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Master of Science Thesis

Strategic solutions to restore profitability in the pork industry: market analysis and product clustering for a family-owned slaughterhouse

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Abstract

The Italian pork processing industry faces unprecedented structural challenges, with slaughterhouses operating at constrained margins despite decades of consolidation and technological advancement. This thesis examines strategic transformation pathways for restoring profitability in a family-owned slaughterhouse facing converging pressures: escalating input costs that cannot be proportionally transferred downstream, sustained demand erosion driven by health and environmental concerns, and intensifying price-based competition from foreign producers unburdened by domestic certification requirements.

The analysis traces the parallel evolution of Italian dietary habits and pork industry development from the post-war period to present, demonstrating how the sector's trajectory mirrors fundamental shifts in how Italians perceive, value, and consume meat. This historical framework establishes that traditional wholesale models prove structurally obsolete, necessitating transformation from commodity supplier to value creator.

To address this challenge, the thesis explores diversification opportunities grounded in valorising underutilized pork materials whose value potential remains largely untapped or represent disposal costs in conventional operations. The methodological approach is structured into four sequential phases. First, high-potential markets, specifically fitness, pet food, and cosmetics, are identified and analysed to assess their suitability for new entry and their strategic alignment with the Company’s core capabilities. Second, specific product concepts are developed for each targeted segment, addressing emerging consumer needs and biochemical potential. Third, these products are organized into integrated industrial clusters to leverage the sharing of fixed costs and investment requirements across different product lines. Finally, a Multi-Criteria Decision Matrix is applied to evaluate the most suitable cluster, taking into account various strategic factors to balance economic estimates with qualitative considerations essential for the research scope.

To address the inherent uncertainty of emerging markets with limited historical data, financial projections incorporate deliberate conservatism across all key assumptions, effectively stress-testing each cluster's viability under adverse conditions. Results demonstrate that strategic clustering represents not merely an opportunity but a structural necessity. This approach led to the identification of clusters with varying performance levels, highlighting how different strategic directions offer distinct potentials for value creation and long-term viability.

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Introduction

This thesis addresses a critical challenge confronting the Italian pork processing industry: the structural decline of traditional slaughtering and wholesale fresh meat operations. Despite its historical significance as a cornerstone of dietary habits and cultural identity, particularly during the post-World War II economic recovery when pork consumption symbolized newfound prosperity and social advancement, the sector now faces unprecedented pressures that threaten its long-term viability.

Over recent decades, meat consumption has come under increasing scrutiny driven by health, environmental, and ethical concerns. Growing awareness of potential carcinogenic compounds, cardiovascular risks, and the environmental impact of intensive livestock farming, including greenhouse gas emissions and resource depletion, has fundamentally altered consumer preferences. The rise of plant-based diets and alternative proteins reflects this shift, as health-conscious consumers seek options aligned with contemporary lifestyle priorities and sustainability values.

These evolving market dynamics have created severe financial pressures across the entire supply chain. Breeders face rising feed costs and input expenses, compelling higher livestock prices, while large-scale retail chains demand lower prices to maintain competitive positioning. Caught between these opposing forces, slaughterhouses experience a profound margin squeeze that undermines operational sustainability. The challenges are particularly acute for fresh meat operations, where products remain largely undifferentiated commodities competing primarily on price, offering limited opportunities for value creation or competitive differentiation.

In response, many industry participants have pivoted toward processed pork products, such as alternative cured meat types, ready-to-eat meals, and snacks, which offer higher margins and differentiation potential. However, this strategic reorientation requires substantial capital investment, specialized capabilities, and market repositioning that extends beyond the traditional competencies of wholesale operations.

Research context and company background

This research is developed in partnership with Aimaretti S.p.A. (hereafter referred to as the “Company"), a mid-sized Italian pork processor based in Villafranca Piemonte, Piedmont.

Founded by Giuseppe Aimaretti in the 1950s during Italy's post-war economic expansion, the Company began as a modest operation and evolved through strategic vertical integration to control significant portions of the value chain. Over decades, it acquired multiple breeding farms in proximity to the slaughterhouse, pioneered certified production under both Parma and San Daniele DOP designations, initially through joint ventures and subsequently via dedicated facilities in each region, and recently established an additional curing site in Ampezzo del Friuli to diversify its portfolio of aged products.

Through continuous investment in automation and process modernization, the Company transformed from a semi-artisanal operation into Piedmont's largest pork slaughterhouse, currently processing approximately 5,000-6,000 pigs weekly. Of this volume, 15-20% originates from Company-owned farms, with the remainder sourced from external suppliers. The Group employs roughly 160 people and generates annual revenues of approximately €200 million.

However, recent years have witnessed a dramatic deterioration in profitability. Declining demand, rising operational costs, increased management complexity, and heightened regulatory and safety requirements (encompassing workplace safety for personnel handling sharp implements, environmental compliance, and stringent sanitary protocols) have collectively eroded margins to unsustainable levels. The confluence of these pressures necessitated a comprehensive strategic reassessment, forming the impetus for this research.

Research objective and methodology

The primary objective of this thesis is to identify and evaluate innovative pathways for enhancing value capture from pork processing operations, moving beyond traditional wholesale fresh meat models. The research adopts a systematic, multi-phase approach grounded in the Company's actual operational parameters and financial constraints.

The investigation begins by establishing the contextual foundation: analyzing post-WWII dietary evolution and demographic shifts that have reshaped meat consumption patterns, examining the structural transformation and current challenges within Italy's pork industry, and identifying high-growth market segments where pork-derived products demonstrate sustained expansion potential. These segments represent categories where consumer willingness to pay

premiums for quality, traceability, and differentiation creates opportunities for margin improvement.

Building on this market analysis, the research proposes a portfolio of innovative product concepts targeting these identified segments. Each concept undergoes rigorous evaluation across production requirements, competitive positioning, capital investment needs, demand forecasting, contribution margin analysis, and standalone profitability assessment. This evaluation reveals a critical structural constraint: most standalone initiatives fail to achieve positive first-year profitability when fixed costs are distributed across uncertain initial demand volumes. This finding necessitates a strategic evolution in the research approach, leading to the exploration of synergistic product groupings that distribute costs across complementary offerings while leveraging shared infrastructure.

All financial projections and operational assumptions are calibrated to the Company's current scale, cost structures, and capabilities, ensuring practical applicability and implementation feasibility. The analysis employs deliberately conservative assumptions to stress-test commercial viability under realistic market conditions and provide robust guidance for strategic decision-making.

Contribution and structure

This research contributes to the broader discourse on strategic transformation in traditional food processing industries facing structural disruption. By developing a replicable methodology for evaluating diversification opportunities, and documenting the iterative process through which strategic insights emerge from rigorous analysis, the thesis demonstrates how mid-sized operators can leverage existing assets to access premium market segments while systematically addressing implementation challenges.

The thesis is structured as follows: Chapters 1-3 establish the contextual and market foundations; Chapter 4 develops and evaluates individual product concepts; Chapter 5 addresses the operational and financial constraints identified in standalone analysis, develops integrated strategic solutions, and applies multi-criteria evaluation to recommend optimal pathways.

1. Structural transformation of the Italian pork processing sector

Since the end of World War II, Italian dietary habits have evolved in direct response to the nation's economic development, cultural transformations, and shifting societal values. The pork industry has mirrored this evolution with striking fidelity, expanding during periods of prosperity, consolidating as consumption patterns matured, and contracting as contemporary concerns have reshaped food choices. The Company's trajectory exemplifies this phenomenon: established during the post-war reconstruction era, it expanded alongside rising meat consumption through the economic boom, achieved scale through consolidation in subsequent decades, and now confronts the structural challenges characterizing the industry’s contemporary crisis. This chapter traces their parallel trajectories from post-war reconstruction through the economic boom to the present crisis, demonstrating how the sector's fortunes have consistently reflected broader transformations in how Italians perceive, value, and consume meat.

The analysis proceeds chronologically through four distinct phases, examining not only production volumes and consumption trends but also the structural factors that have progressively eroded industry profitability. Particular attention is devoted to understanding how the convergence of declining demand, escalating operational costs, and intensified regulatory requirements has compressed margins to unsustainable levels. Additionally, the analysis addresses how certification frameworks, while ensuring quality standards and territorial authenticity, impose rigorous production specifications that reduce adaptability to evolving market conditions characterized by intensifying foreign competition. Through this integrated examination of dietary evolution, industrial transformation, and economic sustainability, this section establishes the strategic imperative for fundamental business model innovation within a sector facing structural obsolescence.

1.1 Evolution of the Italian pork industry and dietary habits

Post-War reconstruction and emergence (1945-1960)

In the immediate aftermath of World War II, Italy remained a predominantly rural nation where dietary habits reflected necessity rather than choice. Meals centered on staple foods, bread, pasta, legumes, and seasonal vegetables, while meat consumption remained minimal, reserved primarily for wealthier households as a luxury commodity. Traditional agriculture, based on polycultures and extensive methods, supported a frugal diet tied to natural cycles, with short supply chains and minimal waste characterizing the food system.

The pork industry operated within these constraints of scarcity and limited purchasing power. Swine farming functioned on a small, family-run scale, often integrated with cereal cultivation or cattle breeding. Farms were concentrated in northern regions, Lombardy, Emilia-Romagna, Veneto, focusing on subsistence and local markets with minimal production standardization. Slaughterhouses mirrored this fragmentation: numerous but small-scale facilities operated with artisanal methods, processing primarily fresh products and traditional cured meats such as hams and sausages. The decentralized supply chain, while preserving regional traditions, hindered technological advancement and prevented economies of scale. Limited traceability and rudimentary health checks characterized the period, with small-scale producers struggling against rising feed and equipment costs that constrained already narrow margins.

As post-war reconstruction progressed and incomes gradually rose, meat began transitioning from luxury to aspiration. Pork, previously viewed as a secondary option inferior to beef, started gaining prominence due to its economic accessibility and versatility, providing a cost-effective protein source for a population eager to diversify its diet beyond subsistence staples.

Industrial expansion and the economic boom (1960-1980)

The economic miracle of the 1960s-1970s fundamentally transformed both consumption patterns and production structures, with the pork industry expanding in direct response to rising meat demand. Agricultural industrialization introduced synthetic fertilizers, pesticides, and monocultures that dramatically increased productivity, particularly in the Po Valley. Simultaneously, diets shifted decisively toward processed foods and animal proteins, with overall meat consumption reaching 85 kg per capita by the 1990s (Our World in Data, 2025).

Red meat became a status symbol for a modernizing Italy, representing prosperity and social advancement in a society rapidly distancing itself from wartime deprivation.

Pork consumption rose in tandem with these broader dietary shifts, benefiting from its dual advantages of affordability and cultural resonance. Regional pork products, prosciutto, salami, and other cured meats, gained national and international recognition, transforming pork from a practical necessity into a source of gastronomic pride. The industry responded to this expanding demand through its first phase of mechanization: industrial feed and more efficient breeding techniques gradually increased productivity, though the sector's structure remained fragmented with numerous farms maintaining relatively low average herd sizes.

The 1960s established the foundation for Italy's distinctive specialization in heavy swine (over 160 kg), destined for cured meats like Prosciutto di Parma, a strategic divergence from Northern Europe's focus on lighter animals (80-100 kg) for fresh meat. Improvements in food production, transportation, and storage increased pork availability nationwide, including areas where fresh meat had previously been scarce. While slaughterhouses remained predominantly small and localized, the groundwork for subsequent industrialization was established through genetic adaptation of livestock and emerging quality-oriented production systems, positioning the sector to capitalize on continued consumption growth.

Consolidation and specialization (1980-2008)

By the 1980s, pork had firmly established itself within the Italian diet, no longer merely an affordable alternative but an integral component of national food culture. Italy solidified its strategic focus on heavy swine production optimized for premium cured meats, a specialization that aligned perfectly with the introduction of the EU's Protected Designation of Origin (DOP) system in 1992. This formalization of quality standards and geographic authenticity institutionalized Italy's production model, with Prosciutto di Parma and San Daniele achieving protected status that elevated pork products to symbols of regional identity and culinary excellence.

The industry underwent dramatic structural transformation in response to sustained demand growth and evolving market dynamics. The slaughtering sector consolidated rapidly: industrialized facilities replaced fragmented artisanal operations through automation of slaughter lines, implementation of refrigeration systems, and adoption of mandatory EU

hygiene protocols. Operators that achieved sufficient scale became "industrial giants," leveraging economies to significantly increase production capacity, while smaller facilities either targeted niche markets, organic products, heritage breeds, or closed entirely. Vertical integration emerged as the dominant organizational model, with cooperatives merging breeding, slaughtering, and processing operations under unified management to ensure traceability and cost efficiency throughout the supply chain.

This consolidation accelerated throughout the 1990s as consumption patterns continued evolving favorably for pork. While beef maintained dominance due to its perceived quality and prestige, pork consumption steadily increased, driven by evolving preferences and favorable market positioning. Between 2000 and 2007, these trends consolidated while new concerns emerged around health, sustainability, and food quality. Italian diets diversified under globalization, with greater exposure to international cuisines, though Italy's strong culinary traditions limited penetration of processed ready-made foods.

By 2008, pork consumption had overtaken the combined total of beef and poultry, marking the apex of a multi-decade trajectory (De Bernardi Alberto, 2023). Pork had evolved from a low-cost necessity during post-war scarcity to a symbol of prosperity during the economic boom, ultimately becoming a staple of the national diet at the height of its cultural and economic acceptance. The industry had expanded correspondingly, achieving unprecedented production volumes (*Figure 1.1*) through technological advancement and organizational consolidation.

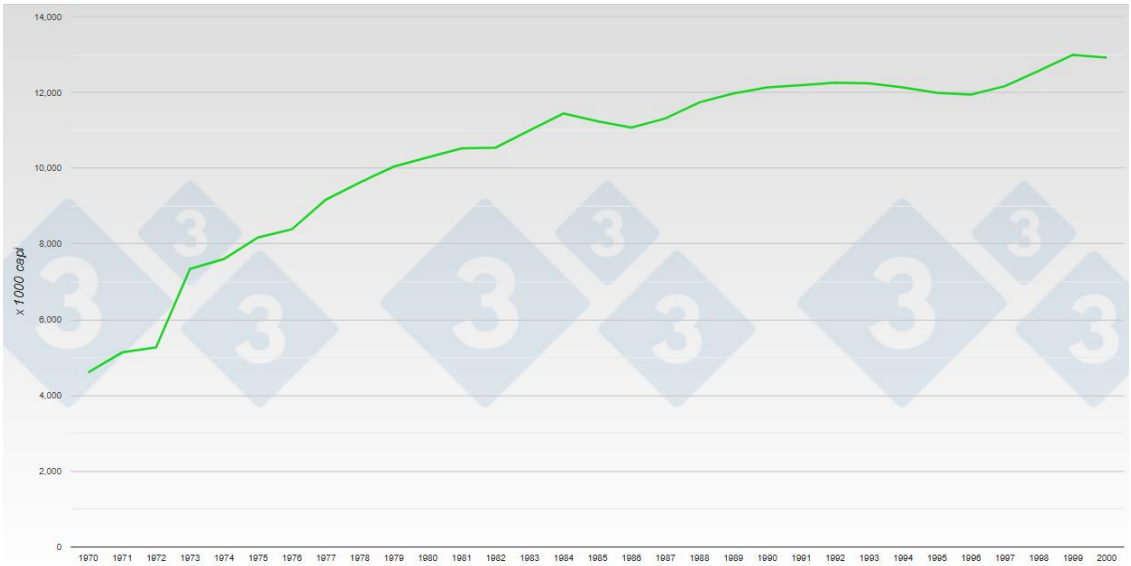

Figure 1.1 – Total number of swine slaughtered between 1970 and 2000 in Italy annually (Source: 3tre3.It*)*

Structural decline and contemporary crisis (2008-present)

The 21st century has brought fundamental reversal of these historical trajectories, with the pork industry experiencing contraction that directly mirrors changing societal attitudes toward meat consumption. Since 2008, Italian dietary habits have undergone significant transformation driven by heightened awareness of health, environmental sustainability, and food quality. Meat consumption, particularly red and processed types, has declined steadily as consumers increasingly perceive it as less healthy and environmentally problematic. This shift reflects broader adoption of vegan, vegetarian, and flexitarian diets, alongside growing interest in lighter alternatives (fish, legumes, plant-based products) and white meats such as chicken and turkey. Pork, once a symbol of economic advancement, has become increasingly associated with health risks and ethical concerns, rendering it expensive relative to alternatives and, for many consumers, readily substitutable. The impact on the pork industry has been severe and immediate. Annual slaughtered pig numbers have diminished consistently throughout the 21st century, reflecting both demand contraction and accelerated supply-side consolidation, as demonstrated by the below graph:

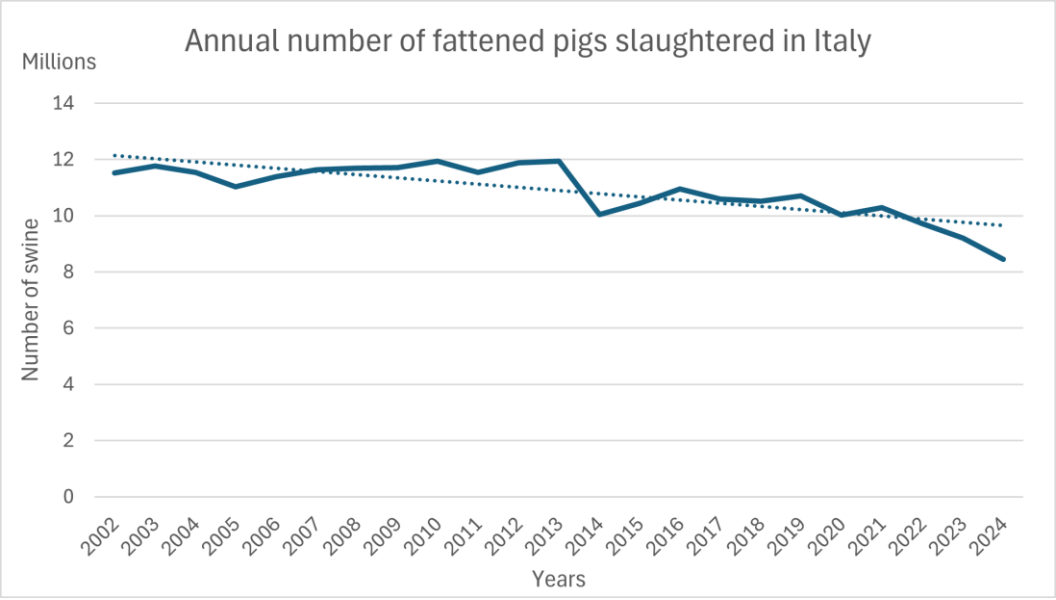

Figure 1.2 – Annual number of fatted pigs slaughtered in Italy (extrapolation from 3tre3.it)

The number of independent producers has declined sharply as smaller operations, unable to compete with rising production costs and increasingly stringent regulatory requirements, have either been absorbed by larger vertically integrated companies or exited the market entirely.

The sector that expanded for decades in response to growing consumption now faces sustained demand erosion, fundamentally undermining the economic logic of scale investments made during previous growth phases, as shown by the following chart:

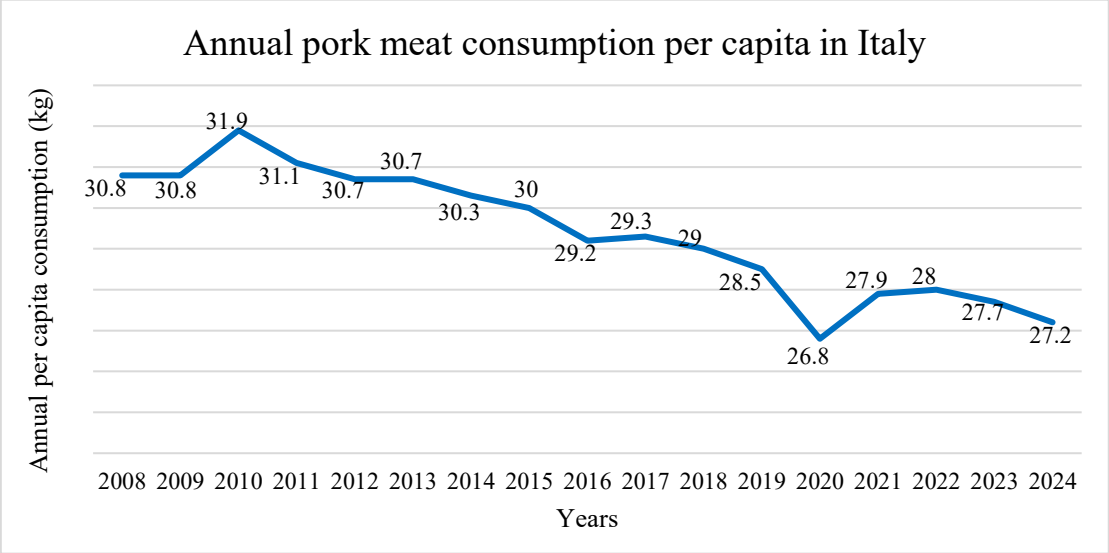

Figure 1.3 – Annual pork meat consumption per capita in Italy (Source: Ismea)

Despite technological advancements enabling remaining firms to enhance efficiency and reduce per-unit costs through automation, the sector faces unprecedented financial pressure. Escalating expenses for raw materials, energy, and labor have compressed already narrow margins, while declining volumes prevent operators from fully leveraging scale economies. Although revenues have risen alongside wholesale meat prices, profitability remains critically constrained, with many operations achieving only break-even results or incurring losses, a stark reversal from the prosperity that characterized earlier expansion periods.

Analysis of net profit margins for major sector players collectively representing approximately 40% of total Italian pig slaughtering reveals the severity of this crisis (*Table 1.1*). Between 2015 and 2023, margins have consistently hovered around 1%, a figure dramatically below the 10% generally considered healthy for most industries and well beneath the 5% threshold typically indicating financial risk and unsustainability (Munro Oliver, 2024).

	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Mec-Carni S.p.A.	0.02%	0.29%	0.68%	0.22%	-0.61%	1.01%	0.51%	0.75%	0.96%	1.09%
O.P.A.S.	0.00%	0.00%	0.14%	0.21%	-0.47%	0.00%	0.00%	0.00%	-0.20%	-2.11%
Annoni S.p.A.	0.15%	0.20%	0.01%	-0.99%	0.39%	2.49%	0.79%	2.27%	1.27%	0.41%
Sassi S.p.A.	0.30%	0.55%	0.79%	0.39%	-0.29%	-0.09%	0.12%	1.12%	0.99%	0.91%
Pini Italia s.r.l.	0.06%	0.12%	0.11%	0.13%	0.06%	0.92%	0.66%	0.67%	0.85%	0.04%
Martelli F.lli S.p.A.	0.65%	0.61%	1.04%	-0.20%	-1.82%	1.15%	1.27%	1.00%	0.54%	0.69%
Aimaretti S.p.A.	0.83%	1.02%	0.95%	0.84%	0.77%	0.62%	0.56%	0.64%	0.97%	0.39%

Table 1.1 – Net profit margin of major slaughterhouses in Italy between 2015 and 2023 (extrapolation from Orbis)

These figures are particularly concerning as even major players, despite their economies of scale, struggle to maintain adequate margins. Current profitability fails to compensate for the significant moral, environmental, and human responsibilities inherent in slaughtering, leaving no buffer against market volatility or capital for reinvestment. A sector that once thrived by providing affordable protein to the post-war middle class now struggles to justify its economic existence in a market that increasingly views its core product as undesirable.

While the industry has historically faced cyclical downturns, the current situation represents a fundamentally structural crisis. Paradoxically, pork has experienced a partial reassessment in premium forms, artisanal, organic, and certified DOP/IGP products like Prosciutto di Parma or San Daniele, reflecting a shift toward “less but better” consumption. However, this premium niche, while culturally significant, cannot offset the structural erosion of the wholesale fresh meat market, which remains the industry's economic foundation.

1.2 Structural drivers of declining profitability

The historical analysis presented in *Section 1.1* traced the transformation of the Italian pork industry from a growth engine during the post-war economic expansion to a sector experiencing sustained contraction in the contemporary period. However, understanding the magnitude of this crisis requires systematic examination of the underlying structural factors that have compressed margins to unsustainable levels. This decline results not from any single cause but from the convergence of multiple interdependent pressures operating simultaneously across demand, cost, and competitive dimensions.

Raw material cost increase

In recent years, the sharp and sustained increase in essential raw material prices has severely hindered the ability of slaughterhouses to leverage economies of scale. This cost escalation has eroded profit margins and operational efficiency, undermining the competitive advantage traditionally derived from large-scale production. Consequently, the industry's financial viability is under significant pressure. These cost drivers include:

- **Swines:**
  Pig prices represent a critical cost factor for slaughterhouses lacking vertical integration.

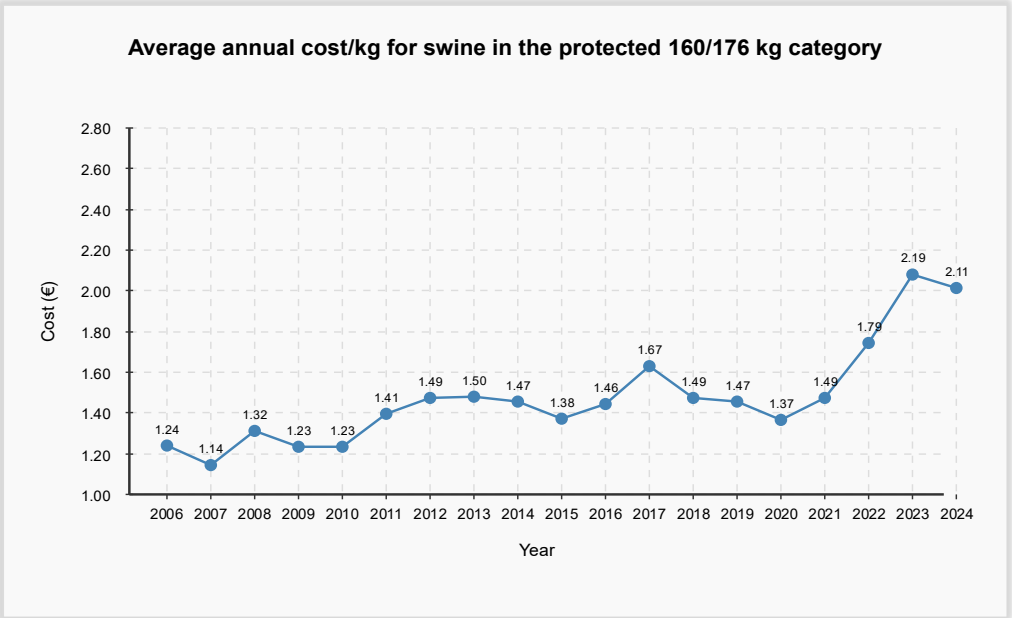

Figure 1.4 - Average annual cost/kg for swine in the protected 160/176 kg category (Source: 3tre3.it)

While some major players, such as Gruppo Veronesi and Gruppo Chiola, operate fully integrated supply chains enabling sourcing from captive breeding operations, most companies must purchase swine externally, remaining highly exposed to the price fluctuations illustrated in *Figure 1.4*.

The data demonstrates significant escalation in pig prices, particularly following the COVID-19 pandemic. Costs have surged by more than 70% between 2006 and 2024. For companies operating at net margins below 1%, such raw material cost increases, representing the largest expense component, directly threaten financial viability.

- **Natural gas and energy**

  Slaughterhouses are highly energy-intensive operations where electricity and natural gas costs significantly impact profitability. Analysis of Martelli F.lli S.p.A. illustrates this vulnerability: energy expenses rose to 2.38% of production costs in 2022 and 1.40% in 2023, a sharp increase from the 0.50%–0.62% recorded in 2017-2018. As shown in the graph below, electricity prices surged to over 300 €/MWh during the pandemic (a 600% increase relative to 2016) while natural gas prices more than doubled over the decade. For an industry operating with net margins often below 1%, these escalating costs represent a direct and destabilizing threat to financial viability.

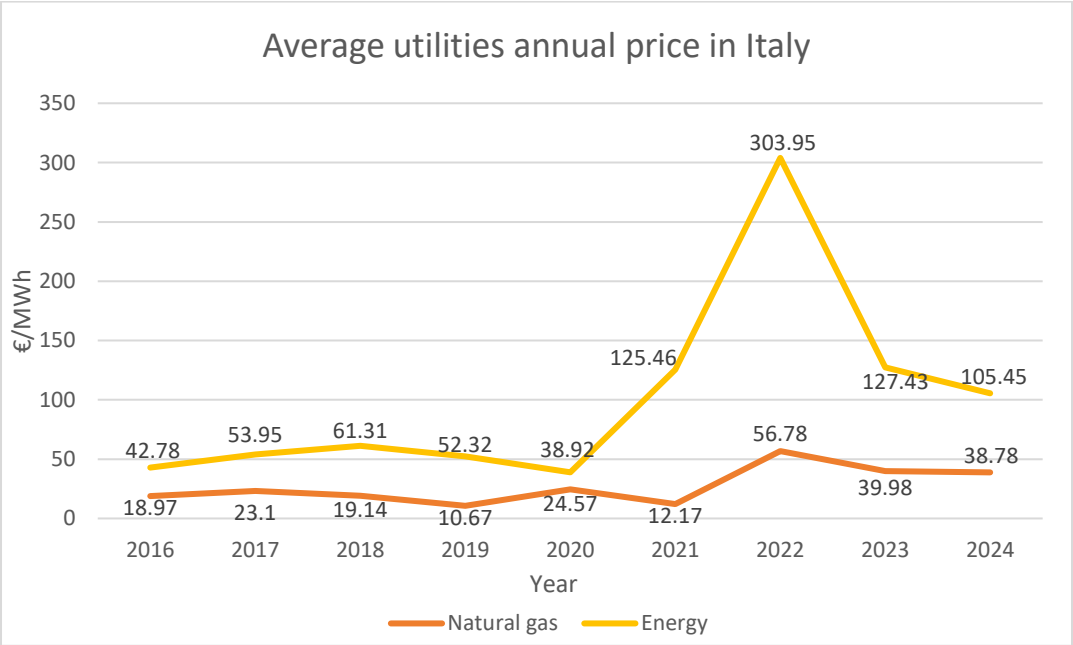

Figure 1.5 – Average annual prices of gas and electricity (€/MWh) in Italy (Source: CNA Varese)

Non-proportional fresh meat price increase

Products		2024	2023	2022	2021	2020	2019	2018	2017	CAGR[1] '17-'24
1. Fresh butcher cuts										
Bologna-style loin	*€/Kg*	4.418	4.419	3.854	3.232	3.351	3.420	3.202	2.884	**6.28%**
Padua-style loin	*€/Kg*	4.470	4.505	3.999	3.425	3.509	3.910	3.386	3.108	**5.33%**
Bust with neck, ribs, no rump	*€/Kg*	4.426	4.493	3.963	3.409	3.430	3.840	3.284	2.949	**5.97%**
Fresh bone-in neck	*€/Kg*	4.881	4.550	4.136	3.529	3.536	3.620	3.127	2.790	**8.32%**
2a. Trimmed fresh leg										
From 10 to 12 kg	*€/Kg*	4.752	4.801	4.383	3.370	2.754	2.690	2.770	3.009	**6.74%**
Over 12 kg	*€/Kg*	4.899	5.092	4.723	3.608	3.186	3.450	3.686	4.078	**2.65%**
2b. Trimmed typical production fresh leg										
da 11 a 13 kg (avg. weight 12)	*€/Kg*	5.637	5.601	4.892	3.688	3.151	3.090	4.309	4.870	**2.11%**
da 13 a 16 kg (avg. weight 14,5)	*€/Kg*	6.070	6.092	5.477	4.284	3.764	3.610	4.650	5.278	**2.02%**
3. Trimmed fresh neck 2.5 kg+	*€/Kg*	6.620	6.190	5.316	4.343	4.483	4.340	4.278	4.339	**6.22%**
4. Boneless and defatted fresh shoulder 5.5kg+	*€/Kg*	4.676	4.705	3.877	3.173	3.260	3.410	2.817	4.255	**1.36%**
5. Ground pork 85/15	*€/Kg*	4.838	4.809	4.026	3.387	3.381	3.510	2.894	3.341	**5.43%**
6. Belly with rind from 7.5 to 9.5 kg	*€/Kg*	2.709	2.610	2.078	1.923	2.168	1.800	1.760	1.942	**4.87%**
7. Square-cut belly 4/5 kg	*€/Kg*	4.710	4.545	3.610	3.623	3.974	3.430	3.240	3.592	**3.95%**
8. Whole throat with rind and lean	*€/Kg*	2.862	3.142	2.375	1.969	1.928	1.710	1.464	1.368	**11.11%**
9. Lard										
Fresh lard 3 cm +	*€/Kg*	3.927	3.706	3.324	2.813	2.881	2.660	2.550	2.520	**6.55%**
Fresh lard 4 cm +	*€/Kg*	4.547	4.498	4.124	3.613	3.700	3.460	3.350	3.320	**4.60%**
10. Lard with rind for processing	*€/Kg*	1.670	1.785	1.772	1.286	1.332	1.370	1.046	1.260	**4.10%**

Table 1.2 – Average annual fresh pork meat price per cut (extrapolation from ListiniCUN)

[1] **CAGR (Compound Annual Growth Rate):** the annualized rate of growth over a specified period, assuming constant compounding.

The table above presents the average annual price per kilogram of the most common cuts of fresh swine meat from 2017 to 2024. The data is sourced from the "*Listini CUN*", where *CUN* stands for *Commissioni Uniche Nazionali* (Unique National Commissions). These are Italian institutions that include all swine meat producers and are tasked with publicly sharing fresh meat prices based on market conditions, with the goal of ensuring transparency and fairness in the sector.

As shown in the table, there has been an overall CAGR of 5.23% between 2017 and 2024, however this growth failed to offset escalating input costs. Live pig prices surged 70% (*Figure 1.4*), while energy costs increased 600% during peak periods (*Figure 1.5*). The sector's inability to transfer these costs downstream reflects its weak bargaining position, a dynamic examined in next sections.

High incidence of raw material

Slaughterhouses are characterized by a cost structure that is heavily influenced by their main raw material: live pigs. The impact of this single input on overall production costs is significantly higher than in nearly all other manufacturing sectors.

Sector	Raw material incidence on total cost
Swine slaughtering and processing	85%
Automotive	47%
Chemicals	57%
Paper and printing industry	70%
Textile	60%
Food industry	51%
Mechanical	63%
Electronics	60%

Table 1.3 - Average percentage of raw material cost over total cost by sector

As shown in the table, raw material costs account for approximately 85% of total production costs in the swine slaughtering and processing industry. This figure not only

far exceeds the average for the broader food industry (51%) but also surpasses that of other key manufacturing sectors, such as automotive (47%) and chemicals (57%).

This high level of exposure to raw material cost fluctuations underscores the analysis reported in the previous section, which highlights how the price of swine directly and heavily affects the economic sustainability of the sector.

To better illustrate this, consider the case of a medium-sized Italian slaughterhouse processing 5,000 pigs per week. If the live pig price is €1.50/kg, and the average live weight is 175 kg, the weekly raw material cost exceeds €1,300,000. Should the price rise to €2.00/kg, the weekly cost increases to €1,750,000, a difference of nearly half a million euros. With such cost pressure, slaughterhouses are often forced to maintain close relationships with financial institutions, relying on bank loans to ensure operational liquidity. This dependency also exposes them to interest rate fluctuations, further increasing financial vulnerability.

Supermarket oligopoly over producers

In the Italian agri-food market (as well as in much of Europe and the rest of the developed countries), the large-scale retail sector, known as GDO (Grande Distribuzione Organizzata - Large-scale retail trade), is highly concentrated, with a small number of dominant companies holding significant market shares. In particular, the top ten retail groups account for over 75% of the national food retail market**,** resulting in a structure clearly identifiable as an oligopoly **(**Statista, 2025). This market configuration grants supermarkets a disproportionate bargaining power over producers, especially small and medium-sized ones. This power is exerted on multiple levels:

- **Price control:** Supermarkets impose rigid economic conditions, forcing suppliers to accept prices that barely cover rising production costs. Simultaneously, increasing retail prices expose a clear misalignment between value generation and its distribution along the supply chain.
- **Control over volume:** the GDO also exercises significant control over the volume of goods purchased. Supermarkets can determine which suppliers to prioritize, how much product to purchase, and how often to rotate items on store shelves. This directly affects a supplier's economic stability, often placing them in a position of dependency.

- **Private labels**: the growth of private label products is another expression of GDO power. These products are manufactured by industrial companies (often SMEs) but sold under the retailer's brand. While they offer lower margins to producers, they guarantee volume stability and savings on marketing and logistics costs. Private labels have grown significantly in Italy, although their market share remains lower than in other European countries.
- **Erosion of profit margins**: empirical analyses show a negative correlation between retail concentration and the profit margins of food companies. This suggests that the increasing pressure from the expansion of large-scale retail has contributed to a contraction in producers' profit margins.
- **Payment conditions**: the stronger party in the negotiation (i.e. the retailer) can leverage its position to obtain more favourable payment terms, such as extended payment deadlines. Empirical analysis suggests a positive correlation between retail concentration and the incidence of trade receivables on the short-term assets of food companies (EuroCommerce, 2023).

Although large-scale retailers must also bear significant expenses, such as service, personnel, and other operating costs, the initial margin is nonetheless extracted from the producers, many of whom struggle to remain economically viable. This effect is particularly pronounced in the swine industry, where only a few brands (e.g., Beretta or Rovagnati) enjoy widespread consumer recognition, while the majority of producers are easily replaceable and thus subject to strong price pressure.

Two examples from the pork sector highlight this imbalance:

- In 2024, the average wholesale price for raw ham was €9.28/kg, whereas supermarket chains sold it at €25–€40/kg, generating margins of over 300% on this product.
- A similar trend is observed for fresh pork meat cuts. For example, in 2024 for Bologna-style loin, one of the most common pork cuts, its average wholesale price stood at €4.41/kg. Once deboned, raising the cost to approximately €5/kg at wholesale level, retailers sell it for over €11/kg, achieving a markup of more than 100%.

Italy's retail concentration grants supermarkets dominant bargaining power over producers. In the pork sector, marked by low brand differentiation and high replaceability, this imbalance allows retailers to extract margins, eroding profitability and supply chain sustainability.

The role of consortiums and foreign competition

The Italian swine industry is characterized by a closely regulated supply chain, which spans from the breed of pigs raised to the methods of slaughter and the subsequent processing of the meat for the production of certified cured meats. This controlled process is required for products bearing DOP (Denominazione di Origine Controllata - Protected Designation of Origin) or IGP (Indicazione Geografica Protetta - Protected Geographical Indication) labels, designations that are highly regarded both nationally and internationally. These certifications attest to a higher level of quality and allow producers to command premium prices, provided that strict standards are met throughout the entire production chain.

It is important to note that not all farms, slaughterhouses, or producers in Italy are required to comply with these standards. However, the majority of producers, particularly slaughterhouses, do. This is primarily because a significant portion of pork is sold to curing facilities that typically produce DOP or IGP certified products. Since these facilities require certified meat, commonly referred to as "marked" meat, slaughterhouses must comply with the relevant specifications, which also extends to the farms from which they source their animals.

This clarification is essential to understand why Italian pork meat is significantly more expensive than imported meat. Foreign products generally do not adhere to such rigorous standards, as the culture of certified cured meat production is largely absent in other countries.

The certifications mentioned are established by consortiums, which are local associations responsible for defining the standards applicable to specific types of cured meat. In Italy, numerous consortiums exist, each governing a different product, such as *Salame di Felino*, *Coppa Piacentina*, and *Mortadella Bologna IGP*.

Among these, the most prominent and influential are those for raw ham: *Prosciutto di San Daniele DOP* and *Prosciutto di Parma DOP*. These two consortiums enforce the most stringent regulations, and as a result, most slaughterhouses adhere to their standards in order to supply meat suitable for the production of these highly certified products.

The rules established by these consortiums govern the entire supply chain. Using the specifications for *Prosciutto di San Daniele DOP* as an example, the main areas of compliance, many of which are common and applicable to other certified products, include the following:

- Pigs must be born, raised, and slaughtered in specific Italian regions and must belong to approved breeds or authorized crossbreeds
- Each phase of breeding is precisely regulated, beginning with a standardized tattoo for traceability, and includes detailed guidelines on the type, quantity, and composition of feed at each stage of growth
- Animals must not be slaughtered before reaching nine months of age and must meet specific weight requirements. The slaughtering process itself must follow strict procedural standards

Each consortium then supplements these general rules with product-specific requirements, particularly in relation to the characteristics of the fresh meat cuts used.

These rigorous standards, while ensuring quality, create substantial cost differentials with foreign producers operating under basic European sanitary regulations alone. In many countries, more efficient genetic lines are employed, feed is optimized to accelerate growth, and pigs are slaughtered at five to six months with average carcass weights of approximately 90 kg. The cost savings from shortening the feeding period by three to four months are considerable.

Moreover, the uniformity of foreign pigs enables extensive automation in slaughterhouses through robotics and specialized machinery. Italian production, conversely, involves animals ranging from 150 to over 200 kg despite the 175 kg average, preventing comparable mechanization. The result is a predominantly manual, highly specialized slaughter process that is substantially more expensive.

This cost structure manifests clearly in trade data. As illustrated in *Figures 1.6* and *1.7*, Italy imports approximately 1,000,000 tons of pork annually, nearly four times the export volume, representing approximately €3 billion and roughly 30% of the national pork industry's turnover.

Notably, while import volumes quadruple export volumes, the monetary values remain comparable. This reflects the fundamental asymmetry: Italy imports primarily fresh meat at low unit prices (averaging €2.83/kg in 2024), while exporting predominantly cured products commanding significantly higher prices (€5.92/kg for cured meat versus €2.68/kg for fresh meat and offal in 2024). Cured pork products represented 73% of Italian exports in 2024, reflecting strong international recognition of quality (ISMEA, 2024), as shown in *Figure 1.8*.

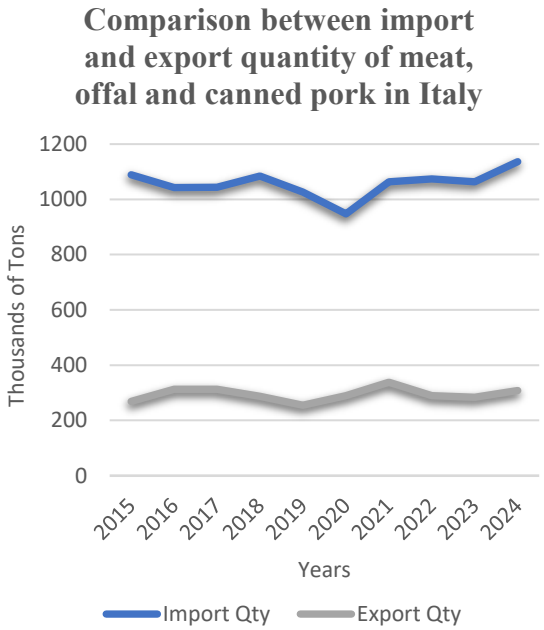

Figure 1.6 - Comparison between import and export of pork meat quantity (Source: Assica)

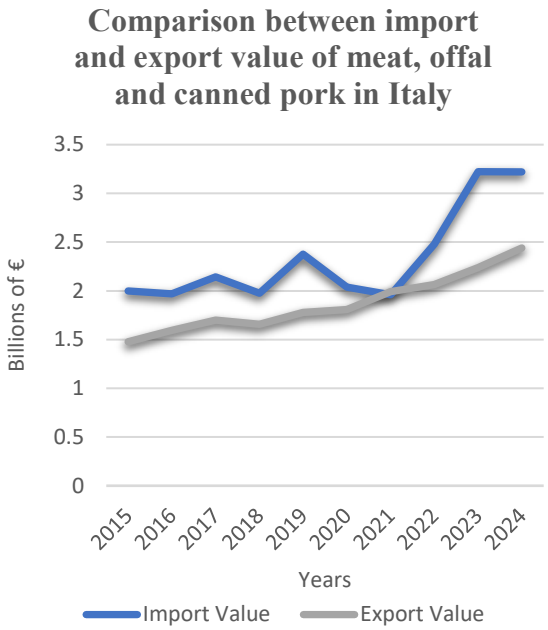

Figure 1.7 - Comparison between import and export of pork meat value (Source: Assica)

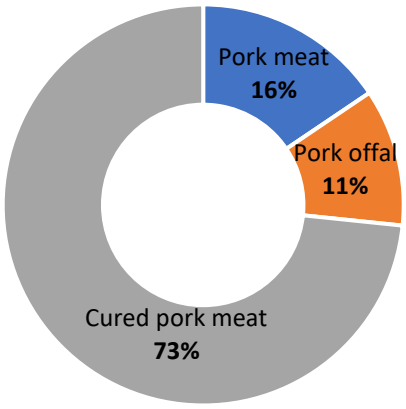

Figure 1.8 -Exported pork meat in 2024 (Source: ISMEA)

However, this export success in processed products cannot compensate for the structural disadvantage in fresh meat markets. Foreign pork is preferred domestically primarily on price, without adequate recognition of the production standards, animal welfare practices, and quality attributes that justify Italian products' higher costs. The lack of price differentiation or consumer awareness enables imported meat to capture substantial market share that could otherwise support domestic operations. For slaughterhouses already operating at margins below 1%, this price-based competition from uncertified foreign sources, combined with the operational constraints imposed by certification requirements, creates an unsustainable squeeze that erodes viability while offering limited flexibility to adapt competitive positioning.

Demographic shifts and changing consumer preferences

The pork industry's demand erosion reflects two parallel demographic transformations: population contraction and fundamental shifts in dietary attitudes. These dynamics have reduced both the absolute number of consumers and per-capita consumption rates, creating compounding pressure on sector viability.

Population decline and reduced market size

Italy's demographic trajectory reversed sharply after 2008. Live births declined from 576,659 in 2008 to 379,890 in 2023, a 34.1% decrease, while net immigration, which had previously offset aging demographics, also contracted (ISTAT, 2025). Total population peaked at 60.8 million in 2014 before declining to 58.9 million by 2024 (*Figure 1.9*).

This contraction fundamentally undermined the sector's expansion trajectory. Industry capacity had been calibrated to serve a growing population and rising per-capita consumption, with operators making substantial capital investments in slaughter lines, processing facilities, and distribution infrastructure throughout the 1980s-2000s growth period. The sudden reversal created structural oversupply: production capacity designed for 60+ million consumers now faced a shrinking market of under 59 million, while simultaneously experiencing declining per-capita demand. This supply-demand imbalance compressed utilization rates and intensified competitive pressure, contributing to operator failures including industry leaders such as Virgilio (2014) and ProSus di Vescovato (2024).

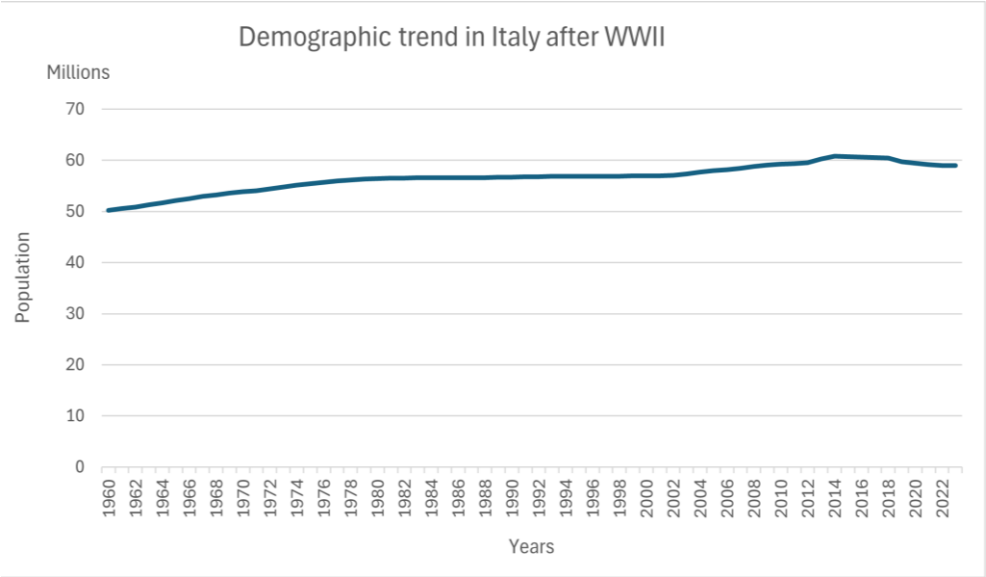

Figure 1.9 – Demographic trend in Italy after WWII (Source: World Bank Open Data)

Erosion of purchasing power and economic constraints

Beyond population decline, Italy's sustained economic deterioration has significantly constrained household food expenditure. Since the 2008 crisis, which saw GDP contract by 5.3%, the country has struggled with successive shocks, including the European debt crisis and the COVID-19 pandemic (GDP -8.9% in 2020). Despite brief recoveries in 2021 (+8.3%) and 2022 (+4.0%), momentum stalled again by late 2024 (Banca D'Italia, 2024). As illustrated in *Figure 1.10*, real GDP per capita remains below 2008 levels, marking over fifteen years of economic stagnation.

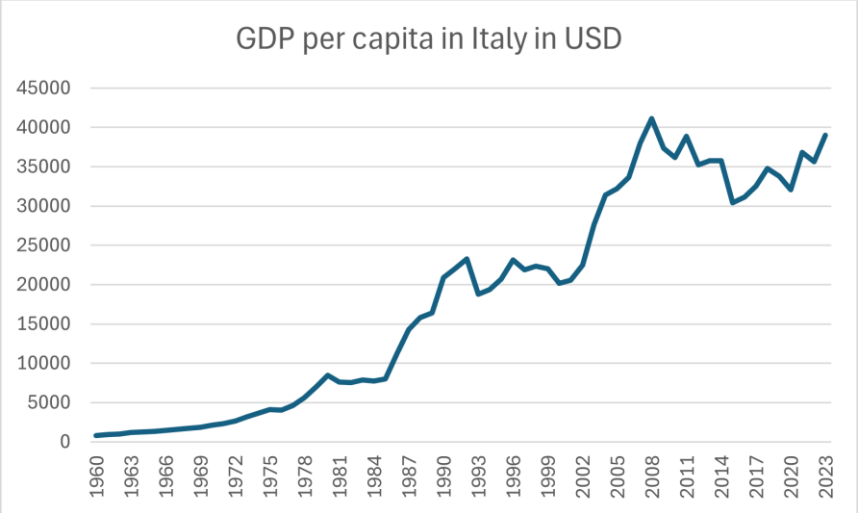

Figure 1.10 – Italian GDP per capita in USD (extrapolation from Banca D'Italia)

More critically, household purchasing power (the actual ability to purchase goods and services) has contracted even more severely than GDP figures suggest. Rising inflation has eroded real incomes, leaving Italians with substantially less disposable income for consumption. *Figure 1.11* demonstrates this deterioration: purchasing power parity declined cumulatively by 23% between 2008 and 2024, representing a sustained sixteen-year contraction in household economic capacity.

This erosion directly impacts food consumption choices, particularly for premium protein categories. As demonstrated in *Table 1.4*, fresh pork prices (€10.02/kg) represent a substantial burden on household budgets. This cost is several times higher than that of dietary staples such as pasta (€2.85/kg), rice (€4.25/kg), and flour (€1.45/kg), and aligns more closely with premium products like extra virgin olive oil (€11.99/kg). Under budget constraints, households increasingly substitute toward lower-cost protein sources or reduce meat consumption entirely.

This dynamic is particularly pronounced given pork's positioning: whereas it served as an affordable protein during the post-war expansion, contemporary price levels position it as a discretionary purchase vulnerable to economic pressure. For an industry already operating at margins below 1%, this demand elasticity creates additional revenue vulnerability that compounds the challenges posed by absolute population decline.

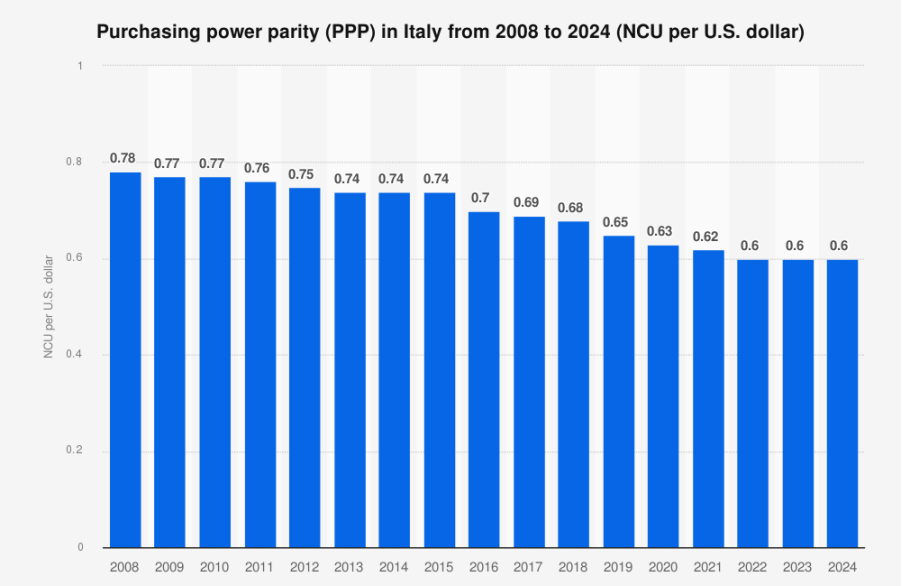

Figure 1.11 - Purchasing power parity in Italy between 2008 and 2024 (Source: Statista)

Aliment	Cost per kg (2024)
Pasta	2.85 €
Bread	4.38 €
Extra virgin oil	11.99 €
Rice	4.25 €
Flour	1.45 €
Bottled tomato sauce (1 l)	1.99 €
Fresh pork meat	10.02 €
Fresh beef adult, prime cut	21.83 €
Chicken breast	14.73 €
Eggs (6 pack)	1.76 €
Frozen peas	4.59 €
Frozen spinach	2.72 €
Milk (1 l)	1.93 €

Table 1.4 – Average actual food price in Italy (Source: Ministero delle Imprese e del Made in Italy, Federconsumatori)

Health, environmental and animal welfare concerns

Consumption patterns evolved substantially as health, environmental, and ethical concerns gained prominence. The WHO's (World Health Organisation) classification of processed meats as Group 1 carcinogens, combined with documented links between saturated fat intake and cardiovascular disease (which accounts for over 40% of Italian deaths), drove dietary reconsideration, particularly among younger demographics. In 2020, over 55,000 colorectal cancer cases were diagnosed in Italy, with processed pork products as a contributing factor, as stated by the Italian Cancer Research Association (AIRC). Medical organizations including ISS (Istituto Superiore di Sanità) and SINU (Società Italiana di Nutrizione Umana) recommended reducing red and processed meat consumption, framing pork as a health risk rather than nutritional benefit.

Environmental consciousness further accelerated this shift. Awareness of livestock farming's contribution to greenhouse gas emissions (14.5% globally according to FAO), intensive water use (6,000 liters per kilogram of pork), and land dedication (75% of Italian agricultural land allocated to animal feed rather than human food (ISTAT, 2010)) positioned meat consumption as ecologically unsustainable. Animal welfare concerns, particularly regarding intensive farming conditions where over 90% of Italian pigs are raised in confinement (Lega Anti Vivisezione, LAV), added ethical dimensions to consumption decisions. The European Food Safety Authority (EFSA) highlighted that in Italy, about 50% of pig farms do not meet the required welfare standards for space, feeding, and environmental enrichment, increasing the population concerns about the topic.

Growth of plant-based alternatives and dietary diversification

These attitudes manifested in measurable behavioral changes. The share of Italians identifying as vegetarian or vegan increased from 6.2% in 2014 to 8.2% in 2023 (*Figure 1.12*), while flexitarianism[2] grew substantially, with 23% of Italians self-identifying as flexitarian by 2024.

[2] **Flexitarianism:** it describes individuals who follow a primarily vegetarian diet but occasionally consume meat or fish. This dietary choice emphasizes flexibility and the reduction of animal protein consumption without the strict adherence required by vegetarianism or veganism

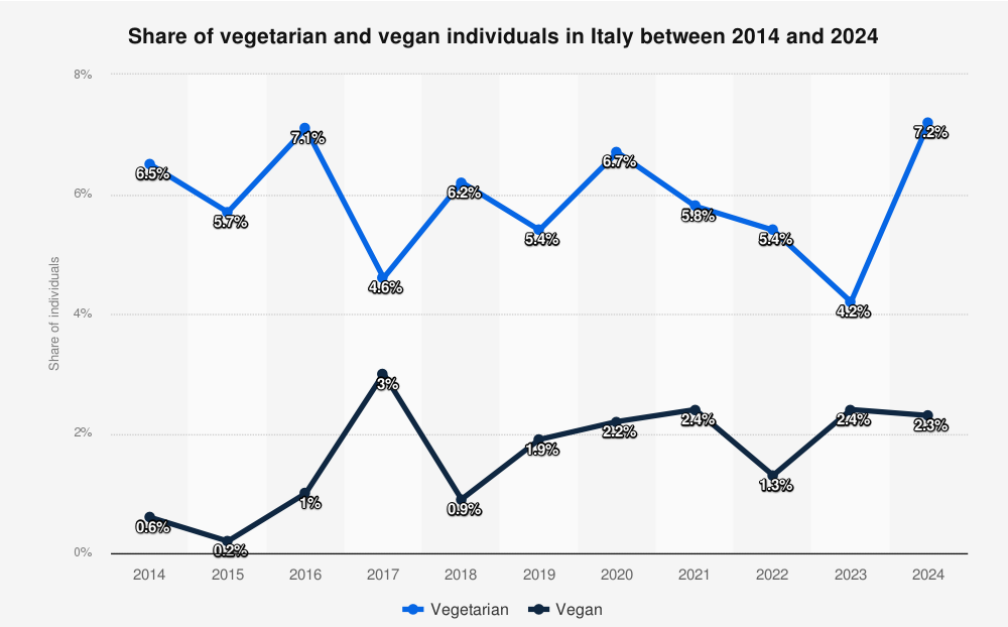

Figure 1.12 – Percentage of Italians that define themselves as vegan or vegetarian (Source: Statista)

Motivations for these dietary shifts varied systematically by age cohort, as illustrated in *Figure 1.13*. Younger adults (25-34) prioritized health concerns (35.3%), middle-aged cohorts (35-44) emphasized animal welfare (33.3%), while environmental sustainability showed particular resonance among those under 35 (15.8%). The consistency of "eating less but better" across age groups (peaking at 26.3% for ages 45-64) reflects broad cultural shift toward mindful consumption and quality over quantity.

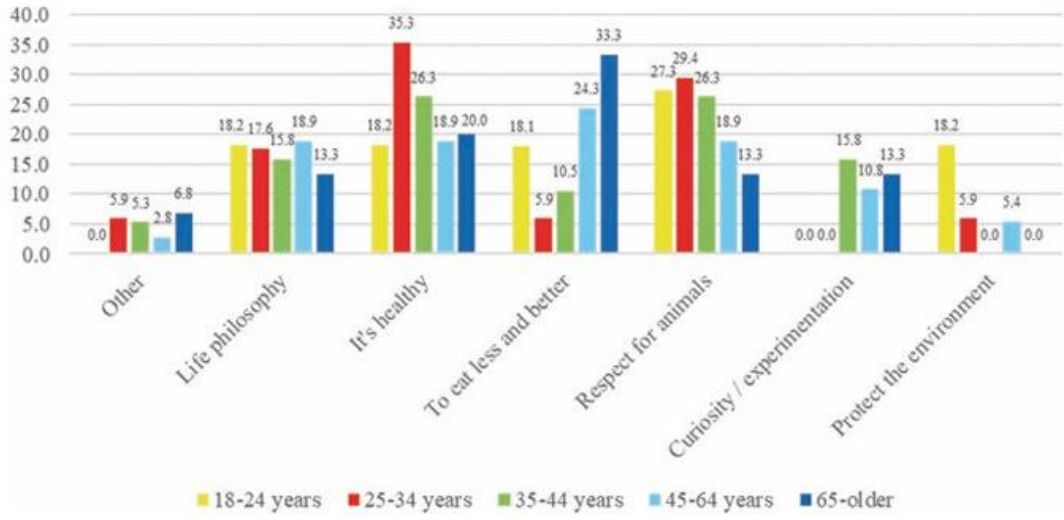

Figure 1.13 – Reasons for adopting a vegetarian or vegan lifestyle by age group (Source: Eurispes)

The plant-based meat market expanded rapidly in response, with sales value increasing 24.2% between 2021 and 2023 to €199 million, unit sales rising 15.1%, and volume growing 11.4% (*Figure 1.14*). While still modest compared to traditional meat markets, this growth reflects structural dietary transition rather than temporary trend, supported by policy initiatives including government incentives for plant-based proteins in the National Recovery and Resilience Plan (PNRR).

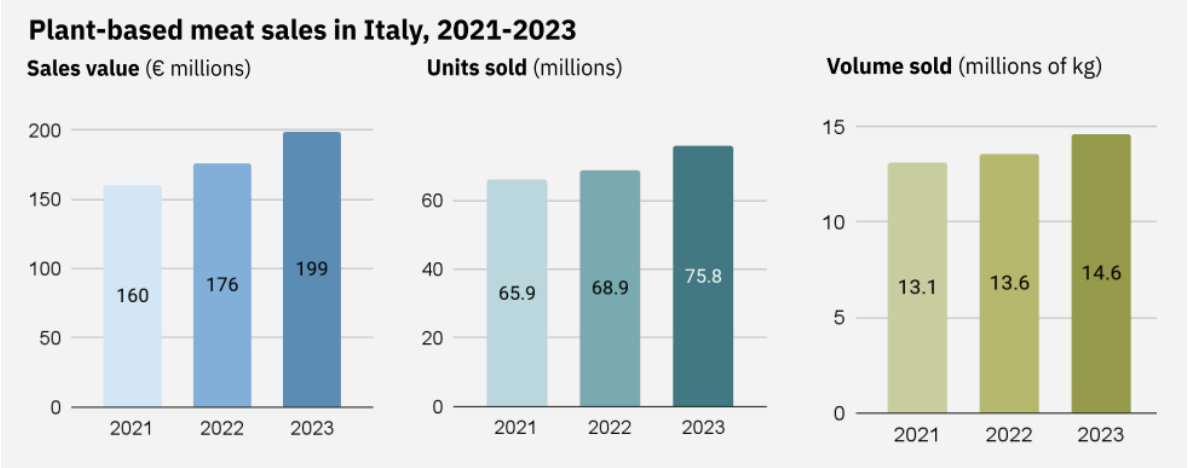

Figure 1.14 – Plant-based meat sales in Italy, 2021-2023 (Source: Good Food Institute Europe)

For the pork industry operating at sub-1% margins, this convergence of demographic contraction, purchasing power erosion, and fundamental dietary reorientation has proven particularly destabilizing. Unlike cyclical demand fluctuations, these shifts represent permanent market transformation, reducing both the size and per-capita consumption rate of the addressable consumer base while simultaneously repositioning pork from prosperity symbol to health liability, a complete inversion of the cultural positioning that drove post-war sector expansion.

This structural change renders the traditional commodity-based business model obsolete. Restoring viability requires moving beyond passive reaction to proactively shaping consumption through innovation, developing products that align with contemporary consumer values while leveraging pork's inherent qualities as a raw material. The strategic challenge is not whether preferences will continue evolving, but whether the industry can transform from commodity supplier to value creator capable of directing market trends.

2. Potential markets

The previous chapters have served to identify the core issue underpinning this thesis: the low profitability of the pork meat industry. By examining the sector from a broad perspective, it has been possible to highlight the main challenges and market trends that have shaped its evolution. Statistical data has shown how an industry that once represented one of the pillars of the Italian economy has gradually moved towards an almost unprofitable state, due to a combination of structural and market-related factors.

In order to address this issue and prevent the sector from further decline, concrete action is required. Slaughterhouses, positioned between livestock farms and large-scale retailers, are currently squeezed between the high and often volatile purchase prices demanded by breeders and the low selling prices imposed by dominant retail chains. Lacking direct recognition from end consumers, they are highly exposed to even minor market fluctuations that can erode their already thin margins, while also facing rising fixed costs.

The present crisis is the culmination of structural societal megatrends that cost optimization can only partially mitigate. The definitive strategic response, therefore, lies in the development of highly differentiated products capable of building strong market equity and capturing the superior profit margins necessary for long-term viability. Such margins would allow producers to better withstand the current period of market contraction and structural change. To this end, the next step is to identify potential target markets, including emerging or previously untapped segments, and to analyse their needs, consumption habits, and preferences. Based on this analysis, a tailored product line can be designed to meet those specific demands.

This chapter evaluates the fundamental pillars and drivers of each target market by analysing official industry reports and institutional statistics. The objective is to quantify market dimensions while mapping the strategic landscape necessary to identify the suitability and potential of various pork-derived applications.

2.1 Fitness enthusiasts

This segment has experienced significant growth in recent years and is particularly attractive due to its high spending capacity. For these consumers, training is a fundamental aspect of their lifestyle, complemented by a strong focus on maintaining a balanced diet in which protein intake plays a central role.

Gym memberships: a quantitative indicator of the fitness megatrend

Current market statistics clearly reflect the mainstream expansion of the fitness-driven phenomenon, which is part of a broader global wellness economy valued at $5.6 trillion in 2022 and projected to grow by 8.6% annually through 2027 (Global Wellness Institute, 2023). Within this landscape, the physical activity sector has emerged as a primary driver of consumer behavior.

The clearest institutional manifestation of this megatrend is found in the gym and health club industry. In Europe, the sector has demonstrated remarkable resilience and growth; the total number of members has increased by over 20 million in the last 13 years, reaching approximately 67.6 million by the end of 2023. This trajectory corresponds to a Compound Annual Growth Rate (CAGR) of 3.28%, confirming that fitness centers have transitioned from niche leisure facilities to essential hubs for a health-conscious population.

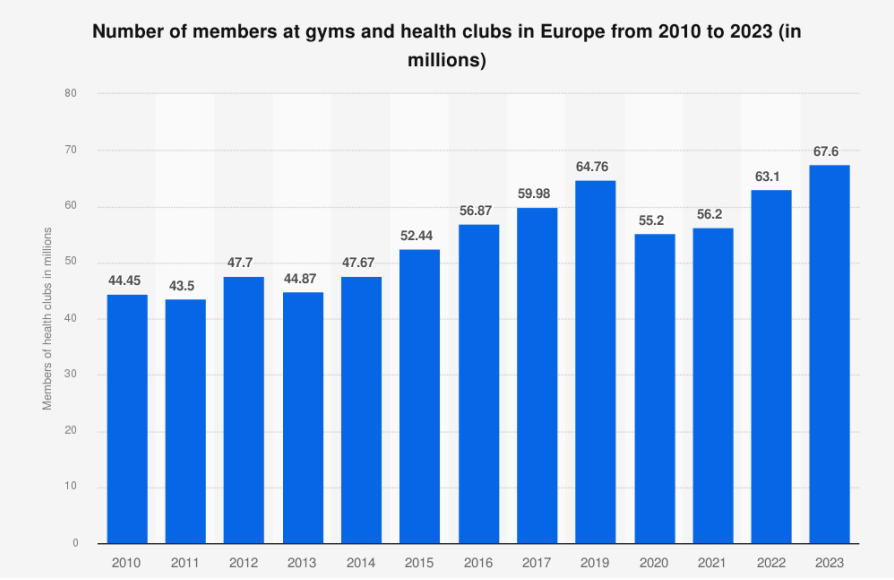

Figure 2.1 - Number of members at gyms and health clubs in Europe (Source: Statista)

A similar trend can be observed in Italy, where the share of the population engaging in physical activity and sports increased from 26.6% in 1995 to 37.5% in 2024. Notably, the most significant growth was recorded among individuals who practise sports on a regular basis, rising from 17.8% to 28.7% over the same period (ISTAT, 2025).

The industry is clearly experiencing a phase of expansion, as illustrated in the graph below. In Europe, the number of sector operators has grown from 48,000 to 65,000, corresponding to a Compound Annual Growth Rate (CAGR) of 2.17%.

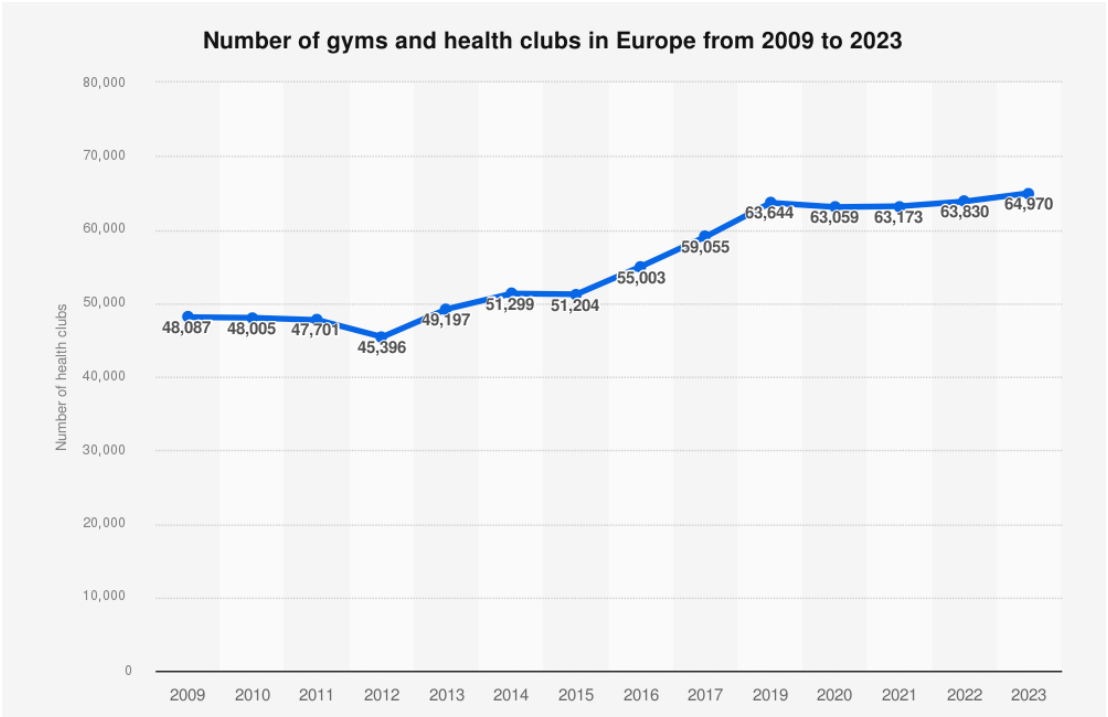

Figure 2.2 - Number of gyms and health clubs in Europe (Source: Statista)

These figures confirm that the fitness industry has evolved into a solid and highly valuable economic sector, firmly established in modern society as a genuine megatrend. Increasingly embedded in the fabric of daily routines, sport has become a comprehensive lifestyle choice for a broad and growing demographic. This shift dictates a wide array of consumer habits, ranging from the adoption of personalized training methods to, more crucially, a heightened and permanent focus on specialized, performance-oriented nutrition.

Consumer spending in the fitness market

Scientific consensus underscores that excellence in sports is the byproduct of a critical synergy between physical training and nutrition, with diet serving as a fundamental tool for translating training effort into tangible physical results and accelerating recovery (Beck et al., 2015). Beyond simply fueling activity, a structured nutritional framework is essential for optimizing performance and accelerating recovery, a correlation now firmly established among health-conscious consumers who increasingly prioritize functional efficiency in their dietary choices.

A 2018 study involving 1,636 Italians investigated their total monthly expenditure on sports-related activities, including gym subscriptions, training programmes, dietary plans, sports clothing, and food products (Pearson, 2018). The results revealed an average total monthly expenditure of around €150, distributed as follows:

- Sports supplements, bars, and snacks: €43
- Gym or other subscription: €39
- Sports clothing: €30
- Diet programme: €20
- Training programme: €16

Notably, food products and supplements account for nearly one-third of total spending, making them the primary cost category for fitness enthusiasts. This confirms the central role nutrition plays in the lifestyle and purchasing behaviour of this segment.

Market expansion is driven by both participation rates and rising expenditure. A 2023 study ranks Italians as the highest spenders in Europe, with an average annual outlay of €2,532 (6.5% of income). Specifically, monthly spending on sports supplements and functional snacks has reached €88 out of a total €210 (Plocco, 2019).

Between 2018 and 2023, total fitness expenditure grew at a 7% CAGR, while nutrition-specific spending surged by 15.4%. Consequently, food's share of total fitness costs rose from 33% to 42%, indicating that nutrition has evolved from a complementary element to the central focus of athletic investment. This structural shift towards performance-oriented products represents a significant business opportunity for companies offering targeted, high-protein food solutions.

The opportunity of performance-oriented meals

The European fitness nutrition market reveals opportunity for meat-based innovation beyond conventional supplementation. While sports nutrition continues robust expansion, the European protein supplements market projected to grow from €8.01 billion in 2024 to €20.95 billion by 2033 (Market Data Forecast, 2025), consumer behavior indicates persistent limitations: taste fatigue, digestive discomfort, and pronounced preference for whole-food protein sources over isolated powders when palatable alternatives exist (Smart Protein Project, 2023).

This preference gap presents opportunity for targeted innovation. Meat-based solutions can address segment-specific nutritional needs through superior sensory profiles: products delivering performance-oriented macronutrient ratios, while offering taste and variety that fundamentally differentiate from powder-based nutrition. Pork, with its favorable amino acid profile, versatility enabling precise fat optimization, and cost advantages versus beef, represents an underexploited platform, transforming protein supplementation from utilitarian necessity into integrated dietary option that captures value through consumer appeal.

Market segmentation

At this stage, it is necessary to size the market in order to better assess the potential profitability of potential products tailored for the targeted market.
This requires defining the TAM, SAM, and SOM[3]:

- **Total Addressable Market (TAM):**
  The Italian sports nutrition market represents a substantial opportunity for innovative protein-based products. According to ISTAT, Italy counts 21.5 million people who practice sports, of which 28.7% (6.17 million) do so regularly, representing the core target demographic most likely to integrate nutritional supplementation into their training routines.

[3] **TAM (Total Addressable Market):** the total market demand for a product or service, assuming 100% market share.
SAM (Serviceable Available Market): the portion of the TAM targeted by a company's products and within its reachable geography or segment.
SOM (Serviceable Obtainable Market): the realistic share of the SAM that a company can capture, considering competition and resources.

Market sizing data indicates that Italy accounted for 2.1% of the global sports nutrition market in 2023, which was valued at $39.46 billion globally (Grand View Research, 2025). This positions the Italian market at approximately $829 million (€750-800 million) in 2023, with projected growth at a CAGR of 7.1% through 2030. The market encompasses protein supplements, sports drinks, performance bars, and recovery products consumed primarily by regular fitness practitioners, competitive athletes, and health-conscious individuals seeking performance optimization.

- **Serviceable Available Market (SAM):**

  Within this Total Addressable Market, the Serviceable Available Market focuses on meat-based protein products for fitness and performance nutrition. Current market composition reveals significant concentration in dairy-derived proteins (whey, casein) and plant-based alternatives. Animal-derived proteins represent 68.79% of European sports nutrition products, yet this category is overwhelmingly dairy-based (Market Data Forecast, 2025). Meat-based protein products, particularly pork-derived offerings, remain largely untapped despite competitive advantages: superior leucine content versus chicken, versatility enabling precise macronutrient optimization, and cost efficiency compared to beef.

  Consumer trends support this opportunity. Over one-third of European consumers actively scrutinize ingredient lists when purchasing protein products, with pronounced preference for recognizable, minimally processed ingredients (Innova Market Insights, 2024). This creates strategic opening for meat-based innovations positioned as whole-food alternatives to powder-based supplementation.

  Targeting 20% of the Italian sports nutrition market through meat-based protein products, with pork-derived offerings capturing around 20% of this segment, yields a Serviceable Available Market of €50 million annually. This represents products specifically designed for fitness applications: high-protein snacks, performance-oriented meals, and clean-label formats leveraging pork's nutritional profile while addressing the sector's current over-reliance on dairy sources.

- **Serviceable Obtainable Market (SOM):**

  The Serviceable Obtainable Market represents the portion realistically addressable considering market entry constraints and competitive positioning. Initial penetration assumptions must account for established competitors, distribution channel access, brand awareness development, and operational scalability.

  For operators with existing meat processing infrastructure and raw material access, market entry benefits from leveraging pre-existing capabilities rather than requiring full value chain construction. Targeting 5% of the SAM reflects ambitious while realistic initial market capture through focused strategies. At this penetration rate, the Serviceable Obtainable Market represents €2.5 million annually, establishing market presence and validating product-market fit before scaling. This conservative estimate provides foundation for evaluating specific product concepts across diverse fitness nutrition applications.

2.2 Pet food

Another promising market to be considered is the pet food industry. In recent years, attention and awareness toward pets have grown remarkably, reflecting not only in their nutritional needs but also in a broader range of expenditures, such as toys, veterinary services, and grooming. Pets are increasingly regarded as true members of the family, and many owners tend to devote significant resources to their well-being, sometimes even prioritising their pets' needs over their own.

This cultural and behavioural shift has transformed pet ownership into a powerful social and economic phenomenon, driving a rapidly expanding industry that attracts the attention of multiple players across the value chain. Within this context, the pet food segment stands out as particularly dynamic, with continuous innovation aimed at combining nutrition, health, and premiumisation.

In this analysis, the figures presented will refer exclusively to dogs and cats, as their diets are more suitable for pig-derived ingredients compared to other pets, and because they represent the most common household animals.

Pet ownership data and trends

In order to gain a clearer understanding of the Italian market context, it is essential to first examine the key figures that describe its current dynamics.

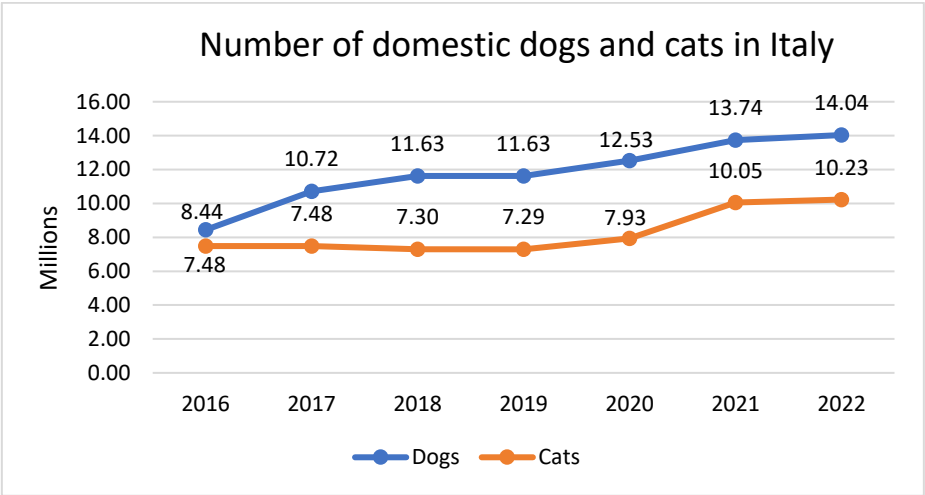

Figure 2.3 - Number of domestic dogs and cats in Italy (Source: ISTAT)

As shown in the above graph, between 2016 and 2022, the population of domestic pets in Italy recorded significant growth, with the number of dogs increasing at a CAGR of 8.46% and cats at 5.35%. These figures highlight a structural trend in Italian society: pet ownership is not only becoming more widespread, but it is also consolidating as a long-term phenomenon.

The fact that both dogs and cats show sustained annual growth rates well above the average demographic or household growth in Italy suggests that pets are increasingly considered essential companions within families and individual households. This is consistent with the broader "pet humanisation" megatrend, where owners treat their pets as family members, dedicating substantial resources to their care, well-being, and nutrition.

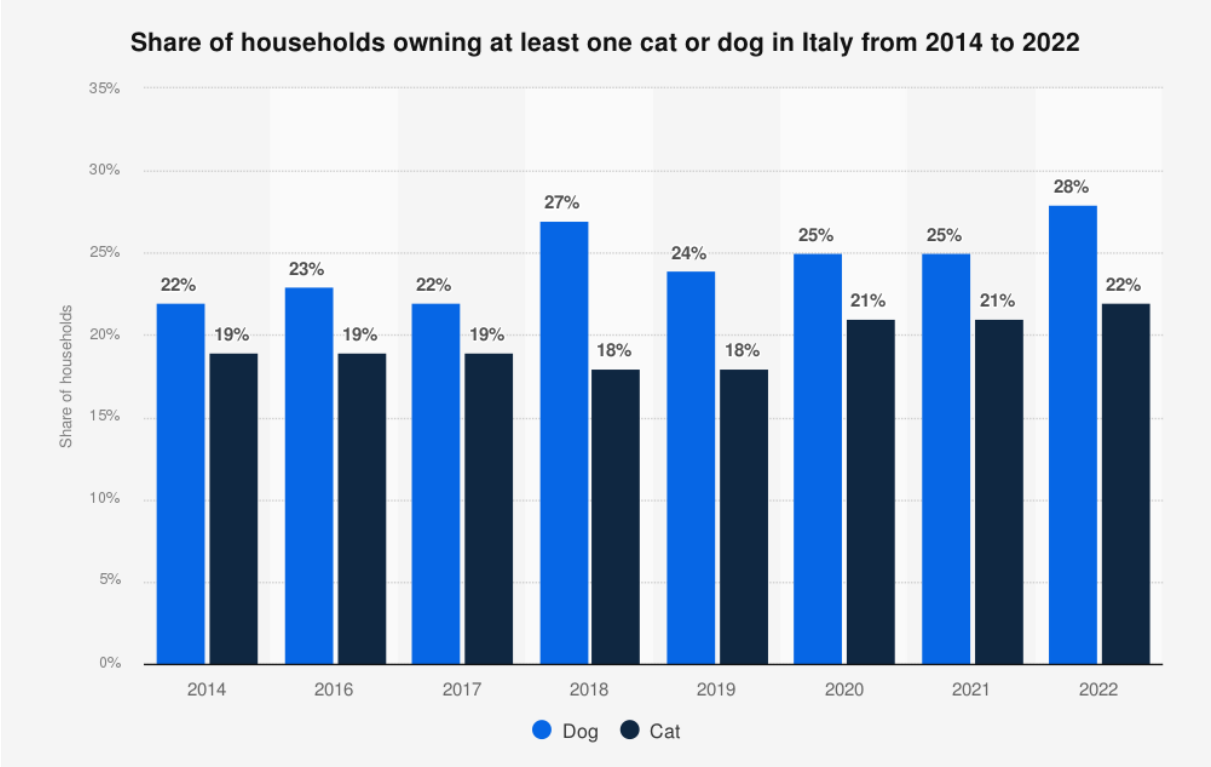

Figure 2.4 - Share of household owning at least one dog or cat (Source: Statista)

The slow growth in pet-owning households (CAGR of 3.06% for dogs and 1.85% for cats) confirms that market expansion is primarily driven by multi-pet adoption rather than new owners. This trend highlights a rising level of commitment among existing owners, with direct benefits for the pet food industry, as multi-pet households generate disproportionately higher recurring expenditure.

Pets as a family members: drivers of growth in the pet food market

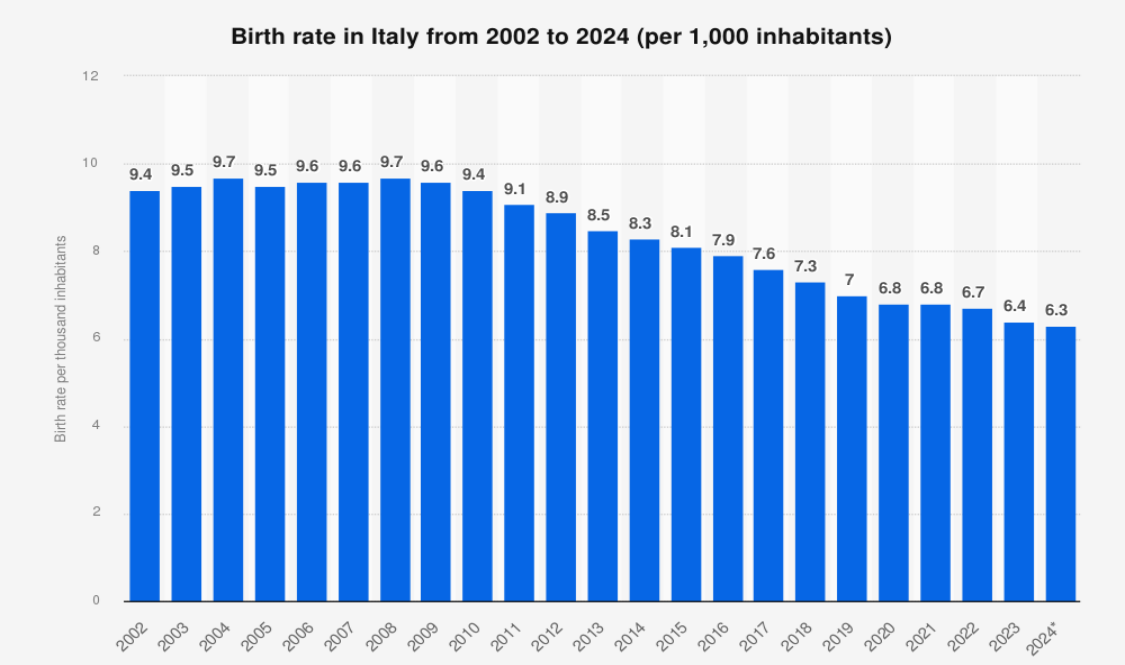

Figure 2.5 - Birth rate in Italy (Source: Statista)

The steady decline in Italy's birth rate, from 9.7 births per 1,000 inhabitants in 2004 to just 6.3 in 2024, offers a valuable perspective on the broader social changes underpinning the growth of the pet industry. As fewer children are born and family sizes shrink, many households are shifting their emotional and financial attention towards pets, who increasingly assume the role of family members.

This demographic trend helps explain why the pet industry is not only expanding in terms of the number of animals but also in terms of economic value. The willingness of Italians to devote substantial resources to pet nutrition, healthcare, and related services is closely tied to this redefinition of family priorities. In this sense, pets are not simply companions, but in many cases are perceived as substitutes for children, leading to higher and more consistent expenditure per household.

A 2024 study conducted by Ipsos on behalf of the Unipol Group, based on a representative sample of 1,720 Italians, stratified by age and geographic region, offers significant insights into the evolving human-animal bond. The research examines shifting patterns in care standards, expenditure categories, and the psychological perception of pets, highlighting several key market dynamics:

1. **Pets as family members:** eight out of ten pet owners in Italy consider their animals not just companions but true members of the family
2. **Companionship and daily care:** the main recognised advantage of owning a pet lies in the companionship and happiness they provide. More than half of owners dedicate between one and three hours each day to their care
3. **Economic commitment:** households owning cats or dogs spend on average around €70 per month (approximately €840 per year), excluding medical and veterinary expenses, demonstrating a significant and recurring financial dedication
4. **Pets vs. parenthood preferences:** two Italians out of ten believe that the majority of pet owners consciously prefer pets over having children
5. **Substitution effect:** three out of ten Italians explicitly state that a pet can represent a substitute for a child within the household
6. **Emotional compensation:** 10% of respondents believe that pets help to fill the emotional gap created by the absence of children
7. **Link to declining birth rates:** one in four Italians (25%) agree that the falling birth rate is, at least partially, connected to the increasing presence of pets in households

Taken together, these findings provide an important perspective: while the decline in birth rates is not primarily caused by the growing presence of pets, the opposite relationship appears more plausible. Social and economic pressures, such as declining purchasing power, rising inflation, and stagnating GDP per capita (as discussed in *Chapter 1*), discourage many families from having children. Within this context, pets increasingly emerge as an alternative source of emotional fulfilment and family identity.

This substitution effect has profound implications for the pet industry. For many households, pets are not merely companions but integral family members. Consequently, owners are willing to allocate growing portions of their budget to their care, feeding, and well-being. What emerges is a structurally expanding market, in which emotional and cultural dynamics converge with economic drivers, consolidating the pet industry as one of the most resilient and promising consumer sectors in Italy.

Dog and cat food expenditure analysis

From a market perspective, such rapid expansion translates into a rising and increasingly segmented demand for products and services related to pets. In particular, the pet food industry benefits directly from this trend, as every additional pet requires regular feeding, and owners are demonstrating a growing willingness to invest in higher-quality, premium, or specialised nutrition solutions.

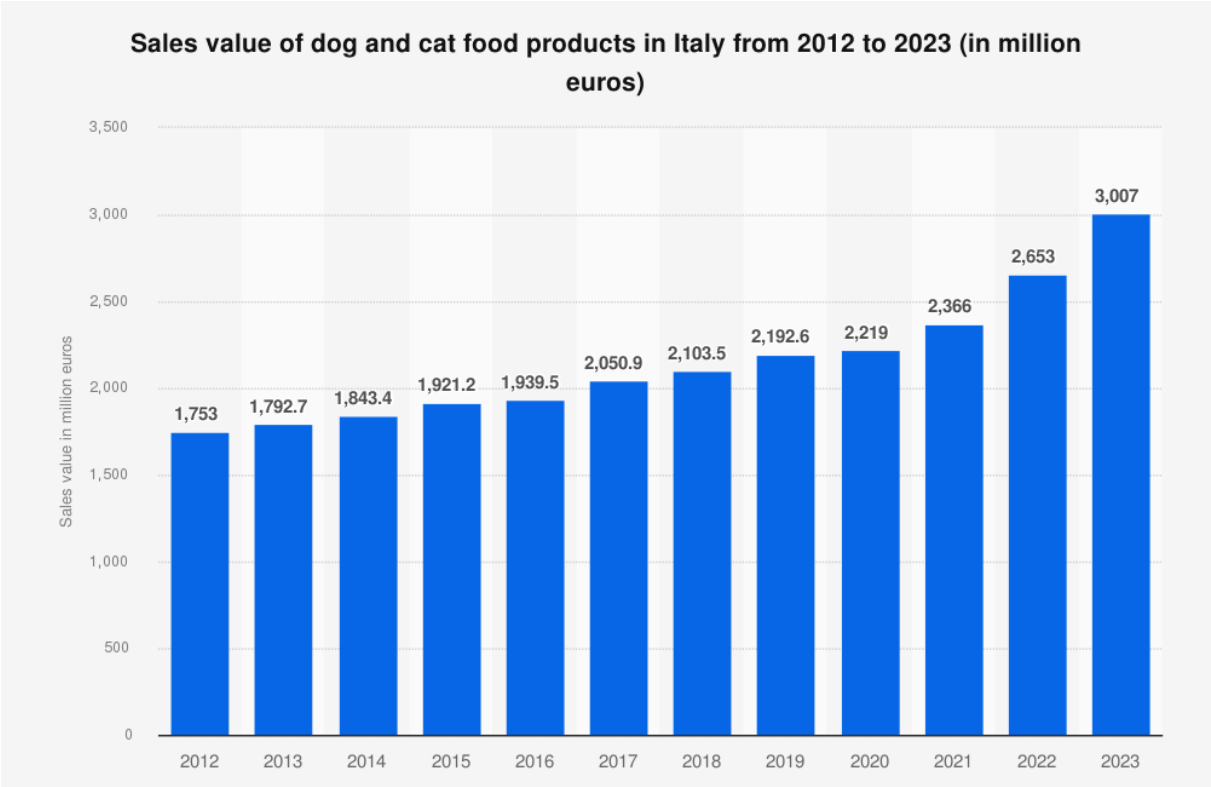

Figure 2.6 - Sales value of dog and cat food products in Italy (Source: Statista)

The graph confirms and reinforces the trends discussed above. Between 2012 and 2023, the sales value of dog and cat food in Italy grew from €1.75 billion to just over €3 billion, which translates into a Compound Annual Growth Rate (CAGR) of 4.60% over a twelve-year period. Such steady and consistent growth is particularly relevant when considering the broader economic context, marked in recent years by rising inflation and decreasing household purchasing power. Despite these challenges, Italian consumers have continued to allocate an increasing share of their budget to pet nutrition, demonstrating the resilience and structural solidity of this market.

This performance is closely aligned with the trends highlighted earlier: the rising number of dogs and cats, the increase in multi-pet households, and the growing financial commitment of owners toward their animals. Taken together, these elements confirm that the pet food sector is not only expanding in volume but also evolving in value, with consumers showing a marked preference for better-quality, more specialised, and nutritionally advanced products. This shift underscores the attractiveness of the sector for innovative solutions, particularly those capable of combining functionality and premium positioning.

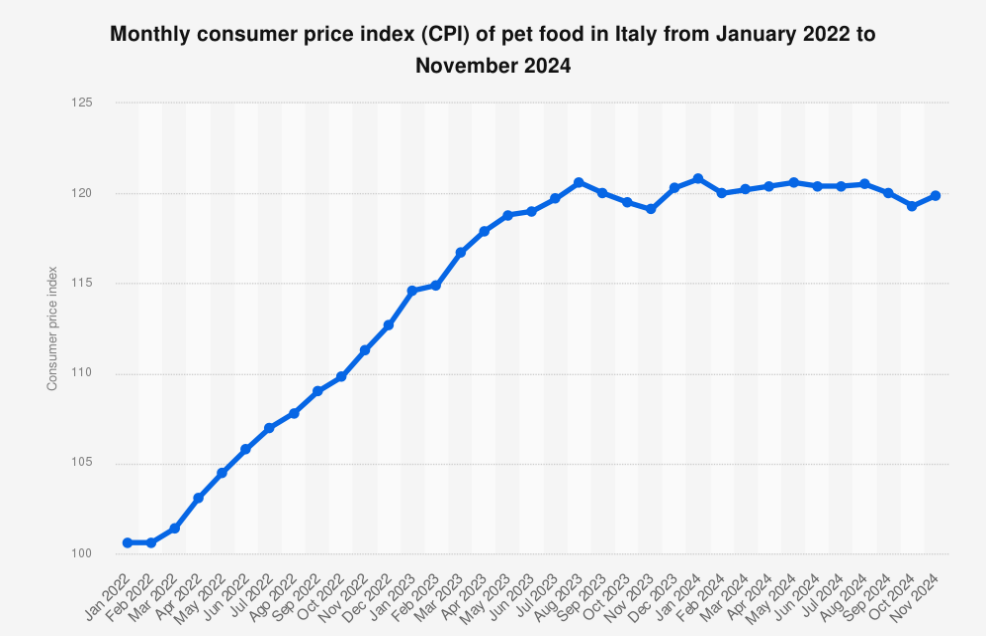

Figure 2.7 - Monthly consumer price index of pet food (Source: Statista)

The graph above further demonstrates the attractiveness of the industry. From early 2022, prices rose sharply, peaking in mid-2023 with an increase of nearly 20% compared to the base year. Although a slight stabilization followed in late 2023 and 2024, overall price levels remain well above the pre-crisis period.

What results particularly interesting is shown in *Figure 2.*8. As illustrated, the volume of dog and cat food sold in Italy has steadily increased over the past decade, rising from around 553,000 tons in 2012 to 673,000 tons in 2023, corresponding to a CAGR of 1.65%. This long-term growth demonstrates the structural expansion of the market in terms of consumption.

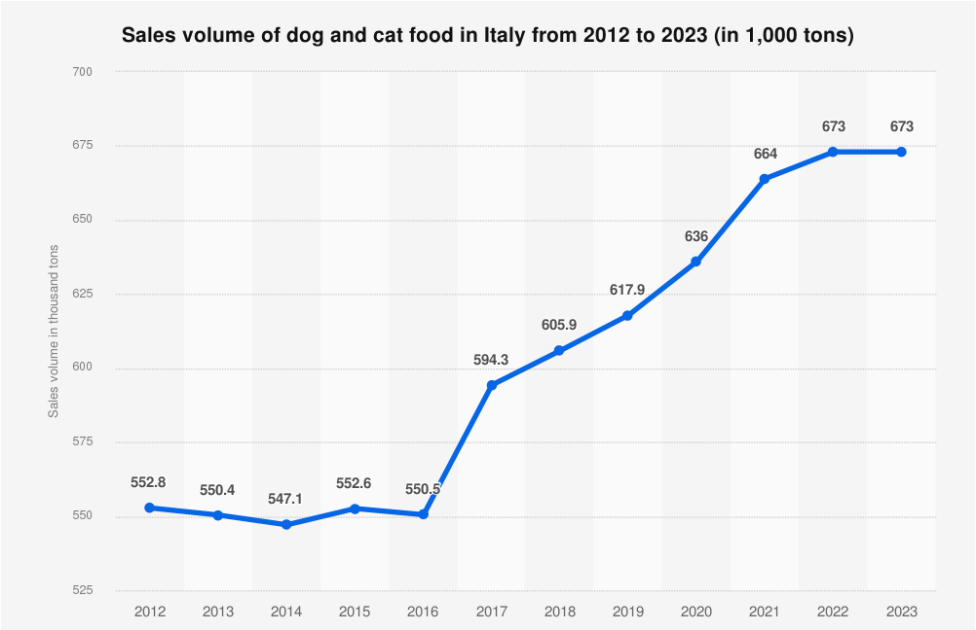

Figure 2.8 - Sales volume of dog and cat food in Italy (Source: Statista)

When this trend is compared with the recent price dynamics (*Figure 2.7*), an even more interesting picture emerges. While volumes had already been growing steadily for over a decade, the inflationary shock of 2022–2023 acted as a real stress test for the industry. Instead of reducing demand, consumers absorbed the higher prices, maintaining stable volumes and confirming their willingness to prioritise pet nutrition. This resilience underlines the inelastic nature of demand in the sector: pet food is perceived as a non-negotiable necessity, and owners are willing to sustain increased expenditure even in a context of declining purchasing power.

Market segmentation

To get to the realistic size of the target market, TAM, SAM and SOM are estimated as follows:

- **TAM (Total Addressable Market):**
  Given that pork meat is more suitable for the nutrition of cats and dogs and considering that these two categories account for roughly 90% of the entire pet food market, the analysis will focus exclusively on this segment. As shown in *Figure 2.6*, the sales value of dog and cat food exceeded €3 billion in 2023, with a Compound Annual Growth Rate (CAGR) of 4.60% over the previous decade. Projecting this trend forward, the Total Addressable Market (TAM) for 2025 can be estimated at approximately €3.3 billion.

- **SAM (Serviceable Available Market):**

  The SAM is a specific segment within the broader Italian pet food industry. The analysis narrows the scope to the premium niche, which is a key area for value-added products and innovation. While premium offerings currently account for approximately 25% of total sales, it's important to note that not all premium pet food formulations are relevant for a pork-based innovation. Chicken, beef, and fish proteins still dominate this segment, leaving pork largely underrepresented despite its high quality. Pork is an excellent protein choice for pets, known for being:

  - Easily digestible
  - Rich in essential amino acids
  - Highly palatable for both dogs and cats
  - A source of optimal quality protein

  Considering the potential for marketing these benefits and educating consumers on pork's value in a pet's diet, the SAM for a new pork-based product could reach 10% of the Total Addressable Market (TAM) can be estimated. This translates to an estimated market value of €330 million.

- **SOM (Serviceable Obtainable Market):**

  The pet food sector is highly concentrated with well-established players at both the national and international levels. Gaining consumer trust with an innovative product would present a significant challenge. However, a strategic approach targeting the premium market offers a solution. By focusing on high-spending consumers who are willing to pay more for superior quality, a new brand can differentiate itself from mass-market products and effectively serve the needs of a lucrative, high-end niche.

  A conservative estimate for the Serviceable Obtainable Market (SOM) for this strategy is 1% of the total Serviceable Available Market (SAM). This translates to an estimated initial SOM of €3.3 million.

2.3 Cosmetics

The cosmetics industry is an attractive and growing field where pork meat and its by-products can achieve higher profitability than in their traditional use. Although unrelated to the food sector and requiring specific expertise, significant investments, and the ability to compete with powerful multinational players, it offers substantial opportunities. Cosmetics is a high-margin market, constantly seeking natural and effective ingredients such as collagen, which can be derived from pork.

These materials can be transformed into valuable semi-finished products sold to established companies, ensuring attractive margins without the need to invest heavily in brand building, or they can be developed into finished products, though with higher risks and costs. In both cases, the sector provides a concrete path to valorize pork resources, turning low-value by-products into high-value applications and aligning with the thesis objective of identifying innovative strategies to revitalize the pork industry.

Market growth and distribution channels

To better assess the actual opportunities offered by the cosmetics industry, it is essential to examine the market figures in greater detail.

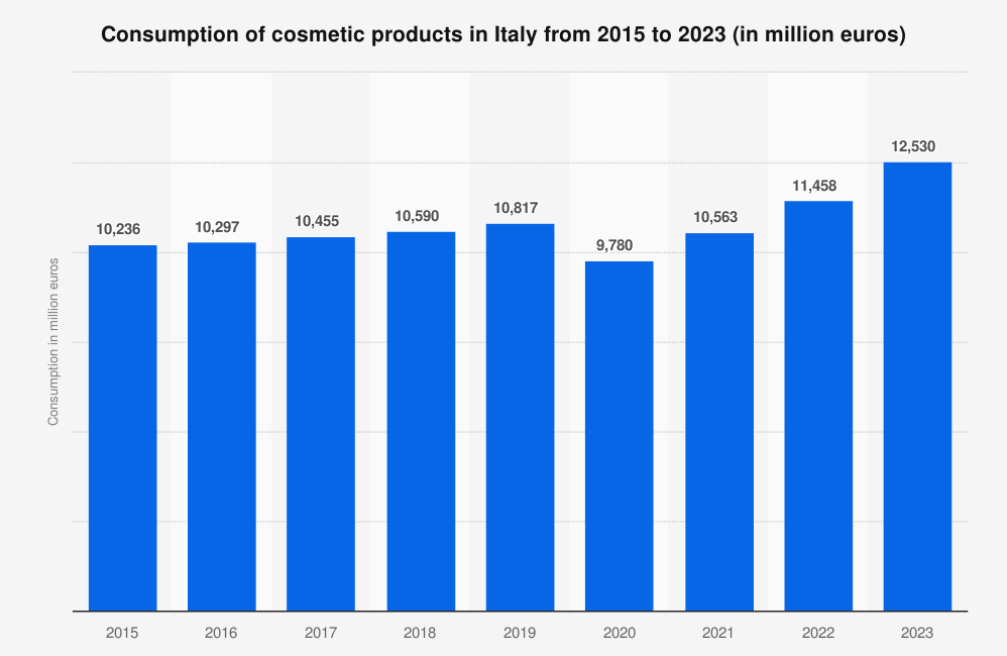

Figure 2.9 – Consumption of cosmetics products in Italy (Source: Statista)

The cosmetics industry in Italy has shown a clear trend of growth over the past decade, as evidenced by the steady rise in consumption levels. Starting from €10.2 billion in 2015, the market has progressively expanded, overcoming even the temporary contraction observed in 2020 due to the pandemic, and reaching a record value of €12.5 billion in 2023. This trajectory corresponds to a Compound Annual Growth Rate (CAGR) of 2.27%, confirming not only the resilience of the sector but also its ability to recover rapidly from external shocks and continue on a path of long-term expansion (Cosmetica Italia, 2024).

Such figures underline the significant weight of cosmetics within Italian consumer habits and reveal the existence of a vast and dynamic market that remains highly attractive for new entrants and innovative solutions. In particular, this growth highlights how consumer demand continues to evolve towards products perceived as high quality, effective, and sustainable, creating fertile ground for alternative raw materials. Within this context, pork-derived ingredients could represent an untapped opportunity, capable of transforming low-value by-products into premium cosmetic applications.

Channel	Consumption	Quantity	Prices
Mass market and other channels	8.3%	6.5%	1.9%
Perfumery	14.2%	6.1%	8.5%
Pharmacy	7.5%	4.4%	2.5%
E-commerce	12.5%	11.5%	2.1%
Direct sales: door-to-door and by mail order	1.1%	0.3%	1.0%
Herbal medicine	12.0%	5.3%	6.7%
Total traditional and digital channels	**9.7%**	**6.3%**	**3.6%**
Hairstyle	5.0%	2.8%	2.4%
Beauty salons	5.3%	3.2%	2.2%
Total direct and professional channels	**5.1%**	**2.9%**	**2.3%**
Total market	**9.4%**	**6.1%**	**3.5%**

Table 2.1 - Trends in distribution channels (Variations % 2022-2023)(Source: Cosmetica Italia)

While the analysis of the 2015–2023 period highlights the long-term resilience and steady expansion of the cosmetics industry in Italy, a closer look at the most recent dynamics (2022–2023) further clarifies the drivers of growth. In fact, detailed channel data show that the increase

is not solely the result of inflation. Total market consumption rose by 9.4%, of which 6.1% can be attributed to higher quantities sold and only 3.5% to price increases. This confirms that the sector's expansion is supported above all by a real rise in demand, and not just by higher prices.

In particular, traditional and digital channels, which overall grew by 9.7%, emerge as especially relevant. E-commerce (+12.5%) has been the fastest-growing segment, largely volume-driven (+11.5%), confirming its role as the most dynamic and accessible channel for innovative products. Pharmacies (+7.5%) also represent a strategic space, given their credibility at the intersection of health and beauty, while the mass market ensures stability and scale with growth primarily supported by volume increases (+6.5%)(Cosmetica Italia, 2024).

This evidence reinforces the view that the cosmetics market offers concrete and expanding opportunities, particularly for functional ingredients. In this perspective, channels such as pharmacies, e-commerce and mass market are the most suitable for introducing pork-derived ingredients, capable of converting low-value by-products into high-value cosmetic applications.

The international dimension of the Italian cosmetics market

A closer look at Italian cosmetics companies reveals that the sector's growth is not limited to the domestic market but extends significantly to international markets as well. Italian beauty and personal care products enjoy strong recognition abroad, where they are associated with quality, style, and innovation. This international appreciation has contributed to a remarkable increase in turnover, confirming the industry's global competitiveness and opening further opportunities to capture value within such a successful sector.

Worldwide turnover of the Italian cosmetics and personal care industry has shown consistent growth over the past decade, increasing from €9.3 billion in 2013 to more than €15.1 billion in 2023. Despite the temporary decline recorded in 2020 due to the pandemic, the sector rapidly recovered and reached record levels in the following years. This confirms the strong international competitiveness of Italian cosmetics and their ability to maintain a solid position in global markets. The following figure illustrates this trend.

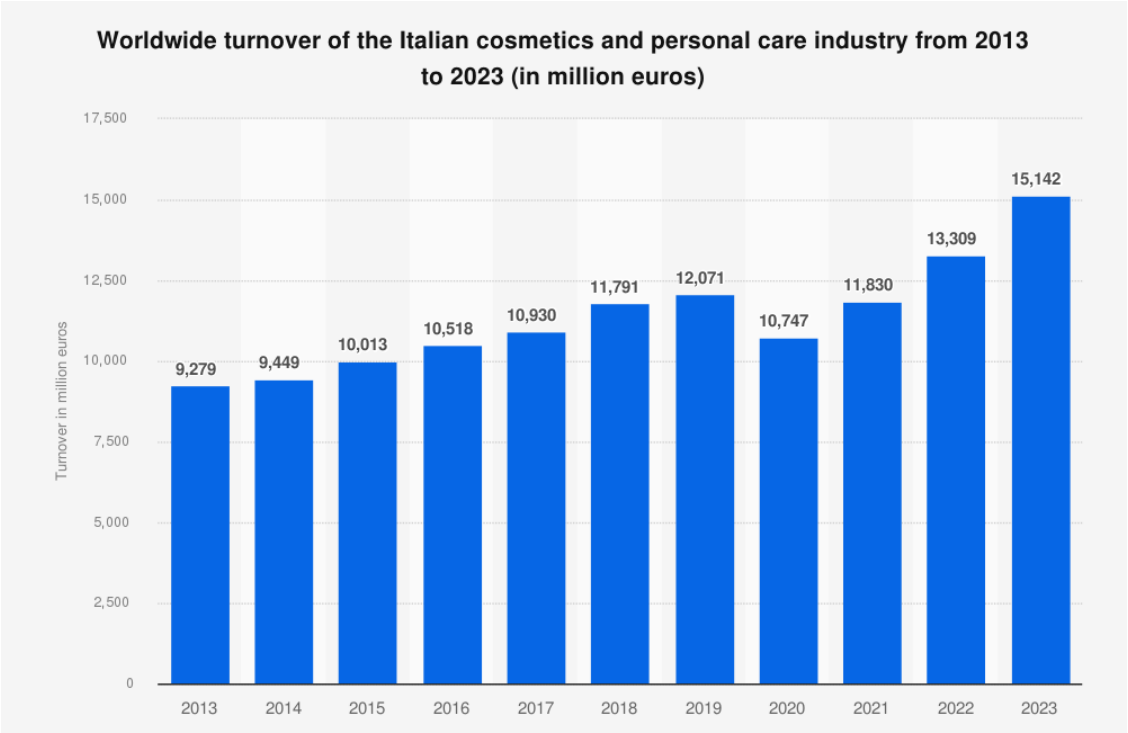

Figure 2.10 - Worldwide turnover of the Italian cosmetics and personal care industry (Source: Statista)

The relevance of this figure emerges even more clearly when set against the following one.

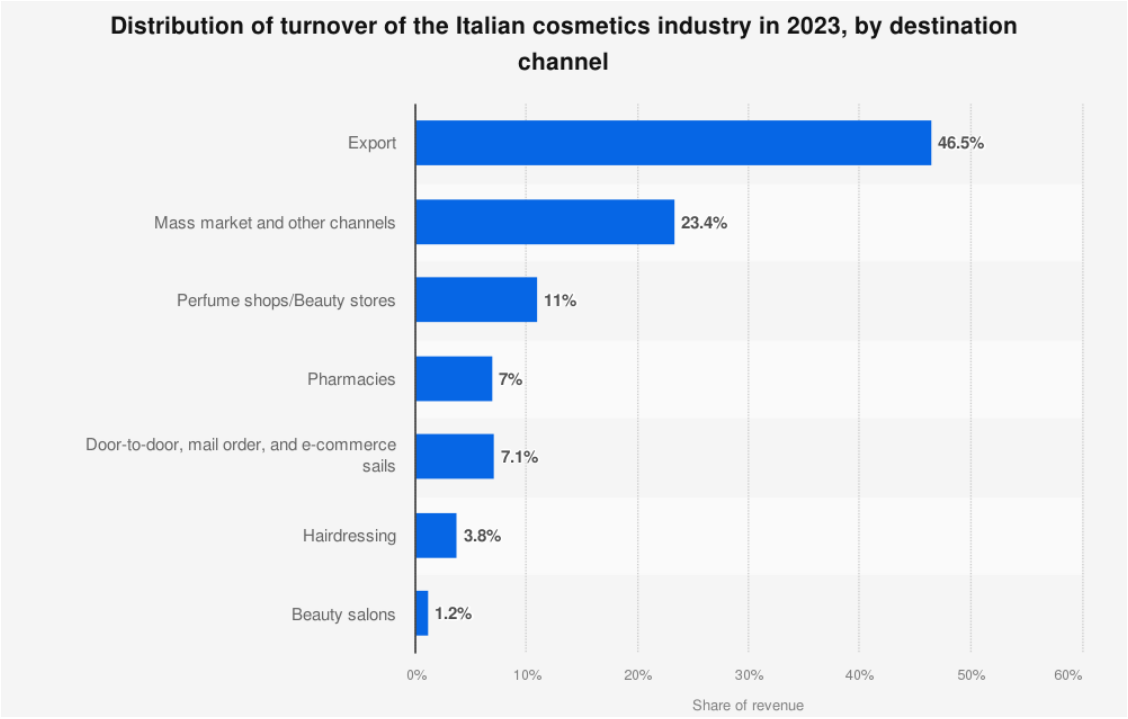

Figure 2.11 - Distribution of turnover of the Italian cosmetics industry (Source: Statista)

As the data show, a substantial share of the Italian cosmetics industry is driven by exports, while the domestic market continues to expand, reaching a commercial value of €4.1 billion. This dual growth highlights the sector's strong international appeal and confirms the increasing attractiveness of its opportunities.

Cosmetics categories and their potential for pork by-products

Before analyzing the specific contribution that pork-derived ingredients can bring to the cosmetics industry, it is important to clarify the main categories in which their use is most relevant. The cosmetics sector is indeed very broad and includes a wide variety of product families that address different consumer needs.

Among these, the categories most suitable for the application of pork-derived ingredients are primarily face care products, body care products, and hair and scalp treatments, which together represent a significant share of the market. To a lesser extent, possible applications also extend to lip care products and hand care products. In these areas, compounds such as collagen, keratin, elastin, and animal lipids are particularly valued for their moisturizing, repairing, anti-aging, and protective properties.

This classification is essential to identify the most promising segments of the cosmetics industry, where pork by-products can be transformed into high-value functional ingredients.

Cosmetic product	Value (€ million)	% of total value
Face care products	1612.2	16.4%
Body care products	1490.5	15.1%
Alcohol-based perfumery	1375.3	14.0%
Body hygiene products	1081.6	11.0%
Hair and scalp products	1028	10.4%
Oral hygiene products	732.5	7.4%
Face make-up products	644.3	6.5%
Eye make-up products	589.2	6.0%
Lip products	469.8	4.8%
Children's skin products	242.1	2.5%
Hand care products	219.2	2.2%
Gift sets	165.6	1.7%
Men's line products	141.6	1.4%
Make-up kits	55.7	0.6%
Total	**9847.5**	

Table 2.2 - Breakdown of consumption by macro-categories traditional channels 2023 (Source: Cosmetica Italia)

Table 2.2 reveals a significant concentration of cosmetic consumption within the Face, Body, and Hair Care segments, which collectively account for over 40% of the total market. This distribution is of high strategic relevance, as these categories represent the primary fields where swine-derived ingredients, such as collagen, elastin, and lipids, can be most effectively utilized for their hydrating, repairing, and anti-aging properties.

A detailed analysis of the Face Care channel (*Figure 2.12)* further confirms that the potential for these by-products is concentrated in the most profitable, high-value segments. While products like toners or facial wipes often rely on synthetic or plant-based alternatives, anti-aging creams, moisturizers, and eye treatments constitute the most lucrative share of the market. It is in these specific niches that functional swine derivatives offer peak performance, ensuring a perfect alignment between consumer demand and the biochemical profile of the raw material.

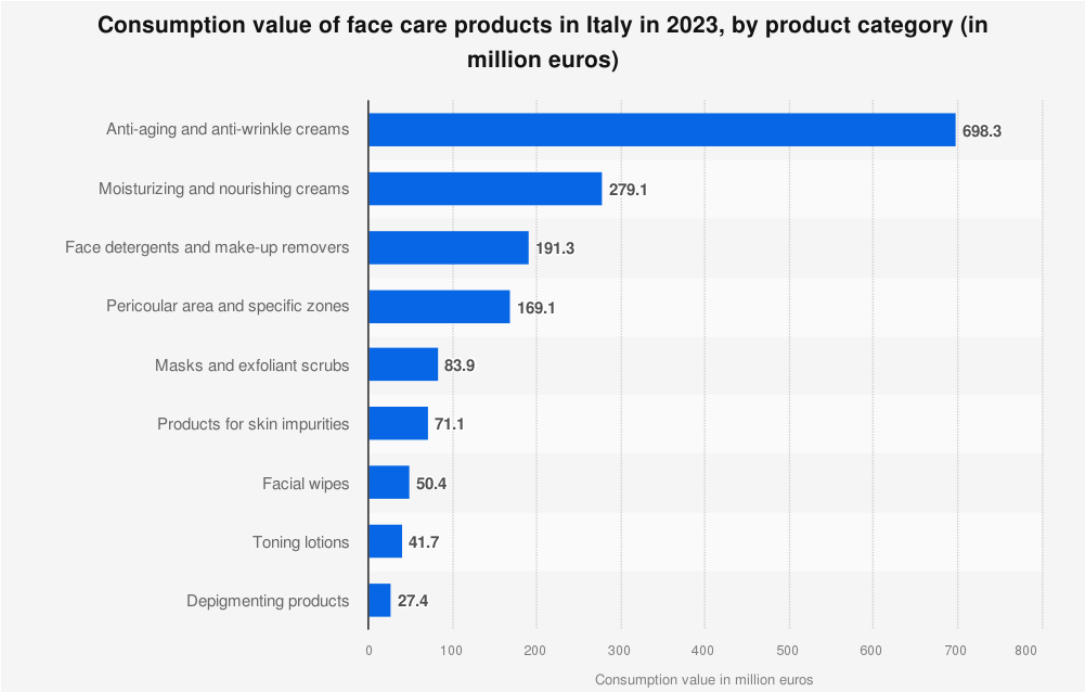

Figure 2.12 - Consumption value of face care products in Italy (Source: Statista)

Ultimately, the structure of the cosmetics market indicates that demand is highest precisely where swine by-products can be upcycled into premium functional ingredients. This synergy allows the pork industry to transform low-value materials into high-value business opportunities within the most resilient and prestigious sectors of the beauty industry.

Market segmentation

As highlighted in the previous sections, cosmetics represent a market segment of great potential, characterized by continuous growth in both volume and revenues, and offering significant opportunities for swine-derived products. To better assess the concrete prospects of this sector, it is useful to take a closer look at the realistic figures that define its scope:

- **TAM (Total Addressable Market):**
  Although Italian cosmetics companies generate about half of their turnover abroad, this analysis focuses on the domestic market to provide a more realistic perspective for the short to medium term. As reported in *Figure 2.9*, domestic consumption of cosmetics amounted to €12.53 billion in 2023, with a CAGR of 2.27%. Following this trajectory, the market value is expected to have reached around €13.11 billion in 2025, which is here considered as the TAM.

- **SAM (Serviceable Available Market):**
  To define the Serviceable Available Market (SAM), a more detailed analysis is required, since not every cosmetic product can be realistically targeted with pork-derived ingredients. The revenues that can effectively be considered as potential therefore correspond only to those categories and subcategories where such ingredients can find a meaningful application. These are highlighted in *Table 2.3*, which reports the segmentation of cosmetic products identified by *Cosmetica Italia – Associazione Nazionale Imprese Cosmetiche*, together with their 2024 revenues. The compatible categories are bolded to provide a clearer view of the market potential and helps isolate the segments where innovation can be most effectively introduced.
  For reasons of clarity, the table considers only revenues from traditional distribution channels, as establishing a strong brand presence in alternative channels is considerably more difficult as soon as the business is established. Summing the revenues of the compatible products, the potential market amounts to €3,411 million, representing roughly 30% of total cosmetics revenues and therefore a significant share of the sector. Since not all products within each subcategory can realistically be replaced with pork-derived alternatives, a more conservative SAM of approximately €3 billion is assumed, providing a solid benchmark to evaluate the real opportunity of swine derivatives in cosmetics.

Categories and subcategories of cosmetic products	2024 revenue (Mln €)
Hair And Scalp	**1096.1**
Shampoo	510.8
Lotions And Intensive Treatments	73.4
Hair Dyes And Colored Mousses	178.2
Hair Sprays	71.9
Conditioners, Balms And Masks	173.6
Hair Fixers And Structuring Mousses	35.7
Gels, Waters And Styling Gums	52.6
Face Products	**1704.2**
Face And Eye Cleansers And Make-Up Removers	206
Face Wipes	48.1
Toning Lotions	45.6
Eye Contour And Specific Areas	175.8
Moisturizing And Nourishing Creams	295.1
Anti-Aging And Anti-Wrinkle Creams	738.9
Masks And Exfoliants	86.1
Products For Skin Blemishes	78.4
Depigmenting Products	30.1
Face Make-Up Products	**689.1**
Foundations And Tinted Creams	334.6
Face Powders	81.2
Concealers, Blushes And Bronzers	273.3
Make-Up Kits	**60.8**
Eye Make-Up Products	**618.7**
Eyeshadows	137.7
Mascaras	249.5
Eyeliners And Pencils	231.6
Lip Products	**511**
Lipsticks And Glosses	336.7
Lip Liners And Pencils	64.3
Protective, Colorless Bases And Sun Sticks	110
Hand Products	**225.4**
Creams, Gels, Lotions And Nail Products	67.3
Nail Polishes	143.1
Removers And Other Products	15
Body Products	**1592.8**
Moisturizing, Nourishing And Exfoliating Products	240.4
Multipurpose Creams	92.9
Body Waters And Oils	33.5
Anti-Cellulite Products	43.8
Firming, Specific Areas And Anti-Aging Body Products	56
Deodorants And Antiperspirants	587.9
Depilatory Products	62.3
Sunscreens And Tanning Products	476.1
Body Hygiene Products	**1125.7**
Soaps And Syndets	105.4
Liquid Soaps	144.3
Shower Gels, Bath Salts, Powders And Oils	494
Talcum Powders And Dusting Powders	30.1
Foot Hygiene Products	32.4
Intimate Hygiene Products	320.6
Oral Hygiene Products	**784.2**
Toothpastes	571.3
Mouthwashes And Breath Fresheners	212.9
Children'S Dermocosmetic Products	**238.1**
Men'S Line Products	**145.4**
Soaps, Foams And Shaving Gels	59.5
Aftershaves	47.6
Treatment Creams	38.3
Alcohol-Based Perfumery	**1524.6**
Female Eau De Toilette And Perfumes	952.9
Male Eau De Toilette And Perfumes	571.7
Gift Sets	**182.6**
Women'S Gift Sets	98.7
Men'S Gift Sets	83.9
Total Traditional	**10498.8**

Table 2.3 - Cosmetic product subcategories compatible with swine-derived ingredients (Source: Cosmetica Italia)

- **SOM (Serviceable Obtainable Market):**

  While the SAM provides an estimate of the total revenues potentially addressable by swine-derived ingredients, the Serviceable Obtainable Market (SOM) narrows this perspective to the share that could realistically be captured in the short to medium term. Considering the competitive structure of the cosmetics industry, the dominance of well-established brands, and the barriers related to regulation, consumer acceptance, and distribution, it would be unrealistic to assume that the entire SAM could be achieved. A more cautious approach suggests that only a fraction of this market could initially be accessed, particularly through niche segments in face, body, hair, and lip care where swine derivatives offer clear functional advantages. Assuming an attainable penetration of around 0.5% of the SAM, the SOM can be reasonably set at €15 million. This amount provides a pragmatic benchmark of the revenues that could actually be captured, reflecting both the opportunities and the constraints of entering such a competitive and innovation-driven sector.

3. Potential products

The previous chapter aimed to identify potential markets that remain, at least partially, untapped by pork derivatives, with the goal of selecting those that offer the greatest opportunities in terms of revenues and, more importantly, profit. These markets are expanding not only in value but also in volume, thus leaving space for new entrants. Each of them generates billions of euros in annual revenues, meaning that even relatively small segments or niches within these markets can correspond to opportunities worth millions of euros.

Given that the underlying problem is to increase industry profitability through new applications of a valuable, high-quality raw material (pork sourced from a certified Italian supply chain that complies with DOP standards) the analysis focuses on **premium market segments**. This choice has been made for different reasons:

1. **Alignment of costs and pricing**: products are developed from an expensive raw material, meaning that high production costs must be matched by positioning in segments where higher prices are acceptable compared to the market average.
2. **Efficient use of by-products**: pork derivatives often require only small cuts, extracts, or by-products. High-end markets attribute significant value even to small volumes, allowing substantial revenues to be generated without expanding raw material sourcing beyond what a typical slaughterhouse already provides.
3. **Maximizing the value of low-margin parts**: the thesis aims to reallocate and valorize derivatives obtained during the slaughtering process in order to increase profitability, particularly by enhancing the economic value of traditionally cuts or parts whose value is not exploited to its maximum extent.
4. **Consumer recognition of quality**: starting from a certified premium raw material facilitates consumer perception of high quality, making product positioning and communication more straightforward and effective.
5. **Distribution channels:** premium products are generally less suited to supermarket shelves, where price competition is intense and margins are compressed. Instead, they can be positioned through alternative channels such as specialized shops or e-commerce. These channels allow for better communication of product value and exclusivity, enabling higher price points and improving profitability compared to mass retail distribution.

Following this reasoning, the present chapter proposes a limited portfolio of possible products for each of the markets identified in *Chapter 2*. The selection criteria focused on proposing products that differ from current market options, either through novelty, innovative features suited to underserved segments, or by leveraging fast-growing categories that offer higher profitability potential.

Each product will be assessed across several dimensions, including:

- **Product description:** derived from market research and strategic intuition, the analysis targets niche and untapped segments to propose realistic, compliant concepts with clear value over existing offerings.
- **Production process analysis:** the production steps are reconstructed from technical literature and logical deduction, with each process mapped to ensure feasibility and alignment with raw-material requirements.
- **Required investment:** investment needs for machinery are estimated by benchmarking comparable industrial plants, ensuring that capital estimates reflect current market standards and technological complexity.
- **Existing competitors:** the analysis maps direct and indirect competitors globally, prioritizing those with similar strategic positioning to sharpen the product's competitive and entry strategy. Prices are set through a top-down approach based on perceived market value minus distribution margins, resulting in a conservative and financially sound ex-factory price.
- **Expected volumes:** supply is based on current slaughterhouse outputs, while demand uses market data with conservative penetration. Estimates incorporate the firm's established distribution, logistics, and commercial assets.
- **Contribution margin analysis:** the section develops a realistic variable cost structure based on internal raw-material costs and estimated additional inputs.
- **Profitability analysis:** this part outlines the fixed cost structure to determine the annual EBIT attainable within the proposed configuration.

Given the innovative nature of the proposed product lines and the scarcity of specific literature regarding these niche business models, the financial projections rely on a series of rigorous assumptions. The entire research process has been underpinned by a comparative analysis of

analogous industrial processes and existing market benchmarks, supplemented by logical deduction to ensure the feasibility of each scenario.

The estimation of fixed and variable costs was derived through benchmarking against current slaughterhouse operations and similar industrial standards. To ensure consistency, the following parameters were established:

- Marketing: to support rapid market entry and accelerate break-even, a €200,000 marketing budget is allocated to each product line (except the collagen hub) to build a robust customer base during the critical early stages of operations.
- Human resources: each concept is assumed to run with a team of three operators, each costing €50,000 per year in line with Italian labor standards. Market development is handled by a dedicated commercial officer with an annual cost of €65,000.
- Administration and overheads: they are estimated at €30,000 per year, assuming full integration into existing corporate functions.
- Quality controls: ranging between €0.10 and €0.30 per unit, they benefit from the company's internal laboratory facilities, generating significant operational synergies.
- Utilities: energy and gas requirements were estimated by comparing the intensity of similar production processes with current facility data.
- Regulatory compliance and certifications: they are budgeted between €5,000 and €10,000, covering both initial certification and annual maintenance.
- Capital assets and depreciation: 10-year linear depreciation period was applied to reflect the long-term nature of the investment. CAPEX excludes building costs, as the Company already owns a suitable integrated facility.

It must be emphasized that while these assumptions regarding demand, costs, and pricing have been carefully modeled, they remain indicative and require further empirical validation for real-world application. Furthermore, this chapter identifies the Year-1 margin, which serves as a conservative baseline for all subsequent projections.

This analysis remains strictly economic and managerial, prioritizing profitability, scalability, and supply-chain integration over technical or chemical formulation aspects. Elements such as pet-food palatability or cosmetic efficacy fall under specialized scientific research and are intentionally excluded. Within this framework, the study identifies the strategic opportunity that best balances profitability and operational synergy.

3.1 Collagen

Before introducing the most promising products for each market identified in *Chapter 2*, it is essential to focus on collagen as a semi-finished stage within the production chain. Research conducted to identify innovative solutions for valorizing pork by-products, currently marketed with very low margins, has consistently highlighted collagen as a key element across multiple applications and market segments. This ingredient stands out for its recognized functional benefits, including joint support, skin health, and overall well-being. Its relevance spans several categories, from human functional foods and nutraceuticals to pet treats and cosmetic formulations, positioning collagen as a strategic resource for value creation.

Beyond its role in finished products, collagen offers a unique opportunity to act as an intermediate step within the supply chain. Implementing a dedicated extraction process would enable the production of a versatile semi-finished ingredient suitable for multiple downstream applications. This approach serves two complementary purposes: supplying internal product lines for human, pet, and cosmetic segments, and generating a B2B revenue stream by selling collagen as a raw material to third-party manufacturers.

This latter aspect deserves particular attention. Market analyses developed within this thesis, while comprehensive, do not originate from a specialized team and may therefore lack precision. Consequently, highly positive Net Present Value (NPV)[4] projections could be influenced by assumptions that underestimate market complexity. Entering B2C markets, especially in premium positioning, requires substantial investment in marketing and brand awareness, which demands time and significant resources. Developing a process that functions as a central node for multiple products and simultaneously provides an initial source of revenue through B2B collagen sales could act as a financial buffer during the early stages of brand development. This strategy would allow reinvestment into building a complete supply chain and a consumer-facing brand, ultimately maximizing profitability across all stages. Such a model would transform collagen from a low-value by-product into a high-value hub, enhancing flexibility and economic resilience.

From a regulatory and sanitary perspective, this concept is feasible under current EU frameworks, provided that strict compliance with hygiene standards is maintained (European Commission, 2004; European Commission, 2009). Collagen extraction can occur in a

[4] **Net Present Value (NPV)**: A measure of investment profitability, calculated as the present value of future cash inflows minus outflows, discounted over time. Positive NPV indicates value creation.

centralized facility authorized for human food production, operating under the most stringent requirements. Once extracted, the same food-grade collagen can be allocated to different markets without requiring separate extraction processes. For instance, part of the batch could be directed to facilities specialized in nutraceutical or food products, another portion to pet food plants and a further share to cosmetic manufacturers. The key requirement is that subsequent processing stages maintain regulatory compliance through physical or functional separation and distinct HACCP[5] plans where necessary.

In addition to its role as a versatile semi-finished ingredient, collagen extraction offers a unique opportunity to establish a technologically scalable and traceable platform within the supply chain. By centralizing the process in a facility equipped for food-grade operations, the company can implement modular production protocols that accommodate different input materials while maintaining consistent output quality. This modularity not only supports internal diversification across human, pet, and cosmetic applications, but also enhances traceability and certification, which are increasingly critical for accessing premium markets. Moreover, the adoption of flexible technologies, such as enzymatic hydrolysis and membrane filtration, enables the company to adjust production volumes and specifications based on market demand, without duplicating infrastructure. This approach transforms collagen from a static by-product into a dynamic asset, capable of supporting both vertical integration and horizontal expansion, while reinforcing the company's commitment to sustainability, quality, and innovation. Products intended for different markets, particularly those related to food, wellness, and cosmetics, must comply with stringent regulatory and quality standards, which can be challenging when raw materials originate from multiple suppliers. A certified and tightly controlled supply chain would therefore represent a significant competitive advantage, enabling access to diverse markets while meeting the highest quality requirements.

Finally, collagen is derived from the least valuable parts of the pig, often sold at negligible prices or even discarded at a cost. Leveraging these underutilized resources perfectly aligns with the thesis objective of creating new value from underestimated components, allowing the company to expand its business without disrupting its core operations, effectively acting as an extension of its original purpose.

[5] **HACCP (Hazard Analysis and Critical Control Points)** is a mandatory EU framework that ensures food safety by identifying and controlling potential hazards throughout the production process. It guarantees that all processing stages meet strict hygiene and safety standards.

Given the significant opportunities this product presents, it will now be examined as a stand-alone solution. The following sections will assess it across all previously defined criteria, treating it not merely as an ingredient but as a potential final product. This approach allows for a comprehensive evaluation of its technical and economic viability as an independent component within the broader supply chain.

- **Product description**

  The collagen analyzed in this study is derived from selected pork by-products, primarily skin, tendons, and cartilage, materials known for their high concentration of type I and III collagen.

  Type I collagen is the most abundant form in mammals and is primarily responsible for the structural integrity of skin, bones, and connective tissues, while type III collagen is commonly found alongside type I and plays a key role in tissue elasticity and repair. These raw materials, often undervalued in conventional markets, represent a valuable source for producing a functional ingredient with significant added value. Through enzymatic hydrolysis and advanced purification technologies, the process yields hydrolyzed collagen in a soluble form, characterized by high bioavailability and a complete amino acid profile, particularly rich in glycine, proline, and hydroxyproline. Nutritionally, the product offers documented benefits for joint health, skin integrity, and metabolic support, making it suitable for applications in pet nutrition, nutraceuticals, and cosmetics (Al Hajj, W., Salla, M., Krayem, M., Khaled, S., Hassan, H.F. and El Khatib, S., 2024). It is typically presented as a fine, odorless, and highly soluble powder, though it can also be formulated in liquid or gel formats depending on the target market. Its versatility, combined with its origin from underutilized resources, positions it as an ideal candidate for sustainable and cross-sectoral valorization strategies.

- **Production process analysis**

  The production system is designed to be modular and adaptable, enabling the generation of multiple collagen-based intermediates, including hydrolysed collagen, liquid concentrates, and bone broth, each tailored to specific end-use applications in the nutraceutical, cosmetic, food, and pet care sectors.

  The process begins with the collection of selected by-products immediately after slaughter and primary processing. These materials, sourced exclusively from certified pigs, are subjected to strict traceability and hygiene protocols in compliance with EU

regulations. Initial pre-treatment involves mechanical cleaning and size reduction to optimise surface area exposure, which is critical for efficient collagen release during extraction. Bones are crushed to 2–5 cm fragments, while skin and cartilage are coarsely minced.

The core extraction phase employs aqueous thermal treatment in stainless steel reactors, operating at 85–95°C for 8–12 hours. This step denatures the native collagen structure, converting it into gelatin and solubilising bioactive compounds. The resulting gelatin-rich broth is then filtered to remove solid residues, yielding a base extract with a complete amino acid profile.

At this stage, the process bifurcates depending on the desired final product. For applications such as bone broth, the clarified extract can be concentrated, optionally enriched with organ meats or natural flavourings, and pasteurised to ensure microbiological safety. This product retains the functional gelling properties of gelatin and offers a nutritionally dense, ready-to-use format. The concentration ratio typically ranges from 3:1 to 5:1, yielding a viscous liquid with collagen content of 25-40% by weight, ready for aseptic packaging.

For more advanced applications, particularly in the nutraceutical and cosmetic sectors, the gelatin extract undergoes enzymatic hydrolysis. This step breaks down the gelatin into low molecular weight peptides, enhancing bioavailability and functional properties such as solubility and absorption. The hydrolysate is then subjected to fine filtration, concentration, and drying, typically via spray-drying or freeze-drying, to produce a stable, powdered collagen peptide product. This format is highly versatile and can be incorporated into capsules, beverages, or functional foods. The resulting hydrolysed collagen powder exhibits protein content exceeding 90% on a dry matter basis.

- **Required investment**

The integration of a collagen extraction facility within the existing slaughtering supply chain entails a series of targeted investments in specialized equipment. Given the limited but industrial scope of the project, the plant should be designed for moderate throughput, ensuring flexibility to produce multiple collagen-based outputs, such as bone broth, liquid concentrates, and hydrolysed collagen powder, while maintaining compliance with food-grade and cosmetic standards. This modular approach requires machinery for raw material preparation, thermal extraction, enzymatic hydrolysis, and final drying and packaging. *Table 3.1* summarizes the main production steps, the corresponding

equipment, and indicative cost ranges based on benchmarks for small-to-medium-scale installations. These estimates exclude infrastructure and installation costs but provide a realistic overview of the capital expenditure required to operationalize the process.

Production step	Equipment	Indicative cost (€)
Raw material reception	Sorting table + Industrial washer	€90,000 – €130,000
Size reduction	Bone crusher + Cartilage mincer	€80,000 – €120,000
Thermal extraction	Stainless steel reactor	€200,000 – €300,000
Coarse filtration	Mesh filter + Transfer pump	€50,000 – €80,000
Liquid concentration	Vacuum evaporator	€150,000 – €200,000
Enzymatic hydrolysis	Reactor	€200,000 – €300,000
Fine filtration	Ultrafiltration system	€150,000 – €250,000
Drying	Compact spray dryer	€300,000 – €400,000
Packaging	Packaging line	€100,000 – €150,000
Total investment cost		**€1,320,000 – €1,930,000**

Table 3.1 - Indicative investment for collagen extraction facility

Although the estimated investment ranges from €1.32 to €1.93 million, a higher-than-average reference value of €1,800,000 is adopted to adequately reflect the plant's complexity. The modular structure allows for the management of different outputs (broth, liquid concentrate, hydrolysed collagen), increasing operational flexibility and reducing the risk of technological obsolescence. This approach also enables a phased implementation strategy, in which only the broth/concentrate line is installed initially, while hydrolysis and drying operations are postponed to a later stage. Such a configuration would lower the initial capital expenditure by approximately 40%. However, this option should be regarded merely as an alternative implementation scenario. For the purposes of the present analysis, the full investment required for the complete process has been considered.

- **Existing competitors**

  The hydrolyzed collagen market is experiencing substantial growth, driven by rising consumer awareness of its benefits, as highlighted in the following analysis:

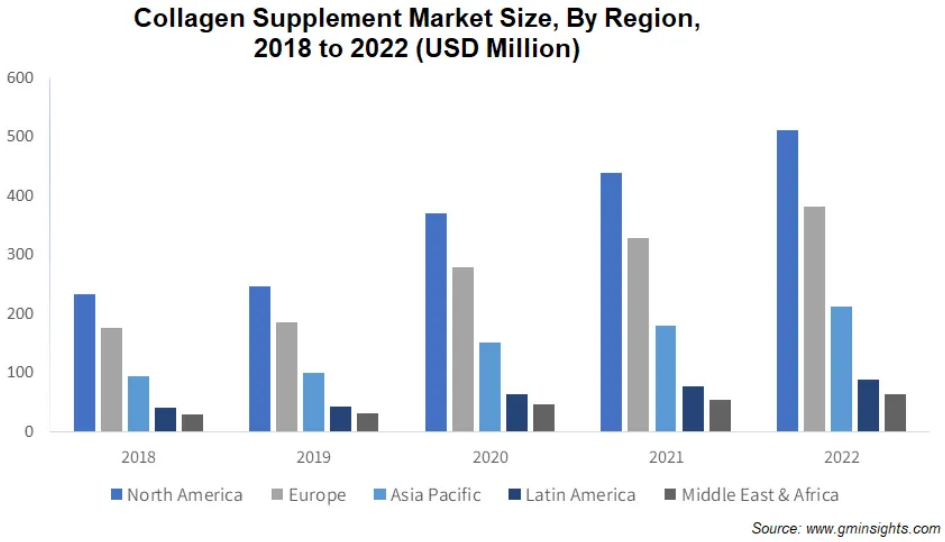

Figure 3.1 - Collagen supplement market size

This expansion has created a highly competitive environment, with both domestic manufacturers and international brands competing across nutraceutical, cosmetic, and functional food sectors. Notwithstanding the considerable market development observed in recent years, projections indicate sustained growth with the European collagen market expected to register an 8.11% CAGR during the 2025-2030 period, with Italy representing one of the principal markets fueling this expansion (Mordor Intelligence, 2025). Wholesale prices for hydrolyzed collagen typically range between €10 and €20 per kilogram, while retail prices average €20 to €30 per kilogram, reflecting the premium positioning of these products. Although this pricing underscores the perceived value of collagen supplements, it also represents a barrier for price-sensitive consumers. To differentiate, established players increasingly adopt strategies such as clean-label formulations, sustainability certifications, and claims of enhanced bioavailability. Consumer preferences are gradually shifting toward marine and bovine sources due to ethical and allergen concerns, despite the continued relevance of porcine collagen, indeed it represents around 25% of total produced collagen (Global Market Insights, 2022). Nevertheless, most producers aim to maximize market reach by offering multi-source blends. Even though the market already appeared to be crowded, a porcine collagen coming from a certified supply chain, produced as a niche in small quantity compared the huge availability, could still represent a smart source of margin, both from a wholesale and retail level, in multiple industries. The table below lists the main players in the Italian market:

Company	Products offered	Source	Market focus
Italgel	Gelatine, hydrolyzed collagen peptides	Bovine, porcine	B2B (Food, pharma, nutraceutical)
Lapi Gelatine	Gelatine, peptolap hydrolyzed collagen	Bovine, fish, porcine	B2B & B2C (food, cosmetics, pharma)
A. Costantino	Hydrolyzed collagen for nutraceutical & cosmetic	Fish, bovine, porcine	B2B
Colpropur Italia	Collagen supplements (powder, functional mixes)	Bovine, porcine	B2C (pharmacies, e-commerce)
Protein S.A.	Colnatur® hydrolyzed collagen supplements	Porcine, bovine	B2C & B2B

Table 3.2 - Key competitors in Italian collagen market

- **Expected volume**

  Looking at the supply point of view, a live swine weighing approximately 175 kg yields around 140 kg of carcass weight, based on an 80% dressing percentage. However, not all collagen-containing materials are available for extraction, as a significant portion is sold with primary meat cuts or diverted to other value chains. A realistic breakdown of usable by-products per animal includes:

  - Bones (trimmings, sternum, smaller skeletal elements): 6-8 kg per animal
  - Skin (trimmings, processing waste): 4-6 kg per animal
  - Cartilage/connective tissue: 2.8-3.9 kg per animal

  For practical purposes, a conservative mid-range estimate of 15 kg per animal represents a realistic baseline for production planning.

  The conversion of raw collagen-containing materials into hydrolysed collagen powder involves multiple stages, each with inherent efficiency losses. Based on established industrial parameters and the literature reviewed (Borges *et al.*, 2022), the following conversion ratios apply:

  - Stage 1: aqueous extraction (85-95°C, 8-12 hours) → 15-18% of input material in form of extracted gelatin solution
  - Stage 2: enzymatic hydrolysis and purification → net retention after purification: 88-92%
  - Stage 3: spray drying → to obtain the final powder

This yields about 1.5 kg of hydrolyzed collagen powder per animal. With a weekly capacity of 5,000 swine over 50 weeks, the facility processes 250,000 animals annually. At this rate, theoretical output is 375,000 kg, but after accounting for seasonal variations, downtime, and quality rejections, realistic annual production is about 300,000 kg.

Although raw material availability is high, reaching full production capacity in the early years will be difficult due to demand constraints. The Italian collagen market is expected to reach €250 million by 2026 (Hannah Blake, 2025). With a 1% penetration target, this would translate into roughly €2.5 million in revenue. At a retail price of €25/kg, the corresponding annual demand would be approximately 100,000 kg.

- **Contribution margin analysis**

Contribution margin analysis for hydrolyzed collagen from porcine by-products requires evaluating variable production costs and setting realistic B2B prices across sectors. These costs include raw materials, enzymatic hydrolysis, processing, bulk packaging, and quality assurance:

Cost component	Unit cost (€/kg)
Porcine by-products (tendons, skin, bones)	€3.00
Chemical additives and enzymes	€1.50 – €2.50
Energy & gas	€2.50 – €3.00
Consumables for filtration and purification	€0.40 – €0.60
Bulk packaging (B2B format)	€0.20 – €0.30
Analytical testing and documentation	€0.20 – €0.30
Total variable costs	**€7.80 – €9.70**

Table 3.3 – Collagen variable costs breakdown

Price determination in the B2B channel reflects significant variation across target industrial sectors based on purity requirements, molecular weight specifications, regulatory compliance standards, and application-specific functionality. The nutraceutical sector, requiring high-purity peptides (>90%) and low molecular weights (2–5 kDa), averages €15/kg. Cosmetics, driven by defined peptide profiles, strict legislation compliance, and dermatological testing, reach about €18/kg. Food and

beverage applications, prioritizing neutral taste, thermal stability, and cost efficiency, remain lower at €12/kg. Pharmaceutical and medical device uses command the highest value at €23/kg due to strict GMP (Good Manufacturing Practices) standards and full traceability. Premium pet food follows at roughly €10/kg. Finally, the premium pet food sector offers lower pricing at approximately €10/kg. A realistic market penetration strategy allocates production across sectors considering an average selling price of €15.00/kg.

Based on the average price, annual demand can be estimated. Conservative projections suggest approximately 100,000 kg. Assuming an average COGS (Cost of Goods Sold) of €8.75, the contribution margin per kilogram is €6.25 (€15.00 – €8.75), resulting in a margin ratio of 42%. This translates into a total annual contribution margin of €625,000 (100,000 kg × €6.25/kg), which represents the financial pool available to cover fixed costs and generate profit, forming the basis for subsequent profitability analysis.

- **Profitability analysis**

Fixed costs in the B2B model encompass the following elements:

Cost category	Annual cost (€)
Depreciation (over 10 years)	€180,000
Production personnel	€150,000
Commercial personnel	€65,000
Maintenance	€30,000
Marketing expenses	€50,000
Certifications and compliance	€10,000
Administration and overheads	€30,000
Total fixed costs	**€520,000**

Table 3.4 – Collagen fixed costs breakdown

The operational workforce required to support an annual production of 100,000 kg of hydrolysed collagen includes a production manager responsible for process optimization and regulatory compliance, overseeing hydrolysis parameters and equipment operation. Two line operators manage material handling, packaging, and ensure batch consistency and documentation. On the commercial side, the B2B model

requires a dedicated account manager for customer relationships, technical sales support, and participation in industry-specific trade events. Administrative tasks such as order management, contract administration, logistics coordination, and warehousing can be handled by a single staff member.

A key challenge in the B2B model is the certification and compliance burden associated with serving multiple industrial sectors. Maintaining concurrent certifications for food safety, cosmetics and potentially pharmaceuticals entail recurring investments in audits, surveillance assessments, and system maintenance.

Given the process complexity, fixed costs are conservatively estimated at €550,000 to simplify financial modelling and consider possible unexpected expenses.

Under standard conditions, annual EBIT is projected at €75,000 on revenues of €1,500,000. Break-even analysis shows that covering these costs requires annual sales of almost 88,000 kg, equivalent to €1,320,000 in revenue.

These numbers show the uncertainty related to this model, which heavily relies on volume and costs. A solid strategy should be evaluated before making the investment, in order to try to catch as much volume as possible since the beginning.

Sensitivity analysis highlights the risk profile of the B2B model:

- In a pessimistic scenario, a 20% drop in demand (to 80,000 kg annually) reduce EBIT to €-50,000.
- Conversely, an optimistic scenario with a 20% demand increase (to 120,000 kg annually), raise EBIT to €200,000.

This analysis highlights the model's inherent limitations, as it performs reliably only when driven by demand and pricing assumptions. In a B2B context, securing long-term fixed-price contracts is key to surpassing the break-even point and ensuring profitability, though this remains possible only under well-assessed market conditions.

3.2 Fitness enthusiasts

The growing relevance of fitness and wellness has also reshaped consumer expectations in the field of nutrition. Regular practitioners, in particular, tend to follow dietary patterns designed to support performance and recovery, often guided by expert advice. Within this context, protein-rich products have gained a central role, with the market already offering a wide range of high-protein solutions, most of which rely on plant-based additives. Pork, however, represents a naturally rich source of high-quality protein that is widely recognized by consumers. Building on this premise, the following section explores a set of innovative product concepts targeted at fitness enthusiasts, each assessed from different strategic and operational perspectives.

3.2.1 Bone broth

Among the potential innovative products for the fitness and wellness segment, bone broth emerges as a particularly promising option. In international markets, especially in the United States and Northern Europe, it already enjoys strong recognition as a functional product rich in protein and collagen, valued for benefits linked to recovery, joint health, and overall well-being. In Italy, by contrast, its presence is still limited, leaving an attractive gap for new entrants.

From a business perspective, bone broth is characterised by relatively high margins, as it transforms low-value by-products such as bones and connective tissues into a premium product that consumers are willing to pay a substantial price for. These conditions make bone broth not only a way to valorize underutilised resources, but also a concrete opportunity for profitable innovation within the Italian pork industry.

To gain a broader understanding of this product, it will be examined from several perspectives:

- **Product description**

  Bone broth is a clear-to-amber, lightly viscous beverage obtained through the slow extraction of bones and connective tissues in water. The result is a protein-rich matrix containing collagen, gelatin, and free amino acids such as glycine, proline, and hydroxyproline, with naturally low-fat levels and negligible carbohydrate content. Depending on the recipe, it also provides minerals, primarily sodium and potassium, with variable traces of calcium and phosphorus, and it can be formulated in low-sodium versions for everyday consumption. Typically, it is marketed in 250–500 ml glass bottles

or Tetra Pak cartons, either as single or double portions. Ambient-stable variants, processed with autoclave or UHT treatments, guarantee a long shelf life without refrigeration. In terms of use, bone broth is designed to be consumed warm as a functional beverage or employed as a culinary base for soups, risottos, or sauces, without overpowering the traditional flavors of Italian cuisine. Fitness-oriented versions may emphasize the declared protein content per serving, absence of added fats, low sodium levels, gluten-free and allergen-free claims (with the exception of specific herbs or flavorings), combined with transparency on raw material origin and full supply chain traceability. Furthermore, it lends itself to differentiated product lines, as it can be made both from fresh meat bones, from specific parts such as ribs or from DOP-cured ham bones, the latter providing a more distinctive and refined flavor profile.

- **Production process analysis**

  The production process begins with the collection of selected bones. Once collected, the bones are carefully cleaned and prepared, ensuring both food safety and product consistency. The cleaned bones are then subjected to slow extraction in water, typically over several hours. Depending on the intended formulation, vegetables, herbs, or spices may be added to enrich the flavor profile. After extraction, the broth undergoes a clarification and filtration phase to obtain a clear product, followed by packaging in glass bottles or Tetra Pak cartons. To guarantee stability and food safety, the packaged broth is subjected to thermal treatments such as autoclave sterilization or UHT processing, which allow the product to achieve an extended shelf life while preserving its functional and sensory characteristics.

- **Required investment**

  The production of bone broth requires the implementation of an internal production process, structured as follows:

Production stage	Main equipment	Indicative investment (€)
Pre-cleaning of bones	Industrial bone washers	€15,000 – €20,000
Size reduction	Bone crusher	€50,000 - €100,000
Extraction	Stainless steel industrial boilers	€200,000 – €400,000
Filtration and clarification	Membrane filters, centrifuges	€80,000 – €150,000
Packaging (glass bottles)	Automated filling and sealing line	€150,000 – €300,000
Sterilisation (autoclave)	Autoclave for sterilisation	€200,000 – €300,000
Quality control laboratory	Basic microbiological and chemical lab equipment	€30,000 – €50,000
Total investment cost		**€725,000 – €1,320,000**

Table 3.5 - Production stages with main equipment and indicative investment costs

As indicated in *Table 3.5*, establishing a dedicated production line for bottled liquid bone broth requires a substantial capital investment, ranging from approximately €700,000 to over €1,300,000 depending on the intended production scale and degree of professionalisation. For the purposes of this analysis, an average investment of €1,000,000 is considered. Although significant, such an investment would enable the company to retain the full added value generated by the activity, particularly relevant given that the process relies on a low-cost raw material, normally treated as waste.

- **Existing competitors**

As noted, this market is still emerging in Italy, while well established in regions like the United States and Northern Europe. Online researches shows few active Italian producers. Key findings are outlined below:

Producer	Origin	Broth type
Brodos family	Italy	Grass-fed cattle
Pascol	Italy	Adult cattle from pasture farms
Jarmino	Czech Republic	Beef and veal
Wishbone	Greece	Beef, chicken, vegetarian
Freja Food	Great Britain	Beef, chicken, fish
Kettle & Fire	USA	Beef and chicken

Table 3.6 - Bone broth producers currently active in the Italian market

The producers mentioned above represent the main competitors in the premium bone broth segment, often differentiating themselves through strong narratives around animal welfare and feeding practices. However, based on available online information, there appear to be no swine-based bone broths on the market, particularly none originating from Italy, from a certified supply chain, or derived from DOP prosciutto bones. This gap is notable, given the category's strong growth abroad and its limited coverage by only a few domestic players with different positioning. Given that competitors retail at €15–20, an ex-factory price of around €10 appears realistic for the intended product positioning.

- **Expected volumes**

  Estimating the potential volume of bone broth requires first determining the raw material needed per liter. Cartilage-rich bones (feet, shanks) require 0.6–0.8 kg per liter of concentrated broth, while drier bones need up to 1 kg. Available raw material from slaughtering is limited because most cuts are sold bone-in. Usable bones represent about 3.6% of live weight. For DOP pigs of 175 kg, this equals roughly 6.3 kg per animal, yielding around 31,500 kg per week at a throughput of 5,000 pigs. Assuming 1 kg of bones per liter, this corresponds to approximately 31,500 liters of broth per week, a substantial capacity for a niche product.

  Regarding demand, the Italian bone broth market is valued at around €200 million (Axixd Holdings, 2025), spanning functional and nutraceutical products, cosmetics, food & beverage, and sports nutrition, and drawing on various raw materials, among which pork is still minimally used. Given this context and the intended product positioning, a conservative 0.5% initial penetration appears realistic. Applied to the current market size and assuming a €17.5/kg retail price, this would yield roughly €1,000,000 in market value, equivalent to about 60,000 litres per year.

- **Contribution margin analysis**

  The high-yield potential of bone broth hinges upon the efficient conversion of low-cost animal by-products into a premium functional food. The revised cost structure reflects a more scalable industrial approach:

Cost component	Cost per liter (€)
Bones	€0.60
Packaging (premium glass/sustainable pouches)	€0.80 – €1.00
Energy & gas	€1.00 – €2.00
Ancillary inputs (organic vegetables & spices)	€0.30 – €0.50
Quality control	€0.10 – €0.20
Total variable cost	**€2.80 – €4.30**

Table 3.7 – Bone broth variable costs breakdown

The total variable cost is estimated between €2.80 and €4.30, on average €3.50 per liter. The achievable Ex-Factory revenue is set at a conservative €10.00 per liter. This results in a unit contribution margin of €6.50 per liter, with a contribution margin ratio of 65%. This figure is exceptionally high for the food industry, confirming the strategic value of "upcycling" raw materials into high-added-value nutraceuticals.

- **Profitability analysis**

  The enterprise-level profitability is determined by the ability of the gross margin to cover the fixed operational base required for market positioning and food safety compliance. For a target production of 60,000 liters, the fixed cost structure is detailed below:

Cost component	Annual estimate (€)
Asset depreciation (CAPEX)	€100,000
Marketing	€200,000
Production personnel	€150,000
Commercial personnel	€65,000
Maintenance	€10,000
Quality compliance	€5,000
Administration and overheads	€30,000
Total annual fixed costs	**€560,000**

Table 3.8 – Bone broth fixed costs breakdown

With annual revenues of €600,000 and variable costs totalling €210,000, the gross contribution margin amounts to €390,000. After subtracting fixed costs of €560,000, annual EBIT stands at –€170,000. Under this cost structure, the break-even point is reached at more than 86,000 kg.

This estimation, though conservative, highlights both the potential and the risks associated with the product. Despite offering an exceptional contribution margin, it is also characterised by substantial fixed costs.

The robustness of the business model has been tested against market volatility:

- A 20% drop in demand (to 48,000 L) results in an EBIT of –€248,000.
- Conversely, a 10% increase in the ex-factory price (to €11), combined with a 20% increase in demand (72,000 L), generates an EBIT of €-20,000

The analysis clearly shows that this product is not sustainable as a stand-alone solution, given its modest performance and the significant fixed costs associated with its narrow market niche.

3.2.2 Meat chips

A further promising direction in the development of innovative products for the fitness and wellness segment is represented by meat chips. Obtained by dehydrating or baking thin slices of meat until crisp, they result in a light, protein-rich snack with a reduced fat content. It is possible to develop a range of products with different versions and flavors, thereby meeting diverse consumer preferences while maintaining the same nutritional purpose. Their high protein density, low carbohydrate profile, and natural composition make them particularly attractive to fitness enthusiasts, who are increasingly looking for convenient and tasty solutions that meet their nutritional goals. Still relatively new in the market landscape, meat chips have already shown encouraging results abroad, suggesting significant potential for their development and adoption also in the Italian context.

In order to fully assess the potential of meat chips within the fitness market, the following analysis will examine the product across several key dimensions:

- **Product description**

  Meat chips represent a novel category of functional snacks that stand out for their simplicity and nutritional profile. Produced from thin slices of pork that are dehydrated or baked, they retain a concentrated content of high-quality proteins, often exceeding 45–50 grams per 100 grams of product, while providing very low levels of carbohydrates and sugars. In addition, they naturally supply essential micronutrients such as iron, zinc, and B-group vitamins, which are crucial for energy metabolism and muscle function, making them particularly suitable for athletes and individuals attentive to performance.

  Unlike many conventional snacks enriched with additives or protein isolates, meat chips can be produced using almost exclusively the raw material itself, with minimal seasoning, thus ensuring a clean-label product. This characteristic becomes even more distinctive when the starting point is certified pork from controlled Italian supply chains, where traceability and quality are guaranteed. Such an approach not only enhances consumer trust but also creates a unique competitive advantage, as the product combines high nutritional value with authenticity and transparency.

  From a business perspective, fresh meat also allows for higher margins, since less valuable cuts can be turned into premium snacks, while still ensuring excellent quality when using noble cuts such as loin and tenderloin. In addition, fresh meat lends itself to

a high degree of product differentiation, as it can be marinated in numerous ways before cooking or dehydration, allowing for a wide variety of flavors while preserving nutritional integrity.

- **Production process analysis**

  The production process that best balances nutrition, health, and taste for meat chips uses controlled hot-air dehydration or low-temperature baking. Fresh, lean pork cuts, ideally loin or tenderloin, are trimmed and thinly sliced to ensure uniform drying and a consistent final texture. At this stage, the meat can be seasoned or lightly marinated with natural herbs and spices to offer flavour variations while maintaining a clean-label profile.

  The slices are then arranged on racks and dehydrated or baked below 100 °C. This gentle treatment ensures microbial safety while preserving proteins, micronutrients, and the inherent nutritional quality of the meat. It also enables mild Maillard reactions[6], which enhance flavour without requiring added fat, salt, or sugar.

  Once the target crispness and moisture level are reached, the chips are cooled to avoid condensation and loss of crunch, then packaged under a protective atmosphere to maintain structure, prevent oxidation, and preserve sensory quality over time.

- **Required investment**

  The process can be divided into several essential stages, each requiring dedicated equipment and incurring specific costs, as detailed in *Table 3.9*. Overall investment for such a production line is estimated between €255,000 and €490,000, depending on scale, automation level, and packaging format (for a medium-scale system, a total investment of approximately €370,000 is assumed). Implementing in-house production would enable full valorization of certified pork cuts, ensure strict quality standards, and allow the company to capture the entire added value generated by this innovative product. Additional efficiencies can be achieved thanks to the immediate availability of raw materials directly at the slaughterhouse, reducing logistics and handling costs.

[6] **Maillard reactions** refer to a set of non-enzymatic browning reactions that occur when amino acids and reducing sugars interact under heat. They are responsible for the development of complex flavors, aromas, and brown coloration in cooked foods such as roasted meat, baked bread, and toasted nuts.

Production stage	Main equipment	Indicative investment (€)
Slicing and trimming	Industrial meat slicer	€10,000 – €20,000
Seasoning	Spray seasoning system	€15,000 – €30,000
Dehydration/baking	Hot-air dehydrator	€80,000 – €200,000
Cooling	Cooling conveyor	€20,000 – €40,000
Packaging	Automatic packaging line	€100,000 – €150,000
Quality control	Basic lab equipment	€30,000 – €50,000
Total investment cost		**€255,000 – €490,000**

Table 3.9 - Production stages with main equipment and indicative investment costs

- **Existing competitors**

  This product can be associated with the jerky meat category, which, although different in purpose, communication, and final characteristics, offers valuable insights into market potential. In the United States, jerky is a well-established and widely consumed product, whereas in Italy the segment remains in its early stages, with only a handful of producers primarily operating online. These competitors, identified through market research, are presented in *Table 3.10*:

Producer	Origin	Product type
Carne Secca Italia	Italy	Meat chips and jerky from different animal sources, with a dedicated fitness line
Tsunami Nutrition	Italy	Beef jerky positioned for the fitness market
Vulcano	Austria	Pork chips and prosciutto-based snacks
Handl Tyrol	Austria	Speck and beef chips
Jack Link's	USA	Meat jerky (beef and other varieties), widely distributed globally

Table 3.10 - Overview of main competitors offering meat chips or similar products in the Italian market

Carne Secca Italia is the closest competitor in terms of positioning, thanks to its fitness-oriented product line. However, no current players use certified Italian raw materials, creating a strong opportunity for differentiation. With clear communication,

being the only producer of certified pork-based chips could offer a meaningful first-mover advantage. Competitor retail prices range from €70 to €90/kg, so an ex-factory price of about €55/kg is reasonable.

- **Expected volume**

  Estimating production volumes requires defining the fresh-to-finished conversion ratio. Dehydration reduces weight by about 4:1 to 5:1, meaning 400–500 g of fresh pork yield 100 g of chips. Loin and tenderloin provide roughly 40,000 kg of usable meat per week from 5,000 pigs, equivalent to 8,000–10,000 kg of chips. At launch, only 10% of these cuts would be allocated to the product, resulting in around 1,000 kg of chips per week. With a 50 g pack size, common in the market, this corresponds to roughly 20,000 units weekly. Such output is sufficient for market testing, controlled scaling, and gradual distribution expansion, supported by the product's long shelf life.

  From a demand perspective, the Italian protein snack market is valued at roughly €4 billion and is expanding at a solid 7.5% CAGR (Nexerv Labs, 2025). Within this category, the meat-snack segment represents about €100 million and is growing steadily at a 5.85% CAGR.

  In this context, even achieving a modest 1.5% penetration would generate around €1.5 million in annual revenues, equivalent to 18,750 kg at an average retail price of €80/kg. This target appears realistic, given the segment's rapid evolution and its relatively limited development. With strong marketing focused on differentiation, consumer education, and brand visibility, the product could scale quickly. Entering the market as the only producer in its specific niche further strengthens this potential, allowing early positioning, stronger brand recognition, and the ability to set the competitive benchmark before new players arrive.

- **Contribution margin analysis**

  The financial viability of meat chips is characterized by high variable costs, primarily driven by the dehydration process and the concentration of raw protein. To maintain a "clean label" fitness profile, the cost structure must account for high-quality lean cuts and specialized processing.

Cost component	Cost per kilogram (€)
Raw material (lean pork)	€20.00 – €25.00
Processing consumable	€1.00 – €1.50
Packaging & labelling	€
Energy & gas	€2.00 – €2.50
Quality controls	€0.20 – €0.30
Total variable cost	**€24.80 – €31.70**

Table 3.11 – Meat chips variable costs breakdown

As shown in the table, COGS are estimated to fall between €24.80 and €31.70 per kilogram, leading to average variable costs of approximately €28.00/kg. With an ex-factory price set at €55.00/kg, this translates into a unit price of €2.75 for a 50g pack, which remains competitive within the functional snack category. At these levels, the product generates a contribution margin of €27.00/kg, corresponding to a contribution margin ratio of 49%.

- **Profitability analysis**

  As previously outlined, the analysis assumes a market opportunity of €1,500,000, an ex-factory price of €55/kg, and an initial annual volume of approximately 18,750 kg. The corresponding fixed cost structure for this output level is detailed below:

Cost component	Annual estimate (€)
Equipment depreciation	€37,000
Marketing	€200,000
Production personnel	€150,000
Commercial personnel	€65,000
Maintenance	€10,000
Certifications	€5,000
Overheads and administration	€30,000
Total Annual Fixed Costs	**€497,000**

Table 3.12 – Meat chips fixed costs breakdown

With a total gross contribution margin of €506,250 (18,750 kg × €27.00/kg) and fixed costs amounting to almost €500,000, the resulting annual EBIT reaches €6,250, while the Break-even Point (BEP) for this product line is estimated at approximately 18,500 kg per year.

A sensitivity analysis provides further insight into the robustness and weaknesses of the business model:

- With a 10% increase in the ex-factory price (to €60.50/kg) and a 10% reduction in variable costs (to €25.20/kg), the contribution margin rises to €35.30/kg. Under these conditions, the projected EBIT reaches €161,875.
- Conversely, a 10% decrease in the price (to €49.50/kg) combined with a 10% increase in variable costs (to €30.80/kg) results in an EBIT of –€149,375.

These findings underline the critical importance of strategic market positioning and effective cost management, as profitability is highly sensitive to both pricing and cost fluctuations. Nevertheless, pork meat remains the primary cost driver, and its steady availability allows for effective cost control and a gradual reduction of its impact over time.

3.2.3 Collagen protein boost

The third product examined within this valorisation framework is collagen protein boost, an ultra-refined hydrolysed collagen powder designed to be incorporated invisibly into any food or beverage without modifying organoleptic properties, thereby enabling dietary supplementation without behavioural change.

While analogous products have achieved commercial maturity in Asian markets, particularly Japan, the old continent landscape presents a less saturated opportunity: the European collagen peptide market is projected to expand at a CAGR exceeding 5.1% from 2025 to 2035 (Future Market Insights Inc., 2025).

In contrast to the preceding products, which are specifically positioned within the fitness segment, this offering occupies a multi-functional nutrition category situated between wellness and sports nutrition, where truly neutral, versatile collagen formats remain scarce. Given that the foundational collagen extraction methodology has been established in previous analysis, the incremental capital requirements to operationalise this product are limited to process enhancements, namely prolonged enzymatic hydrolysis, multi-stage deodorisation, and single-dose stick packaging, while maintaining utilisation of the existing porcine by-product supply chain.

This configuration enables premium pricing strategies and elevated contribution margins, thereby maximising value extraction from the integrated production ecosystem.

- **Product description**

  The proposed product is a high-purity porcine collagen hydrolysate engineered for maximum bioavailability and complete sensory neutrality, odorless and tasteless. Advanced processing ensures seamless integration into daily routines: it dissolves in water, smoothies, coffee, or recipes without altering flavor or texture, unlike conventional collagen powders. Its stick-pack format offers precise dosing and portability for on-the-go use. Technically, it delivers an optimized amino acid profile for type I and III collagen synthesis, supporting muscle recovery, joint health, and skin elasticity, positioning it beyond beauty-focused supplements. Unlike standard bovine or marine collagen, this formulation combines fitness-oriented functionality with a heritage-driven value proposition, leveraging Italian DOP-certified supply chains to meet growing demand for authentic, sustainable, performance-driven wellness solutions.

- **Production process analysis**

  The production of this advanced product requires four key improvements beyond the standard hydrolyzed collagen process described in *Section 3.1*. These modifications ensure complete flavor neutrality, odor removal, and instant solubility in cold water. While the initial processing stages remain unchanged, targeted adjustments transform conventional collagen into a premium, “invisible” protein booster suitable for any food or beverage application.

  The first improvement is extended enzymatic hydrolysis, increasing reaction time from 8–12 hours to 16–24 hours and doubling enzyme concentration from 0.5–1.0% to 1.0–2.0%. This produces ultra-short peptide chains (2,000–3,000 Daltons versus the standard 5,000), significantly reducing taste and aroma while enhancing solubility.

  The second step adds dual-stage ultrafiltration, introducing a finer 5,000 Dalton membrane after the usual 10,000–30,000 Dalton stage, eliminating intermediate peptides and doubling filtration time to 6–8 hours.

  The third and most critical enhancement is multi-stage deodorization, using two to three activated carbon treatments at 60–70°C with intermediate microfiltration, lasting 6–8 hours.

  Finally, post-drying agglomeration rehydrates spray-dried powder and applies secondary fluid bed drying, creating porous clusters that dissolve instantly in cold water, adding 2–3 hours to processing.

  Overall, these changes extend total production time from 31–46 hours to 52–73 hours, reducing capacity by about 40% with the same equipment. However, they deliver a product with superior sensory neutrality and functional versatility, supporting its premium direct-to-consumer positioning.

- **Required investment**

  This process requires an additional capital investment of approximately €220,000 beyond the baseline cost of a standard collagen production line, representing about a 12% increase in total equipment expenditure. This incremental investment covers the four enhanced processing steps outlined earlier. Despite the relatively modest increase, these upgrades enable a strategic shift from a B2B commodity model to a premium direct-to-consumer offering, significantly improving contribution margins and fully justifying the investment through superior product economics and market positioning.

Additional stages	Equipment	Indicative cost (€)
Dual-stage ultrafiltration	Secondary membrane stage	€20,000 – €30,000
Deodorization	Carbon and filtration system	€70,000 – €90,000
Post-drying agglomeration	Fluid bed agglomeration system	€30,000 – €40,000
Consumer packaging	Automatic stick-forming machine	€60,000 – €70,000
Quality control	Spectrophotometric analysis equipment	€10,000 – €20,000
Total investment cost		**€190,000 – €250,000**

Table 3.13 - Additional stages and their relative cost

- **Existing competitors**

  The European collagen supplement market offers strong growth and is highly fragmented, with limited direct competition in the multi-purpose, fitness-focused segment. Current offerings fall into three groups:

  - Italian B2B producers supplying hydrolyzed collagen exclusively through industrial channels;
  - European consumer brands targeting beauty or joint health through formulations that limit culinary versatility;
  - U.S. imports focused on wellness and beauty rather than fitness.

  Porcine collagen remains largely underexploited. Existing products are restricted to niche powders from brands such as BulkSupplements and GAL, often criticized for residual taste and odor due to the absence of ultra-neutral processing. No competitor currently combines porcine sourcing with stick-pack convenience, a fitness-oriented positioning, an ultra-neutral formulation, and the credibility of a premium Italian DOP-certified supply chain.

  Based on a comparison of retail prices among direct competitors, a hypothetical ex-factory price can be estimated. Retail prices typically range between €80 and €110 per kg, depending on product quality, intended use, and market positioning. Given the premium nature of the product, supported by a certified supply chain, superior quality objectives, and favorable market dynamics, a realistic ex-factory price of €70 per kg can be assumed. This estimate is derived from benchmarking the following potential competitors:

Brand	Country	Positioning	Differences
DuLac Farmaceutici	Italy	Beauty	Italian but bovine; additives limit versatility
Naturecan	UK	Sports recovery	Sports angle but bovine; no heritage story
Great Lakes Wellness	USA	Wellness	Format match but bovine; wellness vs. fitness
Ancient Nutrition	USA	Beauty/gut	Convenient but beauty focus; not porcine
GAL	Hungary	Joint/skin	Porcine but lacks ultra-neutral processing
BulkSupplements	USA	General	Same source but poor processing; taste/odor issues

Table 3.14 - Main competitors offering similar products

- **Expected volume**

  Although the core extraction process remains unchanged, producing collagen protein boost requires modifications that affect both cycle time and yield.

  Extended enzymatic hydrolysis and multi-stage deodorization increase the batch cycle from 46 to 72 hours, reducing batch frequency by about 36%. Combined with material losses during deodorization and ultrafiltration, yield per animal drops from 1.5 kg to roughly 1.15–1.20 kg (a 20–23% reduction), resulting in an annual output of approximately 230,000–240,000 kg versus 300,000 kg for standard collagen.

  As outlined in *Section 3.1*, the Italian collagen market is estimated at €250 million. Given the product's niche positioning versus conventional collagen supplements, a conservative 0.3% market penetration can be assumed, corresponding to €750,000 in market share, or approximately 7,500 kg, based on retail price of €100 per kg, a figure that would enable future scalability thanks to substantial availability.

- **Contribution margin analysis**

  The incremental variable costs for the multi-purpose collagen powder derive from advanced processing steps required to achieve its ultra-neutral sensory profile and consumer-ready format. Compared to standard hydrolyzed collagen, the premium variant requires intensified enzymatic hydrolysis to produce low-molecular-weight peptides, increasing enzyme and energy consumption. A secondary ultrafiltration stage with finer membranes adds further filtration costs, while a multi-stage deodorization system, including activated carbon treatment and thermal regeneration, represents the

most significant additional expense to eliminate residual odors. The shift from bulk packaging to single-serve stick packs substantially raises packaging costs. These steps collectively elevate variable costs by more than €5/kg compared to conventional collagen production.

Cost component	Cost (€ per kg)
Base collagen process	€9.75
Intensified hydrolysis (extra enzymes)	€0.50 – €1.00
Additional energy & gas	€0.50 – €1.00
Additional consumables	€1.00 – €2.00
Stick-pack packaging upgrade	€0.10 – €0.20
Total variable cost	**€11.85 – €13.95**

Table 3.15 – Collagen protein boost variable costs breakdown

Taking all production stages into account, average variable costs are estimated at €13 per kg. Based on the assumed ex-factory price of €70 per kg, this results in a contribution margin of €57 per kg, corresponding to 81%. While this figure is highly attractive and highlights the significant potential of this product, achieving profitability will depend on reaching a sufficient demand level, as further discussed in the following paragraph.

- **Profitability analysis**

  The economic analysis of collagen protein boost highlights a cost and revenue structure that is significantly different from traditional hydrolyzed collagen, due both to incremental process costs and to the premium pricing strategy enabled by the direct-to-consumer channel. The transition to an ultra-neutral collagen requires additional investments in equipment and resources, as shown in *Table 3.16*. As the premium product represents 7,500 kg per year on top of a total collagen production capacity of 150,000 kg, it absorbs a proportional share of base collagen fixed costs, amounting to €26,000 [(7,500 kg / 157,500 kg) × €550,000]. For the planned volume, total variable costs reach €100,000, while total fixed costs can be estimated at €430,000.

Fixed cost category	Incremental cost (€)
Plant depreciation	€22,000
Production staff	€50,000
Sales staff	€65,000
Maintenance	€5,000
Marketing expenses	€200,000
Administration and overheads	€30,000
Certifications and compliance	€30,000
Hydrolised collagen fixed costs portion	€26,000
Total additional fixed costs	**€428,000**

Table 3.16 – Collagen protein boost additional fixed costs breakdown

With an ex-factory price of €70 per kg, annual revenues amount to €525,000. After deducting both variable and fixed costs, the resulting operating margin is €-5,000, close to the BEP identified at 7,543 kg of annual production.

The sensitivity analysis highlights promising economic potential but confirms that volume is the primary profitability driver, as scaling is essential to absorb the significant fixed-cost base.

- At –25% volume (5,625 kg), EBIT would decrease to –€109,375
- Conversely, at +25% volume (9,000 kg), EBIT would increase to €83,000, clearly demonstrating the scalability of the concept.

Overall, these results support the economic resilience of the model, which relies on aggressive volume scaling, disciplined cost management, and the strategic valorisation of high-margin niche products.

3.3 Pet food

As already discussed in *Chapter 2.2*, the pet food market in this analysis refers specifically to products intended for dogs and cats. This focus is justified by two main reasons. From a commercial perspective, these two species represent by far the largest share of the pet population, making it easier to achieve scale and reach a broad customer base. From a nutritional standpoint, pork is particularly well suited to the dietary needs of both dogs and cats, providing a valuable source of high-quality protein and essential nutrients.

Meat plays an essential and irreplaceable role in the nutrition of both dogs and cats, whose biological needs reflect their evolutionary adaptation as carnivores. Cats, as obligate carnivores, rely entirely on nutrients found in animal tissues, such as taurine and arginine, which they cannot synthesize in sufficient quantities. Taurine supports cardiac, ocular, and reproductive functions, while arginine is essential for ammonia detoxification. Their metabolism depends primarily on proteins as an energy source, and they require additional animal-derived nutrients such as preformed vitamin A and arachidonic acid, both absent from plants.

Dogs, though more adaptable and classified as facultative carnivores, still depend heavily on animal proteins to meet essential amino acid needs. They share a limited capacity to synthesize arginine and, in some breeds, taurine, deficiencies of which may lead to cardiovascular issues. Adequate intake of high-quality protein is also crucial for maintaining muscle mass, particularly in aging dogs (FEDIAF, 2025).

Plant-based proteins cannot replace animal sources, as they lack taurine, creatine, and structural amino acids such as glycine, proline, and hydroxyproline, which are vital for muscle, connective tissue, and immune function.

The nutritional characteristics of pork make it an excellent foundation for the development of premium pet food products. Rich in essential amino acids, natural creatine, collagen-derived proteins, and highly digestible nutrients, pork effectively meets the physiological needs of both dogs and cats. When sourced from certified supply chains such as DOP, it also provides traceable quality and a strong guarantee of origin, enhancing consumer trust and product value. In the context of a rapidly expanding pet food market, these attributes create a concrete opportunity to introduce innovative, high-quality products capable of capturing a share of this growing and increasingly demanding segment.

When addressing the topic of pet food, the first aspect to consider is the regulatory distinction between products intended for human consumption and those destined for pets. This differentiation is subject to strict legislation, and compliance is essential to avoid reputational or operational risks for the slaughterhouse. Since the purpose of this thesis is to identify a premium, innovative product to be marketed in the mass market, the analysis considers not only by-products but also cuts typically used for human consumption. However, this approach requires careful evaluation of the relevant regulations.

In the European Union, and consequently in Italy, a clear legal separation exists between food intended for humans and that produced for animal nutrition. The main reference framework is provided by Regulation (EC) No. 1069/2009 and its implementing Regulation (EU) No. 142/2011, which govern animal by-products not intended for human consumption, together with Regulations (EC) No. 852/2004 and 853/2004 on hygiene rules for food of animal origin. These laws stipulate that a product or raw material can belong exclusively to one of the two supply chains, human or animal, and, once assigned, it cannot be reintroduced into the other. Consequently, even if a product were identical in composition to one destined for human consumption, it could not legally be marketed as pet food unless produced in a facility specifically authorised for the manufacture of feed for companion animals.

Unlike in the United States, where the “human grade” claim is recognised, European legislation does not allow products to be simultaneously classified as suitable for both humans and animals. It is, however, permitted to state that the ingredients used derive from raw materials fit for human consumption or from certified supply chains such as DOP.

From a strategic perspective, this framework does not prevent the development of premium pet products comparable in quality to human food. By dedicating a separate production line, maintaining traceability, and complying with pet food labelling requirements under Regulation (EC) No. 767/2009, it is possible to create high-quality and digestible pet food in full compliance with European law.

In summary, current legislation permits using raw materials intended for human consumption in pet food, provided dedicated facilities and full traceability are ensured. Within this framework, a slaughterhouse could supply high-quality pork cuts to an authorized line for processing and packaging premium pet food. The following sections will examine the most promising proposals, focusing on the product itself without considering retailer markups, as these items could be distributed through various channels.

3.3.1 Pork loin slice

Among the possible innovative products derived from pork for the pet food sector, a particularly promising concept is represented by a cooked pork loin slice specifically designed for dogs and cats. This product combines the nutritional quality of lean pork cuts with a formulation and presentation tailored to the dietary needs of companion animals. The idea draws inspiration from traditional ready-to-eat meat products intended for humans but adapts them to the pet segment through specific processing, packaging, and nutritional balance. The result is a premium, high-protein, and easily digestible product that aligns with the growing demand for natural and minimally processed pet foods. In addition to its nutritional benefits, this proposal embodies a clear valorisation strategy for high-quality pork, transforming it into a differentiated product capable of enhancing both the image and profitability of the supply chain. The subsequent analysis will address the principal factors concerning its development and potential positioning in the market:

- **Product description**

  The cooked pork loin slice for dogs and cats is conceived as a high-quality, single-protein product that combines technological precision with nutritional functionality. The formulation is based on lean pork loin, which undergoes controlled cooking designed to optimise texture, digestibility, and palatability according to the specific chewing and sensory preferences of dogs and cats. Different cooking profiles can be applied, to achieve the ideal consistency. Each portion is pre-cut and calibrated to meet the daily nutritional requirements of the target animal, ensuring both practicality and dietary precision. The product can be packaged in recyclable trays or cans that can also serve as feeding containers, improving convenience while maintaining hygiene and reducing waste. This packaging solution, together with the natural composition and tailored texture, reinforces the perception of a premium, well-engineered product designed to deliver both nutritional adequacy and consumer usability.

- **Production process analysis**

  The production process of the cooked pork loin slice for dogs and cats is based on the sous-vide cooking technique, selected as the most appropriate method to ensure optimal consistency, nutritional integrity, and food safety. In this process, fresh pork loin sourced from certified supply chains is first trimmed and portioned into slices of uniform

thickness, ensuring consistency and precise portion control. Each slice is then vacuum-sealed in heat-resistant, food-grade packaging that serves both as a cooking vessel and the final retail container. This approach eliminates the need for repackaging, reducing handling, waste, and environmental impact while improving overall hygiene and practicality for the end consumer.

The sous-vide technique offers significant technological advantages compared to conventional cooking methods. By combining vacuum sealing with controlled low-temperature heat treatment, it allows precise regulation of the thermal process, limiting nutrient degradation and moisture loss. This enables the production of slices with differentiated textures according to the target species and size: softer and more tender for cats or smaller dogs, and slightly firmer and more fibrous for larger breeds (FEDIAF, 2025). Moreover, the absence of oxygen within the sealed environment prevents oxidation and contamination, ensuring extended shelf life and stable product quality.

- **Required investment**

  The establishment of a production line for the sous-vide cooked pork loin slice for pets requires a moderate investment and limited structural adaptations within the slaughterhouse. The process can be effectively integrated into existing operations, relying on the continuous availability of fresh raw material and the existing cold chain infrastructure. The necessary investment mainly concerns the acquisition of specialised equipment for vacuum sealing, controlled-temperature cooking, and rapid cooling, as well as packaging and labelling systems. Depending on production capacity and automation level, the overall investment is estimated between €190,000 and €350,000. The investment estimate refers exclusively to the production process and equipment, excluding the construction or adaptation of the separate processing area required by hygiene and traceability regulations. From a supply chain perspective, this integration allows full exploitation of the slaughterhouse's raw material flow, ensuring vertical control and reducing external procurement needs. The packaging system, based on recyclable containers suitable for sous-vide processing, further enhances process efficiency by combining cooking, storage, and serving functions, while supporting the Company's sustainability objectives. Once established, the line can be managed with a limited workforce and coordinated logistics, providing flexibility and maintaining the high-quality standards required by a premium product.

Production stage	Main equipment	Indicative cost (€)
Raw material slicing	Industrial slicer and trimming table	€15,000 – €25,000
Portion weighing	Precision scales and portioning station	€5,000 – €10,000
Vacuum sealing	Double-chamber vacuum sealer	€40,000 – €70,000
Sous-vide cooking	Steam oven	€80,000 – €150,000
Rapid cooling and cold storage	Blast chiller and refrigerated storage unit	€30,000 – €60,000
Labelling and final packaging	Labelling and sealing machine	€10,000 – €20,000
Quality and hygiene control	Basic lab instruments	€10,000 – €15,000
Total equipment cost		**€190,000 - €350,000**

Table 3.17 - Production stages with main equipment and indicative investment costs

- **Existing competitors**

  Market research did not identify any direct competitors offering cooked pork loin slices or similar products for dogs and cats, suggesting that this concept would fall within the super-premium segment, while some producers offering fresh pet food exist, like Freshpet. The product aims to replicate human food while being specifically formulated for pets. Unlike the conventional pet food model, which relies on the valorisation of by-products from the human food chain, this approach is based on a dedicated production line using noble pork cuts that are not fully exploited in the human market. This strategy aligns with the growing demand for premium, human-like pet foods among high-spending consumers. However, successful market entry would require substantial consumer education to justify a higher price through quality, traceability, and formulation. While this positioning limits direct competition, it also benefits from reduced pressure from large-scale producers, which typically prioritise high-volume products and lack access to vertically integrated, premium raw material supply chains.

  Considering the targeted market positioning and the novelty of the concept, the ex-factory price can be estimated by benchmarking against comparable super-premium pet food products. Distribution through specialised pet retailers is essential to enhance product credibility and encourage trial of an innovative offering; however, these

channels are typically characterised by high retail mark-ups. Particularly in the initial market entry phase, an indicative ex-factory price of €25/kg can be considered realistic and conservative. Given an average portion size of 80 g, this would correspond to a unit price of approximately €2 per portion, which remains consistent with consumer expectations in the super-premium segment while supporting perceived value.

- **Expected volume**

  The estimation of raw material availability is based on the operational capacity of the slaughterhouse. Each pig yields two loins of approximately 1 kg each, resulting in a theoretical weekly availability of around 10,000 kg, which represents an upper planning limit.

  As detailed in *Section 2.2*, the estimated market potential for premium pork-based pet food is €3.3 million. Given the novelty of the concept, its super-premium positioning, and the logistical constraints of a fresh product requiring a controlled cold chain, capturing the full market potential would necessitate significant marketing investment and the development of strategic partnerships. Consequently, targeting 30% of the Serviceable Obtainable Market (SOM) appears to be a realistic objective in the short term. This corresponds to an estimated demand of approximately €1,000,000 in annual sales, equivalent to around 25,000 kg per year, assuming a conservative retail price of €40/kg.

- **Contribution margin analysis**

  To maintain a super-premium yet credible positioning, the product line is designed around compact and practical portion sizes that align with both nutritional requirements and price accessibility. This format ensures that the price is not perceived as excessive, given that the product serves as a topper rather than a complete meal. Should this product be selected as the most promising option, further segmentation will be conducted to optimize value across different pet sizes. For the current analysis, a realistic weighted average of approximately 80 g per unit is assumed. This translates into an average retail price of €3.20 per unit.

  The variable cost structure per kilogram of finished product is detailed as follows:

Cost source	€/kg
Pork loin	€6.00 (with 75% yield after sous-vide)
Packaging	€1.00 – €1.20
Additional consumables	€0.50 – €1.00
Energy & gas	€1.00 – €1.50
Quality controls	€0.10 – €0.20
Total variable cost	**€8.60 – €9.90**

Table 3.18 – Pork loin slice variable costs breakdown

The average cost of goods sold (COGS) is estimated at €9.25/kg, resulting in a unit contribution margin of €15.75/kg, corresponding to a ratio of 63%. The efficiency of the production process, combined with direct access to raw materials within the slaughterhouse, supports cost stability and scalability over time, even as production volumes increase. Overall, the product presents a balanced trade-off between super-premium positioning and operational feasibility. Nevertheless, the sustainability of these margins will be further assessed in the following section, with particular attention to the product's ability to support distribution, marketing, and brand-building efforts during the initial market entry phase, while also providing a solid foundation for future expansion and optimization.

- **Profitability analysis**

  With an estimated annual production of 25,000 kg and a fixed ex-factory price of €25/kg, annual revenues should be around €625,000. Variable costs have been estimated at €9.25/kg, therefore contribution margin should be more than €390,000, while fixed costs are conservatively estimated to reflect a lean but functional setup.

  As shown in *Table 3.19*, fixed costs are estimated at €425,000, which effectively offsets the contribution margin at the assumed production level, resulting in a negative EBIT of approximately €10,000. Despite this initial outcome, market research indicates that this product category is promising, as it operates within a rapidly growing segment.

  However, profitability is strongly dependent on achieving sufficient production volumes.

Fixed cost source	Annual cost
Depreciation	€30,000
Personnel	€150,000
Maintenance	€10,000
Marketing and category-building efforts	€200,000
Certifications and compliance	€5,000
Administration and overheads	€30,000
Total fixed costs	**€425,000**

Table 3.19 – Pork loin slice fixed costs breakdown

The sensitivity analysis highlights both the opportunities and risks associated with the business model:

- With a 20% reduction in volume (20,000 kg) and a 10% decrease in the ex-factory price (€22.50/kg), EBIT remains negative at approximately −€160,000.
- Conversely, combining a 20% increase in volume (30,000 kg) with a 10% increase in the ex-factory price (€27.50/kg), the business becomes profitable, generating an EBIT of approximately €122,500.

Overall, the product demonstrates clear market potential but requires careful cost management and extensive market validation to reach the demand threshold necessary to absorb fixed costs and achieve profitability. Once this critical scale is attained, the product could establish a strong competitive position, benefiting from first-mover advantage in this emerging niche.

3.3.2 Bone broth with organs

Bone broth is increasingly recognized as a functional and nutrient-rich supplement within the premium pet food segment, offering natural sources of collagen, amino acids, and hydration support. While its use in the human fitness market focuses on protein intake and recovery, its application in pet nutrition responds to different priorities, such as digestibility, palatability, and complementary feeding. The concept of enriching bone broth with organ meats, such as liver, heart, or kidney, introduces a new layer of complexity and differentiation, aiming to elevate the product's perceived value and align it with evolving consumer expectations around natural and holistic pet care. However, this formulation strategy raises important questions regarding market acceptance, consistency, and regulatory compliance. The following sections will examine the product across multiple dimensions to determine whether it represents a strategically sound extension of the slaughterhouse's value-added pet food portfolio.

- **Product description**

  Unlike standard bone broth, this enriched formulation aims to serve as a complete and nutritionally balanced meal for dogs and cats, rather than a simple topper. In addition to selected organ meats, which provide essential micronutrients such as vitamin A, B-complex vitamins, iron, zinc, and taurine, the product is fortified with calibrated quantities of:

  - pork fat
  - trace minerals
  - a vitamin premix

  to meet the minimum nutritional requirements outlined by regulatory authorities (FEDIAF, 2025). These additions ensure adequate levels of energy, essential fatty acids, and key micronutrients including calcium, phosphorus, and vitamin D, which are not sufficiently present in bone broth alone. The result is a shelf-stable, protein-rich liquid meal that combines hydration, digestibility, and functional nutrition, offering a convenient and high-quality alternative to conventional pet food. By positioning the product as a complete meal, it aligns more closely with consumer expectations for simplicity, transparency, and premium quality in pet nutrition.

- **Production process analysis**

  The production process of bone broth for pets mirrors that of the human formulation (collection, cleaning, extraction, clarification, packaging, and sterilisation) but

introduces specific adaptations to optimise nutritional value, palatability, and process efficiency. Alongside selected pork bones, organ meats such as liver, heart, and spleen are minced and incorporated before extraction to enrich the broth with collagen, amino acids, taurine, and iron. Cleaning is less stringent, as minor fat residues enhance both flavour and energy density.

During extraction, vegetables or herbs are omitted to focus on protein and mineral concentration rather than flavour refinement. The cooking phase is slightly shorter (4–8 hours) and conducted at higher temperatures (up to 98 °C) to improve productivity while preserving digestibility. After filtration to remove coarse solids, full clarification is unnecessary, as light turbidity is acceptable within the pet segment. The finished broth is then packaged in Tetra Pak cartons, a solution that ensures high product protection, long shelf life, and ease of handling throughout distribution. This format also offers a lower environmental impact and superior logistical efficiency compared to glass. Final sterilisation through autoclave or UHT processing guarantees microbiological safety and ambient stability.

- **Required investment**

  The production of bone broth with organs for pets shares many structural similarities with the human-grade bone broth discussed in *Section 3.2.1*, particularly regarding the core extraction process and equipment requirements. Unlike pure bone broth, this formulation incorporates finely ground organs (liver, heart, spleen), requiring additional processing equipment beyond what was outlined in *Table 3.5*:

Additional equipment	Function	Investment (€)
Industrial meat grinder	Fine grinding of organs to homogeneous paste	€8,000 – €15,000
Mixing tank with agitation	Uniform incorporation of organs into broth	€12,000 – €20,000
Homogenizer	Ensuring stable emulsion and preventing separation	€25,000 – €40,000
Total additional investment		**€45,000 - €75,000**

Table 3.20 - Additional equipment and its relative cost

While the remaining stages (extraction, filtration, sterilization, and packaging) are consistent with the human-grade process, a key operational divergence lies in the packaging format. Pet food applications typically utilize smaller units (e.g., 150 ml tetrapak), in contrast to the 500 ml glass bottles used for human consumption. This shift entails recalibration of the filling line (already accounted for in base equipment costs) and a transition to alternative packaging materials, which paradoxically reduces capital expenditure by an estimated €50,000–€100,000 compared to glass bottling line.

Overall, the investment profile remains broadly consistent with that of the human-grade production line, requiring an initial capital expenditure of approximately €1,000,000. While the inclusion of organ meats introduces incremental processing complexity, this is effectively offset by the simplification of packaging formats. As a result, the overall setup maintains operational feasibility without significant deviation in capital intensity.

- **Existing competitors**

  Although the European pet food market is highly saturated, the specific niche of bone broth enriched with organ meat remains largely underdeveloped. Only a limited number of international brands offer products with structural similarities to the proposed Italian-certified pork bone broth with organs, representing a potential competitive threat due to their exclusive focus on pet nutrition, established brand recognition, and premium positioning. Among these, Primal Pet Foods constitutes the closest benchmark, as it offers a pork-based bone broth with a comparable nutritional profile

  However, these international players have a limited presence in Europe and do not operate within the Italian certified pork supply chain, nor do they fully integrate bone broth and organ meat in formats aligned with European consumer expectations. Moreover, no European producers currently offer a comparable product, highlighting a clear market gap, while Italian offerings tend to be smaller and less competitive compared to their American counterparts. This absence of regional competition, combined with the credibility of the Italian pork supply chain and growing demand for premium, functional pet nutrition, creates a strategic opportunity for the proposed product to establish a differentiated and high-value position.

Brand	Origin	Product type
Primal Pet Foods	USA	Pork bone broth with organic vegetables and turmeric
Brutus Broth	USA	Pork bone broth fortified with functional additives
Brodog	Italy	Functional premium bone broth
BarfHouse	Italy	Functional bone broth
Fasson Food	Italy	Poultry, fish and beef bone broth

Table 3.21 - Main competitors, their origin and product type

This product is positioned within a premium niche of the pet food market. An analysis of potential competitors indicates retail prices typically ranging between €20 and €30 per kilogram. Considering the novelty of the concept, its functional benefits, and the use of high-quality fresh raw materials, an ex-factory price of approximately €13/liter appears appropriate for initial market entry, as it supports competitive positioning while facilitating customer base expansion. Given that specialised pet retailers generally apply mark-ups of around 40%, this pricing structure supports a coherent and competitive final retail price, consistent with premium market expectations.

- **Expected volume**

  The estimation of production volumes for the proposed pet bone broth with organ meat is grounded in realistic extraction yields and market-aligned pricing assumptions. The production of a collagen-rich broth requires approximately 2 kg of pork bones per liter, a ratio that is both operationally feasible and cost-efficient within a slaughterhouse environment where bones are readily available as by-products. Moreover, this availability ensures ample production capacity relative to the projected demand, as following discussed.

  As discussed in *Section 2.2*, the Serviceable Available Market (SAM) for pet food is estimated at €3.3 million. Consistent with the assumptions applied to the pork loin slice product, targeting 30% of this market can be considered a conservative yet realistic objective. Assuming a retail price of €20 per litre, this target translates into an annual production volume of 50,000 litres.

- **Contribution margin analysis**

  To assess the economic viability of the proposed product, several factors must be considered. Positioned as a complete meal replacement, the product's format and pricing strategy are shaped accordingly. An ex-factory price of €13/L has been established, reflecting its premium positioning. The cost analysis focuses on actual input values, particularly the economic relevance of slaughterhouse by-products within a vertically integrated system, rather than theoretical market prices that may not represent their true opportunity cost.

Cost category	€/liter
Raw materials	€1.00
Consumables	€0.20 – €0.30
Energy & gas	€1.00 – €2.00
Packaging	€0.50 – €0.80
Quality controls	€0.10 – €0.20
Total variable cost	**€2.70 – €4.30**

Table 3.22 – Bone broth with organs variable costs breakdown

  The resulting average cost structure of €3.50 per litre reflects a lean and strategically efficient operating model. Raw material costs remain low due to the internal valorisation of bones, organs, and fat, inputs with limited standalone commercial value outside the integrated slaughterhouse environment. The resulting unit contribution margin, also equal to €9.50 per litre, represents approximately 73% of total costs, a highly attractive level when compared with margins typically achieved in traditional pork product lines.

- **Profitability analysis**

  The bone broth with organs presents a strong market opportunity, supported by a solid unit contribution margin; however, its economic viability depends on achieving sufficient demand to absorb relatively high fixed costs. With an ex-factory price of €13 per litre and a variable cost of €3.50 per litre, an annual production target of 50,000 litres would generate total revenues of €650,000 and a total contribution of €475,000.

Fixed costs are estimated at approximately €545,000 per year, reflecting the realistic requirements of a vertically integrated, small-batch liquid pet food facility. *Table 3.23* summarises the main fixed cost items identified and considered in the analysis:

Fixed cost source	Annual cost (€)
Depreciation (over 10 years)	€100,000
Production and commercial personnel	€200,000
Maintenance	€10,000
Marketing and brand development	€200,000
Certifications and compliance	€5,000
Administration and overheads	€30,000
Total fixed costs	**€545,000**

Table 3.23 – Bone broth with organs fixed cost breakdown

Based on the current assumptions, the projected figures would result in an EBIT loss of approximately €70,000, indicating that the product is not economically viable at this stage. Nevertheless, the concept exhibits several strategic strengths that could support improved performance in the medium term. In particular, the product is designed as a complete meal with a balanced nutritional profile and is supported by a certified supply chain, both of which enhance its value proposition.

More ambitious yet realistic assumptions, supported by an effective marketing strategy, could significantly improve performance. Specifically, increasing the ex-factory price to €16 per litre and scaling demand to 100,000 litres annually would result in total revenues of €1.6 million and a positive EBIT of approximately €705,000, corresponding to an EBIT margin of 44%.

3.3.3 Skin sticks

The proposed product is a pork-based chew snack, designed to meet the growing demand for functional pet treats in an expanding market segment. Chewing snacks for dogs have experienced significant growth in recent years, driven by consumer interest in products that combine entertainment with health benefits. However, collagen-rich options remain scarce, despite the well-documented advantages of collagen for joint health, skin elasticity, and overall vitality in dogs. This product aims to fill that gap by offering a chew that not only satisfies the instinctive need for mastication but also contributes to musculoskeletal support and digestive well-being. Positioned as a premium alternative to conventional chews, this snack leverages its functional profile and high-quality perception to differentiate itself in a competitive market, aligning with trends toward sustainability and health-oriented pet nutrition.

- **Product description**

  The product is concepted as a pork chew for dogs, developed from selected cuts such as skin and connective tissue, which are naturally abundant in structural proteins, glycine, and proline, amino acids essential for joint health and skin elasticity. Each chew is shaped into uniform strips with a dense, fibrous structure, achieved through a controlled low-temperature drying process that reduces moisture, ensuring microbiological safety and extending shelf life without chemical preservatives. This process also preserves the integrity of collagen fibers, enhancing the functional properties of the snack. The chew's firm texture promotes prolonged mastication, which not only satisfies the dog's instinctive need to chew but also contributes to oral hygiene by mechanically reducing plaque and tartar buildup. Its single-source animal origin and absence of artificial additives respond to consumer demand for transparency and simplicity, while its natural composition and functional benefits position it as a excellent substitute for traditional chews.

- **Production process analysis**

  Collagen sticks are produced through a mechanical-physical process designed to preserve the integrity of the fibrous collagen matrix, ensuring durability and optimal chewing resistance. The process begins with the mechanical separation of the corium, the inner dermal layer rich in type I collagen, from the outer epidermis, followed by thorough cleaning without chemical agents or additives. The purified material is then

cut and shaped into cylindrical sticks through rolling or pressing, preserving fiber orientation and mechanical strength.

The formed sticks undergo slow roasting at 70–82 °C for 8–12 hours, allowing gradual dehydration while remaining below collagen's denaturation threshold. An optional enrichment step involves coating the dried sticks with hydrolyzed collagen to enhance nutritional value without altering texture. Finally, the sticks are cooled and packaged under a protective atmosphere, resulting in a shelf-stable product with a durability exceeding 18 months at room temperature.

- **Required investment**

The development of such a facility requires careful capital allocation across the entire production chain. Capital expenditures include equipment for cleaning, shaping, thermal processing, and packaging, as well as the necessary infrastructure to comply with hygiene, safety, and traceability requirements. For a small- to medium-scale operation, total investment needs typically range between €215,000 and €375,000, depending on the degree of automation and production capacity. For the purposes of this analysis, an average capital investment of €300,000 is assumed.

Production phase	Equipment/machinery	Indicative cost (€)
Raw material preparation	Stainless steel washing tanks with drainage, filtration, and contaminant removal	€35,000 - €65,000
Corium processing	Automatic band knife splitter adjustable cutting station	€50,000 - €100,000
Forming & thermal treatment	Semi-automatic rolling/pressing machine + batch convection oven + cooling system	€100,000 - €150,000
Packaging & quality control	Vacuum sealer + quality control systems	€30,000 - €60,000
Total investment cost		**€215,000 – €375,000**

Table 3.24 – Skin sticks required machinery and investment

- **Existing competitors**

  The Italian and European market for porcine rind-based chew snacks is highly fragmented and dominated by small artisanal producers using traditional drying and rolled formats. Industrial-scale production of pressed porcine sticks is currently absent; the only Italian reference (Record Collagen+) relies on bovine gelatin and targets mass-market channels. Existing porcine rind products are primarily sold through niche e-commerce platforms, with volumes insufficient to justify automation. This points to a potential market gap, although it remains necessary to distinguish between unmet demand and structurally limited consumer interest. While industrialisation could deliver cost efficiency, quality consistency, and improved retail access, successful market entry would require clear differentiation, strong consumer education, and sufficient volumes to overcome unfamiliarity with the format.

Supplier	Location	Product type
Zampalizia	Italy	Artisanal dried rolled pork rind
TopDog	Italy	Dried rolled pork rind 200g
Italdog	Italy	Natural dried pork rind
NaturalmenteDogs	Italy	Dried rind roll
Record Collagen+	Italy	Beef gelatin collagen stick 50%
JR Pet Products	UK	Beef Collagen Sticks

Table 3.25 – Skin sticks existing competitors

Competing products are typically sold at retail prices ranging between €30 and €50 per kilogram. Given the intended premium positioning of the product and its primary distribution through specialised pet shops, where margins generally range from 30% to 50%, a realistic ex-factory price can be estimated at approximately €20/kg.

- **Expected volume**

  Volume projections are driven by market demand rather than raw material availability. At 250,000 pigs annually, this equates to approximately 3.5 million kg of raw skin, of which 30% (around 1 million kg) could be redirected to dog chew production. Low-

temperature drying achieves a 35–40% conversion ratio, supporting a theoretical output of around 400,000 kg per year.

At the international level, the pet chew category is valued at approximately $10.5 billion (Future Market Insights, 2025) out of a global pet food market of nearly $130 billion (Fortune Business Insights, 2026), representing roughly 8% of total sales. Applying this same ratio to the Italian pet food market, estimated at €3.3 billion, yields an indicative chews market of about €264 million. Considering the sector's fragmentation, the large number of competing brands, and the fact that innovative formulations tend to be well-received, a 0.3% penetration rate appears realistic. This corresponds to €792,000 in retailer revenues. Assuming an average retail price of €40/kg, annual demand would equate to approximately 20,000 kilograms.

- **Contribution margin analysis**

  Variable costs per kilogram of finished product are detailed below:

Variable cost component	€/kg
Raw material (pork skin)	€0.50
Consumables	€0.10 – €0.20
Energy & Gas	€1.00 – €1.50
Packaging	€0.30 – €0.50
Quality controls	€0.10 – €0.20
Total variable cost	**€2.00 – €2.90**

Table 3.26 - Skin sticks variable costs breakdown

On average, variable costs amount to approximately €2.50/kg, underscoring the strong economic potential of this product category. These chews are perceived by consumers as high-quality, premium items, despite being derived from very low-value raw materials, often considered by-products or waste streams. The primary cost driver is not the ingredient itself but the energy-intensive and time-consuming processing phase, which requires substantial electricity and gas inputs.

Based on the previously identified ex-factory price of €20/kg, the resulting unit contribution margin is €17.50/kg, equivalent to an 87.5% contribution margin.

- **Profitability analysis**

  Profitability for the porcine chew depends on the balance between production costs, achievable retail pricing, and realistic sales volumes within the premium natural dog treat segment.

  Fixed costs must account for specialized drying equipment, quality assurance infrastructure, and modest marketing expenditure for niche channel penetration:

Fixed cost category	Annual Cost (€)
Depreciation (equipment)	€30,000
Production and commercial personnel	€200,000
Maintenance	€10,000
Marketing expenses	€200,000
Certifications and compliance	€5,000
Administration and overheads	€30,000
Tota fixed cost	**€475,000**

Table 3.27 –Skin sticks fixed costs breakdown

Significant marketing investment has been included, as the market is expected to expand rapidly in the coming years, showing a projected 4.8% CAGR between 2025 and 2035 (Future Market Insights, 2025). This growth potential can be captured through strong marketing initiatives and effective positioning.

Considering the planned annual production volume to 20,000 kg, after accounting for fixed costs of €475,000, as detailed in *Table 3.27*, the operation would generate an estimated annual loss of €-125,000, out of a total revenue of €400,000. The break-even point remains at approximately 27,000 kg/year, corresponding to €540,000 in revenue.

Sensitivity analysis further supports this opportunity:

- A 20% price increase (to €24/kg) combined with a 20% rise in demand (to 24,000 kg/year) would generate an EBIT of €41,000.
- Conversely, a 20% price reduction (to €16/kg) along with a 20% decline in demand (to 16,000 kg/year) would lead to an EBIT of –€259,000.

Thus, skin sticks could fit well within a fast-growing niche segment, although their introduction requires careful evaluation.

3.4 Cosmetics

The cosmetic industry is widely regarded as one of the most profitable and rapidly evolving consumer sectors, particularly within skincare and premium categories. Its expansion is fuelled by strong demand for anti-aging solutions and bioactive ingredients, which theoretically creates opportunities for innovative products derived from animal sources such as porcine collagen (McKinsey, 2023). However, this potential must be critically assessed against structural and cultural constraints that significantly limit feasibility for a company rooted in meat processing.

Several factors make investment in innovative cosmetic products an excessively high-risk endeavour:

1. **Intense market saturation:** the beauty industry, while vast, is highly competitive and dominated by global corporations with extensive resources, established brand equity, and sophisticated distribution networks. These incumbents invest hundreds of millions annually in research, marketing, and influencer partnerships, enabling them to rapidly absorb emerging trends and neutralize niche competitors (Supliful, 2024).

2. **Proliferation of indie brands:** beyond major players, a surge of independent brands leveraging social media-driven strategies and radical transparency has further saturated the market, creating formidable entry barriers for new entrants lacking cosmetic expertise.

3. **Technical and regulatory complexity:** for a meat-processing company, entering this domain would require a radical shift in capabilities. Beyond the challenge of developing safe and effective formulations, compliance with stringent regulations such as EU Regulation 1223/2009 demands specialized knowledge and rigorous safety assessments (Obelis, 2024).

4. **High marketing costs:** premium positioning entails substantial expenditure, with customer acquisition costs often exceeding $100 per person (Supliful, 2024). These structural factors render the short-term development of a competitive cosmetic product incompatible with the thesis objective of delivering a rapid, economically sustainable innovation.

5. **Consumer perception and ethical barriers:** modern skincare consumers exhibit heightened awareness of ingredient sourcing and ethical considerations. Prevailing trends favor “clean beauty,” vegan formulations, and cruelty-free claims, which directly

conflict with the use of porcine derivatives (Supliful, 2024). While collagen remains a sought-after ingredient for its anti-aging benefits, demand increasingly shifts toward marine or plant-based alternatives, driven by ethical and environmental concerns (SSR Solutions, 2024). This cultural sensitivity introduces significant reputational risk: products explicitly marketed as pig-based could provoke aversion among Western consumers and face outright rejection in religiously restricted markets. Although certain Asian regions demonstrate openness to animal-derived actives, these opportunities are niche and require nuanced branding strategies, making them highly complex and resource-intensive for a company without cosmetic expertise or international marketing infrastructure.

Considering these factors, the cosmetic sector does not align with the thesis goal of identifying a simple, profitable, and quickly deployable innovation. Alternative markets such as pet food and fitness supplements offer more favourable conditions: lower compliance burdens, established consumer acceptance of animal-based ingredients, and operational synergies with existing meat-processing capabilities.

Although cosmetics are unsuitable for immediate implementation, the concept retains long-term potential under different conditions. Among future possibilities, hydrolysed collagen stands out for its versatility across applications, from beauty supplements to potential skincare formulations. Its proven efficacy in improving skin elasticity and joint health, combined with abundant raw material availability, positions it as a strategic ingredient for diversification (SSR Solutions, 2024). However, any move into cosmetics should be preceded by partnerships with specialized laboratories and robust compliance frameworks to mitigate technical and reputational risks.

To sum up, while the cosmetic market offers theoretical opportunities for porcine-derived ingredients, its structural complexity and cultural sensitivities make it an impractical choice for the immediate objectives of this thesis. The risk-return profile is unfavourable compared to alternative sectors, reinforcing the decision to deprioritize cosmetics in favour of more accessible markets. Future initiatives may revisit this domain under different condition, greater resources, strategic alliances, and a focus on ingredient supply rather than consumer branding, transforming current obstacles into potential competitive advantages.

3.5 Additional products

Beyond the previously analysed products, which were developed for specific high-growth markets and intended to address particular unmet needs, there are additional innovative and noteworthy options that fall outside those defined segments yet demonstrate sufficient potential to merit further consideration. Although these products may not rank among the most promising proposals, they remain interesting and could represent viable solutions for future development.

3.5.1 Charcuterie chips

The first product worthy to be analysed is a different version of the product already analysed in *Section 3.2.2*. Although the product would be almost identical to the previous version, this falls under a different scope. While lean meat chips target the fitness and sports nutrition market with high-protein, low-fat characteristics, cured meat chips position themselves in the gourmet aperitif segment, capitalising on intense flavour profiles and artisanal appeal. The strategic value lies in production flexibility: identical equipment and core processes enable product diversification without incremental capital investment, thereby optimising asset utilisation and de-risking market concentration.

- **Product description and differentiation**

  Cured meat chips are thin, crispy snacks produced from fatty pork cuts including prosciutto, pancetta, coppa, and guanciale[7], characterised by lipid content ranging from 25-40% compared to 3-5% in lean variants (Keeton and Eddy, 2004). Main differences between the two products come from:

  - Nutritional profile: high-fat (25-40%), moderate protein (30-35%) versus high-protein (60-70%), low-fat (3-5%)
  - Target positioning: gourmet aperitif and artisanal snacking versus functional sports nutrition
  - Flavour intensity: emphasis on cured meat characteristics, saltiness, and umami versus mild protein-forward taste

  The production process for cured meat chips is substantively identical to lean variants, comprising three core stages: slicing (3-5mm thickness), controlled dehydration, and

[7] These are all examples of Italian cured meats, respectively: prosciutto (Italian dry-cured ham), pancetta (cured pork belly), coppa (cured pork neck or shoulder), and guanciale (cured pork jowl).

vacuum packaging. The singular modification involves reduced dehydration temperature, 60°C versus 70°C, to prevent lipid rancidity and preserve fatty acid stability during extended processing cycles of 8-10 hours (Pearson and Tauber, 1984).

- **Market analysis and positioning**

  The Italian snack market exhibits inherent consistency, supported by approximately 30% of the population reporting regular consumption of chips or savory snacks in 2025, positioning the market value at an estimated €6 billion (Statista, 2025). Cured meat chips specifically target the gourmet aperitif segment, appealing to consumers aged 35–55 with medium-to-high disposable incomes who seek premium accompaniments for wine and social gatherings, in addition to individuals looking for a savory break.

  While the underlying production process is relatively straightforward, the main competitive barriers are concentrated around brand recognition and distribution access. Even in the absence of direct competitors offering an identical product with the same unique Italian provenance narrative, the market is influenced by established players who benefit from decades-long relationships with modern trade buyers and robust consumer trust. Therefore, new entrants are required to implement strong differentiation strategies, emphasizing territorial authenticity, persuasive traceability narratives, or stringent quality certifications to successfully justify a premium pricing strategy and secure placement within specialized retail channels.

- **Contribution margin and profitability**

  Assuming an indicative average cost for the raw cured meat material (e.g., trimming from high-quality Prosciutto or Speck) of €10.00 per kilogram, the cost is subject to increase following the dehydration process. Unlike the lean meat chips, the cured material already possesses a reduced moisture content due to the aging process. However, achieving the required crispness for a "chip" format necessitates further drying. Assuming a conversion factor of approximately 2.5:1 (mass of raw cured meat to mass of final chip product), the material cost component in the finished product is estimated at €25.00 per kilogram. Including processing, packaging, and direct labor overheads necessary for a highly specialized product, the Cost of Goods Sold (COGS) is conservatively estimated at €28.00 per kilogram.

  To align with the targeted gourmet aperitif segment and justify the product's premium

positioning (authenticity, traceability, DOP-related quality), a competitive retail price of €90.00 per kilogram is assumed (equivalent to approximately €4.50 per 50-gram serving). Assuming 30/40% of distribution channel markup, an ex-factory price of €60/kg appears reasonable. The resulting contribution margin of 53% confirms the high gross-profit potential of the cured meat chips product, consistent with high-value, niche food innovation.

However, securing market share in the fragmented and brand-driven gourmet sector requires disproportionately high operating expenses related to sales, marketing, and channel development, and volume would be lower than the fitness version, having a broader market to be addressed.

Cured meat chips product is strategically compelling for second-stage diversification. It leverages the same essential dehydration/processing infrastructure required for the lean meat chips, thus maximizing asset utilization and distributing fixed overhead costs across a broader product portfolio. Launching this product after establishing the protein-focused line would allow the company to expand its addressable market beyond the specific 'fitness enthusiast' niche into another market, the 'gourmet snack' segment.

3.5.2 Ready-to-eat pork-based complete meal

Ready-to-eat (RTE) pork-based meals represent a potential diversification avenue targeting the convenience food segment for working professionals seeking alternatives to homemade packed lunches without incurring full restaurant meal costs. These products comprise complete, balanced meals requiring only reheating before consumption, distributed through supermarkets, convenience stores, and workplace cafeterias.

The product concept addresses a specific consumer need: time-constrained workers (office employees, healthcare staff, retail workers) requiring nutritious, affordable midday meals during 30-45 minute lunch breaks. Positioned between homemade lunches (€2-4 per meal) and restaurant dining (€10-15 per meal), ready-to-eat pork meals target a €5-8 price point, offering perceived value through convenience, portion control, and nutritional balance.

- **Product examples and nutritional profile**

  There could be infinite possibilities to create potential product variants leveraging pork as primary protein source, including italian-style pork meatballs with tomato sauce and pasta, asian-inspired pork stir-fry with rice, pork sausage with lentils and root vegetables.

  These formulations target macronutrient distributions aligned with workplace nutrition guidelines: 25-30% protein, 30-35% fat, 40-45% carbohydrates, with portion sizes calibrated to 400-550 kcal per meal (EFSA, 2017). Shelf life through Modified Atmosphere Packaging (MAP) or pasteurisation achieves 14-21 days refrigerated or 12-18 months frozen.

- **Market sizing and competitive landscape**

  The Italian RTE meal market demonstrates robust growth driven by urbanisation, dual-income households, and convenience-seeking behaviours. The Italian refrigerated RTE meal segment reached €1.2 billion in 2023, with compound annual growth of 6.8% (2019-2023). The lunch occasion specifically represents approximately 45% of RTE consumption (€540 million), with workplace consumption accounting for 60-65% of lunch occasions (Hannah Blake, 2024). Market segmentation reveals three primary tiers: economy/private label (€3-5 per meal), mainstream branded (€5-7.50 per meal), and premium/chef-curated (€8-10 per meal).

  Key competitors include established brands such as Beretta, and private label offerings from Coop, Conad, and Esselunga.

- **Cost structure and profitability considerations**

  The cost structure of ready-to-eat (RTE) pork meals differs significantly from single-ingredient products due to multi-component formulations, higher labor requirements, and stricter regulatory compliance. A preliminary cost breakdown for a representative 400 g meal, comprising 120 g pork, 150 g carbohydrate base, 100 g vegetables, and 30 g sauce, indicates the following:

  - Pork component (sliced tenderloin or ground shoulder): €1.20–1.80 (30–35% of COGS)
  - Carbohydrate base (pasta, rice, quinoa): €0.40–0.60 (10–12%)
  - Vegetables (fresh or frozen): €0.50–0.70 (12–15%)
  - Sauce and seasoning: €0.30–0.40 (7–10%)

- Packaging (tray, film, label): €0.45–0.60 (11–14%)
- Labor and processing: €1.20–1.50 (28–32%)

This results in an estimated COGS of €4.05–5.60 per unit, with wholesale prices to retailers ranging from €5.50–7.00 and a recommended retail price (RSP) of €6.99–8.99. Assuming a Serviceable Available Market (SAM) representing 20% of the Total Addressable Market, the potential market size is estimated at €240 million. With a conservative penetration rate of 1%, projected revenues would reach approximately €2.4 million, equivalent to around 350,000 units annually (≈7,000 units per week). Based on these projections, annual contribution margins are expected to fall within 20–30%, significantly lower than those achieved by single-component products (45–65%) due to higher operational complexity and perishability risks. While EBITDA remains challenging to forecast given process variability and flexibility requirements, it can reasonably be assumed to be considerably lower than that of the previously analyzed products.

- **Strategic considerations**

  RTE pork meal development presents substantially higher barriers than previously analysed products. Critical challenges include:

  - Operational complexity: multi-ingredient formulations require diversified supplier management, complex recipe management systems, and coordinated cooking processes. Production requires commercial kitchen certification, HACCP plans covering multiple allergens, and quality control across diverse ingredients.
  - Regulatory requirements: RTE meals face stringent microbiological standards (Regulation EC 2073/2005), mandatory nutritional labelling with full ingredient disclosure, and allergen management protocols.
  - Distribution and shelf-life constraints: refrigerated distribution (2-4°C maintained) limits geographic reach and increases logistics costs (€0.30-0.50 per unit). Typical 14-21 day shelf life creates inventory risk and limits retail placement to high-turnover locations.
  - Capital investment: the dedicated production of RTE meals requires a commercial kitchen infrastructure that is available to produce different types of products without being restrictive.

RTE pork-based meals offer strategic diversification into a large, growing market (€1.2 billion, +6.8% CAGR) with clear consumer demand for convenient, affordable workplace nutrition. However, operational complexity, capital intensity, and compressed margins position this opportunity as Phase 3 consideration following successful market entry and cash flow generation from higher-margin, simpler products.

The multi-ingredient nature fundamentally alters the value proposition of by-product valorisation: pork becomes one component among many, diluting the "zero-waste" narrative and introducing dependency on external suppliers (vegetables, grains, sauces). Contribution margins of 20-28% compared unfavourably to 45-65% achievable in single-ingredient products, while capital requirements and operational complexity (multi-component sourcing, allergen management, cold chain) substantially increase execution risk.

3.5.3 Heparin

Pharmaceutical-grade heparin extraction represents a fundamentally different valorisation pathway compared to food-based products previously examined. Heparin is a critical anticoagulant medication extracted from porcine intestinal mucosa, used globally in surgical procedures, dialysis treatment, and thrombosis prevention. Following BSE (Bovine Spongiform Encephalopathy) related restrictions on bovine sources in the 1990s, porcine-derived heparin now dominates approximately the great majority of global supply. According to industry sources, porcine intestinal mucosa contains approximately 0.5% heparin concentration, meaning each pig yields roughly 1-1.5g of extractable heparin from 200-300g of mucosa (Carni Sostenibili, 2024). Consequently, 700-1,000 animals are required to produce a single kilogram of refined pharmaceutical-grade product.

This extraction process positions the slaughterhouse within the pharmaceutical supply chain rather than food markets, transforming biological waste into life-saving active pharmaceutical ingredients. However, this transition carries profound implications for capital requirements, regulatory complexity, and operational capabilities that warrant careful examination before consideration as a viable opportunity, as it also demands new infrastructure, specialized technical expertise, and sustained compliance with rigorous industry standards, which could significantly influence both timelines and cost structures.

- **Technical requirements and investment implications**

  The extraction process involves multi-stage biochemical purification substantially distinct from food processing. Fresh intestinal mucosa must be immediately frozen at -20°C to preserve mucopolysaccharide integrity, then subjected to alkaline extraction or enzymatic treatment to release heparin from mucosal tissues. Subsequent purification involves sequential alcohol precipitation, activated carbon filtration, ion-exchange chromatography for molecular weight fractionation, and finally sterile filtration with lyophilisation to produce pharmaceutical-grade powder (Casu and Lindahl, 2001). Each batch requires comprehensive analytical validation through high-performance liquid chromatography, nuclear magnetic resonance spectroscopy, and bioassays to meet monograph specifications for potency, molecular weight distribution, and impurity profiles.

  The critical distinction from food-grade processing lies in regulatory requirements, necessitating classified clean rooms, validated equipment with documented installation/operational/performance qualification, comprehensive environmental monitoring, and pharmaceutical quality management. Supporting infrastructure includes dedicated analytical laboratories, uninterrupted cold chain logistics with backup power systems, and extensive documentation architectures covering batch records, change control, deviation management, and continuous process verification (Guerrini et al., 2008).

  Total capital investment for a turnkey heparin extraction facility capable of processing 200-400kg annually ranges €4-7 million**.** This represents approximately 10-15 times the investment required for food-grade products, while serving a production volume measured in tens of kilograms rather than hundreds of tonnes.

- **Market dynamics and competitive realities**

  Despite of revenues of thousands of euros per kg, market access barriers prove formidable. The supply chain exhibits extreme concentration, with Chinese producers controlling the greater part of global crude heparin supply. Established API[8] manufacturers, including Bioiberica (Spain), Opocrin (Italy), Pfizer, Sanofi, and Fresenius Kabi, benefit from decades-long regulatory approvals through validated

[8] API (Active Pharmaceutical Ingredient) manufacturing is the complex process of creating the core chemical or biological substance in a drug that produces its intended therapeutic effect.

supply chains with complete traceability, and long-term contracts with pharmaceutical companies requiring 18-36 month qualification periods for new suppliers.

After the 2008 heparin contamination crisis, regulatory oversight intensified dramatically, creating near-insurmountable barriers for new entrants lacking extensive quality infrastructure, multi-year audit histories, and demonstrated crisis management capabilities. Pharmaceutical companies now demand supplier track records spanning 5-10 years with zero non-conformances before awarding significant business, effectively locking out new market entrants regardless of production capabilities or pricing competitiveness (FDA, 2018).

- **Economic reality and profitability assessment**

  Processing 5,000 pigs weekly yields approximately 1,000 kg of fresh intestinal mucosa (200-300g per animal). Assuming 0.5% heparin content and 70% extraction efficiency, potential crude heparin production reaches around 200kg annually. At conservative pharmaceutical-grade UFH pricing of €3,000/kg (lower bound reflecting new entrant discount), annual gross revenue totals €600,000. This revenue must absorb substantial cost structures inherent to pharmaceutical manufacturing:

  - Variable costs per kilogram include mucosa collection and freezing, chemical reagents and consumables, energy and utilities and comprehensive quality control testing, accounting for more than 1200€/kg.
  - Annual fixed costs include specialised personnel, facility maintenance and revalidation, regulatory compliance covering inspections and certifications and quality management systems, comprehending around €500,000 annually.

  Break-even analysis reveals minimum throughput requirements of at least double the actual pigs processing weekly to generate sufficient gross profit covering pharmaceutical fixed costs. The economics are categorically non-viable at present scale, with no realistic pathway to profitability absent massive volume expansion or contract manufacturing arrangements with multiple slaughterhouses aggregating mucosa supply.

- **Alternative models**

  The preceding analysis of pharmaceutical-grade heparin extraction reveals a critical structural constraint: complete vertical integration into API manufacturing proves economically non-viable for medium-scale slaughterhouse operations processing 5,000 pigs weekly. Two intermediate processing models warrant serious consideration, each representing distinct points on the value-addition spectrum.

  1. The most straightforward option is supplying frozen intestinal mucosa: fresh mucosa collected immediately after slaughter, mechanically separated, washed to remove contents, and flash-frozen at –20°C in standardised blocks for sale to pharmaceutical heparin refiners. This low-processing model requires an estimated €200,000–300,000 in initial capital. With 5,000 pigs per week producing 200–300 g of mucosa each, annual output reaches 52,000–78,000 kg. Market prices for properly handled and traceable frozen mucosa range €8–15/kg, and using a conservative €10/kg benchmark yields €520,000–780,000 yearly revenue. Variable costs stand at €3–4/kg (labour, washing, packaging, freezing energy), while fixed costs remain relatively low at €40,000–60,000 for equipment amortisation, maintenance, and dedicated cold-storage operations.
  2. The second, more advanced option involves crude heparin extraction, processing frozen mucosa through alkaline extraction, initial precipitation, and spray-drying to obtain 30–40% purity crude heparin, which still requires pharmaceutical refinement by downstream buyers. This method adds value through basic extraction chemistry while remaining within food-grade or industrial chemical classifications rather than full pharmaceutical API production. Capital investment rises substantially, exceeding €500,000. Although crude heparin commands €180–280/kg, the severe volume reduction during extraction, yielding only 125–185 kg annually, renders the model economically unfeasible. Even with higher unit prices, annual revenue cannot cover fixed costs, resulting in structural losses.

Given the slaughterhouse's limited scale, a full heparin extraction process would not be economically viable. Instead, performing initial steps and supplying frozen intestinal mucosa to larger manufacturers could be a practical B2B strategy, adding partial value to low-value by-products and opening a path for future diversification.

4. Cluster formation and selection

In the previous chapter, the research examined innovative ways to increase the value of pork cuts that currently yield low returns, with the goal of improving the family business's overall margins. Beyond proposing a portfolio of options, the analysis assessed each concept's production requirements, target market, competitive context, and expected financial performance as a standalone product, using realistic cost and revenue assumptions to gauge individual viability.

From a practical standpoint, a cautious market entry would normally involve extensive validation or reliance on contract manufacturers to limit early exposure. However, since this thesis aims to explore transformative strategic directions, the methodology assumes an immediate "Day 1" capital investment. This deliberately conservative assumption functions as a stress-test, providing a consistent basis for comparison rather than reflecting the most likely go-to-market approach. The model was selected to offer a transparent view of the long-term financial feasibility and structural requirements of the proposed innovations. Accordingly, the economic projections in *Chapter 3* present conservative profitability estimates beginning from the moment the production plant becomes operational.

The findings show that most standalone initiatives fail to reach positive EBIT in their first year, with volumes often hovering around the break-even point. This reveals a structural vulnerability: entering emerging markets with new formulations carries significant uncertainty regarding demand behaviour and operating costs, increasing the likelihood of early losses. Given these results, it became clear that the strongest approach is not the development of isolated product lines, but a strategic move toward clustering. By pooling resources and sharing fixed costs, the company can improve financial resilience while keeping managerial complexity at a reasonable level.

This shift necessitated a disciplined selection process, leading to the exclusion of products lacking sufficient synergy with the rest of the portfolio. Consequently, heparin and ready-to-eat meals were set aside due to significant infrastructural and financial constraints.

The following sections analyse three optimised clusters designed to maximise operational synergies through shared machinery, workforce, logistics and downstream processes. Each cluster combines a core product with complementary add-ons, reducing fixed-cost pressure and enabling economies of scope. As noted earlier, the financial projections in *Chapter 3* offer

useful direction but remain limited by the uncertainties of forecasting new markets. With future costs and demand still uncertain, choosing the most viable cluster requires a broader evaluative approach rather than relying solely on quantitative estimates. To identify the option with the strongest strategic potential, a Multi-Criteria Decision Matrix (MCDM) is applied across seven key dimensions:

1. **Financial intensity:** total upfront cash requirements
2. **Economic potential:** this section presents the total 5-year NPV, Profitability Index (NPV relative to CAPEX and initial NWC) as the main driver, and both simple and discounted payback periods. In terms of followed methodology, infrastructure synergy diagrams use color coding to indicate equipment sharing: dark blue denotes full cross-product utilization, medium blue indicates dual-product sharing, and light blue represents single-product equipment. Fixed costs are adjusted to reflect increased scale and variety while maintaining the core operational synergies that define each cluster's value proposition.
3. **Market opportunity:** assessment of growth trends, addressable market size, and competitive whitespace balanced against incumbent strength
4. **Operational and regulatory complexity:** difficulty of execution regarding technical processes, supply chain dependencies, and regulatory barriers
5. **Strategic fit:** alignment with existing competencies, infrastructure, and brand identity
6. **Time-to-market:** the duration from initial investment to the break-even point, accounting for both technical implementation and market acceptance velocity
7. **Circular efficiency:** effective valorization of by-products and underutilized cuts, transforming potential waste into high-value revenue streams.

These seven criteria were selected to balance economic priorities, execution risks, strategic alignment, and sustainability objectives. After evaluating each dimension, a weighted scoring matrix will be presented. This tool enables a clear, comparative assessment of the alternatives by assigning relative importance to each attribute. The methodology ensures that the final choice is not driven by isolated indicators, but results from a deliberate, multifaceted evaluation that aligns financial expectations with the firm’s strategic capabilities and risk tolerance.

The financial performance of the selected clusters is evaluated using the demand forecasts identified in the previous analysis as a baseline (measured in kilograms for solid products and liters for bone broth). To ensure realistic market penetration and share acquisition, the model incorporates significant fixed marketing investments for each line. Consequently, annual growth rates are differentiated based on the strategic nature of the products:

- B2B commodities are projected to grow in line with standard market benchmarks
- Innovative category leaders grow slowly at first, reflecting consumer education needs, then accelerate as first-mover advantages take effect
- Incremental innovations within established markets are expected to perform slightly above average growth rates

To reinforce the conservative nature of these projections and limit estimation uncertainty, the model excludes learning effects. Fixed and variable unit costs remain constant over five years, omitting efficiency gains. Ex-factory prices are likewise held steady; although brand building could support premiums later, keeping prices fixed avoids overstating viability, as such gains may be offset by input-cost inflation. Absent detailed operating data, net working capital is set at 15% of annual revenues, in line with typical industry ratios of 10–20%. Corporate taxes are applied at 27.9% under Italian regimes. As the business is expected to continue beyond five years, a terminal value is calculated using the Gordon Growth Method with a conservative 2% perpetual growth rate. Given risk and assumption uncertainty, a conservative discount rate of 14% is applied to derive the final NPV.

Regarding CAPEX, facility construction costs are excluded. This reflects a deliberate boundary condition: the Company already has an integrated facility suitable for the new lines and fully connected to existing utilities, energy, water, gas, and logistics.

Finally, waste and process residues are managed through existing industrial synergies with the slaughterhouse. Since most raw materials are by-products already tracked in disposal logs, their use generates no additional logistic burden. The current wastewater treatment plant can absorb the cluster-specific flows, which remain marginal relative to total site volume. Any extra waste will follow established disposal channels, avoiding dedicated CAPEX and preserving the current cost structure, given the limited scale compared with core operations.

4.1 Collagen hub

The first analysed cluster is also the most intuitive. Collagen clearly stands out as a compelling opportunity for valorizing pork by-products: it derives from streams currently treated as waste, offers well-documented functional benefits, and is suitable for multiple high-value market applications. Throughout the research phase, it consistently emerged as a central theme, with several product ideas built around it. Consequently, the collagen cluster is presented as the most coherent and strategically sound option.

This cluster has been developed according to the following rationale:

- **Core product – Collagen B2B:**
  Collagen for B2B applications is positioned as the core product of the cluster. Its role is to enable production at sustainable volumes and to achieve economies of scale that would otherwise be difficult to reach.

- **First co-product – Collagen protein boost:**
  This product represents a natural extension of B2B collagen production. With an additional refining step, it achieves a higher level of purity and quality, making it suitable for a niche branded market with more demanding consumer expectations, while still relying on the same core process. Moreover, it offers an outstanding contribution margin and therefore serves as the primary profit driver of the cluster, helping to ensure the overall financial viability of the investment.

- **Second co-product – Human-grade bone broth:**
  Human-grade bone broth strengthens the cluster by making efficient use of the same processing steps required for collagen, with only a final additional phase needed to obtain the finished product. It creates an extra revenue stream that helps absorb fixed costs, thereby improving the overall profitability of the cluster.

Pet-grade bone broth with organs could also be a logical extension of the cluster, as it shares most of the process used for human-grade broth. However, it is considered an optional future development rather than part of the core cluster. Entering the pet-food market would require separate protocols and introduce additional complexity. Nonetheless, it remains a feasible product line that could be integrated later without disrupting the main structure of the cluster.

In the following section, the cluster will be evaluated against the previously defined criteria to determine whether it represents the most suitable option from multiple perspectives.

1. **Financial intensity**

The financial intensity of the Collagen Hub is characterized by substantial upfront Capital Expenditure (CAPEX), which is strategically mitigated by extensive infrastructure synergies. As illustrated in *Figure 4.1*, the "Hub logic" enables the distribution of costs across three product lines that share the majority of the upstream value chain, maximizing resource utilization from raw materials that would otherwise incur disposal costs:

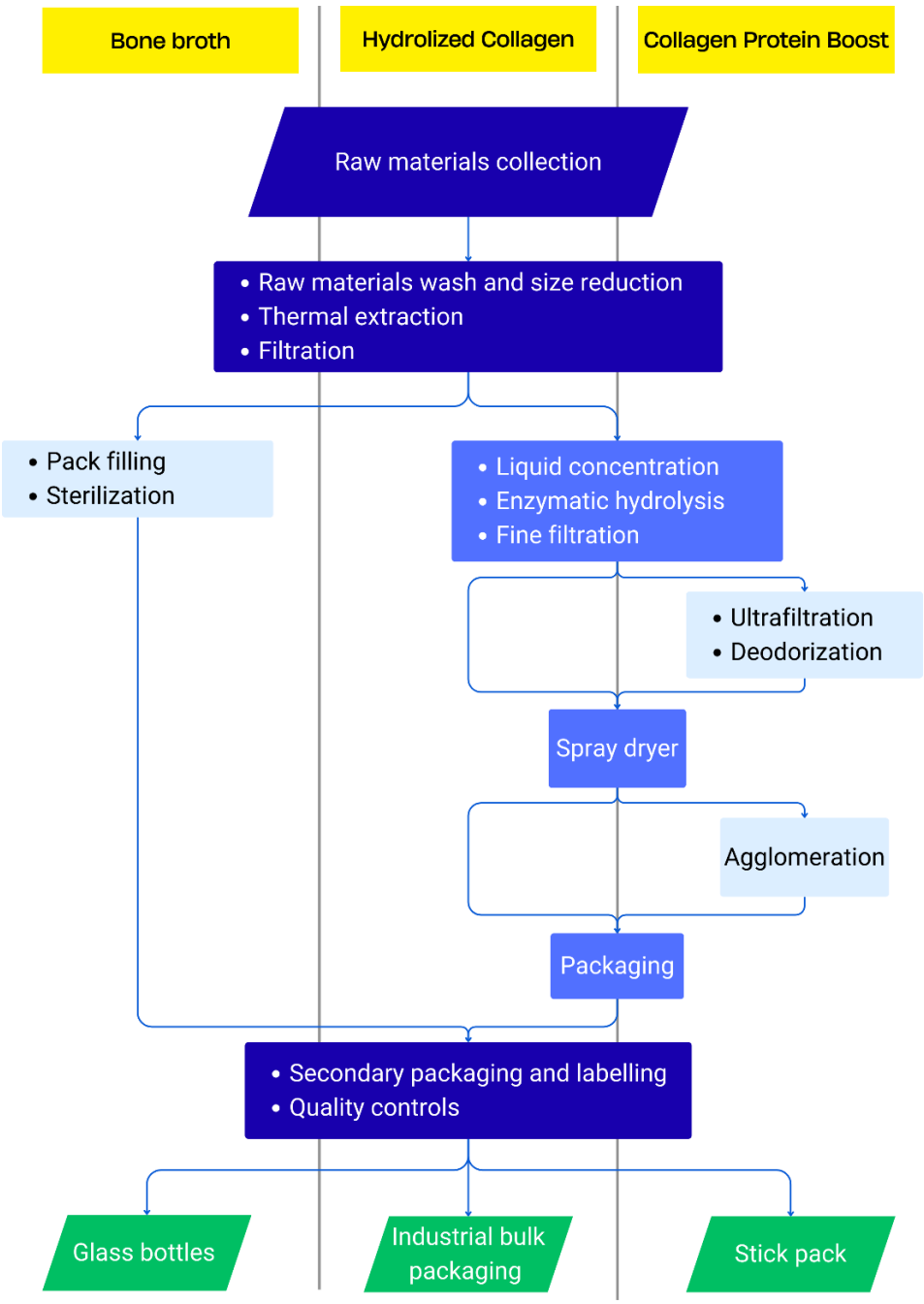

Figure 4.1 - Collagen hub infrastructure synergies

While Human-grade bone broth requires specific downstream stabilization, it still utilizes the core processing backbone shared by Collagen B2B and Collagen protein boost. As these two collagen-based products were conceived as inherently complementary, their investment assessment assumes a joint development to capture immediate operational efficiencies.

Production step	Equipment	Hydrolized collagen	Collagen Protein Boost	Bone Broth	Indicative cost (€)
Raw material cleaning	Sorting table + Industrial washer	☒	☒	☒	90,000 – 130,000
Size reduction	Bone crusher + Cartilage mincer	☒	☒	☒	80,000 – 120,000
Thermal extraction	Stainless steel boiler	☒	☒	☒	200,000 – 300,000
Coarse filtration	Mesh filter + Transfer pump	☒	☒	☒	50,000 – 80,000
Liquid concentration	Vacuum evaporator	☒	☒	☐	150,000 – 200,000
Enzymatic hydrolysis	PH and temperature control reactor	☒	☒	☐	200,000 – 300,000
Fine filtration	Ultrafiltration system	☒	☒	☐	150,000 – 250,000
Dual-stage ultrafiltration	Secondary membrane stage	☐	☒	☐	20,000 – 30,000
Deodorization	Carbon and filtration system	☐	☒	☐	70,000 – 90,000
Drying	Compact spray dryer	☒	☒	☐	300,000 – 400,000
Post-drying agglomeration	Fluid bed agglomeration system	☐	☒	☐	30,000 – 40,000
Packaging	Packaging line (liquids and powders)	☒	☒	☒	250,000 – 350,000
Sterilization	Autoclave for sterilisation	☐	☐	☒	200,000 – 300,000
Quality control laboratory	Lab equipment	☒	☒	☒	40,000 – 60,000
Total investment					**€1,830,000 – €2,650,000**

Table 4.1 - Collagen hub investment breakdown

As shown in *Table 4.1*, total CAPEX is estimated at around €2.25 million. Some shared equipment costs were adjusted to account for the slightly different production needs. The total investment is notably lower than developing each line independently: B2B Collagen (€2.0M), Protein boost (€0.22M), and Bone broth (€1.0M) would total €3.22 million. The cluster approach therefore generates CAPEX savings of over 30% through shared assets, a benefit also visible in the capital allocation:

- 40% of the investment is fully shared across all three lines
- 43% is shared between two product lines
- Only 17% represents complementary investment for individual products.

2. Economic potential

To accurately estimate the economic potential of the Collagen Hub, it is essential to quantify the operational synergies generated by shared resources. In an integrated manufacturing environment, producing multiple derivatives on a single, versatile line facilitates a transition to batch production. This model allows the firm to spread fixed overheads across a broader output base, significantly reducing the cost burden on individual product lines. The estimated annual fixed costs for the cluster are detailed in *Table 4.2*:

Cost category	Annual cost (€)	Comments
Depreciation (over 10 years)	225,000.00 €	Cluster depreciation
Production personnel	250,000.00 €	5 FTE[9] (1 manager, 3 operators, 1 QC technician)
Commercial personnel	130,000.00 €	2 FTE (Sales manager, marketing manager)
Maintenance	20,000.00 €	Preventive + corrective for shared line
Marketing expenses	300,000.00 €	Unified B2C + dedicated B2B campaigns
Administration and overheads	50,000.00 €	ERP, accounting, legal
Certifications and compliance	20,000.00 €	HACCP protocols, annual audits, lab testing
Total fixed costs	**995,000.00 €**	

Table 4.2 - Collagen Hub fixed costs breakdown

As shown, the total fixed costs for the cluster amount to approximately €1.0 million.

This consolidated cost structure represents a substantial improvement over the standalone production model. Based on the individual assessments in *Chapter 3*, the independent fixed costs were estimated at €550,000 for hydrolysed collagen, €430,000 for collagen protein boost, and €560,000 for bone broth, resulting in a theoretical aggregate of €1.54 million.

By adopting a cluster-based strategy, the firm achieves an Opex saving of 35%.

After defining the total fixed cost structure, the NPV of the cluster can be estimated,

[9] **FTE (Full-Time Equivalent):** A standardised unit that expresses the workload of an employee in terms of a full-time schedule. One FTE corresponds to the hours worked by one full-time employee, while part-time workloads are represented as fractions of an FTE.

since variable costs have already been established for each product. The analysis begins by treating each product as an independent unit to calculate its annual contribution margin, based on growth trajectories derived from the market considerations outlined earlier in the chapter.

- Hydrolyzed collagen operates as a B2B commodity and is expected to follow market dynamics, growing at an estimated CAGR of 8.11%
- Collagen protein boost enters with an innovative offering, initially slowed by consumer-education needs, then surpassing market growth, fixed at 5.1%
- Human-grade bone broth competes in a market expanding at roughly 8% annually. However, given its novelty and premium formulation, it is expected to outperform the underlying market growth

On the basis of these assumptions, the annual contribution margin associated with each product line is calculated as shown below:

Hydrolized collagen	Year-1	Year-2	Year-3	Year-4	Year-5
Price	15.00 €	15.00 €	15.00 €	15.00 €	15.00 €
Unit contribution margin	6.25 €	6.25 €	6.25 €	6.25 €	6.25 €
Demand	100,000	108,000	116,640	125,971	136,049
Growth rate		8%	8%	8%	8%
Revenue	1,500,000.00 €	1,620,000.00 €	1,749,600.00 €	1,889,568.00 €	2,040,733.44 €
Contribution margin	625,000.00 €	675,000.00 €	729,000.00 €	787,320.00 €	850,305.60 €

Table 4.3: Annual contribution margin analysis – B2B Hydrolyzed Collagen segment

Collagen protein boost	Year-1	Year-2	Year-3	Year-4	Year-5
Price	70.00 €	70.00 €	70.00 €	70.00 €	70.00 €
Unit contribution margin	57.00 €	57.00 €	57.00 €	57.00 €	57.00 €
Demand	7,500	7,650	7,956	8,433	9,108
Growth rate		2%	4%	6%	8%
Revenue	525,000.00 €	535,500.00 €	556,920.00 €	590,335.20 €	637,562.02 €
Contribution margin	427,500.00 €	436,050.00 €	453,492.00 €	480,701.52 €	519,157.64 €

Table 4.4: Annual contribution margin analysis - Collagen Protein Boost segment

Human-grade bone broth	Year-1	Year-2	Year-3	Year-4	Year-5
Price	10.00 €	10.00 €	10.00 €	10.00 €	10.00 €
Unit contribution margin	6.50 €	6.50 €	6.50 €	6.50 €	6.50 €
Demand	60,000	63,600	69,960	76,956	83,112
Growth rate		6%	10%	10%	8%
Revenue	600,000.00 €	636,000.00 €	699,600.00 €	769,560.00 €	831,124.80 €
Contribution margin	390,000.00 €	413,400.00 €	454,740.00 €	500,214.00 €	540,231.12 €

Table 4.5: Annual contribution margin analysis –Human grade bone broth segment

Following the methodological framework previously established, the Net Present Value (NPV) of the cluster has been determined:

Year	0	1	2	3	4	5
Total revenues		2,625,000.00 €	2,791,500.00 €	3,006,120.00 €	3,249,463.20 €	3,509,420.26 €
Total contribution margin		1,442,500.00 €	1,524,450.00 €	1,637,232.00 €	1,768,235.52 €	1,909,694.36 €
Total fixed costs		-775,000.00 €	-775,000.00 €	-775,000.00 €	-775,000.00 €	-775,000.00 €
EBITDA		667,500.00 €	749,450.00 €	862,232.00 €	993,235.52 €	1,134,694.36 €
Total investment	-2,250,000.00 €					
Depreciation and amortization		-225,000.00 €	-225,000.00 €	-225,000.00 €	-225,000.00 €	-225,000.00 €
EBIT		442,500.00 €	524,450.00 €	637,232.00 €	768,235.52 €	909,694.36 €
Taxes		-123,457.50 €	-146,321.55 €	-177,787.73 €	-214,337.71 €	-253,804.73 €
NOPAT		319,042.50 €	378,128.45 €	459,444.27 €	553,897.81 €	655,889.63 €
Net working capital	-393,750.00 €	-418,725.00 €	-450,918.00 €	-487,419.48 €	-526,413.04 €	-536,941.30 €
Δ in NWC	-393,750.00 €	-24,975.00 €	-32,193.00 €	-36,501.48 €	-38,993.56 €	-10,528.26 €
Terminal value						5,485,571.68 €
Free Cash Flow	-2,643,750.00 €	519,067.50 €	570,935.45 €	647,942.79 €	739,904.25 €	6,355,933.05 €
PV	-2,643,750.00 €	455,322.37 €	439,316.29 €	437,342.93 €	438,082.71 €	3,301,072.46 €
NPV	**2,427,386.76 €**					

Table 4.6 - Collagen Hub NPV

As illustrated in *Table 4.6*, the project yields an NPV of approximately €2.43 million, a result that underscores the significant financial viability of the investment.

To account for market volatility and its potential impact on performance, a sensitivity analysis was conducted by simulating two divergent demand scenarios (±20% variance across all product lines):

- Pessimistic Scenario (-20% Demand): yields a positive NPV of 514,758 €
- Optimistic Scenario (+20% Demand): results in an NPV of 4,340,016 €

The business model's resilience is confirmed by a positive NPV across all market scenarios. However, a Profitability Index of 0.92 highlights the cluster's capital-intensive nature and gradual return profile. This is further evidenced by a 4.25-year payback period (6.03 years discounted), indicating an extended recovery horizon. Despite these initial constraints, the hub stabilizes to generate approximately €900,000 in annual net profit, with overall valuation heavily driven by terminal value. Ultimately, the cluster represents a robust source of perpetual value, aligning with the firm's long-term strategic objectives by prioritizing sustained profitability over immediate capital efficiency.

3. **Market opportunity**

As previously highlighted, each product is positioned within a high-growth market. Specifically:

- Hydrolyzed collagen shows a European CAGR of 8.11%
- Collagen protein boost stands at 5.1%
- Human-grade bone broth is growing at approximately 8%

These figures demonstrate that the Collagen hub offers not only significant profitability but also a strategic opportunity to establish brand leadership in an expanding landscape. While the B2B collagen market is currently dominated by major players leveraging economies of scale, lower fixed costs can be offset by vertical integration. Developing an internal production plant, directly linked to the core company, will ensure seamless access to raw materials while significantly optimizing procurement and logistics costs. In a fast-evolving market, a well-positioned brand backed by an efficient supply chain is poised to capture an increasing share of the market.

4. **Operational and regulatory complexity**

The operational and regulatory landscape for the Collagen hub is characterized by high entry barriers and significant execution complexity. Technically, producing high-purity hydrolyzed collagen requires precise enzymatic control and validated Clean-In-Place (CIP) protocols to ensure consistency across product lines (Gómez-Guillén et al., 2011). From a supply chain perspective, maintaining 'human-grade' status necessitates an integrated traceability system (as per Reg. 178/2002) to monitor raw materials from pork consortia through to finished goods.

Regulating this cluster involves a multi-layered framework. Beyond mandatory sanitary authorizations (Reg. 853/2004), the facility requires HACCP validation and, for B2B/retail scalability, international certifications such as ISO 22000 or BRC/IFS Food, which entail an initial investment of €25,000 to €40,000 in audit fees alone. Product-specific compliance adds further friction: dietary supplements require Ministry of Health notification and strict adherence to EFSA health claim restrictions, while bone broth necessitates rigorous thermal process validation (EFSA, 2011). Collectively, these requirements demand a significant additional CAPEX for structural compliance and QC laboratory setup, significantly increasing the cluster's overall financial and operational intensity.

5. **Strategic fit**

The strategic fit of the Collagen hub is characterized by strong operational synergy with the core company. The slaughterhouse converts low-value porcine by-products into high-value raw materials, securing the supply chain while utilizing existing waste management systems to achieve a closed-loop circular economy. The Company's B2B expertise transfers directly to the industrial collagen market, while its established network with large-scale retailers and food-industry brokers provides strategic access to the B2C segment, mitigating typical barriers in human nutrition. The certified supply chain offers a competitive advantage through transparency, addressing consumer demand for safety and traceability. However, the cluster faces a strategic branding challenge: targeting three distinct markets, B2B industrial collagen, consumer supplements, and premium food, requires differentiated positioning for each segment. This fragmentation prevents unified brand-building, as products enter their respective markets independently rather than benefiting from shared brand equity. Unlike single-focus clusters, each product must establish market presence individually, potentially diluting impact and requiring greater marketing investment to achieve comparable recognition.

6. **Time-to-market**

The implementation phase is significantly influenced by the stringent certification requirements previously discussed, which impose an estimated regulatory lead time of 12 to 18 months. This duration accounts for the gap analysis, structural upgrades, and the multi-layered audit processes required for human-grade food safety standards. While the technical construction of the facility is subject to the inherent risks of industrial projects, the projected payback period is calculated at 4.29 years from the commencement of production.

Regarding market acceptance velocity, while entering the human nutrition segment introduces higher uncertainty compared to traditional B2B streams, this risk is mitigated by the favorable macroeconomic landscape. The products are positioned within high-growth markets characterized by CAGRs between 5 and 10%, which facilitate faster market penetration and adoption. Consequently, while the initial phase requires a patient capital approach due to the slow implementation, the robust demand for high-purity collagen provides a clear pathway toward achieving the break-even point within a reasonable industrial timeframe.

7. Circular efficiency

The Collagen hub represents the pinnacle of the project’s sustainability strategy by converting industrial by-products into high-value bioactive ingredients. Practically, this cluster shifts the company’s operational paradigm from "waste management" to "resource upcycling": porcine materials that currently incur disposal costs or yield minimal returns are transformed into premium products. This transition is measured by the value-added spread per kilogram, where the economic output of the raw material is exponentially increased through biotechnological processing.

The system's efficiency is further enhanced by its seamless integration with the existing facility's infrastructure. Any secondary residues generated during collagen extraction do not return to the waste stream; instead, they are diverted into the company’s pre-established rendering or anaerobic digestion systems. This closed-loop approach ensures that no part of the raw material is wasted but rather utilized according to a "cascading" logic, prioritizing human nutrition first, and technical or energy recovery second. By decoupling revenue growth from resource consumption, the Collagen hub serves as a concrete example of industrial symbiosis, maximizing both environmental performance and economic resilience.

4.2 Premium pet hub

The second proposed cluster integrates diverse processing technologies to capitalize on significant downstream synergies. While the pet food industry continues to experience robust growth, it remains a highly consolidated market where large-scale incumbents dominate the mass-market segments. The strategic rationale for this cluster marks a deliberate shift from the previous model: instead of focusing primarily on shared manufacturing infrastructure, it prioritizes the development of commercial and brand synergies. The objective is to establish a distinctive market identity through a portfolio of innovative, high-end products. By leveraging unified marketing strategies and shared distribution channels, this cluster aims to penetrate the high-value niche of functional pet nutrition with the following specialized offerings:

- **Core product – Pork loin slice:**
  This represents the cluster's most disruptive offering in terms of market positioning. As detailed in *Section 3.3.1*, it currently faces no direct competition. By introducing a "human-grade" cut, traditionally reserved for human consumption, tailored specifically for pet nutritional requirements, this product aims to redefine standard industry categories and lead a paradigm shift in how premium pet food is perceived.
- **First co-product – Bone broth with organs:**
  While the manufacturing process mirrors the human-grade variant, this product is formulated as a nutritionally complete meal, a critical factor for regulatory and marketing claims. It capitalizes on the "pet humanization" trend by offering a wholesome, palatable alternative to conventional wet food, bridging the gap between home-cooked quality and industrial convenience.
- **Second co-product – Skin sticks:**
  Positioned within the functional chew segment, these sticks provide a natural alternative to traditional treats. Naturally rich in collagen, they support dental hygiene and joint health while serving as a durable enrichment tool. Despite entering a relatively saturated niche, the product distinguishes itself through a superior, clean-label formulation derived from a certified supply chain.

This platform is designed for scalability, allowing for the easy integration of similar products or line extensions. While the current configuration is derived from the analysis in *Chapter 3*, it remains a dynamic framework; future market feedback will dictate the most viable strategic directions to further refine and expand the hub’s offering.

1. Financial intensity

The Premium pet hub exhibits a lower degree of infrastructural optimization compared to the previous cluster, primarily due to the heterogeneous nature of the manufacturing processes involved. The bone broth with organs facility represents the primary capital expenditure (CAPEX) driver, requiring specialized equipment that limits extensive machinery overlap across the product lines. Nevertheless, strategic synergies have been identified to mitigate the investment burden, as detailed below:

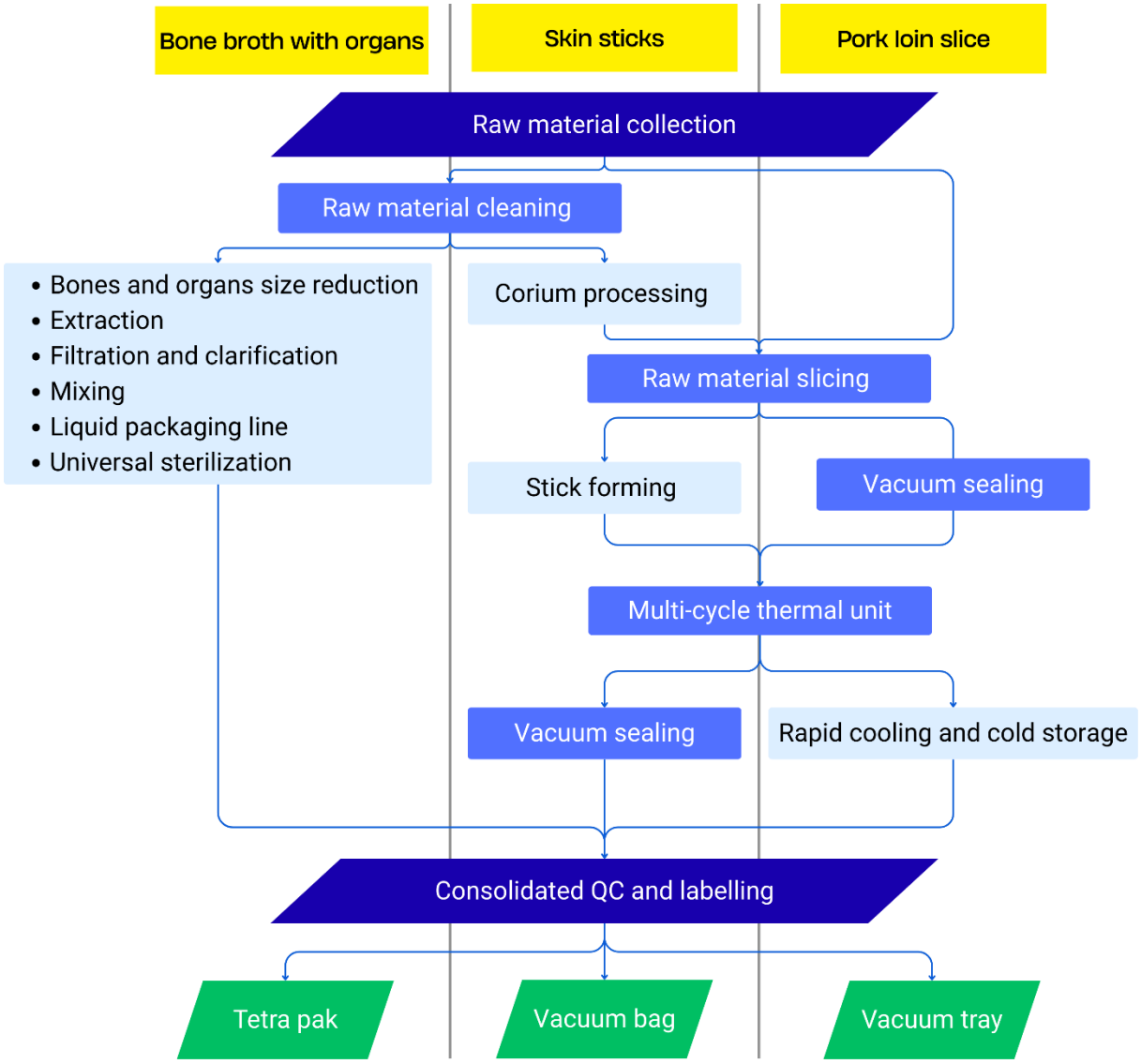

Figure 4.2 - Premium pet hub infrastructure synergies

Several process adjustments were made to share machinery across multiple products. This is the case for the raw material cleaning step, where washing tanks are shared for bones, organs, and pork skin. Notably, a multi-cycle thermal unit replaces the steam and batch convection ovens for the pork loin and skin sticks, respectively, while quality control and labeling have been adapted to handle multiple formats. Currently, the industrial autoclave is used to sterilize the bone broth; however, it could also be used to make the pork loin shelf-stable. At the moment, it serves only one product to maintain the loin's premium perception, but it remains an available asset to lower costs and further optimize cluster synergies.

Production stage	Main equipment	Bone broth with organs	Skin sticks	Pork loin slice	Indicative investment (€)
Raw material cleaning	Washing tanks and filters	☒	☒	☐	€25,000 - €40,000
Corium processing	Automatic band knife splitter	☐	☒	☐	€50,000 - €100,000
Raw material slicing	Slicing and trimming station	☐	☒	☒	€30,000 - €50,000
Bones and organs size reductions	Heavy-duty grinder	☒	☐	☐	€50,000 - €100,000
Extraction	Industrial boiler	☒	☐	☐	€200,000 – €400,000
Filtration and clarification	Membrane filters / centrifuges	☒	☐	☐	€80,000 – €150,000
Mixing	Mixing tank and homogenizer	☒	☐	☐	€30,000 - €60,000
Stick forming and pressing	Semi-automatic rolling machine	☐	☒	☐	€20,000 - €40,000
Vacuum sealing	Double-chamber vacuum sealer	☐	☒	☒	€40,000 – €70,000
Multi-cycle thermal unit	Industrial combi oven	☐	☒	☒	€100,000 - €150,000
Rapid cooling	Blast chiller	☐	☐	☒	€30,000 – €60,000
Packaging for liquid	Packaging line	☒	☐	☐	€150,000 – €200,000
Universal sterilization	Industrial autoclave	☒	☐	☐	€200,000 - €300,000
Consolidated QC and labelling	Universal labeller + centralized lab	☒	☒	☒	€50,000 - 100,000
Total cluster investment					**€1,055,000 - €1,820,000**

Table 4.7 - Premium pet hub investments breakdown

As illustrated in *Table 4.7*, the cluster investment ranges from €1.14 to €1.92 million, averaging €1,430,000. This is slightly lower than standalone lines, where Pork loin and Skin sticks cost €0.3 million each and Bone broth with organs €1.0 million. While the cluster model achieves an 11% saving, the synergy distribution is concentrated:

- Just 5% is shared across all the three products
- 18% is shared between two products
- 77% comes from single products, mainly brought by bone broth

2. **Capital intensity**

The Premium pet hub shows limited infrastructural synergies regarding initial investment, yet fixed cost sharing is optimized across these three products. Operating within the same market segment reduces the effort needed for brand development. Ultimately, the strongest synergy lies in an intangible asset: a diverse product portfolio that positions the brand as a comprehensive, multi-offering label.

Cost category	Annual cost (€)	Comments
Depreciation (over 10 years)	143,000.00 €	Cluster depreciation
Production personnel	250,000.00 €	5 FTE (1 manager, 3 operators, 1 QC technician)
Commercial personnel	130,000.00 €	2 FTE (Sales manager, marketing manager)
Maintenance	20,000.00 €	Preventive + corrective for shared line
Marketing expenses	250,000.00 €	Unified B2C campaigns
Administration and overheads	50,000.00 €	ERP, accounting, legal
Certifications and compliance	10,000.00 €	HACCP protocols, annual audits, lab testing
Total fixed costs	**853,000.00 €**	

Table 4.8 - Premium Pet Hub fixed costs breakdown

As shown in *Table 4.8,* the total fixed costs for the cluster are €853,000, a value that substantially mitigates the overhead burden on individual lines. In a standalone scenario, cumulative fixed costs would reach €1,445,000 (€545,000 for Bone broth, €475,000 for Skin sticks, and €425,000 for Pork loin). By adopting a cluster structure, the company achieves a 41% saving in fixed costs alone, significantly improving the overall financial efficiency of the hub. Indeed, this constitutes the core value proposition of this cluster framework.

Following the definition of the cluster's fixed and variable cost structures, the overall NPV estimation can be conducted. To ensure a realistic projection within each market, a specific growth path for each product must be established based on its respective niche:

- Bone broth with organs targets the pet bone broth market ($1.26B; 8.2% CAGR globally (Dataintelo, 2025)), requiring an initial educational phase for liquid meal adoption. Growth scales as the shelf-stable Tetra Pak format facilitates broader distribution, eventually aligning with industry trends.
- Skin sticks operate in the dental chews niche ($0.78B; 7.86% CAGR globally (Mordor Intelligence, 2025)), focusing on displacing established competitors. Following a cautious entry, growth is sustained by the shift toward natural ingredients and high brand loyalty, ensuring recurring purchase cycles.
- Pork loin slice addresses the European fresh pet food market (€400M; 14.30% CAGR (Sable Aditya, 2025)). Growth begins conservatively due to cold-chain and shelf-space constraints but is projected to outpace market averages, leveraging its premium "human-grade" positioning.

Product-specific contribution margins were derived as follows:

Bone broth with organs	Year-1	Year-2	Year-3	Year-4	Year-5
Price	13.00 €	13.00 €	13.00 €	13.00 €	13.00 €
Unit contribution margin	9.50 €	9.50 €	9.50 €	9.50 €	9.50 €
Demand	50,000	53,000	58,300	63,547	68,631
Growth rate		6%	10%	9%	8%
Revenue	650,000.00 €	689,000.00 €	757,900.00 €	826,111.00 €	892,199.88 €
Contribution margin	475,000.00 €	503,500.00 €	553,850.00 €	603,696.50 €	651,992.22 €

Table 4.9: Annual contribution margin analysis - Bone broth with organs segment

Skin sticks	Year-1	Year-2	Year-3	Year-4	Year-5
Price	20.00 €	20.00 €	20.00 €	20.00 €	20.00 €
Unit contribution margin	17.50 €	17.50 €	17.50 €	17.50 €	17.50 €
Demand	20,000	21,000	22,890	24,721	26,452
Growth rate		5%	9%	8%	7%
Revenue	400,000.00 €	420,000.00 €	457,800.00 €	494,424.00 €	529,033.68 €
Contribution margin	350,000.00 €	367,500.00 €	400,575.00 €	432,621.00 €	462,904.47 €

Table 4.10: Annual contribution margin analysis - Skin stick segment

Pork loin slice	Year-1	Year-2	Year-3	Year-4	Year-5
Price	25.00 €	25.00 €	25.00 €	25.00 €	25.00 €
Unit contribution margin	15.75 €	15.75 €	15.75 €	15.75 €	15.75 €
Demand	25,000	27,000	30,240	35,683	40,679
Growth rate		8%	12%	18%	14%
Revenue	625,000.00 €	675,000.00 €	756,000.00 €	892,080.00 €	1,016,971.20 €
Contribution margin	393,750.00 €	425,250.00 €	476,280.00 €	562,010.40 €	640,691.86 €

Table 4.11: Annual contribution margin analysis - Pork loin slice segment

Once the total annual contribution margin has been determined for each product within the cluster, the NPV calculation can be performed:

Year	0	1	2	3	4	5
Total revenues		1,675,000.00 €	1,784,000.00 €	1,971,700.00 €	2,212,615.00 €	2,438,204.76 €
Total contribution margin		1,218,750.00 €	1,296,250.00 €	1,430,705.00 €	1,598,327.90 €	1,755,588.55 €
Total fixed costs		-710,000.00 €	-710,000.00 €	-710,000.00 €	-710,000.00 €	-710,000.00 €
EBITDA		508,750.00 €	586,250.00 €	720,705.00 €	888,327.90 €	1,045,588.55 €
Total investment	-1,430,000.00 €					
Depreciation and amortization		-143,000.00 €	-143,000.00 €	-143,000.00 €	-143,000.00 €	-143,000.00 €
EBIT		365,750.00 €	443,250.00 €	577,705.00 €	745,327.90 €	902,588.55 €
Taxes		-102,044.25 €	-123,666.75 €	-161,179.70 €	-207,946.48 €	-251,822.20 €
NOPAT		263,705.75 €	319,583.25 €	416,525.31 €	537,381.42 €	650,766.34 €
Net working capital	-251,250.00 €	-267,600.00 €	-295,755.00 €	-331,892.25 €	-365,730.71 €	-373,045.33 €
Δ in NWC	-251,250.00 €	-16,350.00 €	-28,155.00 €	-36,137.25 €	-33,838.46 €	-7,314.61 €
Terminal value						5,469,339.68 €
Free Cash Flow	-1,681,250.00 €	390,355.75 €	434,428.25 €	523,388.06 €	646,542.95 €	6,255,791.41 €
PV	-1,681,250.00 €	342,417.32 €	334,278.43 €	353,272.03 €	382,805.33 €	3,249,062.03 €
NPV	**2,980,585.14 €**					

Table 4.52 - Premium pet hub NPV

As illustrated in *Table 4.12*, the Premium pet hub achieves a 5-year NPV of approximately €3.0 million, a figure that doubles the initial investment and demonstrates the financial robustness of the cluster. To further assess its resilience, sensitivity analysis was conducted by applying a ±20% demand variance across all product lines:

- Optimistic scenario (+20% demand): €4,729,805
- Pessimistic scenario (−20% demand): €1,231,365

The NPV remains strongly positive even under adverse conditions, confirming the cluster's financial resilience. Consistent with the Collagen hub, terminal value significantly impacts total NPV, though the project remains profitable even without it. Strategic weight lies in a unified brand identity, providing a stronger foundation for perpetuity than single-product ventures. Furthermore, a 1.77 Profitability Index and a 3.48-year payback period (4.66 years discounted) ensure rapid capital recovery and high efficiency. This timeline, combined with the favourable growth of the premium pet food sector, makes the cluster highly compelling in today's market.

3. Market opportunity

The Premium pet hub targets high-growth niches that significantly outperform the 5.1% global pet food CAGR (Grand View Research, 2025), offering a highly favorable landscape for specialized entrants:

- Pork loin slice: addresses the European fresh pet food market (€400M; 14.30% CAGR), driven by the shift toward minimally processed diets.
- Bone broth with organs: operates in the global pet bone broth sector ($1.26B; 8.2% CAGR) as a functional liquid topper.
- Skin sticks: targets the dental chews niche ($0.78B; 7.86% CAGR), capturing the transition from synthetic to natural treats.

The project's core advantage lies in its vertical integration with a certified supply chain. This enables a clean-label strategy, which in pet food refers to transparent sourcing, minimal industrial processing, and the absence of artificial additives. By leveraging direct access to human-grade raw materials, the brand can ensure the quality and traceability required to build long-term trust and scalability in the premium "pet humanization" market.

4. Operational and regulatory complexity

The Premium pet hub presents moderate operational complexity through integrating three distinct production workflows: a multi-temperature thermal unit for bone broth and sous-vide loin, a dehydration line for skin sticks, and differentiated packaging systems (aseptic for broth, vacuum-sealed for treats). Simultaneous execution demands rigorous scheduling to prevent cross-contamination between raw materials with different microbiological profiles. The cluster leverages direct vertical integration with the slaughterhouse. Regulated by (EC) 183/2005 and Regulation 1069/2009, maintaining human-grade status requires treating inputs as Category 3 animal by-products with full traceability. While regulatory requirements are less stringent than for human supplements (no HACCP pre-approval is mandated) the facility must demonstrate Good Manufacturing Practices compliance and undergo periodic ASL inspections. The primary constraint lies in cold chain logistics: maintaining 0–4°C throughout production and distribution imposes a 21-day shelf life, limiting market access to Italian pet specialty stores with adequate refrigeration. This creates a significant entry barrier protecting the hub from less-structured competitors.

5. **Strategic fit**

The strategic fit of the Premium pet hub is characterized by deep operational synergies with the core slaughterhouse infrastructure. Upstream, the cluster transforms low-value materials, organs, bones and skin destined for rendering, into premium pet nutrition while enabling the valorization of pork loin, a noble cut that has lost market positioning in recent years due to shifting consumer preferences. Downstream integration leverages existing cold chain infrastructure, including refrigerated storage cells and transport fleet, eliminating the need for additional capital investment in logistics. This closed-loop model ensures cost efficiency while maintaining strict quality standards throughout the supply chain. From a brand perspective, the cluster enables the creation of a unified premium pet food brand launching simultaneously across three complementary segments: complete meal topper (bone broth), fresh treat (pork loin), and dental chew (skin sticks). This portfolio approach strengthens market positioning by addressing multiple pet care needs under a single brand identity, facilitating cross-selling and brand recognition. However, strategic brand separation from the slaughterhouse's B2B identity is critical. Consumer sensitivity regarding shared production between human and pet food necessitates distinct branding, messaging, and visual identity to avoid reputational risk and maintain consumer trust in both channels.

6. **Time-to-market**

The implementation timeline for the Premium pet hub is primarily constrained by the integration of multiple production lines and the establishment of cold chain logistics for fresh products. However, unlike the Collagen hub's extensive regulatory lead time, pet food production operates under less stringent certification requirements, enabling a faster operational ramp-up, though still subject to facility setup and equipment commissioning timelines.

Regarding market acceptance velocity, the cluster anticipates slower initial growth due to the novelty of premium fresh pet food and the need for consumer education around functional nutrition. This gradual adoption curve is mitigated by favourable market dynamics: target segments exhibit CAGRs between 7.9% and 14.3%, facilitating faster penetration once brand awareness is established. The projected payback period stands at 3.48 years from production start, reflecting both the conservative launch phase and the accelerating demand trajectory as the brand gains traction in high-growth niches.

7. Circular efficiency

The Premium pet hub represents a strategic expression of circular efficiency by converting materials with limited commercial value into premium pet nutrition products. Porcine organs and skin, traditionally destined for rendering a few cents or classified as Category 3 animal by-products, are transformed into high-margin functional ingredients. Bone broth captures the nutritional value of organs through hydrothermal extraction, while skin sticks leverage collagen-rich dermal tissue as natural dental chews, effectively shifting these materials from the waste stream to premium product lines.

Paradoxically, the cluster's most compelling circular efficiency case involves pork loin, the noblest cut of the animal. Despite its premium anatomical positioning, evolving consumer preferences have depressed its market value in human food channels. By repositioning this cut as a fresh pet treat at €25/kg, significantly above its human food wholesale value, the cluster achieves maximum economic valorization, demonstrating that circular efficiency extends beyond environmental waste reduction to include strategic reallocation of undervalued assets toward higher-margin applications. This revalorization is enhanced by seamless integration with the slaughterhouse's existing waste management infrastructure. Secondary residues are diverted into pre-established rendering, ensuring zero waste while maintaining a fully closed-loop operation.

4.3 Snacking revolution hub

The Snacking revolution hub embodies a dual strategic advantage: operational synergy and market responsiveness. Unlike previous clusters, these products share nearly identical production processes and target a unified downstream segment: premium protein snacking. This enables a cohesive brand identity while achieving near-total equipment overlap, optimizing both CAPEX and OPEX.

Strategically, the cluster resolves a critical paradox in the pork value chain: noble cuts, while high in quality, often face stagnating margins at the wholesale level due to evolving dietary habits. By repositioning these premium materials into shelf-stable formats aligned with Keto and Clean-Label trends, the hub transforms traditional quality into modern value, capturing significantly higher margins by aligning with market demand rather than resisting it.

Coming to the cluster structure, it would be composed as follows:

- **Core product – Meat chips:**
  The formulation of meat chips aligns with emerging dry meat snack solutions gaining traction in the market yet diverges fundamentally in positioning strategy. Meat chips aim to replace traditional potato crisps with a high-protein, nutrient-dense alternative that preserves the crunchy texture, savoury appeal, and convenient snacking format consumers expect. The product allows for differentiation through marinades or light seasoning layers, such as paprika or herbs, that enhance palatability without compromising its clean-label profile. Positioned within the fitness and health-conscious segment, meat chips maintain minimal salt and fat content while delivering high protein density, making them suitable for functional nutrition occasions.
- **Co-product – Charcuterie chips:**
  While briefly introduced in the previous chapter, this product emerges as the cluster's most complementary offering. It represents the indulgent, flavour-forward dimension of the portfolio. The raw material consists of cured pork products, including prosciutto crudo, speck, pancetta, guanciale, and coppa, essentially any artisanal cured meat. The nutritional profile diverges from the core product: while protein content remains high, fat and sodium levels are significantly elevated due to the curing process. This positions charcuterie chips as a premium indulgence rather than a functional health product, targeting consumers seeking bold, savoury snacking experiences over nutritional optimization.

1. **Financial intensity**

The Snacking revolution hub stands out for its high capital efficiency. Unlike the previous clusters, this facility operates as a versatile manufacturing platform where nearly 100% of the machinery is shared between the "healthy" and "indulgent" product lines. This near-total equipment overlap minimizes initial CAPEX while ensuring optimal capacity utilization. By leveraging a single production stream for diverse market segments, the hub achieves a leaner investment profile without compromising technical scalability.

The operational structure is organized as follows:

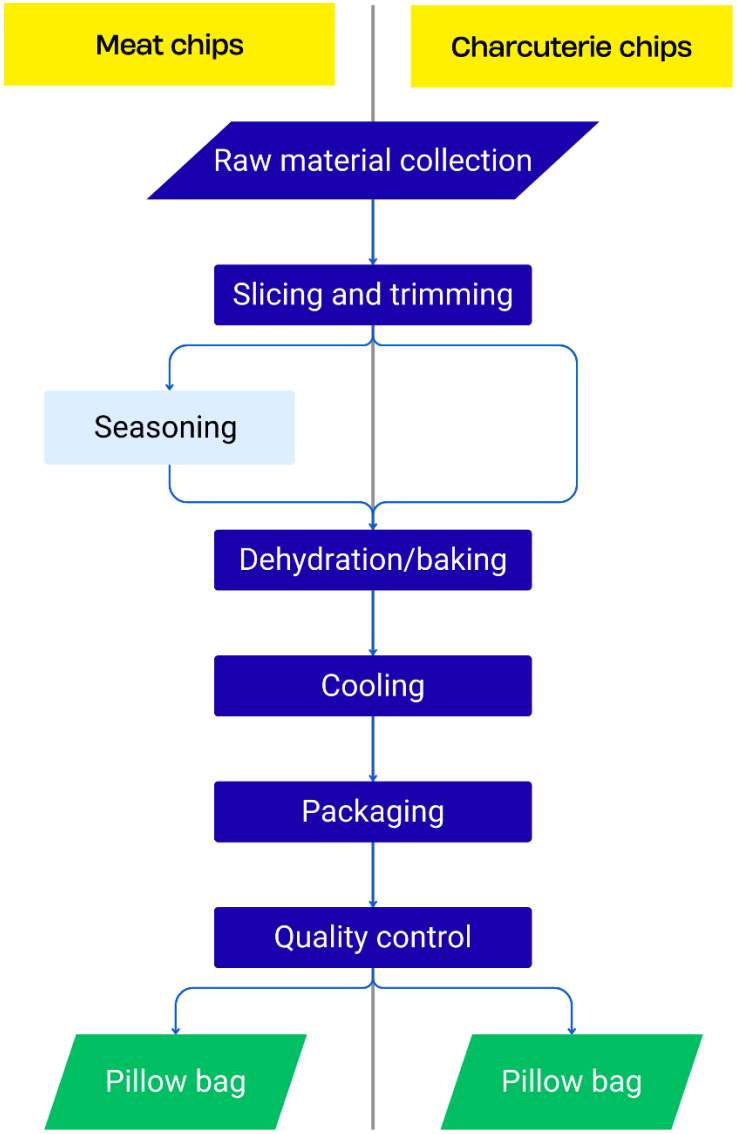

Figure 4.3 - Snacking revolution hub infrastructure synergies

The baseline production process designed for meat chips required minor modifications to accommodate charcuterie chips, which possess distinct material characteristics and processing requirements. The slicing and trimming stage accounts for the firmer texture of cured meat, necessitating a slightly higher equipment specification to ensure consistent precision. Additionally, given the elevated fat content inherent to cured products, a grease collection system was integrated into the dehydration stage to manage fat rendering during thermal processing. The packaging infrastructure, based on Vertical Form-Fill-Seal (VFFS) technology, proves universally compatible with both product formats, enabling complete equipment sharing for the packaging stage.

Production stage	Main equipment	Meat chips	Charcuterie chips	Indicative investment (€)
Slicing and trimming	Industrial meat slicer	☒	☒	€20,000 – €40,000
Seasoning	Spray seasoning system	☒	☐	€15,000 – €30,000
Dehydration/baking	Hot-air dehydrator + grease management system	☒	☒	€100,000 – €220,000
Cooling	Cooling conveyor	☒	☒	€20,000 – €40,000
Packaging	Vertical form-fill-seal (VFFS) packaging line	☒	☒	€100,000 – €150,000
Quality control	Basic lab equipment	☒	☒	€30,000 – €50,000
Total investment cost				**€285,000 – €530,000**

Table 4.13 - Snacking revolution hub investment breakdown

Figure 4.3 and *Table 4.13* illustrate the cluster's exceptional equipment synergy: the infrastructure is essentially a unified production line serving both products, with minor adaptations for charcuterie chips. The total investment ranges from €285,000 to €530,000, with a midpoint estimate of €400,000, significantly lower than previous clusters despite accommodating two product lines. This configuration achieves a 44% CAPEX saving compared to standalone production. The meat chips line requires €370,000, while a dedicated charcuterie line would require approximately €350,000 (excluding the €20,000 seasoning system unnecessary for pre-cured meat), totalling €720,000 for separate facilities. The shared-line approach therefore delivers €320,000 in capital savings. Equipment synergy breakdown reveals:

- 96% of CAPEX shared across both products
- 4% allocated to product-specific equipment (seasoning system)

This platform architecture demonstrates huge scalability opportunities: the core infrastructure remains compatible with various thin-sliced meat formats, enabling additional product integration with minimal incremental investment.

2. Economic potential

While the cluster demonstrates strong equipment synergy, the snacking category presents inherent margin pressure. Thin-sliced formats command premium pricing but incur significant weight loss during dehydration, concentrating raw material costs per finished unit. Additionally, fixed operating costs represent a substantial portion of total cost structure. The dual-product platform addresses these challenges by distributing fixed costs across two revenue streams, improving unit economics and overall profitability compared to single-product approaches.

Cost component	Annual estimate (€)
Equipment depreciation	40,000.00 €
Marketing	250,000.00 €
Production personnel	150,000.00 €
Commercial personnel	65,000.00 €
Maintenance	10,000.00 €
Certifications	5,000.00 €
Overheads and administration	40,000.00 €
Total annual fixed costs	**560,000.00 €**

Table 4.14 - Snacking revolution hub fixed costs breakdown

As detailed in *Table 4.14*, the consolidated annual fixed costs for the cluster total €560,000, achieving a 44% OPEX reduction compared to a standalone configuration. Although the charcuterie chips' cost structure was not independently modelled, it is assumed to be identical to the €500,000 baseline established for meat chips. Consequently, while separate entities would incur €1.0 million in costs, this integrated model requires only a marginal €60,000 increase. This delta covers specialized marketing and administrative oversight, while labour remains optimized: the shared workforce manages both lines simultaneously due to their significant technical similarity, effectively maximizing human capital efficiency.

Before presenting the cluster's NPV, the variable cost structure warrants detailed examination. Both products exhibit comparable total COGS per kilogram of finished product (~€28/kg), despite divergent raw material profiles and processing yields. Charcuterie chips utilize higher-cost cured meat inputs (€8-10/kg vs €4-5/kg for fresh pork) but retain greater mass during dehydration due to pre-existing fat content (yield:

35-40%). Conversely, meat chips source lower-cost lean cuts but experience more severe moisture loss (yield: 20-25%). These offsetting factors result in approximate COGS parity across both product lines, given that raw materials represent the primary driver of variable expenses. Before projecting financial performance, baseline demand assumptions must be established for each product:

- Meat chips: the Italian meat snack segment (€100M, 5.85% CAGR; Nexerv Labs, 2025) is accelerating in premium subsegments driven by low-carb trends (10.2% CAGR; Future Data Stats, 2024) and Italy's premium snacks growth (7.92%; Data Bridge, 2024). An average CAGR of 8.5% is adopted, above commodity (5.85%) but below pure keto (10%+), reflecting clean-label differentiation. Growth starts below market in Year 2 (new-brand friction), then accelerates above market as fitness-oriented consumers adopt the product.
- Charcuterie chips: Italy's gourmet aperitif segment is estimated at €300M (5% of €6B savory snacks; Statista, 2025). Assuming 0.3% initial penetration yields baseline demand of €900,000 (~10 tons at €90/kg ex-factory). Applying Europe's cured meat snack growth (7.5%; Persistence Market Research, 2025), an average CAGR of 6.5% is adopted, slightly below market due to premium pricing and niche positioning. Growth starts below market in Year 2 (consumer education), converging to market rate by Year 4-5 as brand awareness builds.

Unit contribution margins for each product line are determined as follows:

Meat chips	Year-1	Year-2	Year-3	Year-4	Year-5
Price	55.00 €	55.00 €	55.00 €	55.00 €	55.00 €
Unit contribution margin	27.00 €	27.00 €	27.00 €	27.00 €	27.00 €
Demand	18,750	19,875	21,664	23,830	25,975
Growth rate		6%	9%	10%	9%
Revenue	1,031,250.00 €	1,093,125.00 €	1,191,506.25 €	1,310,656.88 €	1,428,615.99 €
Contribution margin	506,250.00 €	536,625.00 €	584,921.25 €	643,413.38 €	701,320.58 €

Table 4.15: Annual contribution margin analysis - Meat chips segment

Charcuterie chips	Year-1	Year-2	Year-3	Year-4	Year-5
Price	60.00 €	60.00 €	60.00 €	60.00 €	60.00 €
Unit contribution margin	32.00 €	32.00 €	32.00 €	32.00 €	32.00 €
Demand	10,000	10,500	11,130	11,909	12,743
Growth rate		5%	6%	7%	7%
Revenue	600,000.00 €	630,000.00 €	667,800.00 €	714,546.00 €	764,564.22 €
Contribution margin	320,000.00 €	336,000.00 €	356,160.00 €	381,091.20 €	407,767.58 €

Table 4.16: Annual contribution margin analysis - Charcuterie chips segment

Following the determination of total contribution margin by product, NPV modelling was executed:

Year	0	1	2	3	4	5
Total revenues		1,631,250.00 €	1,723,125.00 €	1,859,306.25 €	2,025,202.88 €	2,193,180.21 €
Total contribution margin		826,250.00 €	872,625.00 €	941,081.25 €	1,024,504.58 €	1,109,088.16 €
Total fixed costs		-520,000.00 €	-520,000.00 €	-520,000.00 €	-520,000.00 €	-520,000.00 €
EBITDA		306,250.00 €	352,625.00 €	421,081.25 €	504,504.58 €	589,088.16 €
Total investment	-400,000.00 €					
Depreciation and amortization		-40,000.00 €	-40,000.00 €	-40,000.00 €	-40,000.00 €	-40,000.00 €
EBIT		266,250.00 €	312,625.00 €	381,081.25 €	464,504.58 €	549,088.16 €
Taxes		-74,283.75 €	-87,222.38 €	-106,321.67 €	-129,596.78 €	-153,195.60 €
NOPAT		191,966.25 €	225,402.63 €	274,759.58 €	334,907.80 €	395,892.57 €
Net working capital	-244,687.50 €	-258,468.75 €	-278,895.94 €	-303,780.43 €	-328,977.03 €	-335,556.57 €
Δ in NWC	-244,687.50 €	-13,781.25 €	-20,427.19 €	-24,884.49 €	-25,196.60 €	-6,579.54 €
Terminal value						3,309,160.71 €
Free Cash Flow	-644,687.50 €	218,185.00 €	244,975.44 €	289,875.09 €	349,711.20 €	3,738,473.73 €
PV	-644,687.50 €	191,390.35 €	188,500.64 €	195,657.43 €	207,057.10 €	1,941,646.11 €
NPV	**2,079,564.14 €**					

Table 4.17 - Snacking Revolution Hub NPV

The Snacking revolution hub delivers an NPV of €2.08 million over the five-year projection period (*Table 4.17*). While this absolute value is comparable to the previously analyzed clusters, this hub achieves such a return with a substantially lower CAPEX and through a streamlined portfolio of just two products, thereby reducing operational complexity.

The financial model demonstrates robust performance across different demand scenarios. Sensitivity analysis on ±20% demand variations yields:

- Optimistic scenario (+20% demand): NPV of €3.18 million
- Pessimistic scenario (−20% demand): NPV of €0.98 million

The cluster's resilience is further evidenced by its 3.23 Profitability Index and a 2.63-year payback period (3.33 years discounted), the shortest among all evaluated clusters. This rapid capital recovery ensures that from Year 4 onward, the hub generates approximately €350,000 in annual net profit, representing nearly half of the total initial investment (including working capital) recovered each subsequent year.

3. Market opportunity

The Snacking Revolution Hub addresses two high-growth opportunities within Italy's evolving snacking landscape. Meat Chips target the €100 million Italian meat snacks market, growing at 5.85% CAGR through 2030 (Nexerv Labs, 2025), with the premium segment expanding at 9.2% CAGR (Grand View Research, 2026). This product capitalizes on converging trends: meat-based protein snacking, the low-carb food movement (10.2% global CAGR; Future Data Stats, 2024), and ketogenic diet adoption in Italy, which increased from 1.5% to 2.3% between 2023-2024 (Food Navigator, 2024). The strategy emphasizes supply chain integration and traceable quality, creating whitespace distinct from commodity dried meat.

Charcuterie Chips address the €300 million gourmet aperitif segment within Italy's €6 billion savory snacks market (Statista, 2025), leveraging Europe's cured meat snack growth of 7.5% CAGR (Persistence Market Research, 2025). The product transforms traditional artisan cured meats into shelf-stable formats, occupying gap between commodity jerky and traditional charcuterie boards.

4. Operational and regulatory complexity

The Snacking revolution hub operates under EU food safety regulations for processed meat products. Production must comply with Regulation (EC) No 852/2004 requiring HACCP-based procedures and documented safety management, and Regulation (EC) No 853/2004 for specific hygiene rules on food of animal origin, including establishment approval and health marking. Dehydration-based production benefits from simpler regulatory oversight compared to thermal or aseptic systems, as ambient-stable products eliminate cold chain compliance post-production. Operationally, the cluster employs a streamlined linear workflow: slicing, seasoning (meat chips only), dehydration, cooling, and VFFS packaging. Supply chain dependency remains moderate: fresh lean pork is sourced from the integrated slaughterhouse, while cured meats are procured from Company’s curing facilities, with extended shelf life (6-12 months), providing procurement flexibility.

5. **Strategic fit**

The Snacking revolution hub demonstrates strong strategic alignment through favorable risk-return dynamics, with limited capital requirement yielding substantial returns while maintaining contained investment risk. Operationally, modest raw material volumes avoid disrupting core slaughterhouse operations, while the extended shelf life of finished products enables production scheduling during periods of lower demand for fresh pork loin or whole cured meats, optimizing facility utilization across seasonal cycles.

Upstream integration maximizes process synergies: fresh lean pork originates directly from slaughter operations for meat chips, while cured meats for charcuterie chips are sourced from the Company's internal aging facilities, ensuring complete supply chain control. The ambient-stable nature of final products eliminates fresh product logistics complexity, simplifying inventory and distribution. Downstream, the cluster builds on existing GDO relationships and retail networks developed through current distribution channels. However, the consumer-facing brand positioning represents a strategic departure from B2B operations, requiring dedicated marketing capabilities. This positions the cluster as a value-generating spin-off that diversifies revenue streams while leveraging core competencies in meat processing and quality assurance.

6. **Time-to-Market**

The Snacking revolution hub presents a compressed implementation timeline. Equipment procurement and installation for dehydration-based production requires approximately 4-6 months, followed by 2-3 months for process optimization and regulatory approval, yielding an estimated 6-9 months period from capital commitment to commercial launch, substantially shorter than thermal or aseptic processing systems. Market acceptance velocity benefits from existing category awareness: consumers demonstrate familiarity with both meat snacks and artisanal charcuterie concepts, reducing educational barriers. Initial distribution leverages established retail relationships, accelerating shelf placement in specialty and health-focused channels.

The cluster achieves breakeven at 2.63 years post-launch, the fastest capital recovery among evaluated options, reflecting modest investment, operational efficiency, and favourable unit economics. This compressed payback period de-risks the investment while enabling rapid reinvestment capacity should market reception exceed projections.

7. Circular efficiency

The Snacking revolution hub presents a distinct value proposition within the circular economy framework. Unlike other clusters that transform low-value by-products into premium ingredients, this cluster processes already-valorized cuts, fresh lean pork loin and artisanal cured meats, which paradoxically generates additional processing waste during slicing and trimming operations. From a strict material flow perspective, the cluster exhibits lower waste revalorization efficiency compared to collagen or pet food clusters that convert disposal costs into revenue streams.

However, the strategic value lies in price stabilization and market diversification rather than waste valorization. By creating an alternative commercial channel for premium cuts experiencing declining profitability in traditional wholesale markets, the cluster enables the Company to restore appropriate value capture for high-quality products. This addresses a market failure where premium fresh pork loin faces commoditization pressure, allowing redeployment into shelf-stable formats commanding sustainable margins.

Processing waste generated, primarily fat trim from cured meats and lean tissue from slicing operations, integrates into existing waste management infrastructure, processed through established rendering channels alongside other slaughter by-products, maintaining operational efficiency without requiring dedicated waste handling systems.

4.4 Multi-Criteria Decision Matrix: Analytical Hierarchy Process

Following the analysis of the three product clusters, the evaluation now shifts to a systematic comparison using the established criteria framework. While financial projections are foundational, they cannot fully capture market dynamics, operational integration, and strategic alignment, factors that are critical yet difficult to quantify. Consequently, the Multi-Criteria Decision Matrix (MCDM) is employed to synthesize financial, operational, strategic, and sustainability dimensions into a coherent decision. By weighting and scoring each cluster, the MCDM facilitates a transparent evaluation of trade-offs, identifying the optimal solution relative to the Company's specific capabilities and strategic priorities.

To enhance methodological rigor beyond subjective weight assignment, this analysis employs the Analytic Hierarchy Process (AHP), a structured decision-making technique developed by Saaty (1980) that derives criterion weights and cluster scores through systematic pairwise comparisons, on a standardized 1-9 scale, where 1 indicates equal importance, 3 moderate preference, 5 strong preference, and 9 extreme dominance. The methodology constructs comparison matrices whose principal eigenvectors yield normalized weights and scores, with Consistency Ratios (CR < 10%) validating logical coherence (it measures logical coherence in pairwise comparisons: if A > B and B > C, then A should be proportionally greater than C. CR < 10% indicates acceptable consistency; CR = 0% is perfect). The evaluation unfolds in two stages: first, pairwise comparison of the seven criteria establishes their relative weights; second, for each criterion individually, pairwise comparison of the three clusters determines their relative performance. These cluster-specific scores are then aggregated using the criterion weights to produce final rankings.

Through systematic pairwise comparisons across all seven criteria, the AHP methodology derives the weight structure presented in *Table 4.18*. The weight distribution emphasizes economic performance (42.1%) while maintaining balanced consideration of strategic alignment (37.6%) and operational factors (15.4%). This allocation reflects the primacy of financial viability in early-stage diversification decisions, where capital constraints prioritize rapid return generation, while ensuring that strategic and operational considerations receive substantive weight.

Criteria	Weight	Comment
Financial intensity	12.1%	Captures upfront capital risk exposure
Economic potential	30.0%	Primary driver of investment viability
Market opportunity	22.1%	Reflects long-term growth potential
Operational and regulatory complexity	7.5%	Important but manageable constraint
Strategic fit	15.5%	Critical for successful implementation
Time-to-market	7.9%	Relevant for cash flow timing
Circular efficiency	4.9%	Valuable but not commercially decisive

Table 4.18 – AHP derived criterion weights

For each criterion, pairwise comparisons of the three clusters were conducted based on quantitative evidence (e.g. CAPEX, PI, payback periods) and qualitative assessments (e.g. brand integration, market dynamics, execution complexity) from preceding analyses. To illustrate the methodology, *Table 4.19* presents the economic potential criterion matrix, where comparisons reflect clusters' economic performances, considering Profitability Index as the main score driver:

- Collagen Hub: PI = 0.92
- Premium Pet Hub: PI = 1.77
- Snacking Revolution Hub: PI = 3.23

	Collagen Hub	Premium Pet Hub	Snacking Revolution Hub
Collagen hub	1	0.5	0.25
Premium pet hub	2	1	0.5
Snacking revolution hub	4	2	1
Normalized score	**0.142857**	**0.285714**	**0.571429**

Table 4.19 - Illustrative pairwise comparison matrix: economic potential

Normalized scores are derived by scaling each matrix column to sum to 1.0, with the final score representing the average across columns, ensuring proportional weighting of relative performance. The Consistency Ratio (CR) of 0% validates logical coherence of pairwise judgments, falling well below the 10% threshold (e.g., if A outperforms B, and B outperforms C, then A should outperform C proportionally). All seven criteria matrices achieved CR < 5%; complete comparisons are provided in *Appendix B*.

Table 4.20 presents the comprehensive evaluation, integrating criterion weights with cluster-specific performance scores. Each cell represents the normalized score derived from pairwise comparisons, reflecting relative cluster performance on that dimension.

Criteria	Weight	Collagen hub	Premium pet hub	Snacking revolution hub
Financial intensity	12.1%	0.09	0.22	0.69
Economic potential	30.0%	0.14	0.29	0.57
Market opportunity	22.1%	0.16	0.54	0.30
Operational and regulatory complexity	7.5%	0.12	0.32	0.56
Strategic fit	15.5%	0.16	0.54	0.30
Time-to-market	7.9%	0.12	0.32	0.56
Circular efficiency	4.9%	0.67	0.22	0.11
Final score	100.0%	**0.17**	**0.38**	**0.46**

Table 4.20 - AHP-Validated Multi-Criteria Decision Matrix

The weighted scores are calculated by multiplying each criterion weight by the corresponding cluster score and summing across all criteria.

The Snacking revolution hub emerges as the optimal investment (0.46), establishing leadership through dominant performance on financial and operational dimensions: 0.69 on financial intensity (CAPEX €400,000), 0.57 on economic potential (PI 3.23), and 0.57 on both operational complexity (streamlined linear workflow) and time-to-market (2.63-year payback). This profile reflects superior capital efficiency, minimal execution risk, and rapid value realization, characteristics compelling for organizations prioritizing immediate diversification with contained financial exposure.

The Premium pet hub follows at 0.38, distinguished by leading performance on strategic criteria: 0.54 on both market opportunity (CAGR 7.9-14.3%) and strategic fit (unified brand identity enabling cross-selling). This positioning highlights Pet hub's strength in long-term market potential and organizational integration, making it the compelling choice when strategic priorities emphasize brand-building and multi-segment diversification over immediate capital efficiency.

The Collagen hub scores 0.17, constrained by substantial capital requirements (€2.25M CAPEX), extended regulatory timelines (12-18 months), and operational complexity. However, it achieves dominant performance on circular efficiency (0.67), reflecting its core value

proposition of transforming waste by-products into premium bioactive ingredients. The cluster generates considerable profits anchored in the stable B2B industrial collagen market, positioning it as a viable option when sustainability leadership is a strategic priority, despite elevated entry barriers.

The 8.3 points gap between Snacking and Premium Pet indicates clear leadership while acknowledging Pet hub's substantial merit under alternative prioritization scenarios. The 20 points gap between Premium Pet and Collagen reflects the latter's capital intensity relative to more accessible alternatives.

This analysis achieves its core objective: identifying viable pathways to enhance value capture from underutilized pork cuts through strategic innovation. All three clusters demonstrate commercial viability with positive NPVs under conservative assumptions, confirming the inherent value of the cluster-based approach through operational synergies, shared infrastructure, and distributed fixed costs. The Analytic Hierarchy Process validates this assessment through systematic pairwise comparisons, achieving excellent logical consistency (CR = 1.9% for criterion weights, all cluster matrices < 5%) while synthesizing financial, strategic, operational, and sustainability dimensions into transparent rankings.

The evaluation identifies the Snacking revolution hub as the optimal investment for organizations prioritizing capital efficiency, execution simplicity, and rapid payback. Its combination of minimal capital exposure, streamlined operational architecture, and fastest capital recovery positions it as the prudent choice for immediate strategic diversification with contained financial risk. However, the analysis reveals that strategic context determines optimal selection: Premium pet hub excels when long-term brand integration and multi-segment market diversification take precedence over immediate returns; Collagen hub becomes compelling when sustainability leadership and stable B2B market positioning align with organizational values, despite higher capital intensity. Ultimately, the final selection depends on the organization's risk appetite, strategic time horizon, and relative prioritization between immediate financial returns, long-term brand equity development, and environmental stewardship.

Conclusions

This research addresses a critical challenge facing mid-sized slaughterhouses operating in wholesale markets with minimal product transformation: traditional business models no longer generate sufficient profitability to withstand market volatility, shifting consumer preferences, and commodity price fluctuations. Analysis of major nutritional trends reveals an urgent need for strategic repositioning to align with evolving demand patterns rather than resist market forces.

The slaughterhouse infrastructure, however, presents a strategic asset capable of supplying fresh and cured raw materials, currently undervalued or treated as waste, to establish differentiated business ventures. This vertical integration offers multiple competitive advantages: reduced procurement costs and complexity, seamless operational integration across the value chain both upstream and downstream, established distribution networks and industry knowledge, and inherent marketing credibility through certified supply chain transparency.

Following this strategic reorientation, the research identified high-growth market segments where pork-derived products demonstrate sustained expansion driven by macro trends: fitness nutrition, premium pet food, and cosmetics. The first two categories emerged as optimal targets, aligning with existing operational competencies while accessing premium niches underserved by mass-market incumbents. Cosmetics, conversely, presented prohibitive entry barriers due to market concentration among established multinational brands and significant operational distance from core capabilities.

Within the selected segments, the analysis proposed innovative product concepts designed to disrupt incumbent positioning by targeting quality-conscious consumers. Each product underwent systematic evaluation across multiple dimensions: product and process description, competitor analysis, capital investment requirements, expected volumes and initial demand forecasting, contribution margin analysis, and profitability assessment. This comprehensive approach ensured that all relevant commercial and operational aspects were captured.

Initial findings revealed that most standalone initiatives failed to achieve first-year profitability, with fixed cost burden representing the primary constraint when distributed across uncertain demand volumes for novel offerings. This structural vulnerability necessitated a clustering strategy: grouping synergistic products to distribute fixed costs, leverage shared production process and strengthen market positioning through unified branding and distribution. Three

clusters emerged: the Collagen hub, maximizing operational similarities and equipment sharing; the Premium pet hub, building unified brand identity and marketing synergies; and the Snacking revolution hub, combining both infrastructural and commercial advantages.

Cluster selection employed a Multi-Criteria Decision Matrix (MCDM) framework balancing multiple evaluation dimensions, by using the AHP (Analytic Hierarchy Process), a structured methodology employing pairwise comparisons to derive mathematically consistent priority rankings. Financial metrics (financial intensity capturing upfront capital risk and economic potential measuring value generation) were complemented by strategic considerations, including market opportunity to assess growth potential, strategic fit to evaluate organizational alignment, operational and regulatory complexity to quantify execution risk, time-to-market to measure speed to breakeven, and circular efficiency to account for sustainability impact.

The evaluation identified the Snacking revolution hub as the optimal investment, achieving the highest Profitability Index while minimizing capital exposure and operational complexity, thereby maximizing returns while reducing risk. However, the analysis confirms that all three clusters represent commercially viable opportunities with positive NPV under conservative assumptions, positioning them as potential sequential spin-offs to maximize the slaughterhouse's strategic asset base.

Methodological considerations and limitations

Throughout the analysis, uncertainty regarding market and operating data represented a persistent methodological challenge. Fixed and variable cost projections, while calibrated against actual expenses currently incurred by the Company for comparable operations, remain subject to scaling assumptions when applied to novel production lines. Equipment investment estimates, though consistent with benchmarks for similar industrial installations, carry inherent variability given supplier-specific pricing and technical specification differences. Ex-factory pricing assumptions, derived by applying credible retail markup standards to competitor pricing observed across multiple channels, nevertheless depend on market acceptance of positioning strategies and the Company's ability to command comparable price points as an emerging entrant.

The most methodologically vulnerable aspect remains the estimation of initial market penetration rates. Projecting first-year demand for novel products entering emerging categories

requires assumptions that cannot be validated without actual market testing. The penetration rates employed reflect reasoned approximations based on comparable product launches, anticipated distribution reach, and planned marketing investment. Rigorous demand validation would require extended consumer surveys, test market launches, or secured pre-sales agreements, methodologies incompatible with this thesis scope. The decision to evaluate multiple product categories required balancing analytical breadth with depth, accepting that demand forecasts for new market entrants inherently involve greater uncertainty than cost projections grounded in operational benchmarks or competitive assessments relying on observable market data.

To compensate for these inherent forecasting risks, the financial model incorporates multiple conservative measures: a 14% discount rate well above industry standards, a conservative 2% perpetual growth assumption, constant costs and prices throughout the projection period excluding efficiency gains or pricing power, averaged equipment and COGS estimates, and comprehensive sensitivity testing. Beyond financial conservatism, the Multi-Criteria Decision Matrix methodology balances quantitative metrics with strategic fit, operational and regulatory complexity, and circular efficiency, aligning investment selection with organizational capabilities rather than pursuing purely economic optimization. Validation through Analytic Hierarchy Process (AHP) methodology, yielding an overall Consistency Ratio of 1%, confirms the logical coherence of comparative judgments while providing mathematical rigor to the weighting framework.

These uncertainties, while systematically addressed through conservative assumptions and multi-dimensional evaluation, underscore that financial projections represent informed feasibility estimates rather than precise forecasts. The methodological approach prioritizes realistic viability over aspirational optimism.

Cluster as an emergent strategic solution

A critical finding is that clustering emerged as a necessary response to structural economic constraints rather than an initial design principle. Standalone profitability analysis revealed that most concepts failed to achieve positive EBIT in Year 1, with fixed cost burdens overwhelming contribution margins when distributed across uncertain initial demand volumes.

This necessitated grouping synergistic products to distribute fixed costs, leverage shared infrastructure, and strengthen market positioning. The resulting clusters demonstrate CAPEX savings of 11–44% and OPEX reductions of 35–44% relative to standalone development, transforming marginally viable concepts into commercially robust ventures. Because products were not originally designed for integration, achieved synergies represent near-term optimization rather than maximum theoretical efficiency. Purpose-built cluster development from inception could enhance infrastructural compatibility, align production workflows, and create stronger brand coherence.

Nevertheless, the empirical finding that clustering converts economically marginal standalone products into viable business units represents perhaps the most actionable insight of this research. Reducing fixed cost pressure per product by 35–45% provides a replicable framework for future development initiatives, demonstrating that even imperfectly integrated clusters deliver substantial economic benefits.

Strategic implications for the pork processing industry

This research illuminates a broader strategic imperative: the traditional business model of wholesale distribution of minimally processed cuts has become structurally unprofitable. Innovation in competitive markets demands continuous evolution to align with shifting consumer preferences, as past business success no longer guarantees future viability. Market dynamics favour vertically integrated players who capture consumer-level margins while maintaining commodity supply chain efficiency. Large Italian groups such as Cremonini, Martelli, and Veronesi exemplify this positioning, controlling the entire value chain from livestock procurement through branded consumer products to maximize value capture through direct retail distribution and premium pricing enabled by brand equity.

For mid-sized operators, the path forward requires strategic repositioning rather than operational optimization. Reconceptualizing the slaughterhouse as a raw material supply platform feeding specialized derivative businesses unlocks critical advantages: undervalued cuts and by-products transform into premium ingredients; certified supply chain transparency becomes a marketing differentiator; operational knowledge and distribution networks, valuable intangible assets developed through decades of wholesale relationships, facilitate market entry into adjacent categories. However, consumer perception of pork as less healthy than poultry or plant-based alternatives persists regardless of business model transformation. This perception

constraint necessitates proactive brand positioning emphasizing quality, traceability, and functional nutrition benefits through transparency initiatives and scientific communication rather than competing on generic protein attributes.

The analyzed clusters represent potential pathways for this strategic pivot and need not be pursued simultaneously. A phased implementation approach launching clusters sequentially as spin-off ventures allows iterative learning, demand validation, and capital risk management while establishing organizational capabilities in branded consumer marketing and retail distribution. Alternative configurations warrant evaluation before full capital commitment: contract manufacturing through third-party facilities eliminates upfront CAPEX while enabling market validation; joint ventures with established producers distribute capital requirements and provide access to complementary expertise. These asset-light approaches can serve as initial market entry phases, validating demand before committing to production infrastructure ownership.

This thesis deliberately assumes immediate capital investment to stress-test financial viability under conservative assumptions, establishing baseline economics in the most capital-intensive scenario. However, the analysis recognizes that such configurations may ultimately prove simpler to manage and more resilient to market uncertainty. The optimal pathway requires subsequent evaluation of partner availability, quality control frameworks, and strategic trade-offs between capital efficiency and operational control.

Ultimately, supply chain control toward consumer-facing branded products represents the sustainable competitive positioning for pork processing businesses. The commodity wholesale model faces persistent margin compression as retailers consolidate purchasing power and consumers commoditize undifferentiated protein, while fitness nutrition and premium pet food markets exhibit sustained growth and differentiation opportunities through quality positioning and supply chain transparency. The slaughterhouse transitions from being the business itself to being the competitive advantage enabling derivative businesses, a strategic reorientation essential for long-term viability.

Implementations considerations and future development

Successful implementation requires extending this feasibility analysis into operational execution. Detailed process engineering, warehouse management system design, waste stream integration validation, and certification pathway quantification must refine capital budgets and launch schedules before capital commitment.

Marketing strategy development represents a critical success factor. The recommended clusters target markets where young consumers drive category growth through values-based purchasing: sustainability credentials, ingredient transparency, and functional nutrition benefits. These demographic segments demonstrate high social media engagement, making digital platforms a cost-effective channel for brand building. Instagram, TikTok, and YouTube enable targeted reach to niche audiences with flexible budget allocation and real-time performance tracking. However, social media success depends on content strategy quality and authentic brand storytelling rather than mere spending, capabilities requiring dedicated expertise.

Financially, the Company must recognize that projected NPV figures depend significantly on terminal value assumptions, representing a great portion of total enterprise value. This concentration implies that business performance in Years 4–5 disproportionately influences ultimate returns. If growth trajectories falter or competitive pressures compress margins during this period, terminal value, and thus overall NPV, would decline substantially. Management must remain responsive to demand signals, adjusting product formulations, pricing strategies, or marketing approaches based on real-world performance rather than rigidly adhering to initial plans when evidence suggests course correction is warranted.

Final remarks

In conclusion, this research establishes three fundamental pillars that define the strategic path forward for mid-sized pork processors. First, the analysis confirms that the traditional wholesale model has reached a point of structural unsustainability; in a market defined by margin compression and retail consolidation, incremental operational improvements are no longer sufficient to restore long-term profitability. Second, viable growth pathways exist within high-value niches, where products command a premium price by meeting evolving consumer demands. Third, and most crucially, clustering emerges as the ultimate enabler of commercial viability. Rather than a mere efficiency tool, the cluster approach transforms individually

marginal products into a robust portfolio, distributing fixed costs and mitigating the risks inherent in single-product market entry.

The convergence of these findings identifies the Snacking revolution hub as the most compelling strategic choice. As highlighted by the multi-criteria evaluation, this cluster achieves the optimal balance between financial efficiency, operational simplicity, and rapid payback, making it the ideal "entry point" for the Company’s transformation.

These results provide directional guidance rather than rigid implementation blueprints. Developed under deliberately conservative assumptions, projections demonstrate a realistic commercial feasibility while acknowledging the uncertainties of new markets. The true value of this work lies in the methodological framework it provides: a structured approach to evaluating strategic alternatives.

This study should therefore serve as a foundation for subsequent validation pilots and detailed operational studies. While ultimate success will depend on execution quality and organizational commitment, the economic fundamentals are clear: the path toward sustainable growth lies not in the optimization of a legacy model, but in the strategic repositioning for the markets of tomorrow.

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Appendix A: Full NPV calculation

Contained within this appendix are the detailed tables illustrating the complete NPV calculation process, including the specific parameters of the sensitivity analysis. Each section reports both the annual contribution margins for individual products and the total NPV for each strategic cluster, ensuring full transparency of the financial assumptions.

Collagen Hub:

	Year-1	Year-2	Year-3	Year-4	Year-5
Hydrolized collagen					
Price	15.00 €	15.00 €	15.00 €	15.00 €	15.00 €
Unit contribution margin	6.25 €	6.25 €	6.25 €	6.25 €	6.25 €
Demand	100,000	108,000	116,640	125,971	136,049
Growth rate		8%	8%	8%	8%
Revenue	1,500,000.00 €	1,620,000.00 €	1,749,600.00 €	1,889,568.00 €	2,040,733.44 €
Contribution margin	625,000.00 €	675,000.00 €	729,000.00 €	787,320.00 €	850,305.60 €
Negative scenario (-20% demand)	500,000.00 €	540,000.00 €	583,200.00 €	629,856.00 €	680,244.48 €
Positive scenario (+20% demand)	750,000.00 €	810,000.00 €	874,800.00 €	944,784.00 €	1,020,366.72 €
Collagen protein boost	Year-1	Year-2	Year-3	Year-4	Year-5
Price	70.00 €	70.00 €	70.00 €	70.00 €	70.00 €
Unit contribution margin	57.00 €	57.00 €	57.00 €	57.00 €	57.00 €
Demand	7,500	7,650	7,956	8,433	9,108
Growth rate		2%	4%	6%	8%
Revenue	525,000.00 €	535,500.00 €	556,920.00 €	590,335.20 €	637,562.02 €
Contribution margin	427,500.00 €	436,050.00 €	453,492.00 €	480,701.52 €	519,157.64 €
Negative scenario (-20% demand)	342,000.00 €	348,840.00 €	362,793.60 €	384,561.22 €	415,326.11 €
Positive scenario (+20% demand)	513,000.00 €	523,260.00 €	544,190.40 €	576,841.82 €	622,989.17 €
Human-grade bone broth	Year-1	Year-2	Year-3	Year-4	Year-5
Price	10.00 €	10.00 €	10.00 €	10.00 €	10.00 €
Unit contribution margin	6.50 €	6.50 €	6.50 €	6.50 €	6.50 €
Demand	60,000	63,600	69,960	76,956	83,112
Growth rate		6%	10%	10%	8%
Revenue	600,000.00 €	636,000.00 €	699,600.00 €	769,560.00 €	831,124.80 €
Contribution margin	390,000.00 €	413,400.00 €	454,740.00 €	500,214.00 €	540,231.12 €
Negative scenario (-20% demand)	312,000.00 €	330,720.00 €	363,792.00 €	400,171.20 €	432,184.90 €
Positive scenario (+20% demand)	468,000.00 €	496,080.00 €	545,688.00 €	600,256.80 €	648,277.34 €

Table A1 - Collagen Hub single products annual contribution margin

Year	0	1	2	3	4	5
Total revenues		2,625,000.00 €	2,791,500.00 €	3,006,120.00 €	3,249,463.20 €	3,509,420.26 €
Total revenues (- scen.)		2,100,000.00 €	2,233,200.00 €	2,404,896.00 €	2,599,570.56 €	2,807,536.20 €
Total revenues (+ scen.)		3,150,000.00 €	3,349,800.00 €	3,607,344.00 €	3,899,355.84 €	4,211,304.31 €
Total contribution margin		1,442,500.00 €	1,524,450.00 €	1,637,232.00 €	1,768,235.52 €	1,909,694.36 €
Total CM (- scen.)		1,154,000.00 €	1,219,560.00 €	1,309,785.60 €	1,414,588.42 €	1,527,755.49 €
Total CM (+ scen.)		1,731,000.00 €	1,829,340.00 €	1,964,678.40 €	2,121,882.62 €	2,291,633.23 €
Total fixed costs		-775,000.00 €	-775,000.00 €	-775,000.00 €	-775,000.00 €	-775,000.00 €
EBITDA		667,500.00 €	749,450.00 €	862,232.00 €	993,235.52 €	1,134,694.36 €
EBITDA (- scen.)		379,000.00 €	444,560.00 €	534,785.60 €	639,588.42 €	752,755.49 €
EBITDA (+ scen.)		956,000.00 €	1,054,340.00 €	1,189,678.40 €	1,346,882.62 €	1,516,633.23 €
Total investment	-2,250,000.00 €					
Depreciation and amortization		-225,000.00 €	-225,000.00 €	-225,000.00 €	-225,000.00 €	-225,000.00 €
EBIT		442,500.00 €	524,450.00 €	637,232.00 €	768,235.52 €	909,694.36 €
EBIT (- scen.)		154,000.00 €	219,560.00 €	309,785.60 €	414,588.42 €	527,755.49 €
EBIT (+ scen.)		731,000.00 €	829,340.00 €	964,678.40 €	1,121,882.62 €	1,291,633.23 €
Taxes		-123,457.50 €	-146,321.55 €	-177,787.73 €	-214,337.71 €	-253,804.73 €
Taxes (- scen.)		-42,966.00 €	-61,257.24 €	-86,430.18 €	-115,670.17 €	-147,243.78 €
Taxes (+ scen.)		-203,949.00 €	-231,385.86 €	-269,145.27 €	-313,005.25 €	-360,365.67 €
NOPAT[10]		319,042.50 €	378,128.45 €	459,444.27 €	553,897.81 €	655,889.63 €
NOPAT (- scen.)		111,034.00 €	158,302.76 €	223,355.42 €	298,918.25 €	380,511.71 €
NOPAT (+ scen.)		527,051.00 €	597,954.14 €	695,533.13 €	808,877.37 €	931,267.56 €
Net working capital	-393,750.00 €	-418,725.00 €	-450,918.00 €	-487,419.48 €	-526,413.04 €	-536,941.30 €
Net working capital (negative scenario)	-315,000.00 €	-334,980.00 €	-360,734.40 €	-389,935.58 €	-421,130.43 €	-429,553.04 €
Net working capital (positive scenario)	-472,500.00 €	-502,470.00 €	-541,101.60 €	-584,903.38 €	-631,695.65 €	-644,329.56 €
Δ in NWC	-393,750.00 €	-24,975.00 €	-32,193.00 €	-36,501.48 €	-38,993.56 €	-10,528.26 €
Δ in NWC (- scen.)	-315,000.00 €	-19,980.00 €	-25,754.40 €	-29,201.18 €	-31,194.85 €	-8,422.61 €
Δ in NWC (+ scen.)	-472,500.00 €	-29,970.00 €	-38,631.60 €	-43,801.78 €	-46,792.27 €	-12,633.91 €
Terminal value						5,485,571.68 €
Terminal value (- scen.)						3,162,757.34 €
Terminal value (+ scen.)						7,808,386.01 €
Free Cash Flow	-2,643,750.00 €	519,067.50 €	570,935.45 €	647,942.79 €	739,904.25 €	6,355,933.05 €
Free Cash Flow (- scen.)	-2,565,000.00 €	316,054.00 €	357,548.36 €	419,154.23 €	492,723.40 €	3,759,846.44 €
Free Cash Flow (+ scen.)	-2,722,500.00 €	722,081.00 €	784,322.54 €	876,731.35 €	987,085.10 €	8,952,019.66 €
PV	-2,643,750.00 €	455,322.37 €	439,316.29 €	437,342.93 €	438,082.71 €	3,301,072.46 €
PV (negative scenario)	-2,565,000.00 €	277,240.35 €	275,121.85 €	282,917.17 €	291,731.81 €	1,952,746.42 €
PV (positive scenario)	-2,722,500.00 €	633,404.39 €	603,510.73 €	591,768.69 €	584,433.62 €	4,649,398.50 €
NPV	**2,427,386.76 €**					
NPV (- scen.)	514,757.61 €					
NPV (+ scen.)	4,340,015.92 €					

Table A2 - Collegen Hub full NPV calculation

[10] **NOPAT (Net Operating Profit After Taxes):** it represents a company's operating profit after accounting for taxes, excluding the impact of financing activities. It reflects the profitability generated solely from core operations.

Premium Pet Hub

	Year-1	Year-2	Year-3	Year-4	Year-5
Bone broth with organs					
Price	13.00 €	13.00 €	13.00 €	13.00 €	13.00 €
Unit contribution margin	9.50 €	9.50 €	9.50 €	9.50 €	9.50 €
Demand	50,000	53,000	58,300	63,547	68,631
Growth rate		6%	10%	9%	8%
Revenue	650,000.00 €	689,000.00 €	757,900.00 €	826,111.00 €	892,199.88 €
Contribution margin	475,000.00 €	503,500.00 €	553,850.00 €	603,696.50 €	651,992.22 €
Negative scenario (-20% demand)	380,000.00 €	402,800.00 €	443,080.00 €	482,957.20 €	521,593.78 €
Positive scenario (+20% demand)	570,000.00 €	604,200.00 €	664,620.00 €	724,435.80 €	782,390.66 €
Skin sticks	Year-1	Year-2	Year-3	Year-4	Year-5
Price	20.00 €	20.00 €	20.00 €	20.00 €	20.00 €
Unit contribution margin	17.50 €	17.50 €	17.50 €	17.50 €	17.50 €
Demand	20,000	21,000	22,890	24,721	26,452
Growth rate		5%	9%	8%	7%
Revenue	400,000.00 €	420,000.00 €	457,800.00 €	494,424.00 €	529,033.68 €
Contribution margin	350,000.00 €	367,500.00 €	400,575.00 €	432,621.00 €	462,904.47 €
Negative scenario (-20% demand)	280,000.00 €	294,000.00 €	320,460.00 €	346,096.80 €	370,323.58 €
Positive scenario (+20% demand)	420,000.00 €	441,000.00 €	480,690.00 €	519,145.20 €	555,485.36 €
Pork loin slice	Year-1	Year-2	Year-3	Year-4	Year-5
Price	25.00 €	25.00 €	25.00 €	25.00 €	25.00 €
Unit contribution margin	15.75 €	15.75 €	15.75 €	15.75 €	15.75 €
Demand	25,000	27,000	30,240	35,683	40,679
Growth rate		8%	12%	18%	14%
Revenue	625,000.00 €	675,000.00 €	756,000.00 €	892,080.00 €	1,016,971.20 €
Contribution margin	393,750.00 €	425,250.00 €	476,280.00 €	562,010.40 €	640,691.86 €
Negative scenario (-20% demand)	315,000.00 €	340,200.00 €	381,024.00 €	449,608.32 €	512,553.48 €
Positive scenario (+20% demand)	472,500.00 €	510,300.00 €	571,536.00 €	674,412.48 €	768,830.23 €

Table A3 – Premium Pet Hub single products annual contribution margin

Year	0	1	2	3	4	5
Total revenues		1,675,000.00 €	1,784,000.00 €	1,971,700.00 €	2,212,615.00 €	2,438,204.76 €
Total revenues (- scen.)		1,340,000.00 €	1,427,200.00 €	1,577,360.00 €	1,770,092.00 €	1,950,563.81 €
Total revenues (+ scen)		2,010,000.00 €	2,140,800.00 €	2,366,040.00 €	2,655,138.00 €	2,925,845.71 €
Total contribution margin		1,218,750.00 €	1,296,250.00 €	1,430,705.00 €	1,598,327.90 €	1,755,588.55 €
Total CM (- scen)		975,000.00 €	1,037,000.00 €	1,144,564.00 €	1,278,662.32 €	1,404,470.84 €
Total CM (+ scen.)		1,462,500.00 €	1,555,500.00 €	1,716,846.00 €	1,917,993.48 €	2,106,706.26 €
Total fixed costs		-710,000.00 €	-710,000.00 €	-710,000.00 €	-710,000.00 €	-710,000.00 €
EBITDA		508,750.00 €	586,250.00 €	720,705.00 €	888,327.90 €	1,045,588.55 €
EBITDA (negative scenario)		265,000.00 €	327,000.00 €	434,564.00 €	568,662.32 €	694,470.84 €
EBITDA (positive scenario)		752,500.00 €	845,500.00 €	1,006,846.00 €	1,207,993.48 €	1,396,706.26 €
Total investment	-1,430,000.00 €					
Depreciation and amortization		-143,000.00 €	-143,000.00 €	-143,000.00 €	-143,000.00 €	-143,000.00 €
EBIT		365,750.00 €	443,250.00 €	577,705.00 €	745,327.90 €	902,588.55 €
EBIT (negative scenario)		122,000.00 €	184,000.00 €	291,564.00 €	425,662.32 €	551,470.84 €
EBIT (positive scenario)		609,500.00 €	702,500.00 €	863,846.00 €	1,064,993.48 €	1,253,706.26 €
Taxes		-102,044.25 €	-123,666.75 €	-161,179.70 €	-207,946.48 €	-251,822.20 €
Taxes (negative scenario)		-34,038.00 €	-51,336.00 €	-81,346.36 €	-118,759.79 €	-153,860.36 €
Taxes (positive scenario)		-170,050.50 €	-195,997.50 €	-241,013.03 €	-297,133.18 €	-349,784.05 €
NOPAT		263,705.75 €	319,583.25 €	416,525.31 €	537,381.42 €	650,766.34 €
NOPAT (negative scenario)		87,962.00 €	132,664.00 €	210,217.64 €	306,902.53 €	397,610.47 €
NOPAT (positive scenario)		439,449.50 €	506,502.50 €	622,832.97 €	767,860.30 €	903,922.21 €
Net working capital	-251,250.00 €	-267,600.00 €	-295,755.00 €	-331,892.25 €	-365,730.71 €	-373,045.33 €
Net working capital (negative scenario)	-201,000.00 €	-214,080.00 €	-236,604.00 €	-265,513.80 €	-292,584.57 €	-298,436.26 €
Net working capital (positive scenario)	-301,500.00 €	-321,120.00 €	-354,906.00 €	-398,270.70 €	-438,876.86 €	-447,654.39 €
Δ in NWC	-251,250.00 €	-16,350.00 €	-28,155.00 €	-36,137.25 €	-33,838.46 €	-7,314.61 €
Δ in NWC (negative scenario)	-201,000.00 €	-13,080.00 €	-22,524.00 €	-28,909.80 €	-27,070.77 €	-5,851.69 €
Δ in NWC (positive scenario)	-301,500.00 €	-19,620.00 €	-33,786.00 €	-43,364.70 €	-40,606.16 €	-8,777.54 €
Terminal value						5,469,339.68 €
Terminal value (negative scenario)						3,329,949.65 €
Terminal value (positive scenario)						7,608,729.72 €
Free Cash Flow	-1,681,250.00 €	390,355.75 €	434,428.25 €	523,388.06 €	646,542.95 €	6,255,791.41 €
Free Cash Flow (negative scenario)	-1,631,000.00 €	217,882.00 €	253,140.00 €	324,307.84 €	422,831.76 €	3,864,708.43 €
Free Cash Flow (positive scenario)	-1,731,500.00 €	562,829.50 €	615,716.50 €	722,468.27 €	870,254.14 €	8,646,874.39 €
PV	-1,681,250.00 €	342,417.32 €	334,278.43 €	353,272.03 €	382,805.33 €	3,249,062.03 €
PV (negative scenario)	-1,631,000.00 €	191,124.56 €	194,783.01 €	218,898.56 €	250,350.35 €	2,007,208.45 €
PV (positive scenario)	-1,731,500.00 €	493,710.09 €	473,773.85 €	487,645.50 €	515,260.31 €	4,490,915.60 €
NPV	**2,980,585.14 €**					
NPV (negative scenario)	1,231,364.93 €					
NPV (positive scenario)	4,729,805.36 €					

Table A4 – Premium Pet Hub full NPV calculation

Snacking Revolution Hub

	Year-1	Year-2	Year-3	Year-4	Year-5
Meat chips					
Price	55.00 €	55.00 €	55.00 €	55.00 €	55.00 €
Unit contribution margin	27.00 €	27.00 €	27.00 €	27.00 €	27.00 €
Demand	18,750	19,875	21,664	23,830	25,975
Growth rate		6%	9%	10%	9%
Revenue	1,031,250.00 €	1,093,125.00 €	1,191,506.25 €	1,310,656.88 €	1,428,615.99 €
Contribution margin	506,250.00 €	536,625.00 €	584,921.25 €	643,413.38 €	701,320.58 €
Negative scenario (-20% demand)	405,000.00 €	429,300.00 €	467,937.00 €	514,730.70 €	561,056.46 €
Positive scenario (+20% demand)	607,500.00 €	643,950.00 €	701,905.50 €	772,096.05 €	841,584.69 €
Charcuterie chips	Year-1	Year-2	Year-3	Year-4	Year-5
Price	60.00 €	60.00 €	60.00 €	60.00 €	60.00 €
Unit contribution margin	32.00 €	32.00 €	32.00 €	32.00 €	32.00 €
Demand	10,000	10,500	11,130	11,909	12,743
Growth rate		5%	6%	7%	7%
Revenue	600,000.00 €	630,000.00 €	667,800.00 €	714,546.00 €	764,564.22 €
Contribution margin	320,000.00 €	336,000.00 €	356,160.00 €	381,091.20 €	407,767.58 €
Negative scenario (-20% demand)	256,000.00 €	268,800.00 €	284,928.00 €	304,872.96 €	326,214.07 €
Positive scenario (+20% demand)	384,000.00 €	403,200.00 €	427,392.00 €	457,309.44 €	489,321.10 €

Table A5 – Snacking Revolution Hub single products annual contribution margin

Year	0	1	2	3	4	5
Total revenues		1,631,250.00 €	1,723,125.00 €	1,859,306.25 €	2,025,202.88 €	2,193,180.21 €
Total revenues (- scen.)		1,305,000.00 €	1,378,500.00 €	1,487,445.00 €	1,620,162.30 €	1,754,544.17 €
Total revenues (+ scen.)		1,957,500.00 €	2,067,750.00 €	2,231,167.50 €	2,430,243.45 €	2,631,816.26 €
Total contribution margin		826,250.00 €	872,625.00 €	941,081.25 €	1,024,504.58 €	1,109,088.16 €
Total CM (- scen.)		661,000.00 €	698,100.00 €	752,865.00 €	819,603.66 €	887,270.53 €
Total CM (+ scen.)		991,500.00 €	1,047,150.00 €	1,129,297.50 €	1,229,405.49 €	1,330,905.80 €
Total fixed costs		-520,000.00 €	-520,000.00 €	-520,000.00 €	-520,000.00 €	-520,000.00 €
EBITDA		306,250.00 €	352,625.00 €	421,081.25 €	504,504.58 €	589,088.16 €
EBITDA (- scen.)		141,000.00 €	178,100.00 €	232,865.00 €	299,603.66 €	367,270.53 €
EBITDA (+ scen.)		471,500.00 €	527,150.00 €	609,297.50 €	709,405.49 €	810,905.80 €
Total investment	-400,000.00 €					
Depreciation and amortization		-40,000.00 €	-40,000.00 €	-40,000.00 €	-40,000.00 €	-40,000.00 €
EBIT		266,250.00 €	312,625.00 €	381,081.25 €	464,504.58 €	549,088.16 €
EBIT (negative scenario)		101,000.00 €	138,100.00 €	192,865.00 €	259,603.66 €	327,270.53 €
EBIT (positive scenario)		431,500.00 €	487,150.00 €	569,297.50 €	669,405.49 €	770,905.80 €
Taxes		-74,283.75 €	-87,222.38 €	-106,321.67 €	-129,596.78 €	-153,195.60 €
Taxes (negative scenario)		-28,179.00 €	-38,529.90 €	-53,809.34 €	-72,429.42 €	-91,308.48 €
Taxes (positive scenario)		-120,388.50 €	-135,914.85 €	-158,834.00 €	-186,764.13 €	-215,082.72 €
(NOPAT		191,966.25 €	225,402.63 €	274,759.58 €	334,907.80 €	395,892.57 €
NOPAT (negative scenario)		72,821.00 €	99,570.10 €	139,055.67 €	187,174.24 €	235,962.05 €
NOPAT (positive scenario)		311,111.50 €	351,235.15 €	410,463.50 €	482,641.36 €	555,823.08 €
Net working capital	-244,687.50 €	-258,468.75 €	-278,895.94 €	-303,780.43 €	-328,977.03 €	-335,556.57 €
Net working capital (negative scenario)	-195,750.00 €	-206,775.00 €	-223,116.75 €	-243,024.35 €	-263,181.63 €	-268,445.26 €
Net working capital (positive scenario)	-293,625.00 €	-310,162.50 €	-334,675.13 €	-364,536.52 €	-394,772.44 €	-402,667.89 €
Δ in NWC	-244,687.50 €	-13,781.25 €	-20,427.19 €	-24,884.49 €	-25,196.60 €	-6,579.54 €
Δ in NWC (negative scenario)	-195,750.00 €	-11,025.00 €	-16,341.75 €	-19,907.60 €	-20,157.28 €	-5,263.63 €
Δ in NWC (positive scenario)	-293,625.00 €	-16,537.50 €	-24,512.63 €	-29,861.39 €	-30,235.92 €	-7,895.45 €
Terminal value						3,309,160.71 €
Terminal value (negative scenario)						1,960,936.57 €
Terminal value (positive scenario)						4,657,384.85 €
Free Cash Flow	-644,687.50 €	218,185.00 €	244,975.44 €	289,875.09 €	349,711.20 €	3,738,473.73 €
Free Cash Flow (negative scenario)	-595,750.00 €	101,796.00 €	123,228.35 €	159,148.07 €	207,016.96 €	2,231,634.99 €
Free Cash Flow (positive scenario)	-693,625.00 €	334,574.00 €	366,722.53 €	420,602.11 €	492,405.44 €	5,245,312.48 €
PV	-644,687.50 €	191,390.35 €	188,500.64 €	195,657.43 €	207,057.10 €	1,941,646.11 €
PV (negative scenario)	-595,750.00 €	89,294.74 €	94,820.21 €	107,420.41 €	122,570.66 €	1,159,041.28 €
PV (positive scenario)	-693,625.00 €	293,485.96 €	282,181.07 €	283,894.44 €	291,543.55 €	2,724,250.94 €
NPV	**2,079,564.14 €**					
NPV (negative scenario)	977,397.31 €					
NPV (positive scenario)	3,181,730.97 €					

Table A6 – Snacking Revolution Hub full NPV calculation

Appendix B: AHP pairwise comparison matrices

This appendix presents the complete set of pairwise comparison matrices employed in the Analytic Hierarchy Process evaluation, ensuring full methodological transparency and enabling independent replication of results. All matrices demonstrate logical consistency with Consistency Ratios (CR) below the 10% threshold established by Saaty (1980).

- **Criterion weight matrix**

Criteria	Fin. Int.	Ec. Pot.	Market Op.	Complexity	Strategic fit	TTM	Circ. Ef.
Fin. Int.	1	0.333333	0.5	2	0.5	2	3
Ec. Pot.	3	1	2	4	2	3	4
Market op.	2	0.5	1	3	2	3	4
Complexity	0.5	0.25	0.333333	1	0.5	1	2
Strategic fit	2	0.5	0.5	2	1	2	3
TTM	0.5	0.333333	0.333333	1	0.5	1	2
Circ. Ef.	0.333333	0.25	0.25	0.5	0.333333	0.5	1
Total score	**12.07%**	**30.02%**	**22.10%**	**7.53%**	**15.54%**	**7.88%**	**4.87%**

Table B1 - Criterion weight matrix (CR:1.9%)

The pairwise comparisons reflect strategic priorities where economic performance takes precedence (economic potential, considered the main driver of the analysis, receives 3× weight vs financial intensity, 2× vs market opportunity), while operational factors serve as constraints (operational complexity receives 1/4× weight vs economic potential). Circular efficiency, though valued for sustainability, receives the lowest relative priority given its secondary role in commercial viability.

Having established criterion weights through the 7×7 pairwise comparison matrix, the Analytic Hierarchy Process applies the same methodology to derive cluster scores for each of the seven criteria:

- **Financial intensity**

  This criterion evaluates upfront capital requirements and financial risk exposure. Comparisons are grounded in CAPEX differences: Snacking (€400,000), Premium Pet (€1,430,000), Collagen (€2,250,000).

  Rationale: The 6× comparison (Snacking vs Collagen) reflects the 5.6× CAPEX differential (€2.25M / €400k), while the 4× comparison (Snacking vs Pet) captures the 3.6× differential (€1.43M / €400k). These judgments are proportional to actual capital exposure differences.

	Collagen Hub	Premium Pet Hub	Snacking Revolution Hub
Collagen	1	0.333333	0.166667
Premium Pet	3	1	0.25
Snacking	6	4	1
Normalized score	**0.091401**	**0.217648**	**0.690951**

Table B2: Financial Intensity - Cluster comparison (CR: 4.6%)

- **Economic potential**

  This criterion assesses value generation through Profitability Index. Comparisons reflect PI ratios: Snacking (3.23), Premium Pet (1.77), Collagen (0.92), while also considering the payback period and the NPV.

	Collagen Hub	Premium Pet Hub	Snacking Revolution Hub
Collagen	1	0.5	0.25
Premium Pet	2	1	0.5
Snacking	4	2	1
Normalized score	**0.142857**	**0.285714**	**0.571429**

Table B3: Economic potential - Cluster comparison (CR: 0%)

Rationale: The 4× comparison (Snacking vs Collagen) aligns with the 3.5× PI ratio (3.23 / 0.92), while the 2× comparison (Snacking vs Pet) reflects the 1.8× PI ratio (3.23 / 1.77). Premium Pet's 2× advantage over Collagen captures the 1.9× PI ratio (1.77 / 0.92).

- **Market opportunity**

  This criterion evaluates growth potential and market dynamics. Premium Pet exhibits the highest CAGR range (7.9-14.3%) across diversified segments; Snacking operates in dual markets (8.5-9.2% CAGR); Collagen spans three markets (5.1-8.11% CAGR).

	Collagen Hub	Premium Pet Hub	Snacking Revolution Hub
Collagen	1	0.333333	0.5
Premium pet	3	1	2
Snacking	2	0.5	1
Normalized score	**0.163425**	**0.539613**	**0.296962**

Table B4: Market opportunity - Cluster comparison (CR: 0.79%)

Rationale: Premium Pet's 3× advantage over Collagen reflects superior CAGR (14.3% vs 8.11% maximum) and multi-segment diversification. The 2× advantage over

Snacking captures higher growth rates and broader market coverage. Snacking's 2× advantage over Collagen reflects stronger CAGR in concentrated niches (8.5-9.2% vs 5.1-8.11%).

- **Operational and regulatory complexity**

  This criterion assesses execution difficulty. Snacking features linear workflow and 6-9 months implementation, even though it requires stricter legislative compliance; Premium Pet requires three distinct workflows and cold chain logistics; Collagen involves multi-stage processing with 12-18 months regulatory approval.

	Collagen Hub	Premium Pet Hub	Snacking Revolution Hub
Collagen	1	0.333333	0.25
Premium Pet	3	1	0.5
Snacking	4	2	1
Normalized score	**0.121957**	**0.319619**	**0.558424**

Table B5: Operational and regulatory complexity - Cluster comparison (CR: 1.6%)

Rationale: The 4× comparison (Snacking vs Collagen) reflects the substantial gap in implementation timelines (6-9 months vs 12-18 months) and process complexity (linear vs multi-stage enzymatic). The 2× comparison (Snacking vs Pet) captures the difference between single streamlined workflow versus three integrated production lines with cold chain requirements.

- **Strategic fit**

  This criterion evaluates organizational alignment and integration potential. Premium Pet creates unified brand identity enabling cross-selling; Snacking achieves vertical integration but two different downstream segments are targeted; Collagen integrates well operationally but faces brand fragmentation across three distinct markets (B2B, supplements, food).

  Rationale: Premium Pet's 3× advantage over Collagen stems from unified brand architecture versus fragmented market positioning (B2B, B2C supplements, premium food). The 2× advantage over Snacking reflects established brand equity versus marketing departure from B2B operations. Snacking's 2× advantage over Collagen captures complete vertical integration versus brand fragmentation challenges.

	Collagen Hub	Premium Pet Hub	Snacking Revolution Hub
Collagen	1	0.333333	0.5
Premium Pet	3	1	2
Snacking	2	0.5	1
Normalized score	**0.163425**	**0.539613**	**0.296962**

Table B6: Strategic fit- Cluster comparison (CR: 0.8%)

- **Time-to-market**

  This criterion measures speed to operational breakeven. Snacking achieves breakeven in 2.63 years with 6-9 months implementation; Premium Pet requires 3.48 years with 9-12 months setup; Collagen demands 4.25 years with 12-18 months regulatory process.

	Collagen Hub	Premium Pet Hub	Snacking Revolution Hub
Collagen	1	0.333333	0.25
Premium Pet	3	1	0.5
Snacking	4	2	1
Normalized score	**0.121957**	**0.319619**	**0.558424**

Table B7: Time-to-market - Cluster comparison (CR: 1.6%)

Rationale: The 4× comparison (Snacking vs Collagen) reflects the 1.6× payback period differential (4.25 / 2.63 years) combined with doubled implementation timeline (12-18 months vs 6-9 months). The 2× comparison (Snacking vs Pet) captures the 1.3× payback differential (3.48 / 2.63 years).

- **Circular efficiency**

  This criterion evaluates waste valorization effectiveness. Collagen transforms disposal-cost by-products into premium bioactive ingredients (maximum efficiency); Premium Pet converts low-value organs, bones, and skin into functional nutrition; Snacking processes premium cuts, generating new profit from underestimated cuts, more efficient than simple disposal.

	Collagen Hub	Premium Pet Hub	Snacking Revolution Hub
Collagen	1	3	6
Premium Pet	0.333333	1	2
Snacking	0.166667	0.5	1
Normalized score	**0.666667**	**0.222222**	**0.111111**

Table A8: Circular efficiency- Cluster comparison (CR: 0%)

Rationale: The 6× comparison (Collagen vs Snacking) reflects the fundamental difference between waste-to-value transformation (disposal cost elimination + premium revenue) versus processing-of-valorized-cuts (generates waste). The 3× comparison (Collagen vs Pet) captures the superior wide range of waste by-products used by Collagen Hub. Premium Pet's 2× advantage over Snacking reflects by-product valorization versus noble-cut processing.

- **Summary of Consistency Ratios**

  All pairwise comparison matrices demonstrate excellent logical consistency, with Consistency Ratios substantially below the 10% threshold:

Matrix	Consistency Ratio
Criterion Weights (7×7)	1.9%
Financial intensity	4.6%
Economic potential	0%
Market opportunity	0.8%
Operational Complexity	1.6%
Strategic fit	0.8%
Time-to-market	1.6%
Circular efficiency	0%

Table B9 - Summary of Consistency Ratios

The consistently low CR values confirm that all comparative judgments are logically coherent, mathematically sound, and free from contradictions, validating the reliability of the AHP-derived rankings.