RECYCLING ACADEMY.

CASE STUDY

Mini-guide

Case study : Capiobianco Soluciones

Documentation of a plastic recycling initiative in the Dominican Republic

Key learning outcomes:

- *Understanding the genesis and development of a recycling project*
- *Understand and visualize the operations of a plastic recycling center*
- *Gain feedback on the business model*

PLASTIC ODYSSEY

Updated by Thibault ROUDIER on 04/12/2023

Table of content

The contents of this guide are proposed in **open source**

Contributions to this mini-guide are welcome → please send an e-mail to jean-baptiste@plasticodyssey.org

1. Capobianco Soluciones in short

- **Name of the company :** Capobianco Soluciones
- **Owner :** M. Fermin Capobianco
- **Location :** Santo Domingo, Dominican Republic
  Used Plastic feedstock : Rigid plastics (HDPE, PP)
- **Products :** Plates, profiles, assembled products (litter garbage cans, benches, barriers, etc.)
- **Date of creation :** 2013
- **History:**
  - **2013 :** Purchase of land $70k (1000m2) and construction of workshop $50k
  - **2014 :** Purchase of a shredder $10k
    Purchase of extrusion line and barrel $130k
  - **2015 :** Purchase of board manufacturing line for $150k
  - **2017 :** Purchase of two extruders for $150 k
  - **2018 :** Lot extension (+1000m2) $70k
  - **2020 :** Partnership with Proplanet
- **Financing :** self-financing
- **Current machines operating:**
  - Board production line: 26 boards (1.3m*2.4m *12mm (40kg)) / day
  - Extruders:: 2 x 150 kg/h
- **Quantity of plastic recycled per year:**
  - ~ 3,5 T / jour
  - ~ 1000 T / an
- **Operators :** 8 employed + 4 extra workers depending on needs
- **Yearly turnover 2023 :** 400 k$

@capobiancosoluciones

2. Presentation of Capobianco Soluciones

Introduction

During our stopover in the Dominican Republic (September 2023), we received a record mobilization of Dominican recycling players. In Santo Domingo, we met over 300 entrepreneurs, students, professors and employees with projects to recover and reduce plastic waste. However, companies offering solutions for transforming materials into finished products can be counted on the fingers of one hand.

Capobianco opened the doors of its recycling workshop, which we spotted on YouTube several years ago for its plate-making method. Committed to developing sustainable solutions to the problem of plastic pollution, Fermin shared with us his experience in the world of semi-industrial-scale recycling.

|Fermin Capobianco

Fermin, an agricultural engineer and forestry manager in the Dominican Republic, has devoted over 20 years of his life to transforming wood into various objects used for agriculture, such as fences, enclosures and shelters. However, increasingly strict regulations aimed at preventing deforestation have prompted him to rethink his business. The country's environmental situation and his ecological awareness prompted him to explore opportunities in plastic recycling.

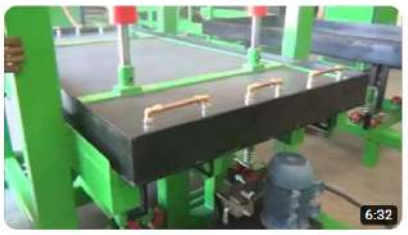
In 2008, he decided to train in plastic recycling, traveling to Colombia on several occasions to learn about recycling machines and valuable end products.

In 2013, he acquired a 1000m² plot of land and built his first warehouse. He begins by purchasing a shredder to accumulate shredded plastic resources, then acquires a profile line with barrels. In 2014, he bought an automated system for making plates. The sale of raw plates doesn't work out so well at first. He changes strategy and trains his employees in the construction of finished products, as this is a better fit with the Dominican market. In 2016 he buys 2 extruders in Colombia, and starts producing profiles and planks to vary his offerings. In 2017 he expands his warehouse by a further 1000m². In 2019, he sets up a partnership with Proplanet SAS Colombia to whom he sends scrap in tetrapack to receive polyaluminium sheets in return. The acquisition of various machines enables him to create street furniture such as park benches, school desks and any other object that can be useful in everyday life. Fermin also collaborates in the construction of houses made from recycled plastic, offering valuable support to several families in the region.

🎥 **Link to the YouTube videos** which introduced us to this board-making technology that we couldn't wait to discover :
https://www.youtube.com/watch?v=DRd53yhS95I

Capobianco Soluciones Ecológicas
8,7 k vues • il y a 10 ans
sweetlemonpro
Capobianco Soluciones Ecológicas es una empresa comprometida con el medio ambiente, dedicada a la recolección, ...

https://www.youtube.com/watch?v=v9fmVkgeGQA



Madera Plastica Fabricacion de Tableros de Madera Plastica
1 M de vues • il y a 11 ans
mexhealthcare
Madera Plastica es un material que se fabrica utilizando residuos plasticos de todo tipo. Es la solucion a los desechos plasticos ...

https://www.youtube.com/watch?v=m9nYgMtxWFY

Madera Plastica
448 k vues • il y a 8 ans
maquiventa maq
Maquinas para fabricar madera plastica a partir de desechos plasticos de casi cualquier tipo.

History

Although Capobianco Soluciones is now profitable, it wasn't until the 9th year that the company achieved a positive balance sheet. All investments have been private and personal. Fermin insists that his company could not have gotten off the ground here in the Dominican Republic with a system of bank loans or external aid. Combining the manufacture of his finished products in the same warehouse and with the same employees enables him to reap significant benefits. He insists on the added value of his employees' know-how for finished objects, which are far more valuable than the simple resale of profiles or sheets. Below are a few figures recalling the investments and milestones in the recycling company's development:

Revenues :

2014 : 5,5k$
2015 : 15k$
2016 : 38k$
...
2023 : 400k$

After three years, running the barrel extrusion line (purchased from American Cierrade Paul Vanderpool $130k in 2014, 300kg/h 85-100hp at 100kW), Fermin decided to stop it as too energy-intensive, preferring to buy two extruders with three-way valves. The barrel profile production line is still in the derelict workshop.

3. Production workshop and technologies

Presentation of the workshop

The production workshop now extends over 2,000m2, divided into different areas. The entrance serves as a storage area for finished products, with the management offices on the upper floor overlooking the workshop. The latter is shown in the photo above. You can see an area dedicated to joinery activities (center), the sheet production line on the right and the two extruders (far right).

Behind the production area are two storage areas, the first for raw materials (flakes and waste) and the second for polyaluminum products and finished profiles and sheets.

Chaîne de production de plaques

This is the second processing line for the material purchased by Fermin from Heatmx in Mexico. This automated production line produces HDPE sheets measuring 1.3m x 2.4m and 1.2cm thick. Occasionally, he can make sheets by adding a fraction of PP to the HDPE to make them more resistant. However, PP is often more expensive than HDPE, so he mainly produces HDPE sheets. Each plate mold is mounted on a cart that can be moved by hand to follow the rails.

- Daily production time : 4h / day
- Capacity : 6 boards of 40kg / day
- Energy consumption per hour of production : 45 kWh
- Dedicated generator : 100kW (oversized)
- Generator consumption : 30L/h (i.e. around 32$/h)

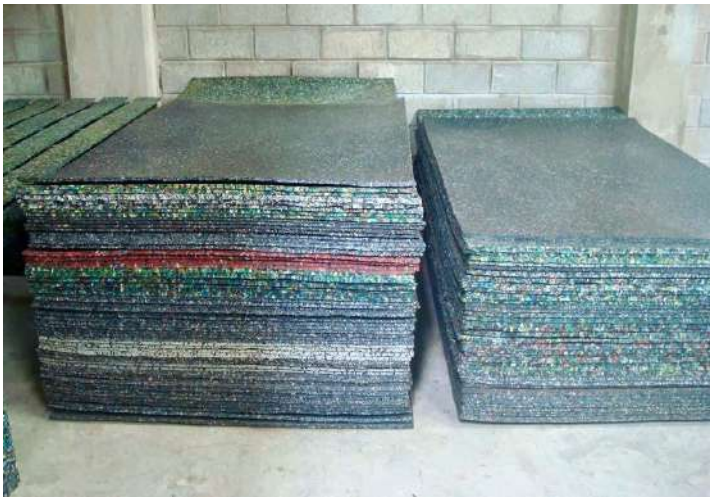
The process breaks down as follows:

- Silicone film applied with a cloth to the bottom of the mold
- Pouring the flakes
- Homogenizing the shredded material on the plate
- Heating: 10 min 180 degrees / 40 min 225 degrees
- Press: pressure for 40 minutes between 1200 and 1500 PSI with 8-degree coolant system
- Demolding
- Keeping the shape under press for 24h

The molds are made of steel, with silicone applied to the bottom as a lubricant. The ovens operate with a system of 4 resistors beneath the mold, heating the material in the mold by convection.

A ruler runs through the entire mold, smoothing out the material over the entire plate. On compression, it leaves a little margin on the side to allow the material to overflow.

Note that the cooling time under the press, cooled to 8°C, is essential for unmolding the plate. They are then stacked under a conformer (a heavy plate lifted by a goat) so that they retain their flatness. Finally, they are stacked for storage.



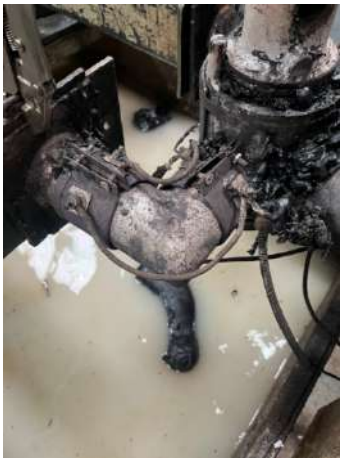
Chaîne de production de profilés

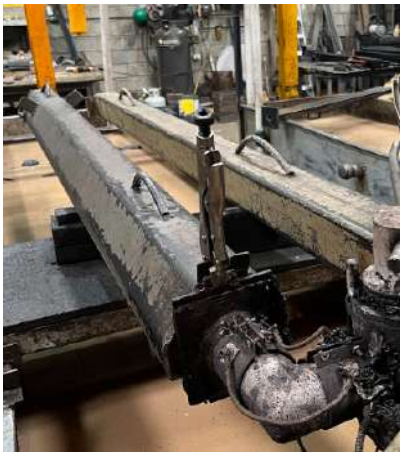
In 2017, two years after purchasing the plate production line, Fermin invested in a first extruder in 2017 ($27k) and then a second identical one in 2020 ($33k) to replace his extrusion line coupled with a barrel. With transport and installation of the machines from Colombia, this cost the company around $150k. Two operators handle mold changes, three-way valve switching and profile demolding.

- Daily production time : 4h / day
- Capacity : 150 kg/h (per extruder)
- Energy consumption per hour of production : 25 kWh (per extruder)
- Dedicated generator : 50kW
- Generator consumption : 19 L/h (i.e. arond 20$/h)

After 6 years in operation, and having inherited the know-how of Colombian recyclers, we can point to several technical subtleties that maximize the machine's effective production time and reduce the human time invested in production and maintenance.

The Ecomodulares extruder heats the shredded material to 225°C using 5 conventional 1500W heating clamps. The three-way valve manufactured by Ecomodulares in Colombia is equipped with 6 x 1500W - 220V heating collars to keep the valve at a slightly lower temperature than the screw, but prevent the material from congealing and blocking the flow. The valve is made of stainless steel, as it is not subject to mechanical stress and cannot be painted.



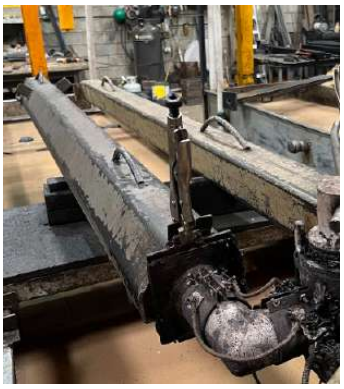


The molds used by Capo Bianco are made by Ecomodulares in Colombia. These molds caught our attention because they are very easy to demold and fairly light. The molds are mechanically welded from high-quality steel. By way of example, the most widely used mold is a 120cm x 10cm x 2.5cm, 3mm-thick plank mold costing around $130. These molds are fairly light and can be easily handled by operators, who grab the molds by their handles with their bare hands to move them. The 120cm molds with special geometry are sold for around $280.

Capobianco, for example, uses "fish-shaped" molds to make the planks used to build the walls of the houses. Until now, Fermin had to chamfer all his planks to prevent light from entering the houses. Thanks to these molds, no further carpentry work is required.

For the three-way valve/mould interface, the profile is fitted with a plate with a hole at the end. The hole acts as a material inlet. Its size is identical whatever the geometry of the profile to be filled, thus standardizing the valve/mould interface. The advantage over open-section molds is also that when the mold is disconnected, molten plastic cannot leak out of the mold. You can even hold your finger over the orifice just after unhooking the mold to prevent a little material from escaping; in a few seconds, the material is firm enough not to escape again.

Molds are pressed onto the extruder exit by a vice grip, enabling operators to carry out mold changes simply and efficiently. The molds are simply placed on profiles cut at the right height to keep the molds horizontal.



At the other end, the molds are fitted with notches that allow a wedge to be slid in to close them. Operators wait before closing to check filling. A solution seen in other workshops is to have a wooden wedge inside the mold, which is pushed in as the material advances, indicating when the mold is almost full. In Capobianco's workshops, cycle time management is based on experience. On larger-volume molds, to avoid pressurizing the extruder and mold, and thus causing the mold to swell, a small orifice allows the molten plastic to overflow.

Once the molds have been filled, the three-way valve is switched to fill a second, empty mold already in place. The freshly filled mold is immersed in the bath below, filled with water and water-miscible cutting oil. The cutting oil prevents corrosion and facilitates demolding by lubricating the mold. Immersing the hot mold in water reduces the plastic's setting time, which also helps with demolding.

For demolding, they use a metal aluminum rod that they hammer with a mallet. Aluminum is a highly ductile metal (the ability of metal to be shaped without increasing in volume or breaking).

As aluminum is "softer", this prevents excessive scratching when the bar rubs the inside of the mold. Once primed, the profiles are easy to remove from the mold.

Employees are trained in basic maintenance, with external and specialized maintenance accounting for only 5 to 10% of operations. The main maintenance costs relate to changing the heating collars. As an indication, the price of a standard 5kW collar is $250. On average, over a year's operation, the entire set of collars is replaced due to successive failures. The molds, although of good quality, are also parts to be renewed. They tend to swell and rust over time. Many molds are stored in the workshop because, to meet large orders, it is necessary to ensure production of the same type of profile with the 2 extruders in parallel, with at least 3 sets of 2 profiles per extruder. Maintenance of the extruder screw is necessary

every 5 to 10 years. It consists of removing the screw, cleaning it with a wire brush and, if necessary, adding material by welding, then reworking it by turning. A full service is invoiced at $300 in Colombia.

Once the profiles have been demolded and dried, a blowtorch can be used to obtain a better surface finish.

Organization of work in the workshop

The workshop and the pace of production are highly flexible, depending on demand. That's why all the workers are fairly versatile. For example, during our 3-week stopover in Santo Domingo, we didn't see the plate production line in operation. In the morning, the teams generally focus on profile production. Then, in the afternoon, they focus on the joinery department to shape the finished products. Recycled plastic profiles are processed in the same way as wood. This involves the use of conventional tools and fasteners: circular saws, wood screws, hinges and so on.

In the morning, two operators are all that's needed to run an extruder, and they can also handle plate production in parallel. A third operator concentrates on cutting profiles with a circular saw. A fourth operator takes care of the joinery all day long. During busy periods, two other operators are added to the workshop.

4. Feedstock supply and finished products

Feedstock supply

Capobianco processes HDPE (high-density polyethylene) and PP (polypropylene), which are hard plastics. It buys 85-90% of its waste already shredded, mainly HDPE at around $480/T. Less PP is purchased because its price is often higher than that of HDPE. Fermin confides that to keep his business viable, he will never buy material above $500 per tonne. He continually monitors the waste market informally, following prices from a number of sources, his main concern being to have a secure, good-quality deposit.

Indeed, Fermin stresses the importance he attaches to the quality of waste deposits, as the shredded material he buys comes only from post-industrial waste and never from

post-consumer waste. Dirty and contaminated waste is the main source of wear and tear on its machines. For example, during our 4-week stopover in Santo Domingo, no plates were produced by Capobianco Soluciones because the raw material of sufficient quality for this process was too expensive.

In addition, Capobianco Soluciones recovers 10-15% of its waste free of charge through a partnership with a motor oil company. These are used and contaminated HDPE cans/flasks. This represents around 100 tonnes a year.

The Capobianco Soluciones workshop is also equipped with a shredder (60hp - 200kg/h purchased for $30k) which enables it to grind its purges as well as its carpentry offcuts in order to transform the material once again.

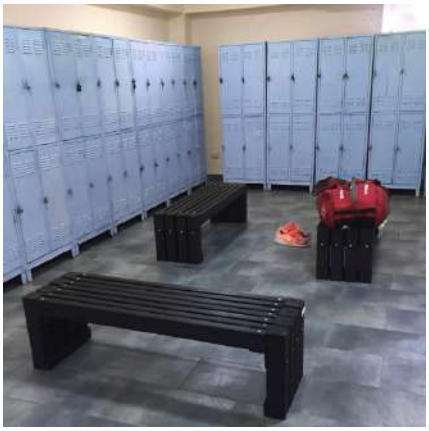
As part of the partnership he signed with Proplanet in 2019, Fermin collects 300 tons of tetrapack a year, which he ships to Proplanet's processing center in Colombia. In return, 200 tonnes of polyaluminium sheet and plate are returned to him.

Finished products

We'll come back to this later, but Fermin began by making semi-finished products such as sheets and profiles, but **over time he came to see that it was much more economically worthwhile to offer finished products.** He therefore offers a wide range of products that are assemblies of sheets and profiles:

|Bins

|Benches and tables



|Fences

|Parking space stops

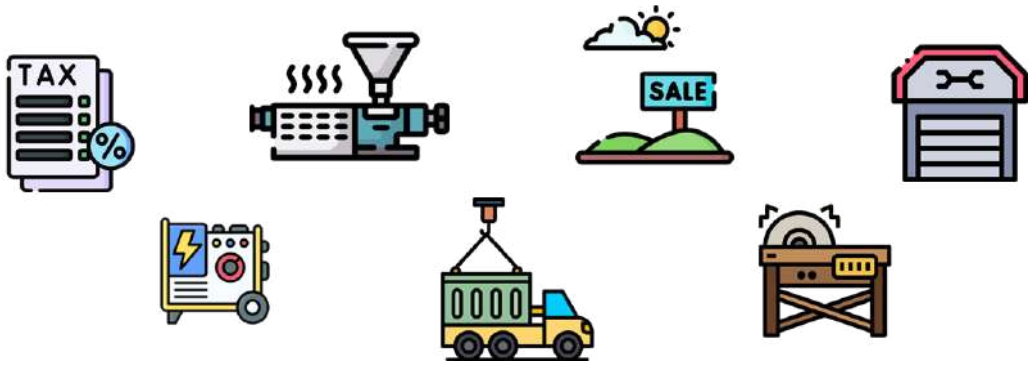
|House fronts

|Pallets

5. Business Model

Presentation of the cost-revenue analysis methodology

Below, we will carry out a cost-revenue analysis based on the Capo Bianco model. This analysis gives an idea of the company's business model, but it's difficult to extrapolate these figures, as the company adapts a great deal to fluctuations in demand, and the thoughts set out below are a little removed from the reality on the ground and the financial considerations held by Fermin. Still, it's interesting to compare margins by product and the process used to arrive at these valuations...

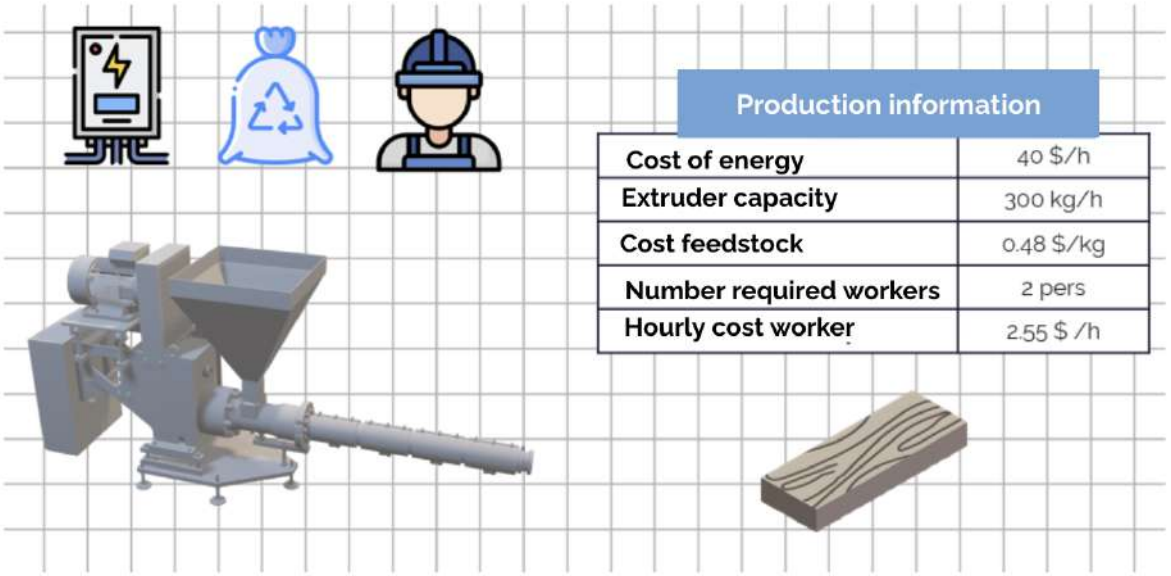


NB: As a first step, we calculate the operating cost of producing one kilogram of plastic, without taking into account the depreciation of the machines and molds, as well as the other fixed costs illustrated above.

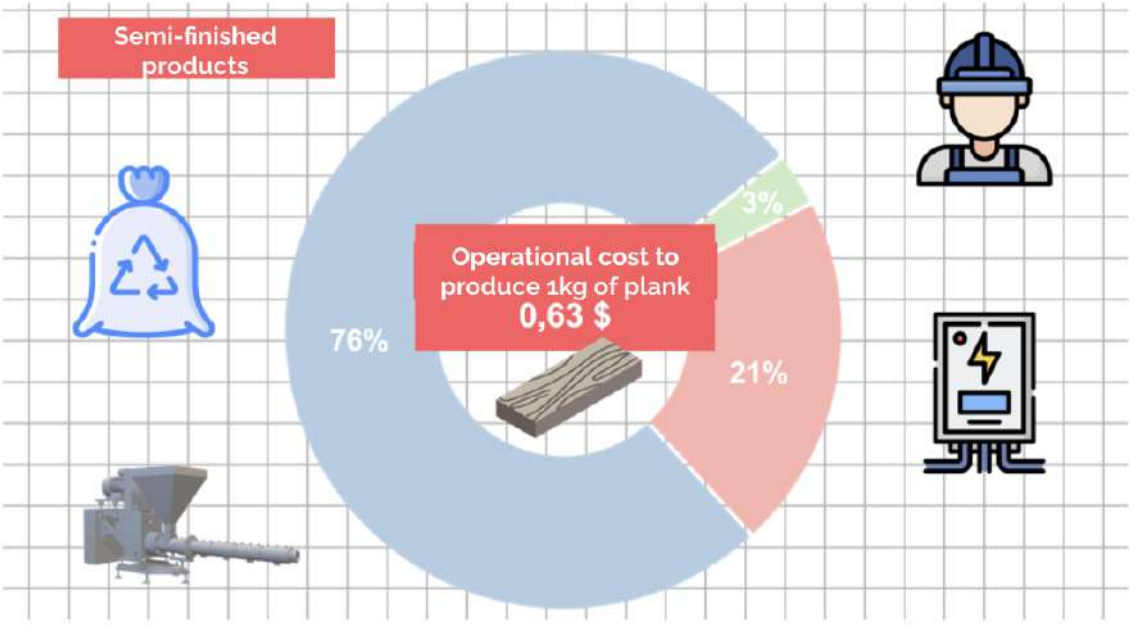
To do this, we first reduce all costs to a cost per unit hour of production. With the production capacity of the extruders, we can then relate this to the cost of a kilogram of extruded profile. Here, we'll make the simplifying assumption that no material is lost from the mill to the finished product, although depending on the product and the dimensions of the profiles required, joinery can lead to a non-negligible proportion of offcuts.

Secondly, we'll evaluate the costs associated with joinery operations separately for three products: a waste garbage can, a bench and a parking stop.

Production cost of extrude beams semi-finished products



Production information	
Cost of energy	40 $/h
Extruder capacity	300 kg/h
Cost feedstock	0.48 $/kg
Number required workers	2 pers
Hourly cost worker	2.55 $ /h

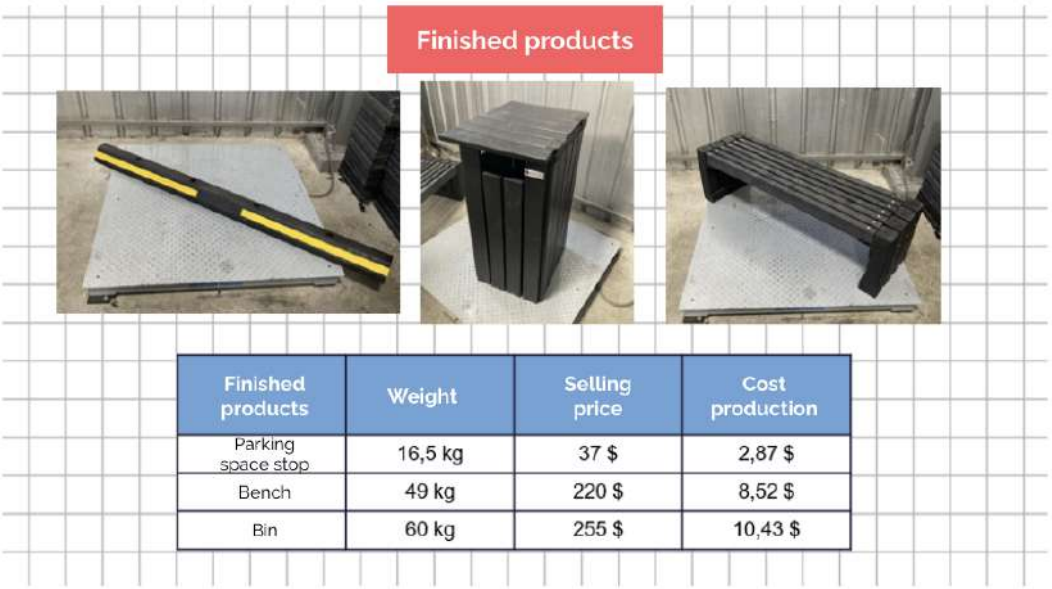


In terms of cost breakdown, 3% of costs correspond to labor, 21% to energy and 76% to plastic waste. **As a reminder, this does not take into account overheads, only immediate operating costs.**

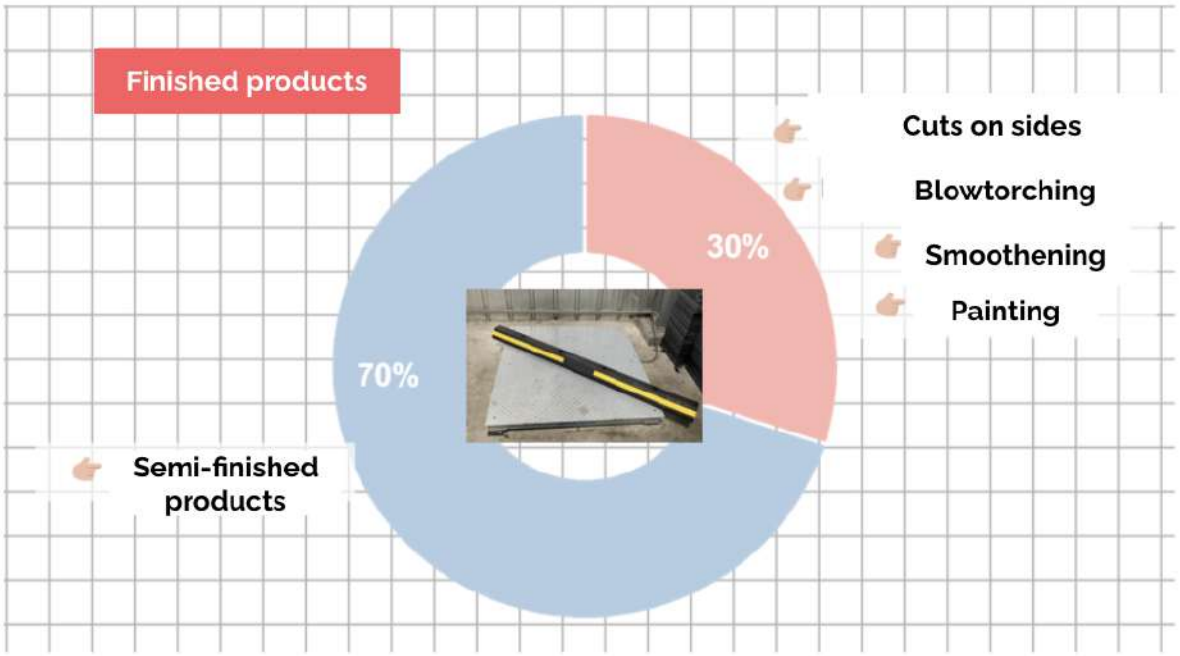
Carpentry production costs

To complete our analysis, given the typology of finished products, we can't omit the costs associated with joinery. It's difficult for us to know exactly how much joinery time is needed for each product, but we'll try to approximate it. The aim here is to identify orders of magnitude and to push forward a methodology.

We also need to approximate the cost of metal parts such as metal frames, hardware, hinges, etc. For simplicity's sake, we'll assume that the weight of recycled plastic remains unchanged.



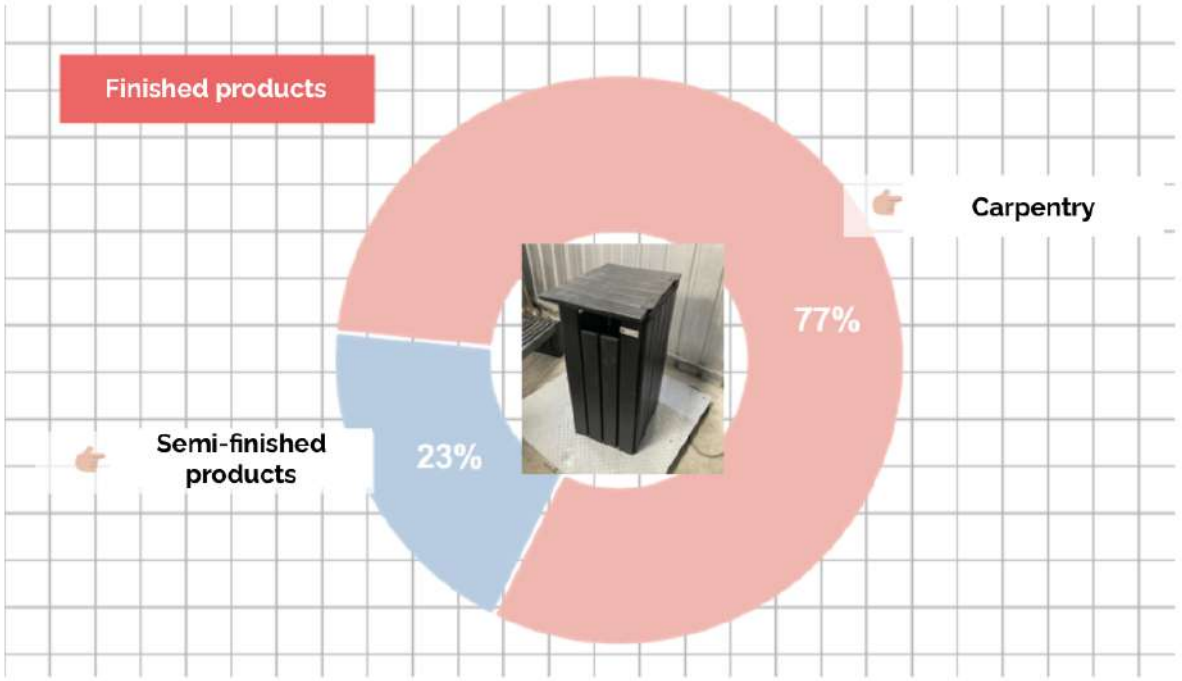
Finished products	Weight	Selling price	Cost production
Parking space stop	16,5 kg	37 $	2,87 $
Bench	49 kg	220 $	8,52 $
Bin	60 kg	255 $	10,43 $



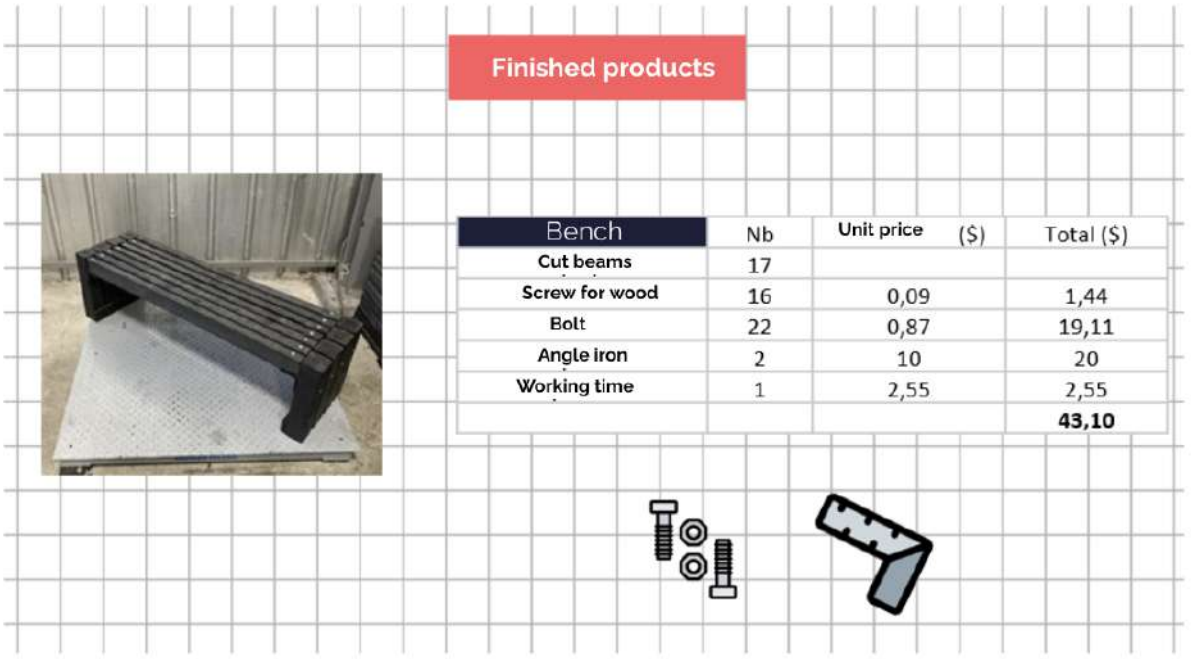
The parking stopper, widely used in Latin America, is the finished product that requires the least amount of carpentry work. This means that the cost of recycling the plastic is always the main consideration.

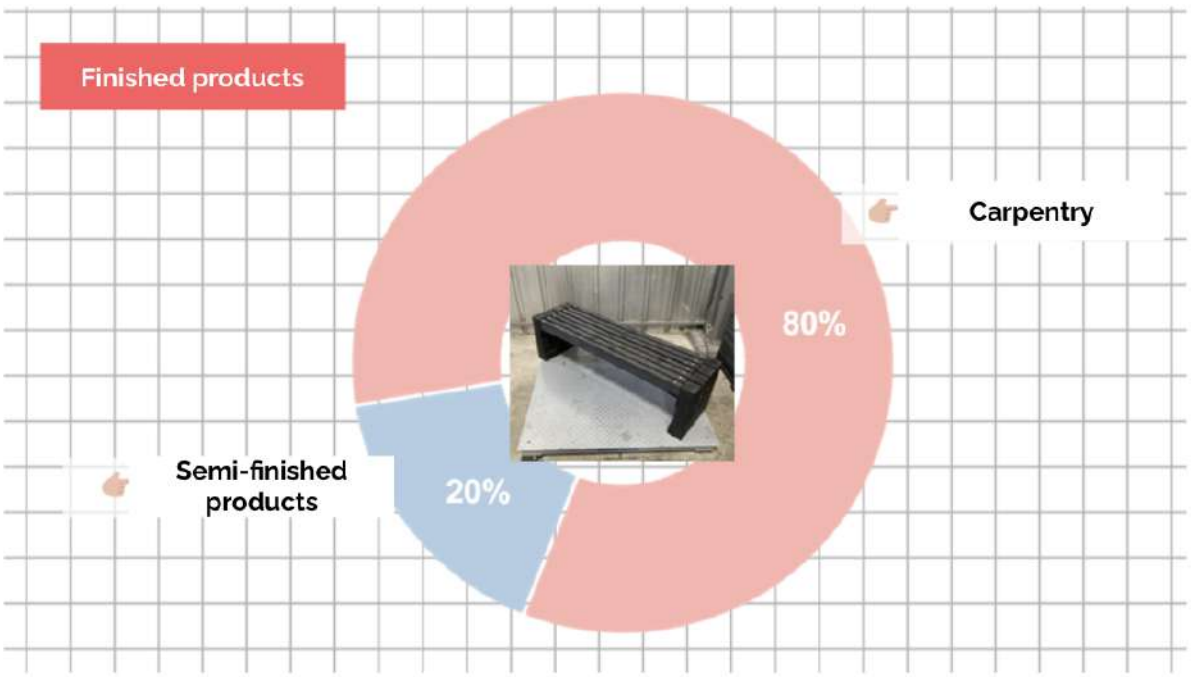
Finished products

Bin	Nb	Unit price ($)	Total ($)
Metal frame	2	15	30
Screws	110	0,0478	5,258
Hinges	2	2,95	5,9
Working time	1	2,55	2,55
			43,708



Here, joinery operations are much more extensive, and the metal parts used account for a large proportion of manufacturing costs.





The bench has a somewhat similar typology to that of the dustbin.

6. Conclusion

At Capobianco Soluciones, raw material procurement plays a central role in the by-product manufacturing process. This major expense item underlines the strategic importance of efficient raw material management in optimizing production costs. Indeed, the nature of the raw materials used can directly influence the company's overall profitability.

At the same time, the company has established a significant correlation between carpentry time and the time required to recycle waste into semi-finished products. This relationship underlines the coherence between manufacturing operations and recycling processes, indicating an intelligent integration of production flows. The time taken to recycle waste is thus optimized to match the time required for joinery, reinforcing the overall efficiency of the production chain.

Given the costs associated with these two crucial aspects of the manufacturing process, Capobianco Soluciones has positioned itself as a recycling company as much as a joinery company. The breakdown of production costs and working hours underscores Capobianco Soluciones' dual expertise, and gives it a more advantageous market position than if it restricted itself to semi-finished products.

It's now up to you to take this knowledge and apply it to the environment around you.