutions that meet the needs and priorities of cities and their communities, creating meaningful and sustainable impact. The program provides and coordinates baseline assessments to gauge the efficacy, challenges, and opportunities of existing waste management systems. Urban Ocean sparks critical conversations that help participating cities identify, develop and implement solutions to improve waste management and reduce plastic pollution through circular and resilient lenses that also promote social inclusion, public health, environmental protection, and reductions in greenhouse gas emissions. Once opportunities are identified, Urban Ocean supports cities to attract support to implement solutions.

Program Approach

Urban Ocean provides support for cities to develop strategies and projects designed to address the interrelated challenges of ocean plastics and community resilience. The program approach in cities is shown in figure 2:

FIGURE 2
Urban Ocean Program Approach

Preparation Forum

- Sessions related to Resilience, Plastic Policy, Science-based solutions, Finance and Circularity Incubators
- Innovation Dialogues with the private sector

Gap Assessment

- Circularity Assessment Protocol (CAP)
- Framing Session
- Participatory Session
- Solutioning Tool
- OPPORTUNITY ASSESSMENT

Project Design

- Project proposal development
- Pilot Implementation

Project Statement

This project statement is the result of two years of work and dedication by the Municipality of Santa Fe, Universidad Nacional del Litoral and the Urban Ocean team to develop specific actions that the city hopes will advance solutions to address plastic waste challenges. The project statement is based on the results of a Circularity Assessment Protocol (CAP), a rigorous gap assessment process and several one-on-one interactions and consultation sessions that helped the city pinpoint the best opportunities for impact. It outlines the context and the needs of the city on which the project is built. It provides the city's vision and outlines the desired impact.

The statement presents the specific characteristics and conditions of Santa Fe that have a direct impact on the detailed project. For a more detailed overview of the functioning of the waste management system and the local political context, see Santa Fe's Waste Management Profile. For a more comprehensive analysis of waste streams and opportunities to drive the transition to a more circular economy, see the Circularity Assessment Protocol. Both documents were developed within the Urban Ocean framework.

2. Executive Summary

Santa Fe Context

Improving integrated municipal solid waste management is a challenge of particular importance for the city of Santa Fe. The city, one of the 10 oldest settlements in Argentina, is located in the Pampas region, the country's farming and industrial heartland.

Surrounded by two major watercourses, the Paraná and Salado Rivers, some 70 percent of Santa Fe's area urban area consists of islands, wetlands and lagoons. This situation presents various challenges for community development, especially due to rising river levels and heavy rain that can cause flooding. Inadequate waste management, unplanned urban growth, poor drainage infrastructure and the impacts of climate change are all factors that increase flood risk. Social inequality and high levels of poverty (above the national average) exacerbate this situation and should be addressed through resilient development.

Waste management in Santa Fe

Established in 2010, Santa Fe's landfill, located at the metropolitan waste management Facility known as the Complejo Ambiental receives 500 tons of waste per day from different parts of the Greater Santa Fe metropolitan area. The facility comprises a 12-hectare landfill, a leachate treatment plant and a solid-waste sorting plant. Household waste separation at source also began in 2010, although residents' uptake of this practice has been irregular despite ongoing mass media campaigns and awareness raising initiatives.

The current municipal administration has prioritized waste management, which represents 13.8 percent of the entire local budget, through the Compromiso por una ciudad más limpia (Commitment for a Cleaner City) initiative. This initiative has brought together several organizations in a bid to progress toward a circular economy. The city has also designed a network of facilities, known as Eco Puntos, to receive and store recyclable materials dropped off by residents. A total of 35 Eco Puntos have been installed since 2021. Through these facilities, the city has recovered increasing amounts of high-quality recyclable materials.

However, recycling initiatives have so far proved ineffective and insufficient in bringing about meaningful change: less than 1 percent of all waste is recovered. Additionally, the recycling value chain remains underdeveloped and there are no useful records on waste pickers, cooperatives or organizations working in the informal sector.

Opportunity Assessment

In the Circularity Assessment Protocol for Santa Fe, 22 opportunities for improvements were identified, most notably:

- → expanding the collection and recycling of highly recyclable products—polypropylene (PP), polyethylene terephthalate (PET), and high-density polyethylene (HDPE)—in businesses;
- → increasing the rerouting of waste to recycling plants;
- → generating incentives for the community and businesses that promote reuse and/or recycling;
- → expanding the system of fixed collection points for recyclable materials spread across the city.

The city of Santa Fe already has a waste-sorting plant, but CAP data reveal that plastic waste represents the largest portion of waste leaking into the environment. The growing urgency to expand the landfill underscores the city's increasing volume of solid waste, and local legislation has already authorized the establishment of an organic waste treatment plant.

The project

The selected project opportunity specifies the installation of a plastic reprocessing plant, supported by the expansion of the network of Eco Puntos. This

project will promote new valorization and recycling strategies to process recovered plastic waste and transform it into intermediate or final goods for reintegration into the value chain. The expansion of the Eco Puntos network will seek to increase the amount and quality of recyclable materials – especially plastic – being recovered, thus reducing the volume of waste being sent to the landfill, extending the lifespan of materials and limiting environmental impact of waste leakage.

Plastic Reprocessing Plant

The main component of the project is the installation of a mechanical recycling plant to reprocess highly recyclable plastic waste (PET, HDPE and PP), mainly through melting and molding, to convert it into new intermediate or final products. This process represents the simplest way of recycling plastic waste and requires the lowest initial investment.

A broad range of products and equipment can be manufactured with recycled material, including street furniture, children's playground equipment, speed bumps, in addition to bricks and slabs for construction and paving. Furthermore, the installation of the plant at the waste management facility will support the mission of the Environmental Education Center that the Municipality of Santa Fe (MSF) is developing at the same site, while promoting community engagement and awareness through the reintroduction of valuable products made from recyclable materials into public spaces.

Expanding the Eco Puntos Network

To ensure its sustainability, the project also includes an expansion of the network of Eco Puntos by setting up 40 new sites to receive recyclable materials across the city. The collection system will also be redesigned and optimized to increase the amount and quality of materials available for processing.

The project will also support collaborations with intermediaries such as clubs, neighborhood associations and schools to incentivize the installation of these facilities and raise environmental awareness. Additionally, private companies can also be invited to sponsor Eco Puntos.

Objectives

The general objective of the project is to strengthen the recycling value chain in Santa Fe through the installation of a plastic reprocessing plant and the expansion of the Eco Puntos network, stimulating the circular economy through an integrated and participative municipal solid waste management model.

Implementation and Financing

The proposal includes five components that include 16 specific actions in total. The project's implementation plan is based on a practical roadmap that takes Argentina's current institutional and economic situation into consideration. The proposal was designed to be scalable and progressive, with the installation of basic equipment for the mechanical

TABLE 1 WORK PLAN

Project components	Year 1				Year2			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Phase 1: Diagnosis and design of the program								
Phase 2: Developing the final design								
Phase 3: Building the Plastic Reprocessing Plant								
Phase 4: Expanding the Eco Puntos network and improving waste-collection logistics								
Phase 5: Environmental education and awareness raising								

processing of the material to be recycled forming the initial phase. At a later implementation phase, additional collection units can be acquired and new Eco Puntos installed, increasing availability of recyclable material, and enabling the expansion of the plant's processing capacity. Phase 5 is independent, and its implementation is designed to support and enhance the previous phases.

As a scalable project, the minimum investment for the implementation of a pilot at an initial stage could be around $60,000-80,000 USD. This funding would be aimed at validating the technical and socioeconomic model. The project can then be steadily expanded and completed in subsequent stages.

Alternative financing options are also proposed. These alternatives consider current municipal and provincial budgets, access to international cooperation funds, public–private partnerships and corporate social responsibility programs, in addition to income from the plant itself.

Expected Outcomes and Impact

Finally, in accordance with insights from the CAP model, this project will have a significant direct impact on the waste collection system in Santa Fe by complementing door-to-door collections with an expanded network of drop-off points for recyclable materials. We expect a medium impact on the community through active participation of residents in awareness raising as well as collaboration in targeted action for sorting recyclable materials. By reducing the volume of recyclable materials being sent to the waste management facility, the project will also have a medium impact on the end-of-cycle stage. Reduced waste leakage should be another outcome, albeit on a smaller scale.

3. Santa Fe Context

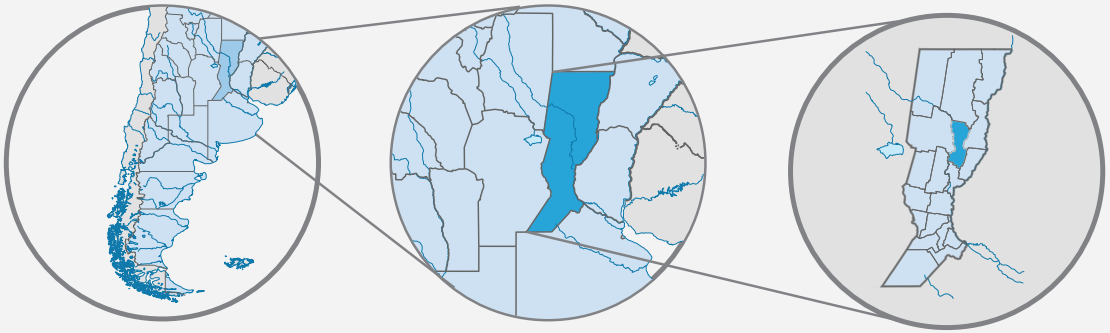
Overview

The city of Santa Fe is the capital of the Argentine province of the same name. Surrounded by water, more than 70 percent of its territory is made up of rivers, lagoons and wetlands. It is part of the Pampas region, the agricultural and industrial heartland of Argentina, and is a key driver of the regional economy. Santa Fe's location makes it a node of a multimodal transport and communications system that connects it strategically to major markets, with links to the Bi-Oceanic Corridor which connects the Atlantic and Pacific oceans.

The area's natural beauty notwithstanding, the city's location, geography and water bodies hinder its development, particularly when river levels rise or heavy rains cause flooding. Climate change, unplanned urban growth, poor drainage infrastructure and inadequate waste management are some of the factors exacerbating this flood risk, representing challenges that need to be addressed through resilient development.

In the greater Santa Fe area, the unemployment rate in the third quarter of 2024 was 6.7 percent, a figure consistent with the Pampas regional average. For the

FIGURE 3
Socio-demographic indicators of Santa Fe



403,878
Residents

8,040 hectares
Urban area

26,800 hectares
Total area of the city (70% consisting of rivers, lagoons and wetlands.)

33,669
Inhabitants: population in informal housing (Population with unmet basic needs[1])

$35 mil USD
The 2025 budget for waste collection, street sweeping, and final disposal represents 18.22 percent of the total municipal budget.

1,614 inhab./km²
Population density (Considering the inhabitable area, the density increases to 5,410 inhab./km².)

Coverage of basic services

95%
Drinking water

99,5%
Electricity

66%
Sewerage

52%
Natural gas

Source: INDEC (2022), MCSF (2023a), MCSF (2024a), IPEC (2024).

same period, poverty levels in the city were 59.8[1] percent (7 points higher than the national figure), while 16.4 percent of the population were living in extreme poverty, in line with the national average (INDEC, 2022). The National Register of Popular Neighborhoods identifies 68 informal settlements in the city of Santa Fe, and the unmet basic needs index correlates with the areas of greatest water risk in the lowest lying areas to the west and north of the city.

The City's Relationship with its Rivers, Lakes and the Ocean

The city of Santa Fe lies between the floodplains of two large rivers—the Paraná and the Salado. The rivers' cycles of high and low water levels make this location unique, having had a considerable impact on the city's development. The city boundaries are largely defined by rivers, and more than 70 percent of Santa Fe's territory (26,800 hectares) consisting of wetlands and water bodies.

FIGURE 4
Aerial view of Santa Fe

Photo: Carlos Ramonell, researcher and professor (Faculty of Engineering and Water Sciences at UNL).

1 According to INDEC survey methodology, households with unmet basic needs are defined as having at least one of the following characteristics:

- unsuitable housing: dwellings that are precarious or unfit for occupation;
- inadequate sanitary conditions: households without toilets;
- overcrowding: more than three people per room;
- no schooling: children of school age (6 to 12 years) who do not attend school;
- subsistence capacity: households with more than four persons per working member, and heads of household who have not completed primary education. (DINREP, 2014)

Over time, land development and urban growth have encroached upon flood-prone areas, either attempting to overcome the risks, or paying them little mind. Accordingly, the city has built levees and complex flood protection systems, filled in low-lying areas and natural significantly altered drainage patterns – ultimately increasing Santa Fe's vulnerability. The city is mainly exposed to water risks such as overflowing rivers, heavy rains, or combinations of the two.

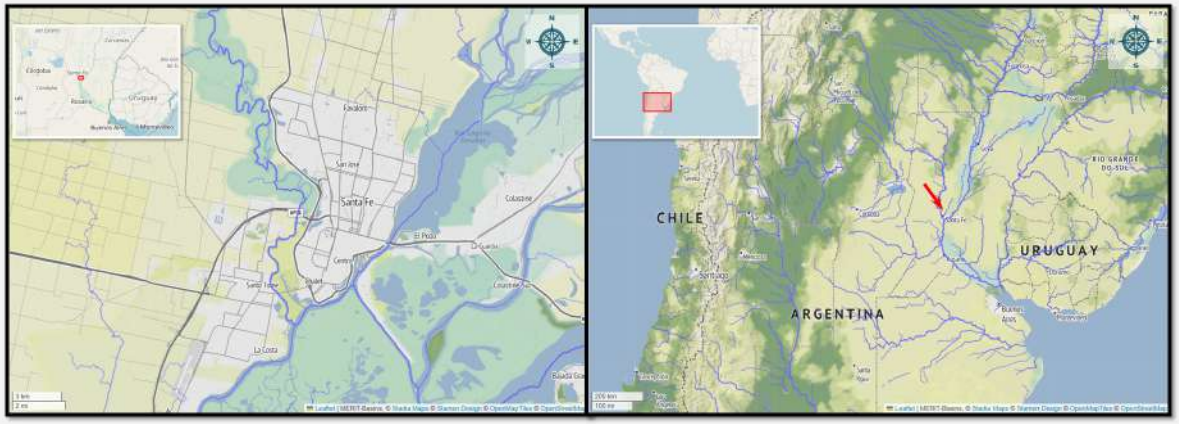
The city of Santa Fe has undergone several emergencies and crises that have led to significant losses of life, material damage, and major impacts to infrastructure and production. The two most recent flood events – one in 2003 caused by the Salado River bursting through its banks; the other in 2007 triggered by intense rainfall – were the most significant given the degree of impact on the territory, the extent of the damage, the material losses for communities and local systems. The social unrest resulting from the loss of trust in the public authorities was particularly damaging, in turn weakening the community's institutional cohesion.

In 2008, the Municipality of Santa Fe began taking a novel approach to this challenge: it placed disaster risk management at the center of its development plan, successfully reducing the impact of both pluvial and fluvial flooding during the following years and positioning Santa Fe as a leading city in the matter.

FIGURE 5
Flooding in Santa Fe in 2003

Photo: Amancio Alem (El Litoral newspaper archive)

FIGURE 6
Maps of the city of Santa Fe showing its location within Argentina's Litoral region, on the shores of the Setúbal lagoon and near the confluence of the Salado and Paraná Rivers

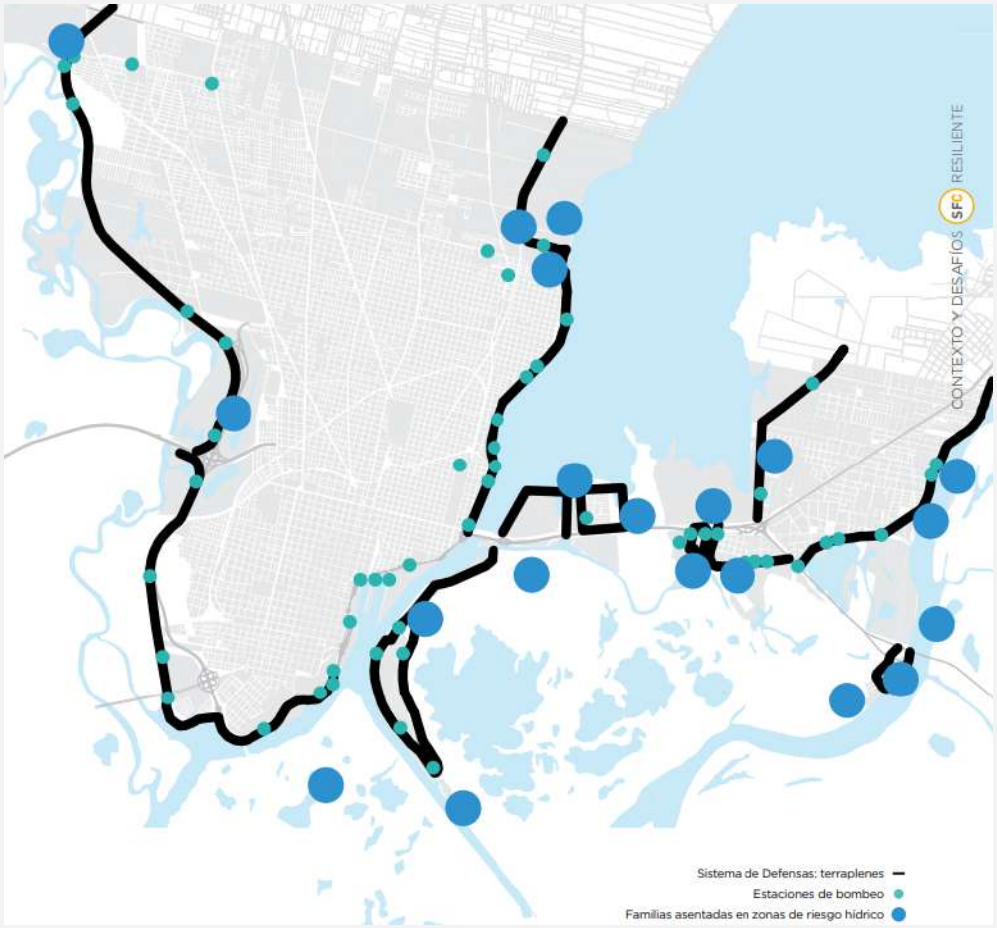


Created by the authors, based on https://mghydro.com/watersheds

FIGURE 7
Construction of levees and embankments.
La Guardia – Villa California

Photo courtesy of Silvia Wolansky

FIGURE 8
Flood protection system and pumping stations to mitigate flood risk, and settlements in areas vulnerable to flooding



Source: MSF (2017)

Resilience Links

Santa Fe faces two main threats to its urban resilience: climate-related shocks, and potential failures of flood-protection infrastructure with knock-on effects on interdependent services. Other critical weaknesses for the city include the potential for outbreaks of waterborne diseases, and the interaction between vulnerabilities and the impacts of economic and institutional crises affecting the country as a whole.

Apart from hydrometeorological impacts intensified by climate change, there are also physical stresses related to poor access to infrastructure and services in the most vulnerable neighborhoods, as well as obsolescence and low levels of redundancy in the city's infrastructure systems. There are also economic and social stresses related to violence, unemployment and informal urban settlements in areas prone to flooding.

In this context, the Santa Fe Resilience Strategy (MSF, 2017) identified inadequate waste management as a challenge in Santa Fe, with impacts including environmental damage caused by low levels of recovery and recycling, as well as blockages and poor performance of the city's drainage and flood protection systems. Moreover, there are over 600 waste pickers working in unhealthy conditions, with illegal dumpsites scattered across the city.

These social challenges are also linked to the city's housing shortage and residents living in areas of unmitigable flood risk. There is also a large proportion of informal or inadequate employment and a lack of opportunities to access secure jobs, as well as increasing urban violence in the northern and western districts, where residents face the greatest risk of flooding and lack access to basic services. There is also an evident need for the city to prioritize a metropolitan approach, in collaboration with neighboring districts, to tackle the environmental challenges posed by waste management across the urban area.

In consideration of these challenges, one of the Resilience Strategy's 11 objectives is to reduce the environmental damage caused by municipal solid waste through the incorporation of new technologies and management processes. Targets include the reduction of household waste and the doubling of the recovery and recycling rate, through the implementation of an integrated municipal solid-waste management plan within 10 years. Of the 50 initiatives in the Santa Fe Resilience Strategy, three are related to municipal solid-waste management, underscoring the need to progress toward a green and circular economy.

FIGURE 9
La Nueva Tablada neighborhood

Photo: Faculty of Engineering and Water Sciences at UNL

4. Santa Fe's Waste Management System

The following sections outline the key aspects of the waste management system of Santa Fe. Further details are provided in the city's Waste Management Profile and the Circularity Assessment Protocol.

Waste generation

In Santa Fe, the primary sources or types of waste are:

1. households
2. individuals
3. special waste (as defined by the relevant regulations)
4. street cleaning
5. maintenance of public spaces.

The waste generation rate per resident is 1.03 kg per day, according to local figures (MSF, 2022). This rate is slightly lower than the estimates for Argentina as a whole, although higher than the average generation for mid-sized cities in Latin America and the Caribbean (Rondón Toro et al., 2016).

According to the latest available assessments on

FIGURE 10
Waste compactor trucks in Santa Fe

Photo: Flavio Raina (El Litoral newspaper archive)

the estimated composition of household solid waste in Santa Fe, food waste represents more than 46 percent, followed by plastics of various kinds (12.7 percent), paper and cardboard (10.4 percent), glass (5.15 percent), and other smaller fractions (La Ciudad Posible, 2014). These figures highlight the potential opportunity to improve circularity through the development of recovery initiatives for organic and recyclable waste.

Urban sanitation, collection and transportation services

Two companies – Cliba and Urbafe – have a concession to operate almost all of Santa Fe's urban sanitation services. The door-to-door waste collection service offers almost 100 percent coverage, with exceptions in certain areas where unpaved roads, alleys and low-lying overhead cables make access difficult for waste collection trucks.

Since 2010, the MSF has promoted a system of sorting dry from wet waste at source. This initiative, which is essential to improve waste management and to encourage recycling, has seen varying levels of uptake among residents.

Starting in 2021, the city has installed a network of recycling containers and Eco Puntos. The latter are facilities designed to receive and temporarily store recyclable materials. There are currently 35 Eco Puntos across Santa Fe, 11 of which are equipped to provide a service to the public. This network is an important part

FIGURE 11
An Eco Punto in Santa Fe

Photo: MSF

FIGURE 12
Public waste bins for separated materials

Photo: MSF

FIGURE 13
Mass-media campaign image for collections of sorted waste (2024).

of the strategy to encourage the sorting of waste and to promote the recovery of recyclable materials.

Over the past 15 years, the MSF has promoted public awareness raising strategies on this topic through educational initiatives and mass media campaigns (Figure 13), in conjunction with actions promoting environmental protection through schools, neighborhood associations, clubs and various other institutions. However, not until the past five years has a greater focus been placed on activities specifically related to circularity, with consideration for the entire life cycle of materials and products.

Waste treatment and disposal

Since 2010, the city of Santa Fe has operated a metropolitan-scale waste management facility known as the Complejo Ambiental, located in the northwest of the city on the banks of the Salado River (Figure 14). This site is comprised of a landfill (operated by Milicic), a leachate treatment plant and a dry-waste sorting plant, operated by the Asociación Civil Dignidad y Vida Sana recycling cooperative.

According to municipal estimates, almost all waste generated in the city is sent to the waste management facility. Of all household waste sorted at source, more than 99 percent ends up in landfill, and only 0.68 percent is processed and recovered by the dry-waste sorting plant. This points to poor management of a large proportion of the city's waste. Official figures

FIGURE 14
Complejo Ambiental de Santa Fe: landfill, sorting, and leachate treatment plant

Photo: El Litoral newspaper archive

FIGURE 15
Interior of Santa Fe dry-waste sorting plant, operated by Asociación Civil Dignidad y Vida Sana

Photo: Pausa newspaper

record the plant's recovery rate (efficiency) at around 24 percent.[2]

Waste recovery and recycling

Asociación Civil Dignidad y Vida Sana sells eight types of material processed at the dry-waste sorting plant. Much of this waste comes from the Eco Puntos, which provide a higher quality of pre-sorted materials.

In 2023, 28.7 percent more materials were collected at the Eco Puntos compared to the previous year: 452.1 tons of recyclable materials, with a monthly average of 37.7 tons.

The processed materials are sold to various industries. Sometimes buyers are local, but they are also often located hundreds of kilometers away, with environmental and financial implications including increased logistical costs and carbon footprint of transporting the materials.

In areas in and around the city of Santa Fe, there are some formal and informal non-state, recycling-related industries and initiatives, albeit in an early stage of development.

Despite these efforts, initiatives have so far failed to generate a significant change in the amount of recovered waste materials (still under 1 percent, according to 2024 figures).

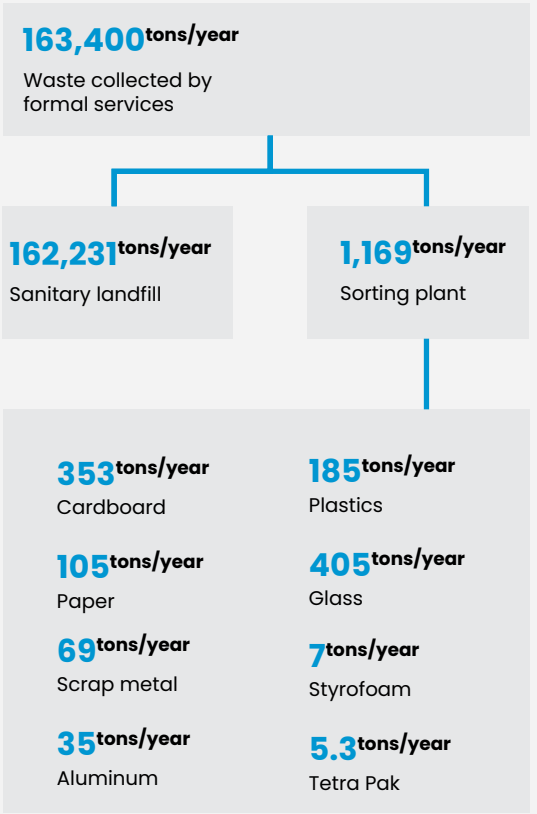
On the informal recycling sector

Some materials are not collected by the formal municipal services; instead, they are recovered, collected and sold informally, but no reliable data nor statistics exist to estimate annual quantities. While the MSF recognizes the existence of waste pickers, cooperatives, and acopiadores (intermediaries working in the sector), no current record exists of these actors nor of their current activities.

For 2025, the city plans to inaugurate five puntos limpios – collection points where independent and informal waste pickers can drop off recyclable materials. At these facilities, a workers' cooperative will receive and manage the waste, enabling the integration of waste pickers into the cooperative system (a type of labor and commercial organization in Argentina).[3] This initiative will mark the beginning of a process to concentrate and register workers in the informal sector, helping to reduce the proliferation of informal systems and to formalize and legalize their work.

Formalizing the work of waste pickers could strengthen the recycling system, improve its efficiency and broaden its impact. Conducting the census and consolidating the puntos limpios will be vital for the expansion and improvement of the city's waste management system.

FIGURE 16
Amount and type of materials recovered through the dry-waste sorting plant at the Complejo Ambiental de Santa Fe (average 2011-2024).



Source: compiled by the authors based on municipal data

2 Despite a decline in solid waste collection over the past five years, the amount of material entering the sorting plant annually has remained steady at around 4,000 tons, while the recovery rate has increased.

3 A cooperative is an autonomous association of people who voluntarily come together to meet their social, cultural and economic needs and aspirations through a democratically run and jointly owned enterprise. Cooperatives are mutual organizations that provide services to their members and are therefore subject to cooperativism's "Golden Rules" – a set of guiding values and principles (Instituto Nacional de Asociativismo y Economia Social, 2020).

Summary

- More than 160,000 tons of solid household waste generated per year.
- Very low recycling rate: under 1 percent.
- Limited capacity of the only landfill in operation for Santa Fe and its metropolitan area.
- 8,701 tons of plastic waste generated per year (12.77 percent of total), of which only around 200 tons (around 2 percent) are recovered (2014).
- 8,500 tons of plastic are improperly disposed of, causing major environmental impacts.
- Residents' adherence to household waste-sorting initiatives has been varied; high approval rates of Eco Puntos.
- Lack of an updated record of waste pickers, cooperatives and organizations working in the informal waste sector.

Policies and Decrees

In terms of environmental governance, the MSF is responsible for the overall management of waste generated within Santa Fe, in accordance with National Law no. 25.916, which establishes the national minimum environmental protection budgets for the management of household waste. At a provincial level, Law no. 13.055/09 promotes the Basura Cero (zero-waste) principle to reduce, sort and recycle waste, while Resolution 128/04 establishes technical norms for treatment and final disposal.

At a local level, the Honorable Municipal Council – the municipal legislative organ – has approved ordinances, resolutions and other regulatory instruments directly connected to waste management (collection, final disposal, and reduction), in particular:

- Tenders and contracts for waste collection and treatment (Ordinances10.035/96, 11.237/05, 12.804/21);
- Plastic reduction and composting programs (Ordinances 12.697/19, 12.787/21);
- Management of special waste (Ordinance 11.917/12) and electronic waste (Ordinance 12.738/20);
- Expansion of landfill expansion and development of treatment plant (Ordinance 12.804/21);
- Awareness raising campaigns (Honorable Municipal Council Resolution 12.724/08);
- Agreements with private companies to improve collection and expand services with Cliba and Urbafe (municipal decrees).

At a metropolitan level, each of the municipalities and communes of Greater Santa Fe have their own strategies and regulations linked to waste management in their respective jurisdictions, although it should be noted that there is only one site for final disposal (the landfill at the waste management facility). This situation necessitates the establishment of metropolitan-scale environmental governance frameworks to reach service-level agreements and articulate collaborative and integrated initiatives. Over the past two years the Greater Santa Fe Metropolitan Coordinating Bureau[4] has held working meetings towards this objective.

At other levels of government, the province of Santa Fe – through its Ministry of Environment and Climate Change – is responsible for supervising various regulations linked to the final disposal of waste, managing hazardous materials, submitting environmental assessment studies, and more.

In 2024, the current municipal administration adopted the Commitment for a Cleaner Santa Fe (Compromiso por una Santa Fe + Limpia). This governance strategy includes 10 pillars involving more than 500 local institutions and seeks to reduce the generation of waste and to optimize its collection for a greener and more sustainable city.

4 The Greater Santa Fe Metropolitan Coordinating Bureau was set up in 2018 within the framework of Provincial Law Nº 13.532, to coordinate and articulate policies for common problems, bringing together 25 municipalities and communes and with the involvement of the provincial government.

5. Translating Challenges into Opportunities

Challenges

The Santa Fe CAP report (Circularity Informatics Lab, 2024) provides an in-depth analysis of waste management, materials flows and plastics use in Santa Fe.

Plastics represent 90 percent of all mass-consumption packaging, including to-go containers used in the city's restaurants and rotiserías (take-away delis). The most frequently used materials for basic food packaging and sanitation/cleaning are polypropylene, PET and HDPE.

Opportunities identified in this context include:

- Prioritizing convenience products made of PET and multilayered plastic laminates in conversations about extended producer responsibility and product redesign;
- Incentivizing the use of alternative materials to plastic (cardboard and paper packaging, reusable materials, bulk sales) at retail stores and local takeaway restaurants;
- Identifying opportunities to expand the collection and recycling of highly recyclable products (polypropylene, PET and HDPE) at businesses and other collection points (expanding the existing network).

The last of these opportunities is the focus of this project, as detailed below. The project opportunity to address the challenges in Santa Fe was identified through an assessment based on the outcome of the CAP and the opportunity assessment tool.[5]

Opportunities

During Urban Ocean's gap assessment phase, the program promoted participatory workshops to identify the main opportunities to improve waste management while strengthening urban resilience.

The prioritized opportunities were:

- Eco Puntos
- Composting and valorization of organic waste
- Micro-landfills
- Plastic food packaging

Eco Puntos

Expanding and optimizing the system of fixed collection points for recyclable waste (cans, glass, paper and cardboard, plastics and Styrofoam, batteries and electronic items) distributed across the city. This promotes the recovery, valorization and reuse of recyclable materials for their reincorporation into the value chain, reducing the volume of recyclable waste that is not recovered and extending the lifespan of the landfill.

Composting and valorization

Promoting strategies for composting and/or otherwise recovering the organic fraction of municipal solid waste in households, businesses, industries and institutions, or through centralized collections. The impact of this opportunity includes waste valorization and extending the landfill's lifespan.

5 The Opportunity Assessment Tool consists of three workshops (Framing, Participatory, and Solutioning) and is a process designed to reflect on the CAP results, assess opportunities according to their impact and viability, and prioritize and develop steps to improve the results of waste management and to promote a more circular economy.

Informal micro-landfills

Developing strategies to minimize and/or eliminate illegal dumpsites. The impact of this opportunity includes preventing soil degradation, water and soil contamination, vector proliferation, drainage blockages (storm drains, open drains, gutters); and improving the urban landscape.

Plastic food packaging

Reducing the distribution of single-use plastics in restaurants, bars and rotiserías; incorporating recycled and/or organic materials in this type of packaging; increasing returnability and recyclability. The impact of this opportunity includes reducing the leakage of plastic waste into water bodies and the environment; a reduction in the volume of waste sent for final disposal and extending the landfill's lifespan.

Project Justification

The selected project opportunity specifies the installation of a plastic reprocessing plant, supported by the expansion of the network of Eco Puntos to increase the quantity and quality of plastic waste recovered for processing. A mechanical recycling mechanism will be installed to process highly recyclable plastics such as PET, HDPE and polypropylene through sorting, shredding, compacting, bailing, melting or extrusion. Thermal treatments to produce energy from waste were not considered. This plastic reprocessing plant would be installed at the Complejo Ambiental, the waste management facility of Santa Fe.

A broad range of products and equipment can be manufactured with recycled material, including street furniture, children's playground equipment, speed bumps, in addition to bricks and slabs for construction and paving. Furthermore, the installation of the plant at the waste management facility will support the mission of the Environmental Education Center that the Municipality of Santa Fe (MSF) is developing at the same site, while promoting community engagement and awareness through the reintroduction of valuable products made from recyclable materials into public spaces.

To support the reprocessing plant and enable its sustainability, the network of Eco Puntos will be expanded to increase the quality and quantity of collected materials while leveraging their positive educational impact.

The project will also support collaborations with intermediaries such as clubs, neighborhood associations and schools to incentivize the installation of these facilities and raise environmental awareness. Additionally, private companies can also be invited to sponsor Eco Puntos.

The Resilience Dividend

The identified opportunity will create broad environmental, economic and social benefits for residents of Santa Fe and the region. The creation of formal jobs in the collection, sorting and transformation of plastics will strengthen the local economy and promote the incorporation of informal recyclers into the formal waste management system. In parallel, the production of recycled goods, such as street furniture and playground equipment, will reincorporate economically valuable materials into the value chain, encouraging responsible consumption. The project will also encourage participation through educational and awareness raising campaigns, consolidating a culture of recycling and environmental stewardship that will strengthen social cohesion and improve the quality of urban life.

The impacts of this opportunity are illustrated using the seven spokes of the Circularity Assessment Protocol in Figure 17. These spokes provide a comprehensive analysis of materials flows in a community, whether through waste management systems or through leakage into the environment.

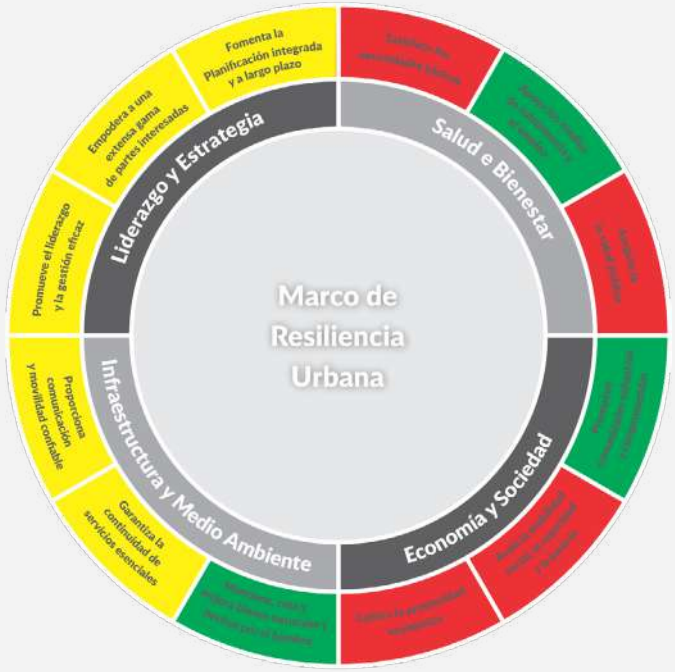
The selected project has a high impact on the waste collection system spoke by integrating door-to-door collection with an expanded network of Eco Puntos with more facilities that receive sorted materials. It has a medium impact on the community spoke, through active participation of stakeholders in awareness-raising and collaborative activities for sorting recyclable materials, and in the end-of-cycle spoke by reducing the amount of recyclable materials being sent to the waste management facility. The project also aims to reduce waste leakage, albeit on a smaller scale.

By analyzing the project through the City Resilience Framework (Figure 18), its impact can be viewed from a resilience perspective, understood as the capacity of a city's individuals, communities, institutions, companies, and systems to survive, adapt and develop

FIGURE 17
Radial chart evaluating the impact of the project through the seven spokes of the CAP

Compiled by the authors based on the seven spokes of the CAP

FIGURE 18
City Resilience Framework for analyzing the levels of opportunities' impact through a traffic light coding



Created by the authors

in the face of shocks or stresses. The City Resilience Framework (CRF) has four dimensions, 12 objectives and 52 indicators that help quantify how the project proposed in this report can have an impact on resilience and generate resilience dividends.

Figure 18 demonstrates the results of this analysis, revealing the type of impact the project has on the different dimensions of the CRF: direct (green), potential (yellow), or no impact (red). The proposed initiative will have a direct impact in three areas:

- Infrastructure and environment: by improving waste management and transitioning towards a more circular economy;
- Economy and society: by promoting cohesive and engaged communities;
- Health and wellbeing: by supporting employment and livelihoods, particularly for waste pickers.

A potential impact is expected for five of the pillars:

- empowerment of a broad range of stakeholders;
- promotion of leadership and effective management;
- fostering long-term and integrated planning;
- providing reliable communication and mobility;
- continuity of service provision.

The United Nations Agenda 2030 Sustainable Development Goals provides another means of evaluating the project's impact.

The project is considered to have a direct impact on the following SDGs.

SDG 11: Sustainable cities and communities

SDG 12: Responsible consumption and production

SDG 9: Industry, innovation and infrastructure

SDG IMPACT

Santa Fe project opportunity impact by SDG. The SDGs are ordered left to right from greater to lesser impact and in two rows

Direct

SDG 11: SUSTAINABLE CITIES AND COMMUNITIES

(Goal 11.6): helps improve the management of plastic waste, reducing the amount being sent to the landfill and promoting more sustainable urban spaces through the installation of street furniture made of recycled materials.

SDG 12: RESPONSIBLE CONSUMPTION AND PRODUCTION

(Goal 12.5): promotes the circular economy by increasing the life cycle of plastics, promoting recycling and reuse of materials.

SDG 9: INDUSTRY, INNOVATION AND INFRASTRUCTURE

(Goal 9.1): promotes the modernization of infrastructure and the development of sustainable industries which use resources more effectively and adopt clean and environmentally friendly technologies and processes.

Indirect

SDG 3: GOOD HEALTH AND WELL-BEING

SDG 8: DECENT WORK AND ECONOMIC GROWTH

SDG 6: CLEAN WATER AND SANITATION

6. Project Description

Project Presentation

This initiative represents a targeted focus on a more sustainable and efficient waste management model, in line with the principles of a circular economy. It seeks to strengthen the recycling value chain, understood as the sequence of processes through which discarded materials are collected, processed, and sold.

The project is designed to reduce the environmental impact of waste and increase the value of recycled materials. It will promote new valorization and recycling strategies by treating plastic waste and turning it into new products which can then be reintegrated into the value chain. Additionally, the expansion of the Eco Puntos network aims to increase both the quantity and the quality of recyclable materials, especially plastics, reducing the volume of waste being sent to landfill and therefore extending its lifespan.

The project specifically proposes the installation of a mechanical recycling system for highly recyclable plastics (PET, HDPE and polypropylene). Mechanical recycling involves reprocessing (mainly through melting and molding) plastic waste to transform it into new intermediate or final products. This process represents the simplest way of recycling plastic waste and requires the lowest initial investment.

Mechanical recycling involves various stages, which generally include (Figure 19):

→ collecting, sorting, and separating;

→ shredding large or thick objects,

FIGURE 19
Mechanical recycling process

Source: Ecoplas Argentina

→ compacting small objects and plastic films;

→ cleaning plastic to remove organic matter;

→ drying and reprocessing.

If the plastic requires prior washing at the waste management facility, the resulting leachate will require treatment.

The plant can be custom designed to produce "plastic wood" (boards, slats, battens, posts, etc.) with a production capacity of around 125 tons/year, calculated based on its processing capacity: 50 kg of plastic per hour and machinery uptime of 10 hours a day. This figure also considers the average number of working days per year (250).

Manufacturing these products requires shredding, mixing and extruding plastic to create "plastic wood". Therefore, as general guidance, this facility may contain a plastic shredder, a plastic agglomeration machine, an extruder and various molds. This production process normally requires a mix of 50 percent hard plastics (HDPE, polypropylene) and 50 percent soft plastics (low-density polyethylene).

The project also includes the expansion of the current Eco Puntos network, with 40 new sites added for the deposit of recyclable materials, in addition to a redesign and optimization of the collection logistics to increase the quantity and quality of materials available for processing.

Objectives

General Objective

To strengthen the recycling value chain in Santa Fe through the installation of a plastic reprocessing plan and the expansion of the network of Eco Puntos, stimulating the circular economy through an integrated and participative municipal solid waste management model.

Specific Objectives

→ To reduce leakage of plastic waste into the environment and water bodies and reduce the amount of waste sent to landfill for final disposal.

→ To implement industrial plastic recycling processes in order to manufacture useful products for the city.

→ To consolidate and expand the network of Eco Puntos in the city.

→ To promote environmental awareness in the community, encouraging the sorting of plastic waste at source and strengthening residents' involvement in the circular economy.

→ To strengthen and formalize local recycling initiatives, creating employment opportunities for stakeholders in the informal waste economy.

→ To increase and improve data collection and create indicators to monitor waste management in the city and its metropolitan region.

→ To contribute to the development of the local waste management facility as a benchmark environmental education center.

Implementation

This section describes the project implementation strategy, establishing the various sequential and chronological stages. The project will begin with setting up a senior management team, consisting of members of the Executive Municipal Department of Santa Fe, to supervise and coordinate the various planned components and activities. It also includes an initial identification of actors for each component, as well as the projected resources required for implementation.

Phase 1: Designing and diagnosing the program

The objective of Phase 1 will be to design the plastic reprocessing plant and plan the expansion of the Eco Puntos network. Subsequently, the planned intervention and work plan will be validated with strategic stakeholders.

The main components and activities are described below.

SETTING UP THE PROJECT MANAGEMENT TEAM

Description: a senior management team will be key to successfully implementing the project. This will be a multidisciplinary body that involves different municipal departments.

The senior management team will also work directly with various strategic partners, who will intervene at different stages of the implementation process. This

TABLE 2 WORK PLAN

PROJECT COMPONENTS	Year 1				Year2			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
PHASE 1: Diagnosis and Design of the program								
1.1 Setting up the project management team								
1.2 Mapping and evaluating existing collection points								
1.3 Analyzing the generation and composition of plastic waste								
1.4 Consultations and participation								
1.5 Developing preliminary design								
1.6 Defining a monitoring and follow-up system								
PHASE 2: Developing the final design								
2.1 Environmental impact assessment								
2.2 Developing the technical and structural design of the plant								
2.3 Preparing the tender								
PHASE 3: Building the Plastic Reprocessing Plant								
3.1 Public infrastructure works								
3.2 Purchasing and installing machinery								
3.3 Launch and operational testing								
3.4 Hiring and training operators								
PHASE 4: Expanding the Eco Puntos network and improving waste collection logistics								
4.1 Selecting strategic locations for new Eco Puntos								
4.2 Designing and purchasing equipment and infrastructure								
4.3 Communications for the Eco Puntos network								
4.4 Analyzing logistics and redesigning waste collection routes								
PHASE 5: Environmental education and awareness raising								
5.1 Delivering educational programs and awareness raising campaigns								

coordination will increase the project management's efficiency and transparency, supporting the achievement of objectives.

Stakeholders: MSF departments and related bureaus, service providers, Asociación Civil Dignidad y Vida Sana.

Resources: team's professional fees and office equipment.

MAPPING AND EVALUATING EXISTING COLLECTION POINTS

Description: the senior management team will lead the mapping and analysis of the network of Eco Puntos and recycling containers. This process will be launched through a detailed survey of their current locations, considering geographical, demographic and accessibility factors.

In parallel, the amount of material recovered at each Eco Punto and recycling container will be quantified and recorded. This process will be based on the compilation of data on the weight of waste collected at different times, broken down by the largest fractions (plastics, paper and cardboard, glass, metals, etc.). This quantitative analysis will be essential for evaluating the efficiency of each collection point.

Finally, areas with low levels of coverage and sites where waste accumulates outside the formal collection system will be identified. This analysis will cross-reference the distribution of existing Eco Puntos against population data and waste generation by area to detect sectors that lack service or have inadequate recycling infrastructure. Field studies and consultations with residents and community organizations will also be done to identify areas where waste tends to accumulate and create pollution hotspots such as illegal dumpsites or puntos sucios (dirty points), degrading the quality of the urban environment.

Stakeholders: MSF, UNL.

Resources: measurement equipment (scales), geo-referencing tools, geographic information systems software, logbook.

ANALYZING THE GENERATION AND COMPOSITION OF PLASTIC WASTE

Description: the analysis of plastic waste generation and composition will begin with the planning and execution of assessment studies on dry waste entering the Santa Fe and Metropolitan Area Waste Management Facility, following the guidelines established in standardized protocols (such as the Argentine Institute for Standardization and Certification's IRAM 29.253:2003 regulation).

After the plastic waste is separated, a detailed assessment will identify the most common types of polymers found in the waste stream.

Stakeholders: MSF, UNL, specialist consultants.

Resources: analysis laboratories, sample inputs, measuring equipment.

CONSULTATIONS AND PARTICIPATION

Description: this component entails stakeholder consultations and participatory activities with key community representatives to ensure the project's effectiveness and sustainability. As a first step, consultation sessions will be held with schools, stores, social clubs, and other organizations in the neighborhoods identified as potential candidates for new Eco Punto facilities. These sessions will help gauge the level of interest of communities and assess the waste separation practices within their communities. For the second phase, a group of experts and key partners in the private sector will be set up to analyze the potential of products developed at the plant. Finally, a participative workshop to present the project's progress and to gather opinions and suggestions for improving its implementation will be organized with stakeholders that participated in the Opportunity Assessment Tool workshops, promoting commitment of local stakeholders to increase long-term sustainability.

Stakeholders: MSF, environmental non-governmental organizations (NGOs), universities, schools, neighborhood clubs, provincial government, city neighborhood associations, companies.

Resources: community facilities, digital and graphic materials, facilitators.

DEVELOPING THE PRELIMINARY DESIGN

Description: the conceptual design phase will begin with the identification and evaluation of possible

sites within the waste management facility to identify which meet the technical, logistical and environmental requirements. After selection of the site, a preliminary layout will define the plant's operational areas: material reception zone, sorting and shredding line, washing areas, extrusion and pelletizing, along with a storage area for the final products. In parallel, possible private-sector partners and other strategic allies will be identified to explore co-financing and opportunities for public–private collaboration.

With respect to the proposed expansion of the network of Eco Puntos (Phase 4), technical and strategic criteria for installing new collection points will be defined according to the findings of the prior analysis. Population density, waste generation patterns, accessibility and visibility of facilities will be considered, prioritizing areas with low levels of coverage and sites where waste accumulates. Additional elements that will be defined include signage, monitoring systems and regular maintenance programs. In parallel, a logistics plan will be drawn up to streamline the collection of materials from the new Eco Puntos, optimizing routes and resources (vehicles, personnel, teams).

Stakeholders: MSF, Santa Fe Ministry of Urban Planning, College of Architects.

Resources: plans, design software, technical resources.

DEFINING A MONITORING AND FOLLOW-UP SYSTEM

Description: this component will strengthen existing information in the MSF and develop new indicators for improved decision-making and evaluation of the project's social, environmental, and economic results and impact. Available data will be compiled, with a focus on quality and consistency; new indicators will also be developed to monitor and improve Santa Fe's municipal solid-waste management system. Finally, MSF personnel involved in this work will receive training to ensure long-term sustainability.

Stakeholders: MSF, UNL.

Resources: statistical analysis software.

Phase 2: Developing the final design

The objective of Phase 2 will be to develop a final design for the plastic reprocessing plant. The main components and activities in this stage are listed below.

ENVIRONMENTAL IMPACT ASSESSMENT

Description: a site will be chosen within the waste management facility (about 400 m2). The facility's environmental impact assessment will be updated to include the reprocessing plant. Environmental, social, and operational impacts will be assessed.

Stakeholders: environmental consultants, provincial Ministry of the Environment.

Resources: technical studies, specialist laboratories.

TECHNICAL, ECONOMIC AND STRUCTURAL DESIGN OF THE PLANT

Description: a plan of the plant's layout and processes will be drawn up; specifications of the machinery and processes (shredding, washing, extrusion, pelletizing) will be defined, along with construction designs (sheds, offices, collection areas). An organization chart, including staff roles and responsibilities, will also be specified, together with an economic analysis of the plant in operation.

Stakeholders: civil engineers, architects, recycling experts.

Resources: computer-aided design software, structural plans.

PREPARING THE TENDER

Description: defining plant equipment and construction requirements. Invitation to construction companies and equipment providers to submit tender proposals.

Stakeholders: MSF, UNL.

Resources: legal documents, specialist consultancy.

Phase 3: Building the Plastic Reprocessing Plant

The objective of Phase 3 will be to build the plastic reprocessing plant at the waste management facility and begin operations.

FIGURE 20
Machinery for the plant

Source: Conti Maquinarias

PUBLIC INFRASTRUCTURE WORKS[6]

Description: earthworks, construction of warehouse (400 m²) and collection areas. Basic public services (water, electricity, sewage) will be expanded as necessary.

Stakeholders: successful bidder, MSF.

Resources: a semi-enclosed, approximately 400m2 shed as the basic infrastructure.

PURCHASING AND INSTALLING MACHINERY

Description: purchase and installation of equipment such as shredders, washers, extruders, pelletizers and molds. Production lines will be set up for PET and HDPE plastics.

Stakeholders: industrial providers, mechanical engineers.

Resources: funds to purchase basic equipment.

The following images are provided to illustrate the type of industrial machinery.

The plant is projected to have an initial plastic reprocessing capacity of between 40 and 80 kg/h, leveraging shredding, mixing, and extrusion to create "plastic wood" (boards, battens, posts, etc.) using the following industrial equipment: (i) shredder; (ii) plastic agglomeration machine; iii) extruder, and iv) various molds.

"Plastic wood" is a circular economy solution as it uses discarded plastic materials, prevents tree felling, and produces a long-lasting and maintenance-free product. Other products made using plastic waste (blocks, bricks) achieve the same objectives while increasing a construction's sustainability.

LAUCH AND OPERATIONAL TESTING

Description: a test of the proper functioning of equipment and processing lines. Prototype production trials (street furniture, playground equipment, etc.).

Stakeholders: process engineers, machinery technicians.

Resources: plastic material for tests, specialist technicians.

HIRING AND TRAINING OPERATORS

Description: plant operators (for sorting, quality control, production) will be hired, and technical and safety training programs will be implemented. The plan is to incorporate informal recyclers, cooperatives and/or local associations into the project to provide dignified work, labor rights and basic services

Stakeholders: MSF, recycling cooperatives, NGOs.

Resources: training facilities, instructors, manuals.

Phase 4: Expanding the Eco Puntos network and improving waste collection logistics

The objective of Phase 4 will be to expand and improve the plastic waste collection infrastructure in the city of Santa Fe. Another aim will be to optimize the collection and transportation of recyclable materials based on analysis and mapping of more efficient routes. The main components and activities of this stage are listed below.

SELECTING STRATEGIC LOCATIONS FOR AN EXPANDED ECO PUNTOS NETWORK

Description: 40 new Eco Puntos and recycling containers will be installed to increase the coverage of the separate-waste collection system in the city. This will facilitate access to convenient and easily identifiable facilities for the proper disposal of recyclable materials. The process will begin with the selection of strategic locations according to the results of prior mapping, prioritizing densely populated urban areas, residential zones with low levels of coverage, and key institutional facilities such as schools, social clubs, shopping malls and community centers, with consideration for proximity to existing collection routes and the ease of access for collector trucks.

During this stage, the project management team will coordinate closely with schools, businesses and neighborhood associations to ensure the viability of the locations, obtain the corresponding permits and

6 This stage proposes the option of only requiring a refit of the waste management facility's existing installations. In case of a new project, the total building area required will depend on the complexity and scale of the desired plastic waste transformation. During the pilot scale, it will be possible to omit this requirement by using the waste-management facility's existing buildings.

sign agreements between the institutions involved in promoting and maintaining the Eco Puntos.

Stakeholders: MSF, neighborhood and business associations, schools.

Resources: prior geolocation of Eco Puntos.

DESIGNING AND PURCHASING EQUIPMENT AND INFRASTRUCTURE FOR ECO PUNTOS

Description: definition of the types of Eco Puntos and bins to be installed and selection of suitable containers for the collection of separate materials including plastics, paper, cardboard, glass, and metals. Eco Puntos will be equipped with differentiated containers and clear signage for users to sort their waste easily and properly.

For less accessible areas, such as neighborhoods with narrow streets, areas on the city's outskirts or those with limited infrastructure, mobile Eco Puntos can be provided. These mobile units (for example, trailers or containers mounted on vehicles) will travel to various areas on a scheduled route for residents to sort and discard their recyclable waste on certain days and at specific times. They will be equipped with proper storage systems and will provide coverage for areas where it is unfeasible to install fixed points.

The installation will also include instructions placed at each Eco Punto, detailing which materials can be dropped off and how they must be prepared (for example, plastics must be clean and dry). Installing fill-level sensors is also foreseen in certain strategic containers as a means of monitoring their capacity in real time, thus optimizing collection routes and preventing overflows.

Stakeholders: local providers, MSF, sponsoring companies, chambers of commerce.

Resources: as necessary to purchase containers, big bags, and signage.

COMMUNICATIONS FOR THE ECO PUNTOS NETWORK

Description: coordination with potential sponsors for Eco Puntos though the corporate social responsibility program, with the companies bearing some of the costs for the new installations and for maintaining or improving existing ones. In parallel, a communication campaign for local communities will be designed and run by the MSF alongside neighborhood organizations to inform residents about the location of the new Eco Puntos and to encourage their proper use, which will strengthen citizen engagement in the recycling system.

Stakeholders: MSF, sponsoring companies, community associations and the media.

Resources: design and communication equipment, printed materials and production of digital or audiovisual products, investment in media campaigns.

ANALYZING LOGISTICS AND REDESIGNING WASTE COLLECTION ROUTES

Description: logistical analysis and design of efficient routes to optimize the collection of recyclable waste from Eco Puntos and containers for a sustainable and efficient system. This process will consider logistical aspects of both fixed and mobile units, as the former require periodical planning, while the latter require flexibility and adjustments to established schedules.

To improve the system's efficiency, an assessment of the current collection equipment will determine whether there is a need for an additional hydraulic tipping truck with crane, a vehicle designed to pick up high-volume containers and big bags. The analysis will also consider incorporating real-time monitoring devices in collection containers to plan dynamic routes and reduce unnecessary journeys. The information gathered will be managed through a centralized system, prioritizing the most critical points of collection. Finally, specific personnel training and operating protocols will be implemented, with a focus on the handling of new equipment, the use of the monitoring system, and best practice to ensure safe and efficient collections.

Stakeholders: urban sanitation companies, MSF.

Resources: logistics software, GPS, purchase of collection truck with crane. Mapping carried out during stage 1.

Phase 5: Environmental education and awareness raising

This will be a cross-cutting phase aiming to boost engagement and provide information about recycling and the circular economy.

DELIVERING EDUCATIONAL PROGRAMS AND AWARENESS RAISING CAMPAIGNS

Description: actions will include awareness campaigns in schools, clubs, and the media about sorting waste, educational programs in Eco Puntos located in institutions (schools, clubs), visits to the Environmental Education Center, and promotion of the circular economy through community events and fairs. The project will be recommended for inclusion in the MSF's existing Environmental Education and Promotion Program.

Stakeholders: MSF, UNL, environmental NGOs, schools, local media.

Resources: multimedia materials, digital platforms, community facilities.

Funding

The project proposes the development of a scalable system for the collection and transformation of plastic waste generated in Santa Fe, with a focus on the circular economy and productive inclusion. Given an estimated total investment of **$540,000 USD**, an initial investment of **$60,000–80,000 USD** is proposed for pilot implementation oriented toward the validation of the technical and socioeconomic model.

As an initial step, MSF's Ministry of Public Administration and the Environment can assign funds to expand the Eco Puntos network and to coordinate and optimize the collection of materials. However, there currently isn't a budget assigned for the design of a plastic reprocessing plant. The MSF also operates a corporate social responsibility program, through which local companies commit to sponsoring public spaces or institutional projects, assigning funds for specific actions.

In general, the possible sources of financing identified to cover the project's estimated costs are as follows:

a) Public funding (governmental)

b) International funding

c) Private funds and impact investing

d) International cooperation funds and NGOs

e) Strategic public–private partnerships (PPPs)

The project also proposes cooperation agreements with local companies to co-finance Eco Puntos and the reprocessing plant, as well as priority-purchase agreements for recycled materials or products. There are also potential business opportunities linked to local plastic recycling initiatives and the production of value-added goods:

- Alliances between the MSF, recycling cooperatives, SME transformers, and large plastic generating companies (extended producer responsibility).
- Regulatory frameworks (Council ordinances) can incentivize increased separation at source and the inclusion of waste pickers and recycling organizations.
- The develoPPP.de sustainable-development program from the Deutsche Gesellschaft für Internationale Zusammenarbeit (German Agency for International Cooperation) (from €100,000 EUR).

In this framework, possible PPP stakeholders have been identified:

- MSF: initial logistics, awareness raising campaigns and separation-at-source regulations.
- Province/Nation: co-financing programs and institutional purchase of recycled products.
- Plastic generating companies:
- Large commercial sectors, food industry, urban logistics: partners in extended producer responsibility programs, infrastructure co-financing, supply of separate materials.
- Possibility of generating circularity compliance certificates to improve brand image and prestige).
- Acopiadores (intermediaries) and companies requiring plastic. For example: Integral Reciclados, or Sucata in the city of Santa Fe, Central Ambiental in Rafaela.
- Cooperatives.

The following business strategies have been identified for recycled products within the framework of the

PPPs:

- Street furniture for the MSF: benches, playground equipment, flooring, paving, etc. Sustainable public purchases (“green” tenders).
- Industrial inputs: plastic pellets or granules for new value chains (injection–molding or extrusion–manufacturing companies). Agreements with manufacturers seeking certified recycled materials.
- Sustainable building: plastic boards, bricks, blocks for public infrastructure or social housing.
- Final consumption and merchandising. Line of own-brand or cooperative products: plant pots, recycled furniture, school items, gardening kits, and so on.
- By-products for innovation: three-dimensional printing filaments, inputs for sustainable design companies, creative industries and entrepreneurs.

Breakdown by components

This proposal is designed to be scalable. The first step will be to install the mechanical equipment to process the material. Additional collection units and Eco Puntos will subsequently increase the amount of material available for transformation, expanding the plant’s processing capacity.

Table 3 describes the largest estimated project costs, broken down into the previously identified components.

The implementation of Phase 4 does not depend on the progress of the previous stages; its scalability is independent. However, as noted above, its implementation will provide feedback and boost the development of Stages 1-3.

TABLE 3 LARGEST ESTIMATED PROJECT COSTS, BROKEN DOWN BY PREVIOUSLY IDENTIFIED COMPONENTS

Phase	Implementation Component	Source	Cost (USD)
PHASE 1	Setting up the project management team	MSF Provincial and national funds NGO	**15.000**
	Mapping and evaluating existing collection points		
	Analyzing the generation and composition of plastic waste		
	Consultations and participation		
	Developing preliminary design		
	Defining a monitoring and follow-up system		
PHASE 2	Environmental impact assessment	Private funds and impact investing International cooperation	**40.000**
	Developing the technical and structural design of the plant		
	Preparing the tender		
PHASE 3	Site selection Public infrastructure works Warehouse construction; services	MSF Provincial and national funds	**150.000**
	Purchasing machinery: shredder, extruder, molds	International funds, APP	**150.000**
	Installing machinery Launch and operational testing Hiring and training operators	MSF APP	**10.000**
PHASE 4	Selecting strategic location for new Eco Puntos	MSF External financing	**10.000**
	Designing and purchasing equipment and infrastructure (including hydraulic truck with crane, big bags, and containers)		**150.000**
	Communications for the Eco Puntos network		
	Analyzing logistics and redesigning waste collection routes		
PHASE 5	Delivering educational programs and awareness raising campaigns	MSF NGO	**15.000**
	Project sustainability and communication		
TOTAL			**540.000**

7. Expected Impacts

The project aims to generate benefits to improve residents' quality of life, promote sustainable development and optimize the use of available resources, with a particular focus on plastic waste recycling. This section describes the positive social, environmental and economic impacts which, in turn, will strengthen community resilience in the city of Santa Fe and its metropolitan region.

The project's main impacts and its contribution to the city's overall development and environment are detailed below.

Social impacts

- Creation of new jobs in plastic waste collection, sorting, treatment, and the production of recycled goods (e.g., street furniture, playground equipment).
- Formal integration of waste pickers, cooperatives, and local associations, promoting dignified work and employment rights.
- Training and capacity building for municipal personnel.
- Strengthening of a recycling culture and increased environmental awareness and stewardship within the community.
- Greater community participation in waste management and the adoption of responsible consumer behaviors.
- Enhanced environmental governance through stronger institutional collaboration between the municipality and key stakeholders.
- Reduction in health risks by limiting the spread of disease vectors associated with micro-landfills.

Environmental impacts

- Reduction in greenhouse gas emissions.
- Decrease in waste sent to landfill.
- Increase in recycling rates.
- Reduction in pollution caused by solid waste leakage.
- Improvement in the quality of urban and peri-urban ecosystems in Greater Santa Fe by reducing waste accumulation in micro-landfills and illegal dumping sites (puntos sucios).
- Protection of local biodiversity through decreased waste entering water bodies and natural environments.
- Conservation of natural resources by reusing plastic materials.
- Promotion of public awareness on recycling through the use of street furniture made from recovered materials.
- Energy savings through the substitution of recycled plastics for virgin raw materials.

Economic impacts

- Improved infrastructure for waste sorting at the source.
- Optimization of waste collection routes and logistics.
- Reduced recycling-related expenditures, especially in transport and logistics.
- Extended operational lifespan of the landfill at the waste management facility.
- Lower municipal costs for cleaning public drains and spaces.
- Consolidation of circular economy projects with long-term impact.
- Generation of new economic opportunities through local recycling and value-added product manufacturing.

- Opportunities for public–private partnerships to fund infrastructure and operations, enhancing cross-sector collaboration.
- Strengthened municipal capacity to access national and international financing for circular economy initiatives.
- Growth in local GDP by registering informal workers and capturing their economic contributions currently unaccounted for in macroeconomic indicators.

Table 4 shows benchmark prices of recovered materials. Based on the stream of each kind of material received at the facility, these amounts give an idea of the "volume of business" available.

Assuming that the reprocessing plant will work exclusively with HDPE and given conservative and representative value of $400 ARS per kilogram of this material, an annual processing volume of around 100 tons would yield a financial value of around $40 million ARS, or about $33,000 USD.

Once the value added by the transformation is considered, and repayments for the equipment, capital costs, salaries and other inputs (e.g. energy) are also factored in, a minimum estimate of the economic value of production could triple to approximately $100,000 USD a year.

TABLE 4 BENCHMARK PRICES (ARS) FOR POST-CONSUMER RECYCLED MATERIALS. PRICES CURRENT AS OF DECEMBER 2024

Material	Minimum	Maximum	Average
Aluminum cans	500	1,500	968
Cardboard	90	180	125
White paper	270	272	271
Oil PET	35	100	76
White PET	50	150	94
Blue PET	220	350	265
Crystal PET	450	615	551
Green PET	200	300	255
Blow-molded Yellow (HDPE)	345	850	313
Blow-molded White/Transparent (HDPE)	460	850	653
Blow-molded Mixed (HDPE)	302	570	402
Glass	39	42	41

Compiled by the authors, based on www.conexionreciclado.com.ar/recursos

TABLE 5 KEY ASPECTS OF THE PROJECT'S IMPLEMENTATION

Block	Description
Value proposition	• Reducing plastic pollution through improved collection and increased recycling of plastic materials • Producing high-quality recycled materials for municipal use or sale • Generating employment in vulnerable sectors through the collection and sorting of plastics, and in the recycling plant • Promoting a circular and sustainable economy
Strategic partners	• Recyclers' cooperatives and associations • Manufacturing companies that require recycled plastic as a raw material • Greater Santa Fe Metropolitan Coordinating Bureau; municipalities and local governments interested in waste-management solutions • Waste-management companies • Environmentally aware consumers
Collection/distribution channels	• Origin of recovered material: • Eco Puntos and community recycling centers • Puntos limpios • Informal collections • Destinations of finished products: • Direct use by the municipality • Direct sales to companies • Alliances with other municipalities
Economic value	• Municipal savings by avoiding the purchase of street furniture • Sale of recycled plastic to manufacturing companies • Sale of products made from recycled plastic
Socioeconomic impact	• Registration of informal workers • Generation of quantifiable local value added (product manufacturing), with contributions to macroeconomic indicators (GDP)
Environmental impact	• Less consumption of virgin natural resources • Longer lifespan of the landfill • Smaller carbon footprint

Block	Description
Key resources	• Municipal budget and human resources • Available infrastructure at the waste management facility • Recycling equipment: shredders, extruders and injection-molding machines • Trained personnel in waste management and production • Initial plastic processing capacity: up to 300 tons per year • Initial budget of $70,000 USD to buy machinery
Key activities	• Administrative and structural adaptation of the waste management facility • Installing a pilot plastics recycling machine on a reduced scale <u>Processes:</u> • Mechanical shredding to reduce particle size • Thermal extrusion for melting and shaping the material • Injection molding to produce pellets and parts
Cost structure and benefits [1]	• Purchase of initial machinery (capital expenditure): includes shredders, extruder, injector, molds: USD$75.000 • Operating and maintenance costs (operational expenditure): 1. electrical power: $20,000 USD per year 2. salaries [2]: $55,000 USD per year • Sales profit [3]: $180,000 USD per year • Lifespan: 15 years

[1] Basis for estimate: 125 annual tons of final product (plastic battens for street furniture or decks, for example). Market price: $2.5-4.8 USD/kg.
[2] On the basis of four employees working an eight-hour day, with a monthly salary equivalent to 1.25 basic “consumer basket” (INDEC).
[3] If products are sold

8.Project Sustainability and Scalability

The pilot plastic reprocessing plant can provide the starting point for a more ambitious project. The project demonstrates high viability potential, both at the pilot scale and after a prospective expansion, as it would not start from square one. It has the following strengths:

- It begins with source separation at the household level and, better yet, with the plastic fraction collected through Eco Puntos. Even if these types of sorting are not optimal, they are preferable to sorting at the plant itself.
- The raw materials to be recycled are already flowing readily to the waste management facility constantly. As such, a pilot does not depend on an expansion of the network of Eco Puntos.
- A physical site for the installation of the pilot plant (and for its future expansion) already exists at the waste management facility, including required infrastructure for basic services.

Moreover, in line with a strategy of gradual implementation, both in terms of scale and complexity, the following key characteristics are noted:

- The process can begin with a single type of plastic material (for example, HDPE).
- A single final product can be produced instead of several different ones, reducing the quantity and variety of equipment needing to be purchased (such as molds).
- Intermediate products can be sold instead of producing a final product (such as "plastic wood" or street furniture). For example, material can be sorted, cleaned, shredded, and pelletized. Pellets can be sold to third parties.
- Scalability can be projected in accordance with the priorities of the municipal administration to meet other demands such as the production of plastic bricks for affordable-housing projects or the manufacture of blocks for building curbs in neighborhoods at greater risk of flooding.

IMMEDIATE INITIAL IMPLEMENTATION

The installation of a small-scale recycling line requires an outlay equivalent to about **$65,000 USD** to purchase the machinery from a supplier within Argentina, a maximum delivery time of two months and minor adjustments to the sorting plant facilities at the waste management facility. The material is already being continually dropped off and processing could begin immediately.

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