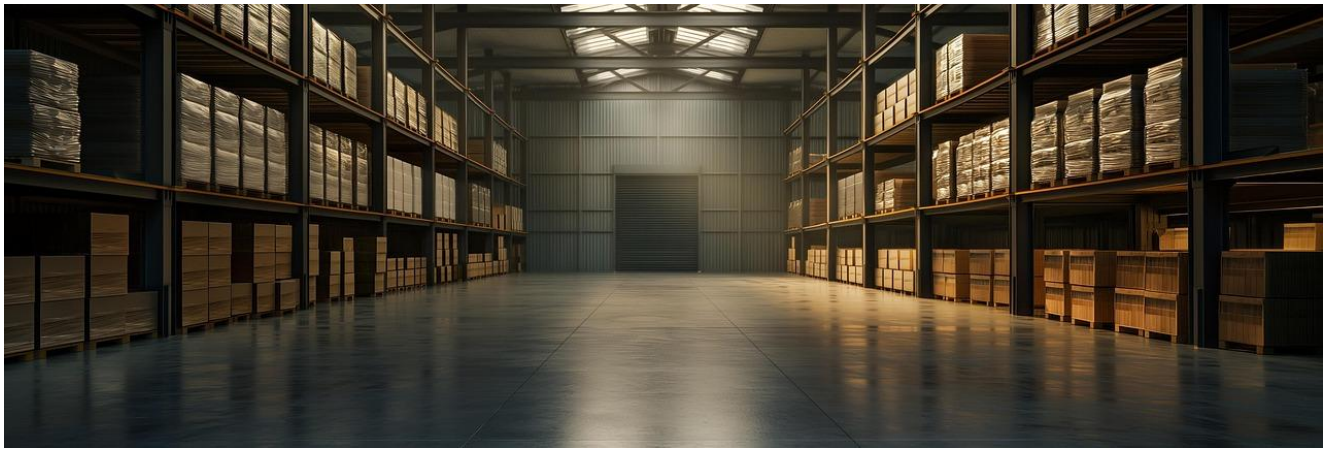


WHITE PAPER OF LOGISTICS REAL ESTATE IN CATALONIA

Logistics Commission
Logistics Real Estate Working Group
Enginyers Industrials de Catalunya. Associació/Col·legi

June 2025

TABLE OF CONTENTS

0. INTRODUCTION

Logistics real estate, the branch of the real estate sector specialized in logistics services—understood as the integration of activities related to land and properties dedicated to warehousing and distribution platforms for goods from industrial, commercial, or service companies, within the framework of comprehensive logistics, which includes Logistics 4.0, digitalization, and reindustrialization as key pillars of modern logistics—has consolidated itself as a key element for the competitiveness of companies in Catalonia.

In a context of global and dynamic markets, the logistics sector, as part of the industry, must provide efficient solutions that allow companies to manage their goods with precision and speed, making the availability of suitable logistics facilities.

This white paper, edited by the Logistics Real Estate Working Group - Logistics Commission - Industrial Engineers of Catalonia, which is composed of Cristian Oller who is its president and Goretti Torrella, Enrique Escribano, Jordi Figueras and Ignacio Errea as membres, aims to provide a practical guide for Catalan companies to improve their logistics operations, reduce costs and increase their competitiveness, from the aspect of selecting alternatives in both the real estate and construction fields.

This document analyzes the current situation and trends in logistics real estate, the best practices adopted by companies, and offers specific recommendations for the optimization of logistics spaces.

The objective is to provide companies with the necessary knowledge to address the logistical challenges of the 21st century and take advantage of the opportunities offered by new technologies.

1. BACKGROUND DATA

1.1. Catalonia, a strategic location in a global market environment

1.1.1. Catalonia, a gateway to southern Europe

Located in the northeast of the Iberian Peninsula and bathed by the Mediterranean Sea, Catalonia acts as a natural gateway to southern Europe and a vital link between the north of the European Continent and North Africa, in a strategic location that grants it a competitive advantage in terms of connectivity, accessibility and economic dynamism which is key to the development of logistics in our country.

Furthermore, the privileged location provide immediate access to key markets such as France and Italy, while simultaneously, its proximity to North Africa offers opportunities for the redistribution of goods to fast-growing emerging markets. This proximity not only facilitates the export of European manufactured products to markets where they are very well valued, but also eases energy imports and investments in production centers within highly competitive territories.

The central location in the Mediterranean also positions it as a privileged platform for world maritime trade, as it facilitates the reduction of time and logistical costs for international routes thanks to a key infrastructure such as the Suez Canal which has suffered from an unstable geopolitical situation in recent years. This situation has allowed the movement of part of the world's traffic towards the Cape of Good Hope, making the port of Barcelona a strategic redistribution hub for containers traffic within the Mediterranean Region.

Catalonia is not only a geographical connection node, but also a region with a broad historical,

cultural and economic influence in the Mediterranean, as demonstrated by the presence in Barcelona since 2010 of the Secretariat of the Union for the Mediterranean (UfM), an intergovernmental organization formed by 43 countries with a firm commitment to strengthening the Euro-Mediterranean Partnership.

1.1.2. A cross-border territory

Over the centuries, Catalonia has played a key role as a link between the Iberian Peninsula and the rest of Europe, becoming a natural crossroads between cultures, economies and trade routes. This role began with the “Roman Via Augusta”, a commercial and military “highway” that connected Hispania with the rest of the Roman Empire, which not only laid the foundations for the economic and cultural development of the territory, but also allowed a flow of goods and people unprecedented for that era.

During the Middle Ages and the subsequent centuries, Catalonia consolidated itself as one of the most important commercial hubs in the western Mediterranean thanks to the dynamism of its ports, especially Barcelona. Its trade spanned routes to Italy, North Africa and the Middle East, connecting it with the main economies of the time, exporting products such as salt, wine, oil and fabrics to Italy, France and North Africa. On the other hand, these ports received spices, Italian luxury goods and raw materials, with routes connecting Catalonia with the Strait of Gibraltar and other important ports in Europe such as Marseille, Bruges and London, facilitating the exchange of English wool, metals and manufactured goods.

Overland, connections across the Pyrenees, especially through La Jonquera, were essential for trade with France and the markets of northern Europe, with royal roads completing this network connecting the ports with the cities in the interior of the peninsula.

In the 19th century, with the Industrial Revolution, Catalonia became an industrial and commercial hub that required efficient connections with Europe. The construction of railway lines, such as the one connecting Barcelona to France via Portbou, inaugurated in 1878, reinforced its role as a hub for trade and distribution of goods, facilitating the import of raw materials and connecting Catalan industrial products with European markets.

During the 20th century, in a context of political and economic changes, Catalonia maintained its cross-border role thanks to its capacity for adaptation. Trade routes continued to expand, boosted by Spain's integration into the European Union in 1986, which allowed Catalonia to benefit from the European single market.

Currently, Catalonia not only preserves this historical role but has also expanded it thanks to an extensive infrastructure network that consolidates it as a key piece in international logistics chains, with an influence that spans across Europe, North Africa, and beyond.

1.1.3. An interconnected and multimodal logistics infrastructure network

The implementation of regional planning public policies, accompanied by a process of economic modernization driven by civil society, led to the consolidation of a strategic infrastructure network of ports, airports, railway networks, logistics platforms, and industrial parks at the end of the 20th century, designed with a comprehensive, nationwide vision and evolving to respond to the demands of global supply chains.

On a públic scale, the Transport Infrastructure Plan of Catalonia (PITC) is currently in force until 2026, but the Generalitat of Catalonia has developed other planning instruments, such as the Infrastructure Master Plan (PDI) 2021-2030, which outlines some aspects of the PITC.

Port network

The Port of Barcelona is one of the most critical infrastructures witnin this network. With specialized terminals for containers, vehicles and bulk goods, it has

Port of Barcelona

consolidated itself as a key multimodal logistics hub for intercontinental trade routes, with a high level of industrial specialization and a diversified logistics ecosystem, with more than 30 specialized terminals for all types of goods, an annual goods traffic valued €118,142 million and access to 400 million consumers in less than 48 hours [1].

Furthermore, its commitment as a key infrastructure is reaffirmed by investments exceeding €1,000 million over the coming years, with projects that include the electrification of wharves, the installation of photovoltaic rooftops, new road and rail access points, and new maritime innovation centers focused on technology, knowledge, and the blue economy.

Likewise, the Port of Tarragona maintains its strategic role as one of the main logistics hubs in the Mediterranean, standing out particularly in the traffic of chemical, petrochemical and cereal products. In recent years, it has experienced significant annual increases in crude oil and asphalt traffic, consolidating its diversification of activities. This diversification includes cruise traffic, which reached a historic record in 2024 with 63 port calls, a figure that is expected to increase even further during 2025.

The international projection of the Port of Tarragona continues to grow thanks to strategic projects such as the new Logistics Activities Zone (ZAL), currently in the urbanization phase, which will occupy a total area of 92 hectares and will significantly strengthen the port's logistics capacity.

Road network

Catalonia's road network, spanning 12,010 kilometers, constitutes one of the essential infrastructures to guarantee the connectivity of the territory with the rest of the Iberian Peninsula and Europe, and is fundamental

El Prat de Llobregat

[1] Source of information: Port of Barcelona, January 2025

for the freight transport, as 76% of the total volume is moved by road [2].

However, this high percentage of road transport, coupled with the abolition of tolls on the country's main highways, is generating high pressure on the entire road network, highlighting the need for significant investments to maintain and modernize the infrastructure. According to recent estimates, the accumulated deficit in infrastructure investment in Catalonia amounts to €42,500 million [3], a figure that evidences the urgency of planning concrete actions to guarantee the sustainability and efficiency of the road system.

In the coming years, the main projects for improving the Catalan road network include strategic actions such as upgrading road access to the ports of Barcelona and Tarragona, key infrastructures for international maritime trade. Works have also been planned to adapt the major highways to optimize the transport of goods towards the Mediterranean corridor, a fundamental logistical axis for connecting Catalonia with European markets. In addition, a modernization of the Barcelona rings roads (rondes) is anticipated, aiming to decongest traffic in metropolitan areas and improve vehicle flow.

In paralell, initiatives are being promoted to encourage more sustainable transport and reduce CO_2 emissions associated with road haulage. This involves creating new low-emission zones, expanding electric vehicles infrastructure and installing photovoltaic plants for the generation of renewable energy, with the goal of achieving emission neutrality in the maintenance of the 6,000 kilometres of roads managed by the Generalitat before 2030.

Railway network

Sustainability is also one of the major challenges facing the Catalan railway network which, spanning 1,865 kilometers, includes Iberian gauge, standard gauge, and metric gauge lines managed mainly by two major operators: Renfe and Ferrocarrils de la Generalitat de Catalunya (FGC).

This network is part of the Mediterranean corridor, a strategic railway infrastructure that is part of the Trans-European Transport Networks and connects the Spanish Mediterranean with the rest of Europe through an international gauge network from Algeciras to the border with France, passing through Andalusia, Murcia, the Valencian Community, Catalonia and Aragon.

However, this infrastructure faces significant execution delays, and the logistics sector views its development with certain reservations. Although this project aligns with the objective of increasing the railway share in the total volume of freight transport—which currently stands at 2.6% and is projected to reach 30% by 2030—logistics operators feel that the continuous string of track works, along with high costs and time constraints, discourage train usage and foster a preference for road transport.

It is worth noting, however, the progress in key projects such as the new railway terminal in “Plana de Lleida”, where construction will begin in 2027 with an approximate investment of 131 million euros, as well as future terminals in Empordà, Penedès and Baix Ebre.

Airport network

Catalonia's airport network is one of the most important and active in southern Europe, comprising four airports including Barcelona-el Prat, Girona-Costa Brava, Reus and Lleida-Alguaire. These airports play key roles in both passenger and freight transport, offering domestic and

[2] “Logistics Observatory”, Cimalsa, 2022

[3] Foment del Treball, July 2024

international connectivity. However, freight transport still accounts for a smaller proportion compared to other modes due to the associated costs and limited capacity relative to cargo volume.

Barcelona-El Prat Airport, the largest and busiest in Catalonia and one of the main European hubs, has a specialized cargo terminal with a capacity to handle more than 150,000 tons per year, and connects Catalonia with more than 70 international destinations for goods, outstanding routes including those to Europe, North America, Asia and the Middle East. Nevertheless, the managed volume does not yet reach the expected figures for an internationalized economy such as Catalonia's.

In this context, the Barcelona Air Route Development Committee (CDRA) has promoted initiatives to reverse the 11.5% decrease in air cargo recorded between 2019 and 2023, reaching 177,000 tons of freight by 2025, a 12.6% increase. This growth would recover pre-pandemic cargo levels, with priority routes being led by Shanghai, Hong Kong, Lima, Delhi, and Tokyo. There is also a strong commitment to developing "belly cargo," which represents 58% of current cargo [4], and to collaborating with logistics companies such as DHL, which is building a new hub in El Prat. These actions are accompanied by measures to promote the airport as a multimodal logistics node and international benchmark.

Girona-Costa Brava Airport, despite being mainly tourism-oriented, also possesses logistics capabilities for air freight transport; however, it is only used as a secondary airport to absorb cargo traffic during periods of congestion in Barcelona.

On the other hand, despite the significant potential that Reus Airport presents for freight transport—thanks to its proximity to logistics infrastructures such as the Port of Tarragona and the economic activity clusters of Tarragona, Vila-seca, Reus, Constantí, or Valls—the lack of an updated Master Plan to guide its future development highlights a significant limitation. A similar situation occurs at Lleida-Alguaire Airport, although in this case, the development of the strategic plan that will define its main guidelines has already begun.

Network of logistics centers and Economic Activity Parks (PAE) in Catalonia

Catalonia boasts an extensive and well-established network of logistics centers and PAEs, which are fundamental for the competitiveness and internationalization of the Catalan economy. This network is made up of infrastructures promoted by both public and private agents, and is strategically distributed throughout the territory to guarantee efficiency and connectivity between the main economic nodes.

Logistics centers

According to the ELIEC (Logistics Strategy for the Internationalization of the Catalan Economy) [5], Catalonia features nearly 10 million m² of logistics land surface, This supply has grown considerably over recent decades across key territorial axes such as the Mediterranean Corridor, the Transversal Axis, and the Ebro Axis, driven by both public and private development.

The main entity in the promotion and management of public logistics infrastructure is CIMALSA, a company of the Generalitat de Catalunya responsible for the development of a nodal network integrated by CIM Vallès, CIM Lleida, CIM el Camp, CIM la Selva, LOGIS Bages and LOGIS Empordà, to which up to 530Ha of new land in six new locations will be added in the coming years, with

[4] Barcelona Air Route Development Committee (CDRA), 2023 data

[5] ELIEC (Logistics Strategy for the Internationalization of the Catalan Economy), February 2021

projects such as LOGIS Montblanc, LOGIS Penedès and LOGIS Ebre.

In the private sector, the development that Prologis executed in Sant Boi de Llobregat during the mid-90s marked a turning point in the creation of large-scale logistics parks within the Metropolitan Area of Barcelona, progressively expanding throughout the entire Catalan territory. Evidencing this growth are the various logistics parks owned by Prologis itself, but also by companies such as Goodman, Logicor, Merlin, P3, Panattoni, or Segro across diferent municipalities in the Metropolitan Region of Barcelona, Girona, Lleida, and Tarragona.

Reus.

Apart from the logistics centers driven by CIMALSA, a significant portion of the public supply of logistics land is concentrated within the ZALs (Logistics Activity Zones) linked to Catalonia's ports and airports. The ZALs at the Port of Barcelona offer high intermodal connection capacity with port terminals alongside excellent operational efficiency, featuring a logistics area of nearly 1 million m^2 and more than 12,000 m^2 dedicated to its Service Center.

Meanwhile, the Port of Tarragona has begun construction on the Tarragona ZAL within the municipality of Vila-seca. Spanning an area of 92 hectares, this project is expected to generate an increase in freight traffic, with an estimated growth of 2.7 to 4.6 million tons annually. Also notable is the AENA sector around El Prat Airport, where 60 hectares of logistics land have been developed, designed to facilitate warehousing,, distribution and freight traffic, taking advantage of the direct connection with international air routes and contributing to the boosting of international trade.

Economic Activity Parks (PAE)

In Catalonia there are currently 1,454 PAE (Economic Activity Parks) identified in the Information System of the Generalitat de Catalunya (SIPAE), spanning an area of nearly 300 million m² and hostings 46,000 established companies. Publicly developed PAEs have traditionally been promoted by INCASÒL, an entity that manages and develops land mainly with the aim of promoting territorial balance and facilitating the creation of new economic clusters. In many cases, city councils collaborate with INCASÒL to develop industrial land within their municipalities.

It should be highlighted, however, that PAEs are usually promoted by private developers—often in collaboration with local administrations, aimed not only at satisfying the demand for industrial land in areas with high economic concentration, such as Bages, Baix Llobregat, Camp de Tarragona, Gironès, Osona, Segrià, or both Vallès, but also providing coverage for land demand for economic activities across the Catalan territory.

1.2. Macroeconomic situation of the logistics sector

1.2.1. Current economic cycle and impact on logistics demand

The Catalan economy, characterized by a high degree of internationalization and a diversified structure, forecasts a growth of 3% in 2024 and 2.4% in 2025, thanks to the dynamism of tourism, investment, and private consumption. However, it is deeply impacted by global economic dynamics, with its cycles of expansion and contraction.

This same pattern is reflected in expectations for 2025, where the Catalan economy remains conditioned by global economic movements. The moderate growth cycles projected internationally—at 1.3% in the eurozone according to the ECB—alongside the persistence of factors such as inflation, high interest rates, and supply chain disruptions, define the context in which Catalonia must continue to adapt its economic activity to maintain competitiveness and seize the resulting opportunities. Added to these elements is a new factor of significant uncertainty: Donald Trump's victory in the US presidential elections and the immediate adoption of a markedly protectionist trade policy. The imposition of high tariffs on products coming from the European Union and other world regions has generated tensions in international trade, with a potential negative impact on Catalan exports.

Persistent inflation and high interest rates will continue to affect consumption and investment, which could moderate the demand for consumer goods and reduce Catalan exports. However, tourism, with its robust recovery, could partially offset this slowdown. On the other hand, the restructuring of supply chains—resulting from geopolitical tensions and the need for greater resilience—will benefit Catalonia due to its strategic position and its logistics infrastructures.

The manufacturing industry, which remains a pillar of the Catalan economy, maintains a steady demand for logistics services, especially for managing more sophisticated supply chains. However, the productivity and investment gap compared to the European average highlights the need to promote more efficient and technologically advanced logistics models to sustain the growth of the sector.

Logistics demand in Catalonia in this context is influenced by a dual pressure: on one hand, the need to satisfy the increasing complexity of supply chains, and on the other, adaptation to current macroeconomic conditions, including high energy costs and environmental challenges. In this scenario, logistics companies will be driven to innovate, adopting more sustainable solutions such as the use of multimodal transport and advanced technologies for operational optimization.

1.2.2. Logistics, a Driving Force for the Catalan and Spanish Economies

The logistics sector contributes significantly to Spain's GDP, representing approximately 6% of the total [6]. This activity includes managing more than 500 million

[6] "1st Report on the Logistics Competitiveness of Spain and its Autonomous Communities", UNO, 2024

shipments annually and 5 million tons of freight, becoming a key piece for the country's economic competitiveness. The logistics sector also stands out for its job-creation capacity, with more than 950,000 direct jobs, to which must be added the indirect jobs derived from activities related to logistics and transport.

The weight of logistics in the Catalan economy, which currently accounts for 14.4% of the Gross Domestic Product (GDP), is evidenced by the expansion in the number of companies within the sector, which have increased by 8.6%, particularly highlighting those dedicated to urban freight distribution, with a growth of 34.1%. This driving force is based mainly on the strength of its industry, the dynamism of the exporting sector, and domestic consumer demand.

1.3 The Logistics Value Chain

The set of coordinated and interconnected activities that make up the logistics value chain allows for the planning, management, and execution of the movement of goods, services, and information throughout supply chains, from the initial supplier to the final customer. This comprehensive structure includes processes such as transport, warehousing, distribution, inventory management, and freight tracking, with the objective of ensuring that products reach the right place, at the right time, and with the expected quality, at the lowest possible cost and with minimal environmental impact.

La Bisbal del Penedès.

With clear objectives that include improving operational efficiency and optimizing costs, among others, the value chain establishes its primary strategies as the implementation of advanced technologies for freight tracking and traceability, the integration of digital systems to improve planning and process automation, the

promotion of multimodal transport to increase efficiency and reduce emissions, and the adoption of sustainable practices to minimize environmental impact throughout logistics operations.

The benefits of a well-managed logistics value chain are numerous and impact both companies and society at large. For companies, it brings greater competitiveness in the market thanks to cost reduction and improved customer service, generating flexibility and resilience to adapt quickly to changes in demand or market conditions. For society, efficient logistics ensures timely access to products, fosters economic development and contributes to achieving environmental sustainability goals.

1.4 Logistics, an essential link in the industry

Logistics is a key piece of the Catalan economy and acts as a driving force that guarantees the competitiveness and economic dynamism of a territory where industry contributes nearly a fifth of its total weight, at 19% [7]. The relationship between logistics and industry is intrinsic, since efficiency in the management of material flows, the distribution of finished products, and the organization of supply chains are decisive factors for the success of industrial activities.

Historically, the country's strategic geographical position, along with a solid infrastructure network and a strong industrial vocation, has allowed Catalan industry—in sectors such as automotive, pharmaceuticals, food, or chemicals—to establish itself as one of the pillars of the economy, exporting to international markets and integrating into global supply chains. This symbiosis between industry and logistics has not only been a decisive factor in the consolidation of Catalonia's industrial past, but is also key to facing future challenges with guarantees of success.

Likewise, in a context marked by globalization, digitalization, and the transition toward a more sustainable economy, logistics has become a key factor in supporting the competitiveness of Catalan industry through strategies such as multimodality, the construction of logistics platforms, and the efficient optimization of processes with highly advanced solutions that ensure punctuality in deliveries, product traceability and efficient cost management.

The contribution of logistics to Catalan industry goes beyond its operational support function. It acts as a catalyst for innovation and sustainability, driving the adoption of advanced technologies, such as automation and artificial intelligence, and promoting initiatives that reduce CO2 emissions. This transformative role ensures that Catalan industry remains competitive in an increasingly demanding world, where logistics is not only a synonym of transport, but also a strategic link for the growth and resilience of the economy.

1.5 The SDGs and ESG

The Sustainable Development Goals (SDGs) and Environmental, Social and Governance (ESG) criteria are fundamental frameworks that are transforming the logistics sector towards more sustainable, responsible and efficient models. These concepts, established by international organizations and adopted by companies and governments, define the standards for a more environmentally friendly, socially inclusive economy with transparent corporate management.

ESG criteria are tools used by companies to evaluate their impact across three key areas. The Environmental aspect (E) analyzes energy efficiency, the use of sustainable resources, and the fight against climate change. In logistics, this translates into the use of electric or hybrid

[7] Idescat, 2022

vehicles, the development of logistics platforms powered by renewable energy, and the implementation of multimodal transport to minimize environmental impact, among others.

The Social aspect (S) includes the well-being of workers, inclusion, and occupational safety. Logistics companies are adopting equality and diversity policies, fostering safe working conditions, and promoting continuous training in logistics skills. The Governance aspect (G) focuses on transparency, business ethics, and regulatory compliance. This implies establishing codes of conduct, supply chain oversight, and mechanisms to guarantee good business practices.

The SDGs, promoted by the United Nations, include 17 goals addressing global challenges such as climate change, inequality, energy sustainability and social justice. Within the logistics field, the SDGs are mainly implemented through measures such as reducing CO_2 emissions (SDG 13 Climate action), adopting clean technologies and renewable energy (SDG 7 Affordable and clean energy), promoting decent and inclusive work (SDG 8 Decent work and economic growth) and promoting a circular economy in resource and waste management (SDG 12 Responsible production and consumption).

In the logistics sector, integrating the SDGs and ESG criteria not only points to social responsibility, but also offers competitive advantages in the area of strategic positioning with responsible business models, reduction of risks associated with environmental and social regulation, increase in operational efficiency and access to sustainable financing.

2. FROM A REAL ESTATE PERSPECTIVE

2.1 Spaces for logistics activity

The evolution of industrial warehouses in Catalonia reflects a constant adaptation to logistics needs and market demands, marked by technical innovations and socioeconomic changes, which has significantly driven the growth of the logistics industry in Catalonia.

2.1.1 Historical evolution

The development of Catalan industrial warehousess, including their logistics facilities, has been concentrated in three key stages.

18th-19th centuries. The beginnings of industrialization

Logistical needs

During this period, a strategic location close to ports such as Barcelona was crucial for importing essential raw materials like cotton and coal, as well as exporting manufactured goods. Proximity to energy sources—initially steam and later hydraulic—was fundamental to power machinery.

The Llobregat and Ter rivers provided hydraulic energy, while steam engines, such as those of Erasme de Gònima in Barcelona's Raval district, marked the beginning of mechanization. The construction of canals, such as the Urgell Canal, also facilitated the transport of goods.

Design and demand

The textile colony model, exemplified by the Igualadina Algodonera (1842), integrated factories, workers' housing, and services within the same complex, seeking to maximize efficiency and control costs. Industrial buildings featured multi-story structures, such as the Vapor Vell de Sants (1840), to optimize space and house heavy machinery. The materials used were mainly brick and wood, featuring a functional design that prioritized production.

Colonia textil Igualadina Algodonera.

Although, of course, we cannot speak here of strictly logistical buildings, the organization of these colonies facilitated the storage and distribution of products.

Another typology of logistics building that appeared during this period was the large port warehouse—now

Girona.

historic landmarks—such as the Almacenes Generales de Comercio in the Palau de Mar. These buildings, designed to store goods arriving at the port and constructed with exposed brick, reflect the influence of the English docks of that era.

Late 19th and 20th Centuries: Expansion and Diversification

Logistics Needs:

The expansion of the railway, with the first Barcelona-Mataró line in 1848, revolutionized freight transport, enabling faster and more efficient distribution. Additionally, the emergence of chemical and energy industries required specialized facilities near urban centers to supply the growing demand for chemicals and fuels. This led to the creation of specific infrastructures, such as gas plants and power stations.

Design and Demand:

At the beginning of this period, factories consistently combined production and storage within buildings that stood out for their Modernista architecture and the use of materials like exposed brick and wrought iron.

However, throughout this period, industrial warehouses became multifunctional, adapting to sectors such as cement (Castellar de n'Hug), chemicals (Flix), or food (cooperative wineries). The introduction of metallic structures allowed for higherceilings and larger open spaces to house complex machinery, and industrial estates began to appear in peripheral areas, such as the Pont del Petroli in Badalona (1965), which facilitated the unloading of fuels and other products.

A remarkable milestone during this era was the implementation of loading docks. Although there are no specific records as to when they first began to be deployed in Catalonia, their use became widespread with

Sant Cugat del Vallès.

the development of port and railway infrastructures. Loading docks allowed for greater efficiency in loading and unloading of goods, improving safety and reducing waiting times for trucks, especially relevant in areas such as the Zona Franca of Barcelona, where port facilities and warehouses were located that required efficient loading infrastructures.

Warehouse types

It was during this period when consolidation and distribution warehouses began to emerge, although the term Cross-Docking was not yet in use. These were spaces focused on gathering different shipments to unify them into batches, improving logistics efficiency and reducing transport costs.

Already in the pre-industrialization era, warehouses evolved into simpler and more functional spaces, focused on efficiency and mass storage, with a tendency to be located—as previously mentioned—in industrial areas such as, for example, Poblenou or Sant Andreu.

It was at the end of the 20th century when the first modern logistics centers began to appear, characterized by their strategic location, advanced infrastructure, and capacity to manage large volumes of freight.

21st century. Globalization and sustainability

Logistical needs

Currently, industrial warehouses require access to advanced technology and a stable power supply. Connectivity is also crucial, with proximity to highways and key logistics nodes—such as Barcelona's second and third rings—to guarantee distribution efficiency. In this context, the logistics industry in Catalonia has established itself as a key sector for achieving successful industrial development throughout the territory; however, the sustained demand for modern and technologically

Tordera.

advanced logistics warehouses, especially in these areas, demonstrates the importance of this sector.

Design and current demand

Aspects such as sustainability, environmental care, corporate social responsibility, good corporate governance, and the like, are currently highly valued in a society deeply aware of the benefits these represent for everyone.

Constantí.

Sant Boi de Llobregat.

Modern industrial warehouses are evolving to comply with BREEAM, LEED, or WELL certifications, incorporate energy efficiency systems, humanize common spaces, reduce waste production, and facilitate recycling, among others.

Another trend to highlight is the pursuit of spatial flexibility through the design of modular surfaces. The large, next-generation logistics centers belong to the 21st century, such as the Prologis logistics park in Sant Boi de Llobregat. These facilities span more than 20,000 m^2 and are designed to be highly sustainable and efficient, flexible to adapt to different tenants, and located in strategic areas to facilitate transport. Specialized logistics platforms also belong to this century, designed for specific products—such as food—which offer specialized services in temperature-controlled handling and storage.

2.1.2 Typologies of Modern Logistics Warehouses

Currently, there is a wide range of options that allows companies to select the most suitable type of warehouse according to their specific storage, distribution, and supply chain needs, in order to optimize costs and time in freight management.

Cross-docking:

This logistics system is characterized by the immediate receipt and dispatch of goods, without the need for intermediate storage. Goods move directly from the inbound docks to the outbound docks, reducing time spent in the warehouse. There are three main types: pre-distributed, where goods arrive already prepared by the supplier; consolidated, involving handling to adapt them to the customer's needs; and hybrid, which combines elements of the previous two.

Consolidation Warehouses:

This type of warehouse allows goods from different suppliers to be gathered in the same space to reduce transport and storage costs. The objective is to group large volumes of merchandise to carry out bulk shipments, optimizing logistics.

Multilevel or Multi-story Warehouses:

These are vertical structures that utilize height to store more merchandise within a smaller footprint. They are ideal for urban areas with limited space or

Break-bulk or De-consolidation Warehouses:

Contrary to consolidation warehouses, these warehouses receive large volumes from a single supplier and divide them into smaller shipments according to customer needs, facilitating their transport and partial distribution.

where land costs are very high. They are also an interesting solution when the plot has access to streets with a significant difference in elevation levels.

Clad-rack Warehouses (High-bay / Self-supporting):

Facilities where the racking system itself acts as the load-bearing structure, supporting both the stored load and the building's enclosures (walls and roof). They allow for considerable heights, great space utilization, and are usually highly automated.

Viladecans, 34 m. altura

Big Box:

These are large-capacity warehouses, frequently used by companies with high inventory volumes. They are designed to handle large quantities of goods and typically feature advanced technology to optimize operations.

Silo-type Warehouses:

Specifically designed to store bulk products such as grains, fertilizers, or construction materials, these are vertical structures that utilize gravity for loading.

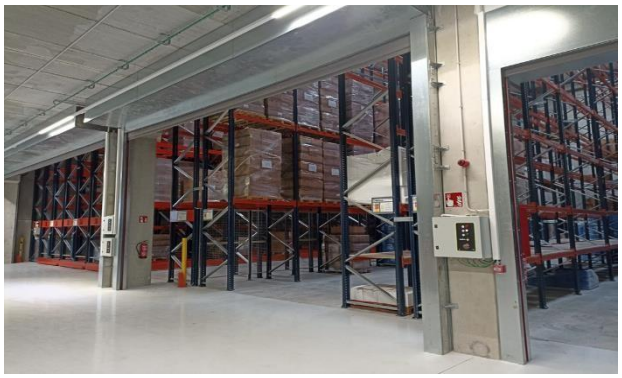
Automated Warehouses:

These incorporate advanced technology such as robots, automated storage and retrieval systems

(AS/RS), and IoT to optimize inventory management. They reduce human error and increase operational efficiency.

Conventional warehouses

They are versatile warehouses that use shelving to take advantage of both horizontal and vertical space. They include subcategories such as dynamic or drive-in shelving, adapted to different logistical needs.



Transit warehouses

They function as intermediate points between regional warehouses and final points of sale, guaranteeing agile distribution and avoiding delays in the logistics chain.

Hazardous materials warehouses

Designed with special safety measures to store chemical, flammable or dangerous products, complying with specific regulations.

2.1.3 The legal framework of logistics and its spaces

A brief note on the set of rules, laws, regulations, and legal principles that govern logistics, as this constitutes the framework establishing the rights, obligations, and procedures to be followed by individuals, companies, and institutions related to this sector.

The legal framework has evolved over time to adapt to the needs of economic growth and sustainable development, both at the state and regional levels. Specifically in Catalonia, it is worth noting that regulations have focused on boosting industrial competitiveness and urban planning for logistics infrastructures.

State Legal Framework

At the state level, the legal framework affecting logistics has developed across several areas:

- Transport and Ports: Laws on land, maritime, and air transport, as well as port regulations, govern how goods are moved across the country. For example, Royal Decree 2591/1998 establishes the organization of airports and their service zones.
- Taxes and Customs: Tax and customs laws determine how imports and exports are taxed, which is crucial for international logistics.
- Industrial Safety: The Industrial Safety Act regulates aspects such as safety in the construction and operation of industrial facilities.
- Building and Construction: The Technical Building Code (Código Técnico de la Edificación - CTE) and the Building Regulation Act (Ley de Ordenación de la Edificación) establish the standards for the construction of industrial and logistics warehouses.

Regional Legal Framework in Catalonia

In Catalonia, the regional legal framework complements state regulations and focuses on specific aspects such as:

- Urban Planning and Spatial Planning: The Generalitat de Catalunya holds exclusive powers over urban planning and spatial planning. The Architecture Law of Catalonia regulates administrative intervention in building construction and land development.
- Industrial Policy: Act 9/2009 on industrial policy aims to foster industrial competitiveness and

innovation in Catalonia, which includes logistics service

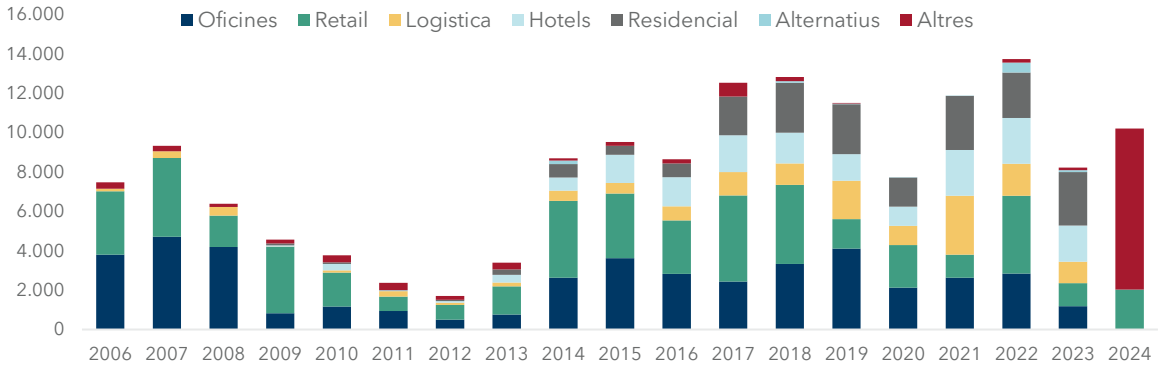
- Industrial safety: Law 12/2008 regulates industrial safety in Catalonia, establishing a general framework that must be complemented with specific regulations.
- Urban planning: regulates logistics infrastructures at the local level. The Urban Master Plan for the Intermodal Logistics Terminal of the Port of Barcelona is an example.

2.2 The real estate market in Catalonia

2.2.1 Historical evolution

The real estate sector occupies a very significant share of the global investment market, and within it, logistics is one of the sectors with the greatest weight. Until recently, investors were primarily focused on offices and retail; however, for a few years now, and especially after the Covid-19 pandemic, preferences have been directed towards this sector due to its strategic and stable value to

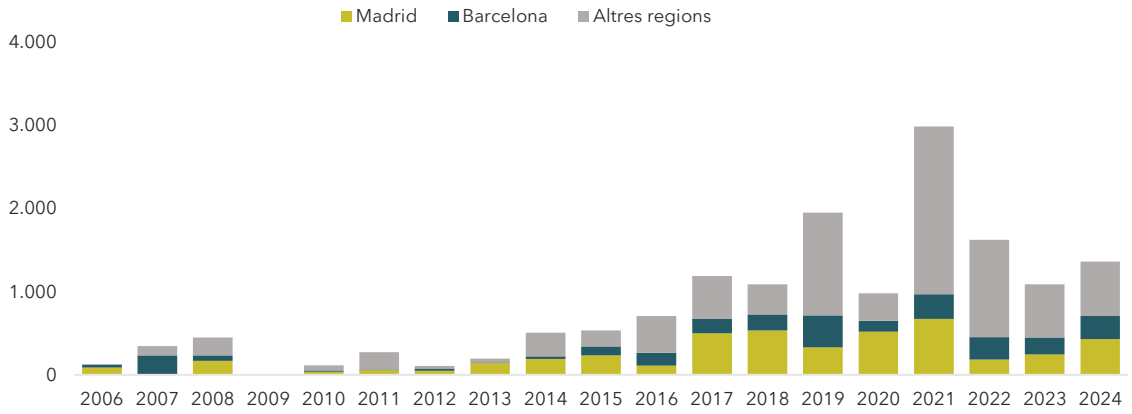
Evolution of investment by type of asset (millions of €)



Source: Cushman & Wakefield.

Si ens centrem només en el sector logístic

Investment in logistics (millions of €) - excl. M&A



source: Cushman & Wakefield.

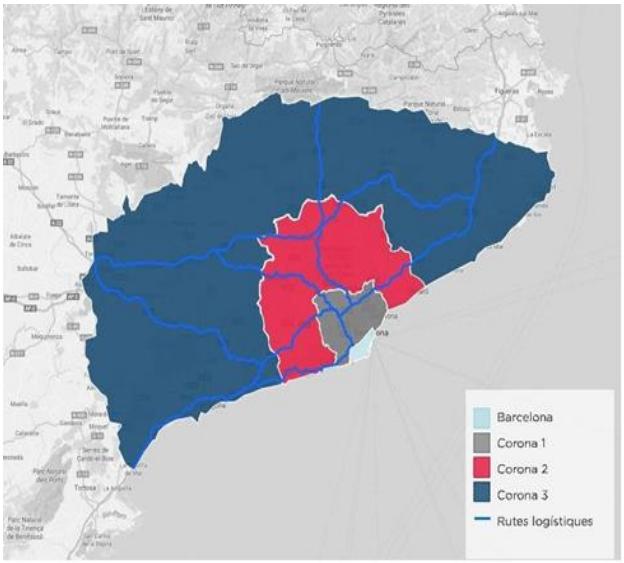
the economy and our lives, as reflected in the graph of investment volumes by asset type in recent years.

Furthermore, the output on logistics operations is more attractive than others asset classes. A logistics warehouse in Barcelona is more profitable than an office in Madrid, which makes it a very important and attractive sector for major institutional funds.

Catalonia generates strong interest within the global market due to both its high level of local industrial activity and its strategic location, which provides access to both domestic markets and Southern Europe.

To provide context relative to the rest of the national market, the main corridor is the Madrid–Barcelona axis. The third largest market, at a considerable distance, is Zaragoza; positioned between both cities, it has developed efficiently in recent times. Following these are the markets of Valencia, Bilbao, and Málaga.

If we focus on the Catalan market, the Barcelona area is clearly dominant and sets the trend for the rest of the markets, being divided into rings as shown below.



Font: Cushman & Wakefield

The main logistics areas in Catalonia are Barcelonès, Vallès Oriental, Vallès Occidental, Baix Llobregat, and Penedès, with the AP-7 highway serving as the backbone axis. Following this highway, we reach the Tarragona area, which features an important activity hub in La Bisbal del Penedès and extends into the areas of Tarragonès, Alt Camp, and Baix Camp. Here, we find large-scale logistics warehouses, known as Big Boxes, which serve as storage hubs because it is extremely difficult to find plots of this size in the areas closer to Barcelona.

Other relevant logistics areas in Catalonia include the Girona area (Riudellots de la Selva, Celrà), Figueres (Vilamalla), Bages (Manresa, Sant Fruitós de Bages, Sallent), Tortosa (Camp-Redó), and the surroundings of Lleida.

The general data of the Catalan market are listed in the following table.

	2024
Estoc (*) (m²)	9.100.630
Disponibilitat (m²)	548,127
Taxa de Disponibilitat (%)	6
Absorció (m²)	710.589
Renda Prime (€/m²/mes)	8,50
Prime Yield	5

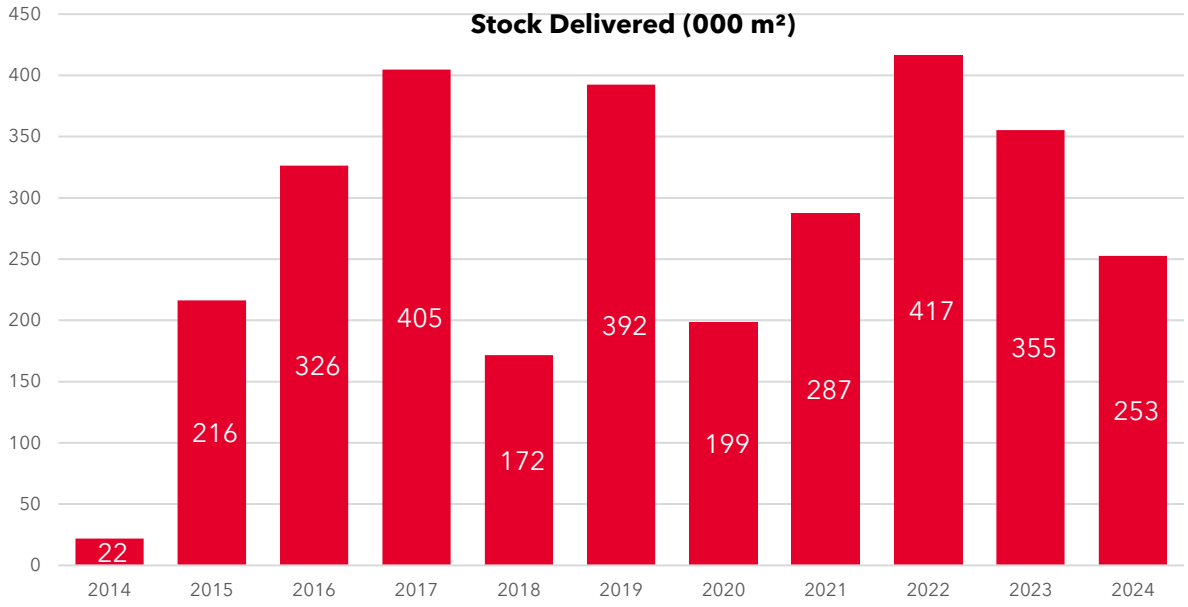
(*) Logistic warehouse area in warehouses larger than 5,000 m²

With data at the end of 2024, the total stock of logistics warehouses in Catalonia is around nine million m², with constant growth year after year.

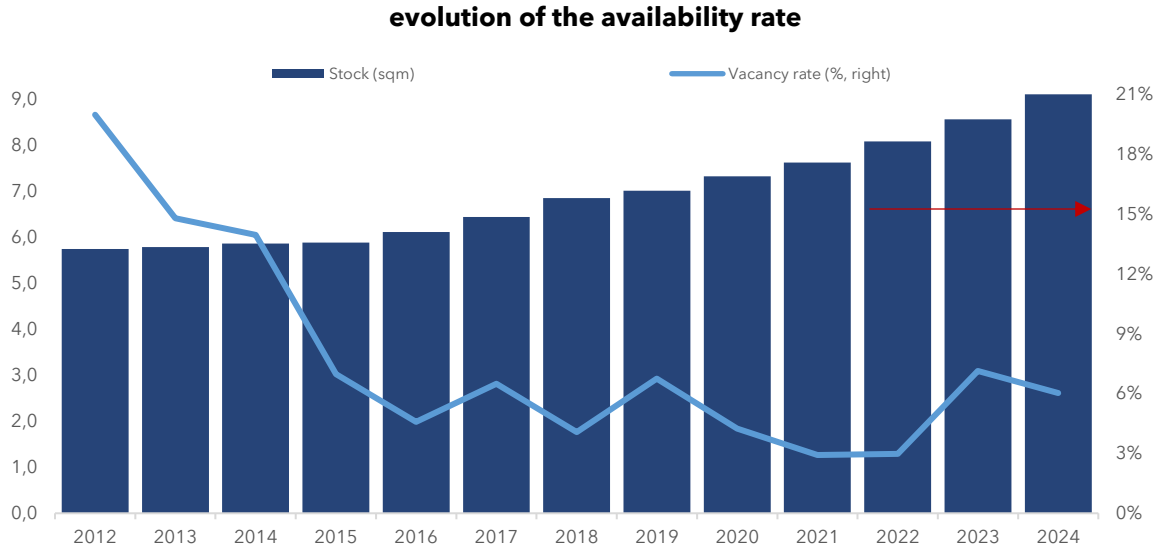
These new constructions have been improving their specifications to respond to the demands of future tenants both in the technical field and in terms of environmental efficiency and compliance with social and governance values.

Except for a few highly exceptional years resulting from the Covid-19 pandemic, the delivery rate of newly constructed warehouses has remained stable and has been conditioned by land availability at any given time.

While the total warehouse stock has been Due to this fact,



Source: Cushman & Wakefield.

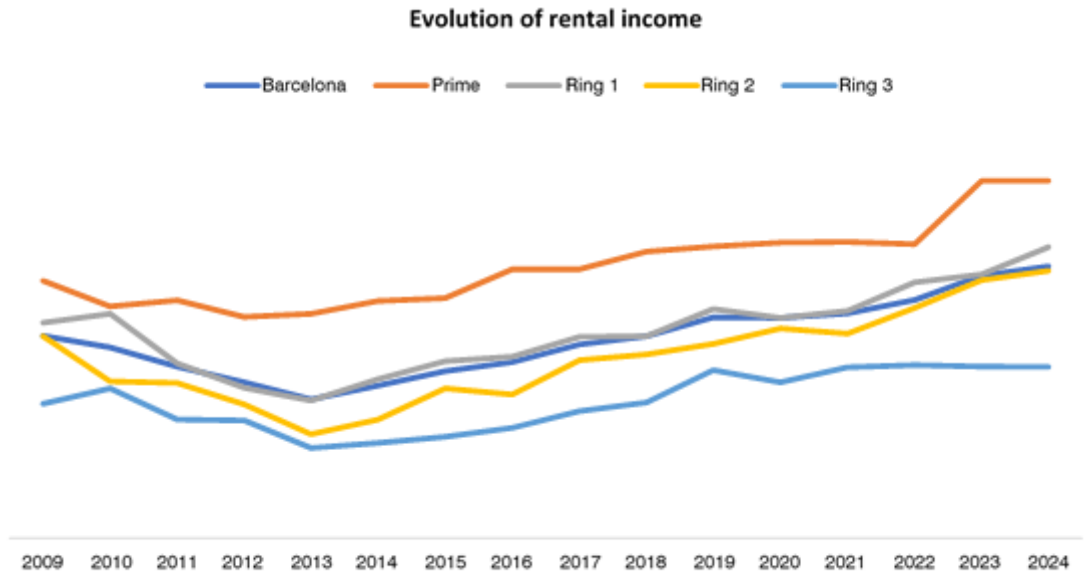


Source: Cushman & Wakefield.

rental prices for logistics warehouses have also

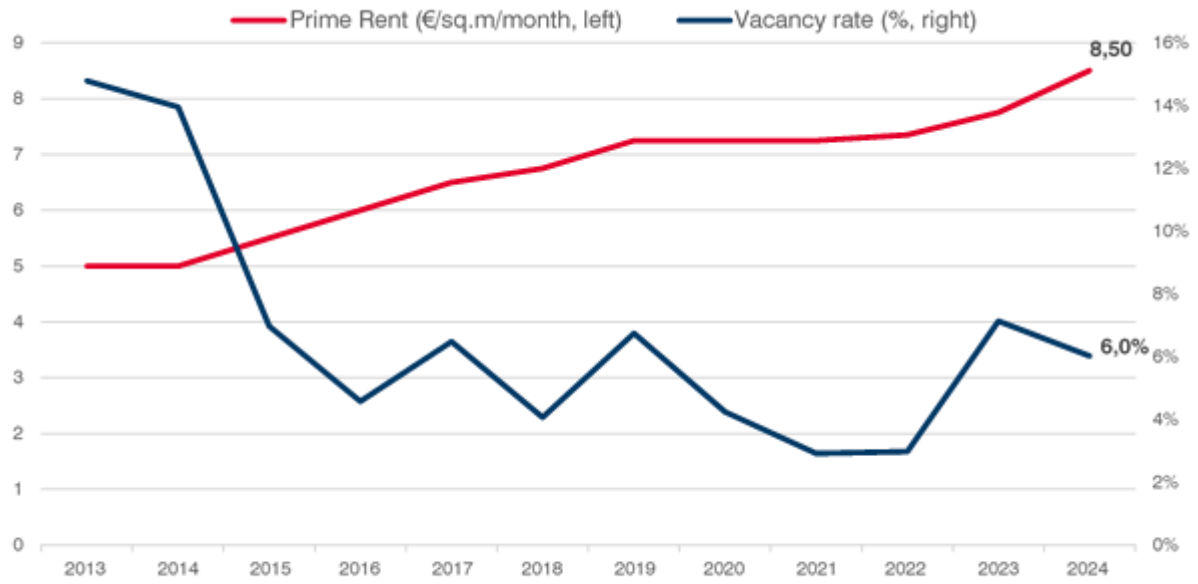
continuously increased across all areasdevelopments, market dynamism has also grown, and with it, space take-up. This fact has led to a steady decline in the vacancy rate, particularly in the first and second rings.

Due to this, the rental prices of logistics buildings have also increased continuously in all areas.



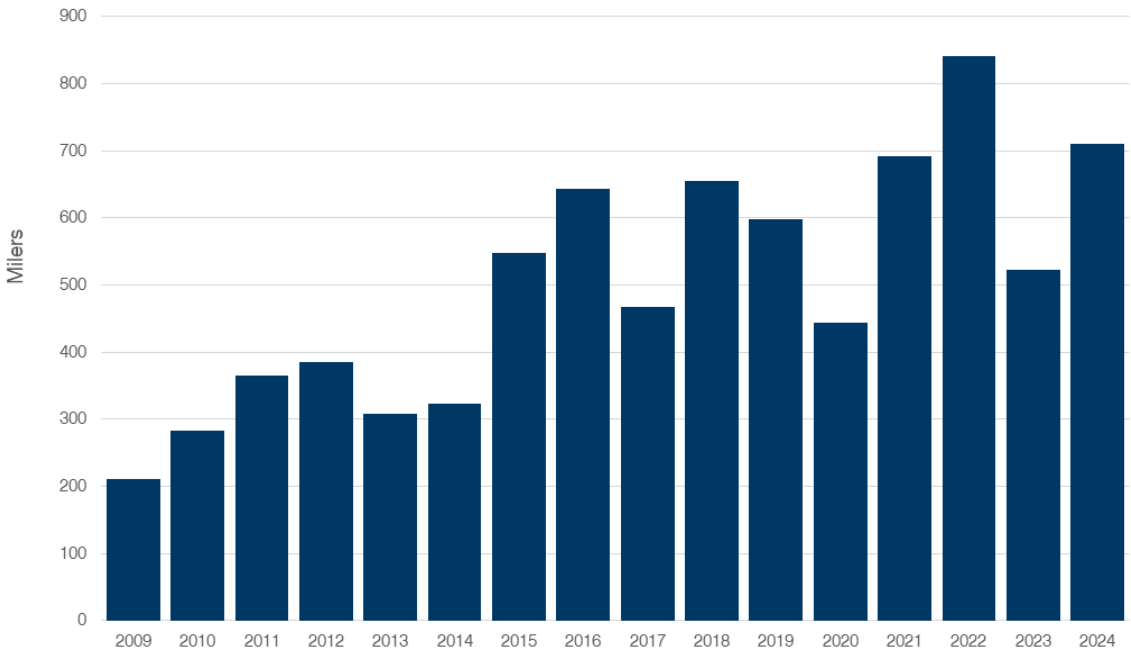
Source: Cushman & Wakefield.

And we observe how rental prices correlate with the availability of warehouses at each market moment.



Source: Cushman & Wakefield.

In the area of demand, understanding as absorption the total hiring of surface area by operators and end users of existing available surface area, the market has shown good evolution during all these years, and except for some specific years, it is considered to have had stable and sustained growth, with good projections for the future.



Source: Cushman & Wakefield.

3. FROM A CONSTRUCTIVE VISION

3.1. From the Warehouse Construction Perspective

3.1.1. Current features of logistics warehouses and their improvements

Today's logistics warehouses have evolved into highly technological spaces that combine sustainability, flexibility and security, always aimed at maximizing operational efficiency and reducing the environmental footprint.

If we had to highlight the key aspects that a modern logistics warehouse must offer to meet the demands of the sector, these would be:

- **Automation and advanced technology**
  - Automated processes using robots, storage and retrieval systems (AS/RS) and autonomous guided vehicles (AGV) that increase efficiency and minimize errors.
  - Integrating warehouse management systems (WMS) with artificial intelligence, the Internet of Things and blockchain to optimize stock tracking and decision-making.

- **Sustainability and energy efficiency**
  - Designs that incorporate recyclable materials, renewable energy sources and efficient lighting to reduce environmental impact.
  - Comprehensive recycling and waste reduction programs to comply with increasingly demanding environmental regulations.

- **Flexibility and adaptability**
  - Versatile spaces that allow the available area to be redistributed and reconfigure according to changing needs and different types of goods.
  - Vertical storage strategies to make the most of the available height without the need to expand the built area.

- **Security and access control**
  - Implementation of advanced systems such as surveillance cameras, motion sensors and biometric access controls to protect both goods and personnel.

- **Strategic location**
  - Proximity to communication hubs such as ports, airports and main roads networks to facilitate fast and efficient transport.

In recent years, the logistics sector has experienced constant transformation, introducing significant improvements in building performance with innovations that can be grouped into four main areas:

- Greater presence of artificial intelligence and machine learning: these technologies have revolutionized demand prediction, optimized routes and allowed for more agile and accurate decision-making in real time.

- Advances in automation: We have seen an increasingly widespread adoption of robots and automated systems that improve efficiency and reduce labor costs significantly.

- Commitment to sustainability: modern warehouses prioritize energy efficiency and sustainable practices, not only to reduce environmental impact, but also for the economic savings they represent in the long term.

- Integration of emerging technologies: the use of drones for inventory, augmented reality to improve daily operations and blockchain to ensure traceability, exemplify how technology is radically transforming the storage sector.

3.1.2. Facilities associated with logistics buildings and their evolution

From a construction point of view, logistics warehouses incorporate several essential facilities without which it would be impossible to guarantee their functionality and efficiency. These facilities are the backbone for the storage, handling and distribution of goods.

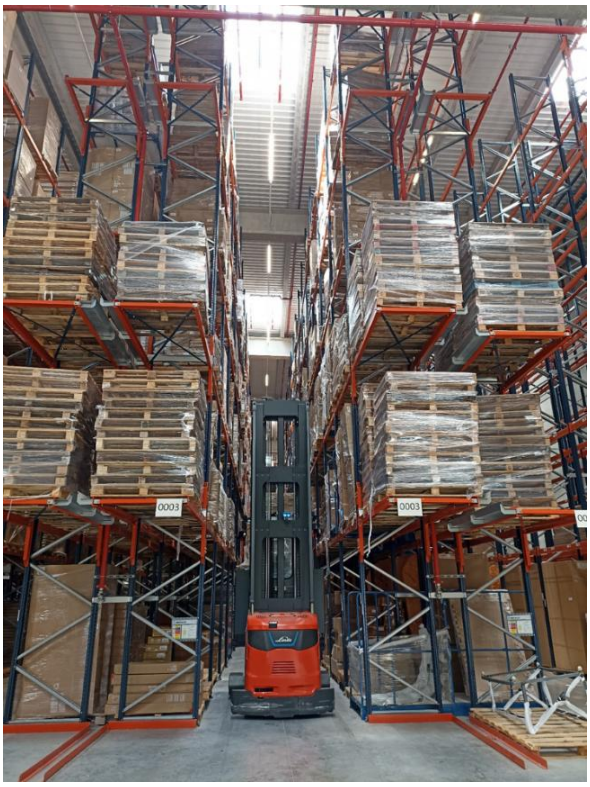
As with the performance of logistics buildings, these facilities have also experienced notable improvements in terms of efficiency, safety and sustainability thanks to the incorporation of advanced technologies and smarter practices.

- **Loading and unloading docks**

Essential elements that facilitate the transfer of goods between vehicles and warehouse, incorporating hydraulic ramps and safety mechanisms. In recent decades they have evolved towards safer and more efficient designs, with the integration of vehicle retention systems and hydraulic levelers that minimize the risk of accidents. Automation has optimized the entire process, reducing downtime and improving overall productivity.

- **Racking and storage systems**

Metallic structures and racks specifically designed to maximize the utilization of available space, dimensioned according to the weight and typology of the goods. We have moved from simple, fixed structures to highly adaptable modular systems that allow for the reconfiguration of space based on changing needs. Their integration with inventory management systems has represented a



qualitative leap in the efficiency and accuracy of stock management.

- **Lighting and ventilation Systems**
  Fundamental for ensuring visibility, safety, and a healthy work environment within the workspace. The LED revolution has transformed lighting by offering greater energy efficiency and durability, combined with smart control systems that adjust light intensity based on actual needs. In parallel, ventilation has evolved toward more efficient systems that reduce reliance on artificial climate control.

- **Fire protection systems**
  These comprise smoke detectors, alarms, and suppression equipment strategically distributed to minimize risks in the event of an emergency. They have advanced toward more sophisticated technologies, featuring smart detectors and suppression systems that utilize cutting-edge sensors and extinguishing agents that are environmentally friendly, while also highlighting the growing importance of performance-based designs.

- **Temperature controlled storage**
  Essential for products requiring temperature control, ensuring that the cold chain is maintained. They have improved significantly with more efficient and sustainable technologies that utilize natural refrigerants with a low environmental impact. Automation and precise temperature control have elevated the preservation quality of perishable goods.

- **Warehouse management systems (WMS)**
  Technological tools that enable precise tracking and comprehensive inventory control. They have evolved from practically manual systems to highly automated and interconnected digital platforms. Integration with technologies such as IoT, artificial intelligence, and blockchain has revolutionized inventory management, allowing for more accurate, real-time, data-driven decisions.

- **Transport and access infrastructure**
  Includes well-dimensioned loading lanes, parking areas and paved access roads that facilitate the movement of goods and personnel. These infrastructures have been optimized through more efficient roadways and better access routes, combined with smarter traffic management that reduces waiting times.

- **Basic services and administrative offices**
  Administrative staff spaces, rest areas, and essential services such as electricity, water, and communications. They have evolved toward more flexible and efficient concepts, featuring modular offices that allow for agile and cost-effective implementation, improving communication between teams and placing a special emphasis on ergonomics and worker well-being.

3.1.3. Construction systems and materials used

The construction of logistics warehouses has evolved significantly since the mid-20th century, incorporating innovative construction systems, advanced materials, and sustainable technologies. This has enabled construction solutions with large, column-free, open-plan spaces and highly optimized heights highly adapted to the logistics industry.

Construction systems

Throughout this time, construction systems have gone through various stages:

- **Reinforced concrete and prestressed concrete**: The introduction of reinforced and prestressed concrete, along with precast construction techniques, enabled the creation of

larger and more slender precast elements, facilitating assembly and reducing execution times.

- **Steel Structures**: Bolted steel structures have become the most widely used skeleton thanks to their ease of assembly, speed of execution on-site, and high versatility in covering large clear spans.

- **Modular Construction**: Currently, modular and precast construction is a rising trend, as it reduces construction times and costs, while also minimizing waste and allowing for greater precision.

- **Mixed Systems**: A combination of concrete and steel structures to leverage the advantages of each material based on the specific needs of each area within the warehouse.

Building materials

Regarding building materials, they have improved remarkably in recent years. Currently, there is an increasing use of advanced, innovative, and next-generation insulation materials that enhance energy efficiency, sustainability, and durability.

However, the most widely used materials in logistics buildings and industrial warehouses in general are:

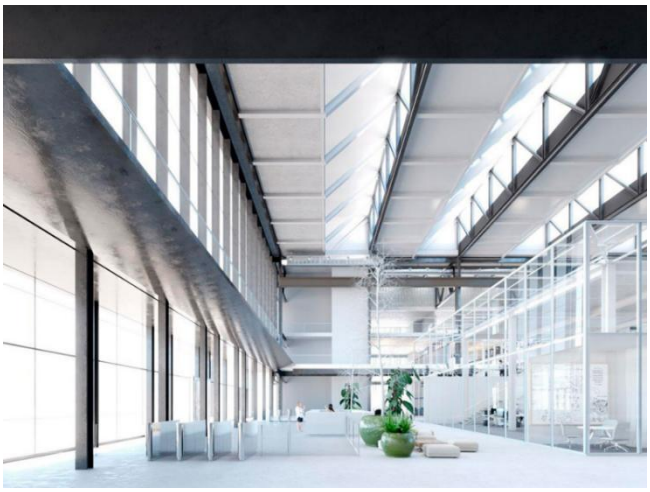
1. **Vertical and horizontal closures**

   - **Precast Concrete Panels**: They stand out for their speed in the construction process, which reduces labor costs and execution time; their resistance to fire and adverse weather conditions, along with long-term durability; and the addition of reinforcing fibers and surface treatments that improve their properties.

   - **Sandwich Panels:** Valued for their energy efficiency as excellent thermal insulation; their high mechanical and structural strength; and their fast installation and low maintenance costs. New developments include cores made of sustainable materials with higher fire resistance. They also allow for a wide variety of highly durable finishes.

   - **Ventilated facades**

     A system that incorporates an air cavity between the insulation and the exterior cladding, improving the thermal performance of the building. This allows for high-quality aesthetic finishes, predominantly ceramic, with high durability in all outdoor environments.



   - **Curtain walls**

     Used for administrative or corporate areas, allowing a large influx of natural light and better integration with the surrounding environment.

   - **Translucent materials**

     Polycarbonates and other materials, featuring a double sheet or layer for thermal insulation, which allow natural light to enter, thereby reducing energy consumption for lighting.

It is worth discussing deck roofs in somewhat greater detail. They began to be used in Spain in the late 1960s and early 1970s, with a higher rate of implementation in Catalonia due to its industrial character. The Zona Franca industrial park in Barcelona was one of the first to adopt this technology on a widespread basis.

This is a flat roof system (with slopes between 2% and 3%), specifically designed for industrial warehouses and large-surface buildings.

It is characterized by being composed of a structural support made of galvanized corrugated steel sheet metal, on top of which an insulation layer is placed (usually rock wool or polyisocyanurate) and, finally, a waterproofing membrane (generally synthetic PVC or TPO sheets).

Since the 1990s and up to the present day, its use has experienced steady growth due to its advantages:

- **Lightness**
  Its reduced weight decreases the loads on the building's structure, facilitating buildings with large structural spans and the optimization of interior space.

- **Waterproofness**
  Against water and snow.

- **Speed of execution**
  The system allows for faster installation than other alternatives.

- **Excellent thermal and acoustic insulation**
  Especially important in climate-controlled logistics warehouses..

- **High fire resistance**
  Particularly when rock wool is used as insulation.

- **Great versatility**
  They allow the installation of solar panels and other equipment.

- **Low maintenance**
  They require less attention than other systems.

- **Optimization of Vertical Space**:
  Being flat, they allow for the utilization of the maximum interior height of the warehouse, which makes it possible to store goods up to the highest point possible, maximizing overall storage capacity.

2. Specialized paviments

Without forgetting that pavements, both outside and inside the buildings, have also evolved towards high-performance and high-flatness solutions, achieving large surface areas with a low proportion of expansion joints:

- **Polished concrete**
  Highly durable and easy to maintain, with the addition of fibers to improve resistance to cracking.

- **Epoxy Resin Finishes:**
  Offering high resistance to corrosion and chemicals, making them ideal for areas with heavy machinery traffic.

- **Antistatic Pavements**
  Specially designed for areas where static electricity control is required.

- **Continuous pavements with polyurethane finishes**
  Offering a seamless surface that is easy to clean and maintain, with high impact resistance.

- **Permeable Exterior Pavements**
  They allow rainwater to infiltrate, contributing to the sustainable management of water resources.

3. Advanced and sustainable construction systems

Current trends in the construction of logistics warehouses also include:

Energy efficiency and sustainability

- **Green roofs**
  The incorporation of vegetation on roofs to improve thermal insulation, reduce the urban heat island effect, and manage rainwater.

- **Integrated photovoltaic panels**
  Utilizing large roof surfaces for renewable energy generation. Current systems allow for installation without puncturing the waterproofing layer, using special fixtures or ballasting.

- **Rainwater harvesting systems**
  Storage and reuse for irrigation or sanitary facilities, featuring filtration and treatment systems integrated into the roof.

- **Advanced Prefabrication and Assembly:**
  Use of factory pre-assembled components that are quickly installed on-site, reducing time and errors.

- **Recycled and recyclable materials**
  Use of materials with a lower carbon footprint and greater capacity for reuse at the end of their lifespan.

- **Skylights and zenithal openings**

Integration of natural lighting systems in the roof that reduce energy consumption, equipped with solar control systems to prevent overheating.

Advanced technologies

- **Intelligent building management systems (BMS)**
  Automated control of lighting, HVAC (heating, ventilation, and air conditioning), and ventilation to optimize energy consumption.

- **Construction modeled with BIM (Building Information Modeling)**
  Allows for more precise planning, detection of collisions between systems and better coordination during execution.

- **Prefabrication and advanced assembly**
  Use of factory-assembled components that are quickly installed on site, reducing time and errors.

Adaptation to new logistics requirements

- **Increased Clear Height Warehouses**: To accommodate automated storage systems and maximize cubic capacity.

- **High-Flatness Slabs:**
  Specifically designed for the safe circulation of automated vehicles and robots.

- **Flexible and modular design**
  Allowing for the expansion or reconfiguration of spaces according to the changing needs of the logistics market.

- **Optimized loading docks**
  With automatic leveling systems and thermal insulation to reduce energy losses during loading and unloading operations.

3.2. Logistics project

3.2.1. Introduction

In the logistics sector, the design of an industrial facility's logistics project represents one of the most decisive factors for operational success. A logistics project is not merely the physical distribution of spaces, but a comprehensive strategy that conditions goods workflows, energy efficiency, personnel productivity, and, ultimately, the profitability of the entire operation. In an increasingly competitive environment, where margins are tightening and demands for speed and reliability are rising, an intelligent logistics project becomes a fundamental competitive advantage.

It is essential that the logistics project is carried out correctly before starting any construction work in order to guarantee that the industrial building is efficient, operational, and adapted to both present and future needs, thereby avoiding potential costs and ineficiencies.

However, it is also highly important that there is good communication between the team carrying out the logistics project and the engineering firm handling the civil engineering and building systems projects, because each must take into account the other's needs and regulations. Only in this way can a successful logistics building be achieved.

Here we will examine the key considerations of the logistics project within industrial logistics building projects, differentiating between constructions at risk (speculative builds, without a defined end customer) and custom-built projects for specific clients (built-to-suit),

analyzing current trends and providing guidelines to optimize these strategic decisions.

- **Material flows and process design**
  The path that the goods follow from reception to shipment must be as linear and efficient as possible, avoiding crossings and backtracking.

Santa Oliva.

3.2.2. Fundamentals

The project of a logistics facility can be defined as the structured plan aimed at designing, improving, or implementing logistics processes within a company, also encompassing the physical layout of the elements that make up an industrial facility.

This layout covers the spaces required for material movement, storage, production equipment, administration, staff services, and other auxiliary activities.

Critical elements in design

- **Analysis of company needs**
- **Application of regulations**
  According to the products stored.
- **Volumes and varieties of stored products**
- **Choice of storage systems**
  Fixed, mobile racking, robòtics systems, etc.
- **Choice of equipment for material handling**
  Pallet Jacks, stackers, AGVs, etc.
- **Differentiated operational areas**
  - Reception area
  - Storage Zone
  - Order preparation area (Picking)
  - Consolidation zone
  - Dispatch area
  - Auxiliary and administrative spaces
  - Sorting area
  - Specialized Operation Zones: (e.g., assembly or heat sealing, among others).

- **Outdoor areas**
  Traffic and truck yard, etc.

- **Flexibility**
  Capacity to adapt to changes in operating volumes or logistics processes.

- **Security**
  For both personnel and materials, including fire prevention and emergency management.

- **Ergonomics**
  A layout designed to reduce unnecessary physical strain and improve working conditions.

- **Sustainability**
  Design that minimizes energy consumption and environmental impact.

- **Digitization**
  Evaluation of applicable technologies (ERP, TMS, IoT, WMS, etc.)

3.2.3. Logistics project for constructions at risk

These are logistics warehouses constructed without a defined end-user (speculative builds), and they present unique challenges in logistics project design because they must offer the maximum possible adaptability.

Main features

- **Modular configuration**
  Structure that allows the space to be divided into different independent modules.

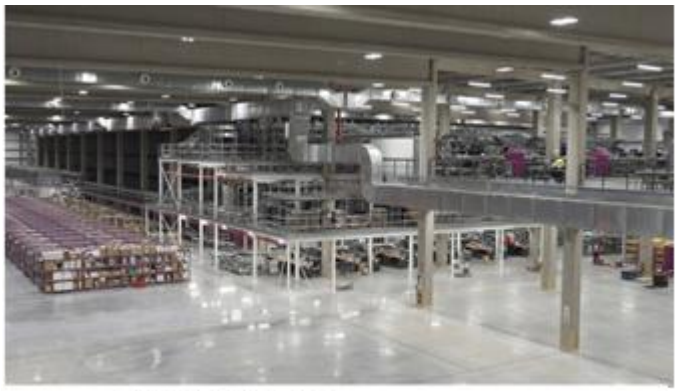
- **Optimized headroom**
  Generally between 10 and 13 meters to maximize vertical storage capacity.

- **High capacity reticles**
  Structural modules with wide spans (normally 12x24m) to minimize obstacles in internal distribution.

- **Multiple accesses**
  Loading and unloading docks strategically distributed along the facade to allow for various operational configurations.

- **Ready-to-Use Utilities**: Pre-installed connection points for future specific requirements.

- **Versatile administrative spaces**
  Office areas with the possibility of vertical and horizontal growth.



Palau -Solità i Plegamans.

Design strategies

- **Universal logistics project**
  Priority is given to a perimeter design with docks on the facade and an open-plan interior space, facilitating any subsequent internal layout.

- **Structural Floor Load**:
  Floors are designed with a high load capacity (generally 5 tons/m²) to allow for intensive storage installations.

- **Generic Traffic Flows**:
  Interior roadways are sized to allow maneuvers for standard industrial vehicles and material flow in multiple directions.

- **Utility Modules:** Concentration of services (electricity, water, fire protection) at strategic points that allow for multiple configurations.

- **Adaptable fire protection system**:
  Provision of installations that comply with different risk levels depending on future use.

3.2.4. Logistics project for specific clients

Projects developed for specific clients with known logistics needs allow for a much more optimized and efficient design, although they are less flexible for future changes of use.

Development process

1. **Requirements analysis**
   Detailed study of the client's operational flows, volumes of goods, types of products, storage systems and planned logistics equipment.

2. **Process simulation**
   Use of specialized software to model different operational scenarios and optimize routes and times.

3. **Integration with management systems**
   The logistics project is aligned with the client's warehouse management systems (WMS) and transportation management systems (TMS).

4. **Custom design**
   Precise sizing of each area according to specific operational needs.

Differentiating characteristics

- **Product-oriented project**
  Layout that considers the physical characteristics of the products (volume, turnover, fragility, special conditions).

- **Integrated automation**
  Provision of spaces for automated storage and handling systems (stacker cranes, conveyors, picking robots.

- **Specialized areas**
  Areas with specific conditions according to requirements (controlled temperature, reinforced security, treatment of dangerous goods).

- **Energy optimization**
  A Layout that minimizes routes and maximizes energy efficiency according to the customer's operating patterns.

- **Planned scalability**
  Provisions for growth phases aligned with the client's business plan.

3.2.5. Current trends

Digital transformation and changes in consumption patterns are driving new approaches to the design of logistics projects:

- **Omnichannel projects**

Designed to simultaneously manage B2B (full pallets) and B2C (individual units) operations, with

differentiated but interconnected areas for the preparation of orders of different characteristics.

- **Integration of Industry 4.0 Technologies:**

  IoT and sensorization: Spaces prepared for the installation of real-time monitoring elements.
  Advanced automation: Forecast for AMR (Autonomous Mobile Robots) and AGV (Automated Guided Vehicles) systems.
  Digitalization: Data access points strategically distributed for mobile devices and management terminals.

- **Sustainability as a priority**

  Energy efficiency: A layout that optimizes natural lighting and minimizes climate control needs.
  Renewable sources: Integration of photovoltaic installations and other clean energy systems.
  Resource management: Spaces dedicated to the management and recovery of waste and recyclable materials.

Castellbisbal.

- **Humanized workspaces**

  Advanced ergonomics: Work zones that reduce physical strain and improve working conditions.
  Integrated rest areas: Relaxation spaces strategically located to minimize unproductive travel.
  Healthy environments: Design that considers air quality, acoustic comfort, and natural lighting to maximize well-being.

3.3. Risk management

In logistics warehouses, various hazardous situations can arise that affect both personnel and stored goods, particularly due to factors related to warehouse design, product handling, and the characteristics of the commodities.

Managing these risks requires a combination of specific regulations, operational best practices, and prevention systems to maintain a safe environment for both people and stored goods.

3.3.1. Safety analysis in the management of hazardous chemical products: ADR regulations, APQ warehouses and SEVESO regulations

Hazard criteria are regulated and can be diverse (explosive, flammable, corrosive, toxic, etc.). The **ADR** regulation ("Accord Dangereux Routier" - European Agreement concerning the International Carriage of Dangerous Goods by Road) regulates the transport of dangerous goods by road. This agreement establishes requirements for the packaging, labelling, documentation, transport and handling of dangerous substances with the goal of minimising risks during their transport.

APQ (Chemical Product Storage) warehouses are regulated in Spain by the Chemical Product Storage Regulation (**RAPQ**) and its complementary technical instructions (ITCs). This regulation establishes the requirements that warehouses and storage areas where hazardous chemical products are handled and stored

must meet, such as their design, location, ventilation, containment systems and emergency management.

The relationship between the two is complementary. While the ADR regulations govern the transport of dangerous goods, the APQ regulations govern their storage.

Many of the substances regulated in the ADR are also subject to storage regulations under the RAPQ, as their hazard characteristics are shared.

Furthermore, **SEVESO** regulations must also be taken into account. This is a European directive that emerged following the 1976 chemical accident in Seveso (Italy), where a dioxin leak contaminated the area and affected thousands of people. This European directive requires member states to identify high-risk facilities, establish prevention and emergency plans, and guarantee public transparency.

In Spain, the directive is transposed through Royal Decree 840/2015, which classifies installations into two thresholds:

- Lower threshold: Facilities with lower quantities of hazardous substances.
- Upper threshold: Facilities with larger volumes, subject to stricter requirements.

SEVESO regulations are triggered when industrial facilities exceed defined thresholds for dangerous substances [8]. See the threshold tables in "Hazard categories in accordance with Regulation (EC) nº 1272/2008 of the European Parliament and of the Council of 16 December 2008" (BOE (Official State Gazette)).

Currently, in Catalonia, there is a growing trend in the demand for **SEVESO**-compliant warehouses due to various factors, such as:

- the high industrial density of Catalonia
- the important chemical activity in Tarragona
- the energy transition, which increases the storage of green hydrogen and ammonia, substances subject to **SEVESO**

3.3.2. Fire risk management in logistics buildings

This is a critical issue, given the concentration of combustible materials, complex electrical systems, and in many cases, stored hazardous substances. Below are the approaches to managing this risk, the most common systems, and recent innovations.

Risks and ignition factors

The causes can be highly varied: defective electrical systems, such as short circuits, overloaded outlets, or damaged cables; photovoltaic panels generating excessive heat or having poorly executed interconnections; lighting equipment, such as poorly installed spotlights or excessive intensity that overheats nearby materials; ignition from sparks when attempting to repair leaking pipes, etc.

They can also be caused by the stored substances themselves, such as liquid fuels (gasoline, oils, and solvents) or suspended combustible dust (flour, starch, or metallic dust).

Fire prevention and protection systems

Early Detecti on Systems: Smoke and heat sensors connected to alert systems to quickly activate control measures; aspirating smoke detection (ASD) systems for early detection, which are particularly useful in large areas.

Fire Suppression Systems: Automatic sprinklers in high-risk areas (flammable goods); portable fire extinguishers placed at strategic points according to the expected type of fire (Class B for liquids, Class C for electrical fires); clean

[8] See the table for threshold values by substance category and specific substances: https://www.boe.es/boe/dias/2015/10/20/pdfs/BOE-A-2015-11268.pdf

agent fire suppression systems (e.g., HFCs, HFOs) in areas with sensitive electronic equipment; hybrid systems that combine sprinklers with foam for combustible dusts or liquids.

Applicable Codes and Regulations

Various regulations apply, such as the Technical Building Code (CTE) in Spain, Law 3/2020 on Industrial Prevention and Safety in Catalonia, or the Construction Products Directive (CPD / DPC).

Sant Feliu de Buixalleu.

- Isolation and Compartmentalization: Zoning by dividing the warehouse into areas with different risk levels and different preventive measures; fire doors and firewalls to block corridors and separate zones in order to contain fires.
- Fire-Resistant Materials and Construction: Floors, walls, and ceilings with fire retardants that prevent flame spread; blast-resistant walls and ceilings (MEA resistance) regulated by standards such as UNE 23067-1.

Today, innovation is growing in many fields, such as the use of advanced sensors, hybrid water/foam suppression systems, fire detection systems combined with anti-theft surveillance, or computational simulation to optimize fire protection system designs and plan safer evacuations.

However, special mention must be made of the New Fire Safety Regulations for Industrial Establishments (RSCIEI):

- Objective:
  To provide a more updated and secure regulatory framework for fire prevention, focusing on upgrading existing and new facilities to the most modern standards.

- Key Aspects:
  - More rigorous requirements for early detection and suppression systems.
  - Incorporation of innovative technologies in fire detection and control.

- Enforcement of periodic inspection and maintenance of systems.

Performance-Based Design (PBD)

Performance-based studies or designs are detailed evaluations that examine the capability of fire protection systems and structural elements to respond to specific fire scenarios. Unlike the traditional prescriptive design approach, PBD allows for the development of customized solutions based on the unique characteristics of each building, its occupants, and potential fire scenarios. Thus, performance-based studies are applied when:

- Prescriptive codes do not fit a specific building well.
- Alternative solutions are sought to meet safety objectives.
- The buildings are complex, iconic, or feature unconventional designs.
- Highly complex process lines, products, and/or situations are involved that are not covered by prescriptive regulations.

3.3.3. The risk of explosion. ATEX regulations

The **ATEX regulations *(ATmosphères EXplosibles)*** are a set of European Union directives that govern the safety requirements for working in potentially explosive atmospheres—that is, places where flammable gases, vapors, mists, or combustible dusts may be present.

Consequently, installations within logistics buildings that store or handle these types of substances must comply with ATEX standards to minimize the risk of ignition:

- Explosion-Proof Equipment: Used to maintain a safe atmosphere by preventing the ignition of dust or gas.
- Zoning: Classifies areas according to the existing explosion risk, regulating access and the use of appropriate equipment for each risk zone (Zone 0, 1, 2 for gases; Zone 20, 21, 22 for dust).
- ATEX complements the RSCIEI by addressing specific explosion risks in industrial environments, whereas the RSCIEI focuses on general fire safety measures. ATEX is also particularly relevant to SEVESO and APQ regulations when the stored substances have explosive potential.

3.3.4. Battery warehouses in Catalonia

A specific example and case study of what has been discussed so far are buildings designed for battery storage. These warehouses are currently booming due to several factors:

- Energy Transition: The push for renewable energy storage (hydrogen, lithium) and the expansion of electric mobility (EV vehicles).
- Technology Industry: Growing use of batteries in data centers, telecommunications, and electronic devices.
- Stricter Regulations: Regulations such as SEVESO and RAPQ force facilities to adapt to meet safety requirements.

Batteries are considered dangerous because they contain chemical materials or compounds with characteristics that can pose risks to health, safety (fire and explosion), and the environment, such as:

- Lithium-ion (*Li-ion*) Batteries: Used for electric vehicles, solar or wind power plants, and electronic devices.

- Lead-acid Batteries: Used in conventional automobiles and backup power systems, among other applications.

- Nickel-cadmium (Ni-Cd) or Nickel-metal hydride (NiMH) Batteries: Used for industrial storage systems, among other applications.

Although next-generation batteries already exist with lower risks, some still contain toxic or flammable materials.

3.3.5. The role of engineering firms in the design of logistics warehouses and their installations

Engineering firms play a fundamental role in the design, construction, and operation of logistics warehouses, especially when dealing with facilities intended for the storage of hazardous substances or those subject to demanding regulations such as SEVESO, ADR, APQ, and others.

Their work not only guarantees the safety, functionality, and legal compliance of the facilities, but also optimizes operations, prevents risks, and ensures sustainability. Specifically, they play a key role in:

- Regulatory and Preventive Compliance: They are responsible for designing warehouses that strictly comply with applicable regulations, such as RAPQ, CTE, RSCIEI, SEVESO, etc.

- Structural and Operational Risk Assessment: Before construction, engineering firms conduct an exhaustive risk analysis to reduce the probability of accidents.

- Specialized Technical Design: They design every technical aspect of the warehouse according to its logistics objectives and the characteristics of the commodities.

- Integration of Technologies for Safety and Sustainability: Engineering firms incorporate advanced systems to guarantee safety and reduce environmental impacts.

- Construction Supervision and Maintenance: During construction, engineering firms supervise that all structures and systems meet the established technical standards. Subsequently, they develop maintenance manuals.

In other words, engineering firms do not merely interpret applicable regulations; they directly incorporate them into the design of logistics facilities.

3.3.6. The Preventive Role of Due Diligence

There are various types of *due diligence* that can be applied in the construction of industrial and logistics buildings.

These are crucial evaluation processes used to identify and mitigate risks associated with the construction and operation of these buildings. They are typically conducted prior to a transaction, such as a purchase or a merger, or before implementing a major project, thereby allowing the client to make informed decisions.

Below is a list of the main types of due diligence and the risks they evaluate:

- Legal and Regulatory Due Diligence: Evaluates legal compliance, permits, authorizations, urban zoning,

and pending lawsuits to verify that the project complies with all local and national laws and regulations.

- Technical Due Diligence (TDD): Analyzes the physical state of the building, structural conditions, mechanical and electrical installations, and energy efficiency to identify potential necessary repairs or improvements and to evaluate the technical condition of the building.

- Environmental Due Diligence: Examines soil and water contamination, environmental impact, and compliance with environmental standards to identify environmental risks associated with the land and the project, such as historical or potential contamination.

- Seismic Due Diligence: Evaluates the seismic resistance of the building and compliance with anti-seismic standards to guarantee that the building can withstand earthquakes and meet local earthquake-resistant construction codes.

- Operational Due Diligence: Analyzes operational efficiency, costs, productivity, and resource management to evaluate the operational sustainability of the building once it is running and to identify areas for optimization.

- Financial and Tax Due Diligence: Examines the financial status of the project, taxes, and fiscal liabilities to evaluate the financial viability of the project and ensure it meets all tax obligations.

The most frequently requested types of due diligence include Technical (TDD), Environmental, and Legal and Regulatory, which are essential to ensure compliance with legal and environmental standards, as well as the technical condition of the buildings. These due diligence processes are particularly relevant in regions like Catalonia, where environmental and urban planning regulations are strict.

4. SUSTAINABILITY

4.1. Sustainability

The first references to the concept of environmental sustainability date back to 1987, defined by the UN World Commission on Environment and Development as meeting the needs of the present generation without compromising the ability of future generations to meet their own needs.

Industrial sustainability, in addition to generating financial profitability, creates environmental, social and economic value in the medium and long term; thus contributing to the progress and well-being of the communities where it operates and of future generations.

More recently, Directive (EU) 2024/1785 of the European Parliament and of the Council of 24 April 2024, in one of the opening points of its considerations, states the need for a climate-neutral, clean, and circular economy, optimizing the use, reuse, and management of resources and minimizing pollution. At the same time, it recognizes the need for deeply transformative policies as well as the need to protect human health and well-being from environment-related risks and impacts.

4.1.1. Main sustainable characteristics of a logistics industrial ship

- Energy efficiency
- Resource conservation
- Safe working conditions
- Improving staff training
- Generation of little waste
- Use of environmentally compatible materials

Consequently, a sustainable logistics industry benefits the areas where it is developed, fosters the growth of local activity, and generates wealth by activating the local economy.

4.1.2. Aspects Required to Achieve a Sustainable Industrial Logistics Warehouse

- Energy efficiency, through conscious and efficient consumption
- Human resources policy, featuring training, integration and inclusion of the people who work there
- Use of Recycled and Non-Polluting Materials, and material optimization.
- Ecodesign
- Reduction of CO_2 emissions

4.1.3. Sustainability Control

In order to carry out a proper sustainability study for the logistics industry, where its impact can be quite significant, the following steps are typically followed:

Communication of the Planned Project to the Administration

Given the scale of the project to be built, several meetings and procedures are usually conducted with the competent administrations to present and explain the project. These projects can have a significant environmental impact, as they sometimes involve transitioning from rural or agricultural land to industrial/logistics plots. On other occasions, retrofitting of existing industrial parks or buildings is carried out.

Analysis of alternatives

The first point that is usually carried out is an analysis of alternatives where at least three are evaluated:

- The "Do-Nothing" Alternative (No Action), which would negatively impact and lead to a loss of competitiveness for companies of high technological and strategic value, as well as a loss in job creation.

- The implementation of a traditional logistics or industrial activity, involving small operators without optimization of space or services, and with a large volume of dispersed traffic.

- The implementation of an advanced and specialized logistics industry, whose environmental impact is lower due to its high degree of optimization regarding resources, spaces, services, and a more contained traffic volume, meaning it will not have as heavy an impact on the mobility plans of the affected areas.

Environmental impact study

Generally, it is not necessary to conduct a full environmental impact study that requires a formal assessment by the Administration; however, it is necessary to consider the study of the following systems against the environmental vectors described below:

Systems to study	Environmental Vectors
Earthworks	Climatology and lithology
Mounds and bases	Erodibility and surface hydrography
Traffic lanes / Roadways	Flora, vegetation, and habitats
Utilities / Supplies	Fauna / Wildlife
Sanitation / Drainage systems	Protected species of fauna and flora
Power lines	Habitats of Directive 92/43/EEC
Construction waste	Legal protection frameworks / Designations
Stockpiling areas	Land and air mobility

Impacts must be considered across the construction phase, the normal operational phase of the activity, and the decommissioning phase.

4.1.4. Main sustainable measures

The most common measures derived from these studies are:

- Dust reduction measures during construction and, if applicable, decommissioning.
- Utilization/reuse of materials already present on-site.
- Control over the proper management and segregation of waste during construction, operation, and, if applicable, decommissioning.
- Treatment of contaminated soils.
- Preservation of historical ruins.
- Implementation of SUDS (Sustainable Drainage Systems).
- Use of renewable energies, primarily photovoltaics.
- Measures for noise emission prevention.
- Measures for the conservation of fauna, flora, or protected habitats.
- Efforts will be made to reinstate all infrastructure, services, and easements affected during the construction phase, and any damages resulting from the activity will be repaired.
- Regular maintenance of the facilities and buildings will be carried out.
- Retention bunds / containment basins for chemical products.
- Reduction, to the extent possible, of light sources and their placement away from potential collision zones (fences, tension wires, overhead lines).
- Use of the best available techniques (BAT) possible for each specific case.

Sant Boi de Llobregat.

4.2. Decarbonization

The climate crisis is no longer a matter of the future, but an unquestionable reality manifested in the form of extreme weather events. These highlight the urgent need to act in the face of a growing climate risk scenario, which already occupies a central position on the strategic agenda of any company with the will to endure over time.

Faced with this reality, the need to decarbonize is not an option, but an indispensable condition to guarantee the viability, competitiveness, and sustainability of the sector within an increasingly demanding global context, where collective awareness regarding the urgency of taking concrete actions to reduce environmental impact is growing. The response implies decisively reducing CO_2 emissions and energy consumption—especially that derived from fossil fuels—through an energy transition that advances toward the progressive electrification of processes, decreased dependence on gas, and the active promotion of renewable energies.

In this scenario, the immologistics sector assumes a dual responsibility in the challenge of decarbonization, both as a developer and manager of real estate assets, and by virtue of its position as a key piece within the logistics system, which is closely linked to freight transport—an activity with a heavy emissions footprint. Consequently, it has become one of the most active and committed branches within the real estate sector by offering assets that help reduce the emissions of their occupants, directly contributing to achieving the Sustainable Development Goals (SDGs) of the user companies through technical, architectural, and technological solutions.

This transformation is not the result of a single cause, but rather the outcome of several factors—regulation, capital, financing, and demand—that converge and and mutually intensify each other, setting a clear and irreversible direction toward the decarbonization of the sector.

One One of the most decisive drivers comes from the European regulatory framework, which is evolving toward increasingly strict environmental regulation, forcing

immologistics operators to adapt rapidly to new legal requirements. In parallel, investment capital is showing a growing interest in assets that meet Environmental, Social, and Governance (ESG) criteria, viewing sustainability as a strategic value that guarantees profitability in the medium and long term. At the same time, financial institutions are incorporating green criteria into their credit instruments, offering more favorable conditions for projects with recognized environmental certifications.

Finally, end users—operating companies, distributors, or logistics centers—are driving this transformation, pressured by their own sustainability policies and commitment to the SDGs, demanding logistics spaces that enable them to make progress on their climate commitments.

In order for the immologistics sector to play an active role in the transition toward a more sustainable economic model, it is necessary to deploy a set of concrete strategies that effectively reduce environmental impact, utilizing mechanisms as diverse as those described below.

Building Certification

One of the first steps toward decarbonization in the immologistics sector is the environmental certification of assets, a fundamental process to guarantee that buildings meet the highest standards of sustainability. Certification seals such as BREEAM (Building Research Establishment Environmental Assessment Method) and LEED (Leadership in Energy and Environmental Design) are key tools to measure and validate the environmental commitment of logistics properties, and they have a direct impact on asset value, operational management, and corporate image.

These two certifications evaluate several key aspects, including energy efficiency through the use of materials and systems that reduce energy consumption and integrate renewable sources, such as photovoltaic plants. They also assess water management strategies, such as water reuse and the reduction of potable water consumption using efficient devices; responsible waste management and the use of recycled materials in both the construction and operation of the buildings; and indoor air quality and user comfort through the utilization of low-emission materials and proper ventilation systems.

Certifications also take into account the environmental impact during construction, promoting the use of sustainable materials and efficient construction practices, as well as the long-term adaptability and durability of the buildings by fostering flexible designs and the incorporation of materials that extend their lifespan.

With this new perspective, buildings with environmental certificates like BREEAM or LEED tend to command a higher value in the real estate market, as they are more attractive to companies seeking spaces with a smaller ecological footprint to improve their corporate image. Furthermore, investors view them as a more stable and profitable investment, featuring more efficient operating costs, higher occupancy rates, and alignment with current sustainability regulations.

Sustainable mobility

Decarbonization strategies also include actions to promote cleaner and more efficient mobility, with the aim of reducing greenhouse gas (GHG) emissions associated with the transport sector, which is one of the main sources of global emissions. These actions can translate into the installation of infrastructure for electric vehicle (EV) charging—for both private vehicles and freight transport—as well as the promotion of public or shared transport among workers, thereby helping to reduce indirect emissions associated with daily commuting.

In addition to these initiatives, the transition toward renewable energies within the mobility sector is fundamental, especially in heavy-duty vehicle transport, such as trucks and freight transportation.

emission vehicles.Moreover, the integration of biofuels and cleaner combustion systems are also important alternatives for heavy vehicles that cannot yet be electrified economically

Palau Solità i Plegamans.

Currently, these vehicles represent a significant portion of the transport sector's emissions, primarily due to their reliance on fossil fuels. For this reason, driving the transition toward cleaner alternatives is a key element in achieving decarbonization targets.

One of the main strategies in this field is the electrification of freight transport through the development of electric or hydrogen-powered trucks. Incorporating heavy-duty electric vehicles not only reduces direct CO2 emissions but also local pollutants such as nitrogen oxides (NO_x) and particulate matter, thereby improving air quality in urban and industrial areas. To make this possible, it is essential to create the appropriate infrastructure for charging heavy vehicles, including fast-charging stations and, in the case of hydrogen, refueling stations for zero- or efficiently, such as long-haul trucks. Combining these technologies with a progressive transition toward renewable energies (such as solar and wind) can help reduce reliance on fossil fuels, yielding a positive impact on the decarbonization of the sector.

This transition not only contributes to reducing emissions from the mobility sector, but also offers other benefits, such as improved energy efficiency, a reduction in noise pollution, and long-term financial savings for companies and users. At the same time, it fosters the creation of charging infrastructures and hydrogen refueling stations, leading to new job opportunities and a substantial shift in the way goods are produced and distributed.

Renewable, efficient and smart energy

Promoting renewable energies is fundamental to reducing reliance on fossil fuels in the immologistics sector, where sustainability is increasingly becoming a priority.

The integration of photovoltaic plants on the roofs or canopies of logistics buildings is one of the most effective measures to generate clean energy on-site. This not only improves the energy self-sufficiency of logistics centers but also helps reduce the carbon emissions associated with conventional energy consumption. Through this renewable energy generation, companies can lower energy costs and enhance their environmental profile, making the buildings more attractive to businesses seeking to reduce their ecological footprint.

Additionally, the digitalization of buildings through smart management systems is another key factor in achieving efficient energy management. With systems that allow real-time monitoring of energy consumption, companies can identify deviations from expectations and optimize the use of resources such as heating, lighting, and air conditioning (HVAC). This smart management enables a rapid response to any anomaly and fosters the implementation of more sustainable operational practices, reducing energy waste and minimizing the consumption of natural resources.

Another essential aspect is the implementation of battery energy storage systems (BESS). These systems allow the energy generated by photovoltaic installations during sunny hours to be accumulated and used at night or during periods of peak demand. This helps reduce reliance on the electrical grid and increases the building's self-sufficiency, enabling cost optimization and better planning of energy use.

The sensorization of spaces is another relevant strategy to improve environmental control within logistics buildings. Through sensors, factors such as temperature, humidity, air quality, and brightness can be monitored, automatically adjusting HVAC and lighting systems to maintain optimal conditions. This technology not only improves worker comfort but also helps reduce energy consumption by optimizing environmental conditions in real time.

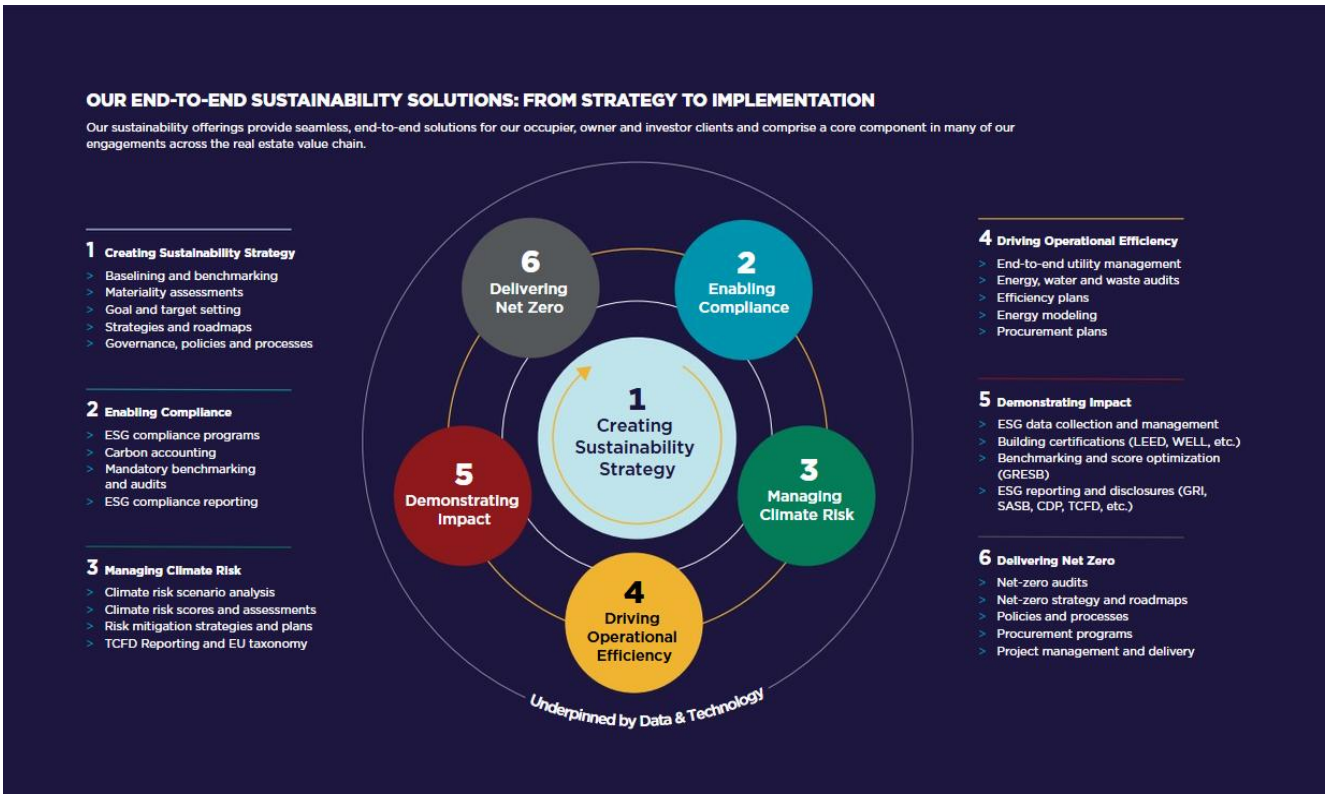
In addition to energy initiatives, water-saving and reuse technologies are key to achieving more sustainable management. Rainwater harvesting systems, for example, can be used to irrigate green areas around logistics buildings or for use in cooling systems, while water-efficiency technologies in private or corporate facilities can help reduce potable water consumption. These solutions enable better management of water resources, reducing operational costs and the environmental impact associated with water consumption.

Taken together, these actions contribute to transforming logistics buildings into more sustainable, efficient, and resilient infrastructure. The combination of renewables, digitalization, energy storage, environmental control, and water management not only improves the operational efficiency of logistics centers but also guarantees their adaptability to future sustainability challenges and environmental regulations.

Space Reuse and Circular Architectural Solutions

Finally, the sector is also committing to the retrofitting of obsolete spaces—such as old factories or industrial parks—in order to avoid the consumption of new land, thereby contributing to more responsible territorial planning. This practice not only prevents the destruction of natural environments but also promotes the reuse of existing resources, minimizing the need for new materials and reducing the waste associated with building new infrastructure.

This philosophy aligns with the principles of circularity in architecture, a key approach to the decarbonization of the sector. Circularity involves designing buildings with the goal of maximizing material reuse, saving resources, and



Source: "2023 Sustainability Report", Cushman & Wakefield.

reducing waste. Thus, instead of building from scratch, priority is given to utilizing existing structures and materials—applying techniques that allow for their restoration, reuse, or recycling—while also using materials that minimize both embodied and operational carbon.

In certain contexts, particularly in areas with high logistics density or space constraints, multi-level architectural solutions can represent an efficient alternative. These solutions, which can range from the renovation of large spaces to the construction of new buildings on top of existing structures, make it possible to maximize the use of available land and minimize territorial sprawl. Although their application still depends on market maturity and the specific demand of each territory, these strategies integrate seamlessly into the broader objective of creating more efficient and decarbonized spaces.

4.3. Net Zero

Achieving climate neutrality—or the Net Zero target—is one of the global commitments established in the Paris Agreement and represents an unavoidable challenge for all economies and productive sectors. This objective implies that, before the year 2050, the net balance of greenhouse gas (GHG) emissions must equal zero. In other words, emissions generated by human activity must be entirely offset by actions that reduce, avoid, or capture equivalent emissions, whether through technological improvements, energy efficiency, the use of renewable energies, or offsetting systems such as carbon capture or reforestation.

In this context, organizations like the SBTi (Science Based Targets initiative) are fundamental in helping companies establish GHG emission reduction targets aligned with climate science.

Created in Great Britain in 2015, it involves the collaboration of international entities such as the CDP (*Carbon Disclosure Project*), the United Nations Global Compact, the We Mean Business Coalition, the World Resources Institute (WRI), and the World Wildlife Fund (WWF). It offers a methodology that enables organizations to define science-based targets that contribute to keeping global warming below 1.5°C, as established in the Paris Agreement.

In its latest report, the "*SBTi Monitoring Report 2023*", it is detailed that at the end of 2023, out of the 4,205 companies and financial institutions with targets validated by the entity, 53% were located in Europe, 27% in Asia, and 14% in North America, with Japan being the country with the highest number of validated companies. These figures are positive, given that the number of companies with science-based targets grew by 102% in a single year. Nevertheless, there is still a long way to go, as only 39% of the global economy, in terms of market capitalization, is made up of companies with science-based targets or commitments.

To measure and structure an organization's greenhouse gas (GHG) emissions, the methodology established by the *Greenhouse Gas Protocol* (GHG Protocol) is used. This protocol distinguishes three levels of scope — known as *Scope 1, Scope 2, and Scope 3* — depending on the source and the degree of control the company has over those emissions. This classification is key to understanding the complexity of the Net Zero challenge and to defining effective reduction and offsetting strategies, such as those proposed by the SBTi, which allow companies to address the entirety of their emissions and act in alignment with global climate goals.

Scope1: Direct Emissions

This includes all direct GHG emissions that come from sources owned or directly controlled by the company. These are emissions generated by everyday operational activities, such as:

- The combustion of fuels in boilers, furnaces, or generators.
- Company-owned vehicles (for example, a delivery fleet).
- Internal industrial processes that release pollutant gases.

These emissions are the easiest to measure and control, as they depend entirely on the organization's internal decisions and operations. Reducing them involves actions such as replacing fossil fuels with clean alternatives, electrifying the vehicle fleet, or modernizing thermal systems with more efficient technologies.

Scope2: Indirect Emissions from Energy Consumption

This scope refers to the indirect emissions associated with the production of the energy that the company purchases and consumes, primarily electricity, but also steam, heating, or cooling.

Although these emissions are not physically generated at the company's facilities, they are attributable to its activity, as they derive from its energy consumption, such as:

- Electricity purchased to illuminate, climate-control, or operate machinery within a logistics warehouse.
- Steam or district heating contracted for an industrial plant.

Reducing this type of emissions relies on energy efficiency (insulation improvements, smart control systems, low-consumption equipment), but above all on the procurement of green energy, either through retailers with guarantees of renewable origin or through self-generation (such as photovoltaic installations).

Scope 3: Value Chain Indirect Emissions

This is, by far, the broadest, most complex, and most difficult scope to control. In many cases, it represents the largest share of an organization's total emissions, making it the greatest challenge for any truly transformative Net Zero strategy.

Scope 3 includes all other indirect emissions that occur outside of the company's facilities but are a consequence of its activity throughout the entire value chain—both upstream (suppliers) and downstream (customers and end users)—and can include, among others:

- The production and transport of purchased materials.
- The use and maintenance of sold products throughout their lifecycle.
- Employee commuting.
- Business travel.
- The treatment of waste generated by the company's activity.
- Subcontracted services (third-party logistics, technical services, etc.).

It is within this third scope where the maximum complexity of the Net Zero challenge is concentrated, as it implies acting beyond the company's own operations and addressing emissions generated throughout its entire value chain. This requires influencing—and even transforming—the environmental behavior of suppliers, partners, and customers, with whom direct control mechanisms often do not exist, so they can advance toward climate neutrality.

Progressing in this area requires not only a high capacity for coordination, traceability, and transparency to facilitate the alignment of goals—such as establishing environmental criteria in supplier selection, co-creating shared decarbonization plans, developing and innovating products and services with a lower environmental footprint, and raising awareness and involving customers in more responsible consumption practices. It also requires significant efforts in knowledge-sharing and education to clearly understand and map out what needs to be done, when it needs to be done, who should take the lead, how costs should be shared, and what mechanisms can enable the financing of the necessary transitions.

5. GOVERNANCE

5.1. Corporate Governance of Sustainability Risks: A Brief Approach to the European Context

Today, when we speak of corporate governance, we also speak of managing environmental and social risks, impacts, and opportunities. Company managers now face an additional area of risk at their desks: what we call sustainability risks, which they must govern alongside financial, quality, labor, legal, and regulatory compliance risks.

Under the European Green Deal, the European Union (EU) has deployed significant legislative activity that shapes the role of business in the transition toward a sustainable, fair, and inclusive economy. This role requires business owners to incorporate diligent governance of the impacts that their economic activity produces—or may produce—on the environment, the rights of individuals and communities, and the fight against climate change.

Within this framework of sustainability governance regulations, we find rules intended to provide greater **transparency** to the market and economic activity, in order to facilitate investment decisions and prevent (*greenwashing and socialwashing)* practices. We also find rules that establish corporate **conduct obligations**, either to introduce standards of conduct that improve the corporate governance of sustainability, or to introduce specific conditions into production processes and the lifecycle of products and services to make them more sustainable.

Both transparency and conduct regulations translate into an obligation to govern risks, impacts, and opportunities regarding sustainability.

The core regulations are the Corporate Sustainability Reporting Directive (known as the CSRD) and the Corporate Sustainability Due Diligence Directive (known as the CSDDD).

5.2. Governance and Value Chains

The CSRD and the CSDDD are regulations targeted at large companies. That is, they apply to companies that exceed certain high thresholds for turnover and number of employees.

However, both directives extend their effects along the chains of activities of the large companies under obligation. These corporations must account for and diligently govern the risks that both their own operations and the activities within their value chains generate regarding the environment and human rights.

This is precisely why the logistics sector—a key player in value chains within a global market—must consider itself directly addressed by this regulatory framework.

5.2.1. Key Concepts of Accountability

The CSRD is a transparency regulation that establishes an obligation for accountability or reporting. However, it also inherently carries an obligation of diligent governance. The annual sustainability report is not an end in itself; rather, it obliges the company to establish a management or governance system for the diligent oversight of sustainability risks and opportunities within its own operations and across its value chain:

- The principle of **double materiality** requires the company to assess both how sustainability affects the business (financial materiality) and how the company's activity impacts the environment, climate change, and human rights (impact materiality).

- Accountability is **forward-looking**, including data on the company's current performance as well as its future strategy and targets.
- Information on specific economic activities must include the perspective of the climate and environmental objectives set by the **green taxonomy**[9].

- Data must be **homogeneous and comparable**. The degree of achievement and performance is measured according to pre-established European standards that apply equally to everyone. Furthermore, the information is provided in a digital format to allow it to be uploaded to the EU single access point, facilitating comparability between companies.

- The information is verified by an independent third party.

Thus, it becomes clear that the obligation to report affects how a company governs its environmental and social impacts, risks, and opportunities. In practice, the regulation aims for companies to:

- Review their sustainability risk management systems and policies to ensure they align with reporting requirements and, specifically, with the results of the double materiality analysis.

- Establish internal procedures that allow for systematic and reliable tracking of sustainability information and data, alongside internal audit and control systems that ensure the accuracy of the information provided in reports.

- Review and define roles and responsibilities within the company's governance and operational structures to ensure the integration, oversight, and fulfillment of sustainability policies, targets, plans, and risk management systems.

5.2.2. Key Concepts of Due Diligence

The CSDDD is a conduct regulation that introduces the corporate duty to diligently manage the adverse effects that a company's own operations, and the operations within its chain of activities, produce or may produce on human rights and the environment (social and environmental impacts). Therefore, its purpose goes beyond the implementation of traditional compliance systems aimed at preventing specific illicit behaviors or actions contrary to business ethics:

- The due diligence obligation takes a **risk-based approach**. That is, it requires the company to deploy systems for investigating and detecting facts that generate or may generate risks to the rights of third parties or the environment, and to adopt the appropriate measures for their management in accordance with the required standard of diligence.

- Specifically, the company **has a duty** to identify, assess, and prevent potential adverse effects, and to eliminate, mitigate, and remedy actual adverse effects on human rights or the environment, as well as the obligation to possess and implement a climate transition plan.

- Due diligence must **extend to the chain of activities** related to the company's products and services, which can be long, complex, and lacking in transparency within the global market.

[9] Taxonomy Regulation (EU) 2020/852 and its Delegated Acts.

- The inventory of operations within the chain and the risk mapping become key elements for due diligence, serving as the foundation upon which the company can identify the appropriate measures to manage each impact.
- The proper management of the chain of activities in terms of the due diligence obligation will rely on transparency, dialogue, and collaboration across the chain of activities. The regulation does not impose an obligation of results, but rather an obligation of means. Consequently, the company will not be held liable for damages caused solely by a business partner within the chain of activities. However, it will be responsible for deploying the appropriate means and exercising its influence across the links of the chain of activities to ensure that adverse effects are prevented, mitigated, eliminated, and remedied.

5.2.3. Conclusion

At the time of writing this chapter, European legislators are reviewing sustainability governance rules in order to simplify them and achieve a better balance between sustainability and the competitiveness of the European economy.

Nevertheless, the role of the company in achieving decarbonization targets and governing the risks and impacts of economic activity from a double-materiality perspective remains intact.

Sustainability reporting and due diligence obligations are defining elements of the European company's responsibility in this transition. The logistics sector plays a leading role in the sustainability governance of business and economic activity, as it is a constant link present across all value chains.

6. CHALLENGES

6.1. Urban planning and management

6.1.1. Introduction. The multidisciplinary nature of urban planning

Urban planning is a public function and a field of knowledge involving various disciplines, both technical (architecture, engineering...) and social (law, economics, sociology...).

There is no single, all-encompassing definition of what urban planning is. However, the definition provided by the current Urban Planning Law of Catalonia (Legislative Decree 1/2010 of August 3) is highly accurate when it establishes that urban planning "is a public function that encompasses the zoning, transformation, conservation, and control of the use of land, the subsoil, and air rights, as well as its development and construction, and the regulation of the use, conservation, and retrofitting of works, buildings, and facilities" (Article 2.2).

It further specifies (Article 2.3) that it comprises: "a) The allocation of powers. b) The definition of land and housing policies and the instruments to implement them. c) The urban planning property regime. d) Urban planning. e) Urban management and execution. f) The promotion and intervention in the exercise of ownership rights relating to land use and building. g) The protection and, where appropriate, restoration of urban planning legality. h) The creation and management of public land reserves for urban planning purposes."

That being said, it must also be taken into account that the environmental sustainability component and the social perspective (cohesion, mixed-use zoning, etc.) are increasingly prominent and carry greater weight. For this reason, urban planning must be understood from an integral perspective that goes far beyond the mere treatment or regulation of land.

Vilanova del Camí.

6.1.2. Urban planning and logistics

General Overview: On the Necessity of Permitting Logistics Use with Adequate Zoning Tailored to Specific Needs.

It is therefore obvious that urban planning plays an essential role in logistics activity, particularly when referring to the spaces or platforms (warehouses, yards, terminals...) where this activity takes place and materializes.

In this sense, given that urban planning is a public function, it is up to the Administration (essentially local and regional governments) to decide through urban planning instruments whether logistics use is permitted—and under what conditions—within a specific territorial area, in view of the statutory nature of real estate property rights. Here, the planner must be aware that we are dealing with a use that possesses its own fundamental autonomy and importance for society and the economy (just as other uses do, such as residential use, for example), as has been demonstrated in other sections of this Book. For this reason, it must also be considered of general interest, given the need to guarantee the supply chain.

Consequently, and particularly with a medium- and long-term vision, a decisive commitment must be made to this use whenever necessary, ensuring it is not unjustifiably restricted (as seen throughout this Book, there are many examples of successful urban developments for logistics purposes that satisfy both public and private interests). This must also be done bearing in mind that the evolution of construction techniques guarantees high standards of quality, sustainability, and safety for both people and property.

Furthermore, this commitment must take into account the current needs of the aforementioned spaces and logistics platforms (greater building heights, larger plots allocated for this use, etc.). All of this must be achieved without losing sight of the need to move past outdated regulations (via urban planning) and to adopt a flexible approach aimed at adapting urban plans whenever necessary. Indeed, it cannot be forgotten that our legal system possesses the unique characteristic where urban plans hold the legal status of administrative regulations. While this is positive in certain instances—as planning provides legal certainty—it can be negative in others, due to the rigidity involved in modifying these planning instruments.

Specific Overview: Urban Planning Law and Immologistics (Industrial Real Estate)

As previously mentioned, one of the disciplines involved in urban planning is law, which in this specific case is identified as urban planning law and is usually considered a (special) branch of administrative law.

This urban planning law plays an essential regulatory role in immologistics (industrial real estate) which, broadly speaking, is defined as the real estate sector activities aimed at generating logistics spaces and platforms for their actual use (by logistics operators, by the manufacturing companies themselves, etc.), which then come to be considered real estate assets.

In short, when referring primarily to the land where constructions and installations intended for logistics use are to be materialized, these assets can be of two types:

1. Land that can be considered "finalist" (shovel-ready / fully-zoned). This concept is not a legal category in the strictest sense; rather, it is normally associated with land that is classified as urban and meets the condition of building plots (solar), where direct construction is permitted through the corresponding urban planning license(s).

2. Or those subject to an urban transformation process, aimed at enabling the land/assets to achieve the aforementioned status of being "shovel-ready" (finalista). This process should

be streamlined as much as possible in territories where there is a demonstrated need to increase land allocated for logistics use.

To accomplish this, the following phases must be completed:

- Urban planning, meaning the approval of the appropriate master and derived urban plans (e.g., partial plans) required to permit logistics use and regulate its regulatory parameters.

- Urban management, which ultimately brings the provisions of urban planning to fruition. In this regard, the Spanish Supreme Court (Judgment of May 30, 1983) has pointed out that "*the principle of planning unity requires a unified and phased process that moves from the most general to the most specific, from the plan to the development by means of the project—the final step in the process—all in such a way that each lower plan is subordinate to the higher one, and all are subordinate to the law (...) all of this through an execution system among those provided by law, which the Administration selects in the exercise of its discretionary powers, yet limited by a series of circumstances such as needs, resources, private initiative collaboration, and characteristics of the area; all of which are planning and execution activities that must follow an order and synchronization, without which the necessary urban planning discipline to prevent the chaotic growth of the city becomes impossible.*"

  This management is carried out through: (i) the development (urbanització) of the corresponding sector (which must be dedicated and transferred to the Administration); (ii) the equitable distribution of benefits and burdens among landowners via a land-consolidation project (reparcel·lació) or similar mechanism (or, when acting under a public execution system, through the eminent domain/expropriation of the corresponding properties), ensuring the community participates in the generated capital gains; (iii) and the configuration of what is known in urban planning as zones (plots intended for private development and use) and systems (parcels of land designated for predominantly general and public use, such as green spaces and the road network).

Finally, within immologistics, in addition to urban planning law in the "strict" sense (that which is contained in general urban planning regulations — laws, decrees/ordenances — and urban plans), sector-specific regulations must be closely considered. Thus, by way of example, attention must be paid to the various easements that may be imposed regarding aviation safety (which is particularly relevant for the height of logistics structures and their geographic location, often around airports and airfields) or the technical requirements imposed concerning the safety of industrial/logistics establishments.

Evidently, all of this framework must always be analyzed through the corresponding legal review (*Legal Due Diligence*) within the framework of reviewing urban development operations and in transactions involving assets destined for logistics activities.

6.2. Regulations and bureaucracy

6.2.1. Regulations

Logistics centers must comply with a series of rules and regulations that can affect their daily operations and future growth capacity, potentially becoming a limiting factor.

Warehouses must comply with safety regulations, especially those related to fire protection.

The Fire Safety Regulation for Industrial Establishments *(Reglamento de Seguridad Contra Incendios en Establecimientos Industriales – (RSCIEI) - RD 2267/2004)*, regulates fire prevention and safety conditions in industrial establishments, including logistics warehouses. This regulation is currently under review and will have a significant impact on logistics warehouses. These changes aim to reinforce safety, improve prevention, and facilitate a more effective response to emergencies in industrial facilities.

Tordera.

Municipal ordinances and urban planning regulations establish the requirements and parameters to be met for the construction of logistics warehouses. These include maximum regulatory height, building volume, plot coverage, maximum buildable area, the required number of parking spaces, or the layout of loading and unloading zones. Recently, the construction of multi-story logistics warehouses has been permitted to address the shortage of available land.

Environmental regulations may require significant investments in cleaner and more sustainable technologies. Although this can entail a high initial cost, it

can also offer long-term benefits, such as reduced operating or maintenance costs and access to subsidies

Performance-based design studies offer alternative solutions when regulations are not technically or economically viable. These types of studies analyze specific risks through simulations of fire development and the performance of existing or proposed protection systems. They are particularly used in buildings or installations with unique characteristics that require a more customized approach.

6.2.2. Bureaucracy

Bureaucracy is perceived as an obstacle to business agility and stands as one of the main challenges that logistics companies must face when building and managing warehouses.

Administrative processes can be highly complex, requiring long timeframes for processing that can vary significantly depending on the project's complexity and the workload of the competent authorities. In some cases, procedures can take months or even years, which can delay major projects such as the construction of new logistics facilities or the expansion of existing operations.

To construct a logistics warehouse, various licenses must be obtained—such as the building permit (llicència d'obres), the environmental license (llicència ambiental), and the activity/operating license (llicència d'activitat)—all of which require the submission of detailed technical projects and compliance with specific regulations.

Depending on the location and size of the warehouse, an environmental impact assessment may be required to ensure that the project will not have significant negative effects on the environment.

6.2.3. Conclusions

In order to improve the situation, it is essential for authorities to work on simplifying bureaucratic processes and reviewing regulations to better adapt them to the needs of the sector. This could include the digitization of administrative procedures, a reduction in the required documentation, and the creation of fast-track processing mechanisms for projects considered strategic for economic and logistics development.

Collaboration between the public and private sectors is fundamental to identifying and addressing bureaucratic obstacles and improving administrative processes. Logistics companies can contribute their practical experience to help design more efficient regulations, while authorities can offer support and resources to help reduce the bureaucratic burden and facilitate the development of logistics projects, thereby contributing to the competitiveness and efficiency of the logistics sector in Catalonia.

6.3. Talent

As a global economic engine and the backbone of production systems, logistics is undergoing a profound transformation that places the focus on one of its main assets: talent. In a context of accelerated technological change, green transition, and growing globalization, the strategic management of human capital has become one of the greatest challenges to guaranteeing the competitiveness and sustainability of the sector.

The demand for qualified professionals is a critical element today. The expansion of e-commerce, the ever-increasing complexity of supply chains, the adoption of emerging technologies, and the need for resilience in the face of global crises have driven up the demand for technical, digital, and strategic profiles capable of designing, implementing, and managing innovative logistics solutions. However, this reality often contrasts

with the general perception of the sector, which continues to be viewed as a traditional operational activity with little appeal for new professionals, adding further difficulties when it comes to attracting young and qualified talent.

According to a study conducted by the Spanish Logistics Center (Centro Español de Logística – CEL) in 2024, 94.2% of logistics companies report difficulties in finding talent. This figure highlights a structural gap between the supply and demand for professional profiles, particularly in emerging fields. In the area of digitization, companies prioritize profiles such as artificial intelligence specialists (26%), data analysts (25%), and cybersecurity experts (21%). Concurrently, in the field of sustainability, waste managers (21%), environmental engineers (19%), and reverse logistics managers (16%) stand out.

This misalignment is aggravated by a concerning demographic reality: many professionals in the sector are approaching retirement age, and there is no clear generational turnover. This aging workforce poses a risk to knowledge transfer and to the operational and strategic continuity of companies, making the onboarding of new, trained profiles—possessing a global vision and adaptability—absolutely essential.

In parallel, technological innovation has established itself as a prerequisite for competitiveness. Process automation, robotization, the use of autonomous vehicles and drones, the implementation of smart management platforms, or the application of artificial intelligence and big data tools require highly skilled professionals to develop and integrate these solutions into complex environments. Thus, digitization is not merely a trend but a foundational backbone of logistics transformation, demanding specific and up-to-date competencies.

Consequently, the most sought-after profiles are those that combine technical knowledge with the ability to adapt to a highly globalized and digitized environment, among which the following stand out:

- Supply chain management specialists, with the capacity to plan, coordinate, and optimize the flows of products, information, and resources.
- Data analysts and big data experts, with the skills to interpret massive datasets and improve operational efficiency.
- International transport and logistics specialists, knowledgeable in customs regulations, route optimization, and the coordination of global operations.
- Automation and robotics technicians, capable of integrating automation systems into warehouses and distribution centers.
- Sustainability and green logistics experts, focused on reducing environmental impact.
- Information technology professionals, who design and implement solutions such as WMS, digital SCM, or blockchain-based systems.

In addition to these technical profiles, there is a growing appreciation for transversal competencies or soft skills—such as communication, leadership, collaboration, and adaptability—which are considered essential for managing multidisciplinary teams and constantly changing processes. The CEL study notes that communication and teamwork are the most highly valued competencies, with an average score of 4.49 out of 5.
Precisely to respond to this growing need, it is worth highlighting initiatives such as the Logistics Institute of Barcelona (Institut de Logística de Barcelona – ILB), a vocational training center (Formació Professional) established in 2022 and located at the Port of Barcelona,

which is the result of a collaboration between the Education of Barcelona and the Port, with the support of Barcelona-Catalunya Centre Logístic, offering an educational curriculum that includes training and placement programs, as well as intermediate and higher vocational training degrees (cicles formatius de grau mitjà i de grau superior). There are also other educational programs, such as the vocational training program at the UAB, the course at the UOC, the courses, master's degrees, and postgraduate programs at the ICIL Foundation, as well as the Chair of Logistics and Customs Management launched in collaboration with the UB.

However, beyond the availability of talent, talent retention is key. In a market where demand is high and supply is scarce, companies compete to retain highly qualified professionals. Because of this, some have begun to train their recruitment teams in marketing techniques to better "sell" their job offers. Strategies such as workplace flexibility (29.5%), internal training and promotion (21%), and process automation (14.4%) are also gaining ground as tools to improve employer attractiveness and retention.

In this scenario, the role of engineers is particularly relevant. Their multidisciplinary profile—with knowledge in technology, management, sustainability, and data analysis—makes them ideal candidates to fill these new roles. Furthermore, they possess the ability to understand processes from a systemic perspective and provide global solutions, integrating efficiency, innovation, and sustainability. The logistics sector needs, more than ever, professionals with this transversal vision and leadership capacity.

7. TRENDS

7.1. Development of logistics land

In the beginning, Catalonia was characterized by small plots owned by small holders, unlike the rest of Spain, where large landowners with extensive parcels predominated. This made it difficult to generate large-scale land plots, as it was complicated to get all the owners to agree in order to move an urban development project forward.

The traditional textile industry developed mainly in Catalonia, with the Vallès area becoming the most industrialized region in Spain. Towards the end of the 20th century, the industrial fabric began to dismantle and convert into logistics activities; practically every time a factory went bankrupt and was forced to close, that land was converted into storage and warehousing activities.

Nowadays, logistics assets are required to meet current needs, and it is difficult to adapt old, existing infrastructure. It is also necessary to update municipal regulations and ordinances.

Although there is no structured planning in place to generate new logistics land, and many town councils prefer other types of economic activities, we find that current regulations are not tailored to real storage needs, except in a few very specific industrial parks. Logistics does not tend to be considered in new urban planning; therefore, we must promote the creation of new land.

The following chronology can be established:

- **The Beginnings**: Logistics was basically concentrated in the port areas of large cities like Barcelona and Tarragona, with the development of public land zones specifically designated for these types of uses.

- **The 1990s**: The beginning of the market's international opening. Establishment of a public network of logistics centers across Catalonia, known as CIMs (Integrated Freight Terminals).

- **Up to approx. 2005**: No logistics planning. New industrial parks were generated as the industrial fabric grew, but without a comprehensive territory-wide action plan.

- **2005–2010**: First planned logistics developments, generally in the industrial areas closest to the city of Barcelona and near major communication routes. Professionalization of multinational logistics companies, introducing specific requirements. Catalonia positions itself as an attractive territory for logistics due to its strong port infrastructure and good connections with the rest of Spain and Europe.

- **2010–2015**: Commencement of e-commerce. An economic crisis leads to low market absorption, but the foundations are laid for the coming years.

- **2015–2020**: Consolidation of e-commerce, with the establishment of large logistics hubs in Catalonia by international distribution companies. Market saturation occurs, with land availability becoming increasingly limited. The importance of sustainability and technology begins to take center stage.

- **2020–2025**: COVID-19 pandemic. Explosion of e-commerce, large-scale expansion of Amazon. Logistics positions itself as a prime asset class. Foreign funds are eager to invest in logistics in Catalonia, with virtually zero land availability in the 1st and 2nd rings (corones). Development of Tarragona as a land provider for large-scale warehouses.

Industrial parks designed from their inception to host logistics activities are now beginning to be developed, and the real estate sector's traditional perception of logistics has shifted. There used to be doubts regarding product specificity and repositioning, but in recent years, the perception of risk has disappeared as the product has become standardized.

There is a market where industry in general requires tailor-made logistics solutions, as this branch is always necessary regardless of the production process and the type of manufacturing. Consequently, we find that logistics has become a competitive advantage for modern companies, given the necessity of maintaining cost efficiency throughout the product's entire value chain.

Generating logistics land is not easy and requires coordination among all parties involved, which ultimately brings the risk of preferring other activities that are simpler to carry out. The reconversion of obsolete or disused spaces, as well as brownfields, present opportunities to generate logistics land and regenerate existing areas to bring overall benefits. It is also necessary for the Administration to streamline and adapt regulations to the sector's needs.

7.2. Reconversion of Spaces

In recent years, the demand for modern, flexible, and sustainable logistics spaces has increased exponentially, driven by diverse factors such as the expansion of e-commerce, the reconfiguration of supply chains, nearshoring strategies, and the shortage of available land—all interwoven with growing global demands regarding sustainability and digitization.

This new context presents a demanding yet strategic scenario for the Catalan economy. It requires a clear and coordinated response from both the private sector and public administrations by guaranteeing an adequate supply of spaces capable of responding to this new reality efficiently and sustainably, with the ultimate goal of reinforcing territorial competitiveness.

In highly densified urban areas such as the Barcelona Metropolitan Area, but also across **the country where land is a highly prized commodity**, the response to new logistics requirements necessarily involves the reconversion of obsolete or disused spaces. This strategy allows for the regeneration of economic activity zones (polígons d'activitat econòmica) and prevents consuming more land than necessary.

These are known as **urban land reuse operations** — equivalent to *brownfield* developments—which intervene in spaces previously occupied by industrial activities that are obsolete by current standards. With the appropriate investment, these can be transformed into modern logistics infrastructures, resulting in economic activity zones that are more accessible to high-tonnage road traffic and public transport, as well as better connected digitally.

However, this type of development entails specific challenges, such as assuming decontamination risks, the need to rehabilitate existing structures or adapting to current regulations, factors that can increase the costs and complexity of projects.

“There is no building more sustainable than the one that does not need to be built.”

The reconversion of logistics spaces is a strategy of pure circular economy, fully aligned with the United Nations Sustainable Development Goals (SDGs) and ESG (Environmental, Social & Governance) criteria. It not only minimizes waste generation by making use of existing buildings, but also incorporates recycling processes when preserving structures is not viable. By reusing a significant portion of construction materials—such as metal structures, which can be salvaged, or concrete, which can be crushed and used as a sub-base in new developments—this model contributes to reducing the extraction and use of natural resources.

Moreover, this reconversion model does not only reduce environmental impact regarding waste management and resource use, but also fosters energy efficiency and the integration of sustainable technologies into rehabilitated buildings. Analyzing and adapting existing structures facilitates the incorporation of solutions such as installing photovoltaic panels, improving thermal insulation, or modernizing HVAC systems. This directly contributes to reducing the logistics sector's carbon footprint and solidifies this model as a real and effective path toward a more sustainable and resilient development.

The Need for a More Agile and Flexible Administration

Despite the clear advantages of this strategy, the reconversion of logistics spaces in urban environments faces several administrative and regulatory obstacles that hinder its rollout.

The development and transformation of these spaces progress at an excessively slow pace due to a highly protective regulatory environment involving multiple administrative departments that often operate without effective coordination. This lack of agility causes significant delays in project execution and, consequently, discourages the necessary investment in initiatives of this nature.

Added to this complexity is the obsolescence of certain urban planning regulations, which fail to meet the demands of today's logistics market. Unjustified restrictions are often maintained regarding parameters such as maximum permitted height, floor area ratios (coeficients d’edificabilitat), or the proportion of allowed logistics use within a plot, thereby restricting the development of efficient and competitive spaces.

This restrictive framework is precisely one of the elements that the Metropolitan Urban Master Plan (Pla Director Urbanístic Metropolità – PDUM)—the instrument intended to replace the current General Metropolitan Plan of 1976—sought to correct. The PDUM was meant to allow for a more flexible, updated regulation oriented toward current economic and territorial realities, thus offering an opportunity to redefine land uses and integrate logistics as a key component of urban development rather than just a use complementary to industry.

However, this progress has also ground to a halt. Despite its initial approval in March 2023, substantial changes proposed by various town councils have forced the AMB (Barcelona Metropolitan Area) to draft a new document. The new timeline sets a second initial approval for the first quarter of 2026, and final approval is not expected before 2027 or 2028—a situation that prolongs the validity of an antiquated and limiting urban planning framework.

This dead-end situation, extending beyond the Barcelona Metropolitan Area's PDUM, can be corrected through a profound reform of urban management mechanisms. This would ensure that reconversion projects do not get bogged down in endless procedures and can be developed with the speed required to meet market demands. To achieve this, it is essential to have an engaged administration that is capable of adapting

regulations to market realities and facilitating the necessary transformations. This administration must also remain flexible when interpreting regulations, allowing for the agile application of necessary modifications to parameters such as land uses and clear heights, among others.

7.3. Adaptation to mechanization, automation and robotics

The adaptation of logistics properties to the needs of intralogistics is clear, given that their ultimate purpose corresponds mainly to internal logistics operations. For this reason, it is crucial that project designs and building construction take this into account.

The main concepts to consider are defined below.

7.3.1. Technical requirements for the floor and enclosures

- Manufacturer Coordination: Internal logistics equipment manufacturers must be consulted—regardless of the degree of mechanization or automation—so they can specify the flooring quality requirements needed to guarantee that the system operates as expected.

- Storage System Impact: The selection of automated storage systems will have a significant impact on the flooring requirements. Flatness, leveling, and the slab's load-bearing capacity for point, distributed, and dynamic loads are key elements to ensure an automated system operates reliably.

- Technology-Specific Demands: Different technologies will impose different requirements on the flooring. These requirements become stricter as the system utilizes greater height, because the impact of poor leveling has a multiplying effect. Care must also be taken with the surface finish and expansion joints, ensuring they do not cause bumps for mobile material handling equipment and allow for smooth rolling.

- High-Bay and Rack-Supported Structures: In the case of high-bay warehouses or rack-supported structures (sitges autoportants), the building enclosures are supported by the automation structure itself. This requires complete coordination between the automation installation and the construction of the warehouse.

- Adapted Layout for AGVs/AMRs: Designated lanes and charging stations must be allocated for automated guided vehicles and autonomous mobile robots.

- Flooring Standards: Various standards are used to measure flooring quality, such as the DIN 15185 standard, the VDMA guideline for AGVs, or the EN15620:2008 regulation. All of these define flooring qualities based on different operational requirements.

7.3.2. Requirements for optimizing intralogistics flow

- Clear Height: Sufficient clear height to accommodate AS/RS (Automated Storage and Retrieval Systems) and mezzanine levels over loading docks, as well as in general.
- Column Spacing: Optimal pillar spacing to maximize racking configurations and discrete material handling elements—whether manual or automated—in order to minimize obstructions.

- Automatic Dock Levelers: Automatic dock levelers to accommodate different truck heights and allow seamless integration with loading processes via conveyor belts.

- Dock Capacity: A sufficient number of loading docks to prevent bottlenecks, enabling simultaneous loading and unloading operations whenever possible.

- Apron Space: A minimum depth for the truck yard/parking area to facilitate safe and easy maneuvering for trucks.

- Conveyor and Sorting Layouts: Definition during the concept phase of the layout and pathways for conveyor belts, sorting systems, and AMR movements, complete with designated lanes and charging points.

7.3.3. Fire protection systems

- Robot-Free Safety Zones: In the case of automated warehouses featuring robotic systems, specific robot-free zones must be designated in advance to ensure safety. In the event of a fire, robots will stop automatically, provided they are not within an area where stopping is prohibited. If a robot is located in one of these restricted areas, it will autonomously move to the nearest safe zone before coming to a secure halt.

- Fire Compartmentalization: It is also necessary to define where doors between compartments and ceiling curtains (lones de sostre) should be positioned to prevent fire spread. These and other elements must be factored into the logistics project phase to ensure that systems can operate at their expected performance levels while maintaining the efficacy of fire protection components.

In the case of storage systems (such as steel racking), both automated and manual, special care must be taken during the design phase of the fire protection and sprinkler Systems. Depending on the storage density and the stored products, the fire load must be taken into account to calculate the required sprinklers and their appropriate positioning.

- ESFR Systems: Consideration must be given to installing ESFR (Early Suppression Fast Response) sprinkler systems, which are specifically designed for high-density automated storage.

- Fire Compartmentalization: Implement proper compartmentalization to contain fires and protect high-value automation systems.

- High Fire Load Storage: Consider whether a dedicated safety enclosure is necessary for storing batteries and other stored items that present a high fire load.

- Specific Regulations (Chemical Sector): For industries such as the chemical sector, a detailed study of specific regulations must be conducted, for example, the MIE APQ: https://www.boe.es/eli/es/rd/2017/06/23/656

- Key Design Stakeholders: In the case of fire prevention systems, there are three key entities that will define the final design: current regulations, the local fire department/authority, and the insurance company. Regarding mandatory legal regulations, the current RSCIEI from the Ministry of Industry applies, which introduces certain changes compared to previous regulations.

- The fire department and local authority will have their own guidelines that must be incorporated into the design.

- Regarding insurance companies, most of them are governed by the design guides published by FM Global and VdS.

7.3.4. Safety Systems, Emergency Exits, and Evacuation Routes

- Facility Layout Planning: The building services project, especially regarding systems related to safety (detection, alarm, and suppression), must take into account that the building is projected as a warehouse and, therefore, must aim not to diminish storage capacity or cause longer travel distances. The same care must be taken in the design of evacuation routes and the location of emergency exits.

- Intralogistics Obstructions: When designing an automated system with conveyors, robots, or other components, elements are added to the facility that may block planned evacuation routes. Care must be taken to respect maximum distances to any designated emergency exit and ensure that the building design remains compliant once the intralogistics equipment is installed.

- System Integration: Emergency systems must be fully integrated with the rest of the facility's systems to guarantee correct operation and

ensure that safety information is visible across all different control levels.

7.3.5. Other systems

- Warehouses for intralogistics activities can have highly specific designs depending on the stored product. An example of this would be warehouses that require specific temperature conditions or cold storage facilities (naus frigorífiques) for storing products at a certain temperature, where appropriate refrigeration and insulation must be factored into the project design.

- Security Systems: Depending on the value of the stored goods, a comprehensive external and internal surveillance system must be designed. Furthermore, for high-value products, consideration can be given to enclosing a specific area of the warehouse with restricted access and access control systems.

7.4. Digitalization and AI

The adaptation of logistics properties to the needs of information and communication technologies is highly important, because all current logistics operations—whether internal, such as those carried out in the warehouse, or external, meaning those corresponding to the truck yard, for example—have a direct implication on their design and construction.

The main concepts to consider are defined below.

7.4.1. ICT infrastructures. Electrification, networks and data

- Power Supply: The electricity supply must be uniform and stable for fixed equipment and mobile equipment stations, as well as for the ICT servers required for proper operations. In most cases, the installation of an *Uninterruptible Power Supply (UPS)* is essential.

- Ventilation, cooling, and heating systems are of great importance to guarantee the well-being of

the operational staff. Therefore, the building services project must also be aligned with the logistics project.

- Smart HVAC Systems: Smart HVAC systems and optimized ventilation to provide improved airflow for both human and robotic operations.
- Connectivity and Access Points: Automated intralogistics systems have an ever-increasing

need for data and electricity at various points across the network. Good installation planning for Access Points (APs) and routers on ceilings and walls is key to ensuring the facility operates reliably and that the data flow meets expectations.

- Flooring Electrostatics: Differences in electrical potential in the flooring can cause static electricity issues, leading to minor shocks to personnel as well as equipment malfunctions. Therefore, facility floors must be tested and compliant with electrical regulations to guarantee proper operation. For these reasons, it is recommended that the data cabling network installation runs parallel to the electrical grid.

- Digital Twins: Digital twins enable the creation of virtual models of warehouses or logistics centers to simulate layout changes, workflows, and environmental conditions.

- Smart Warehouses: *Smart warehouses* incorporate advanced digital technologies to optimize operations and space management.

- IoT and RFID Integration: IoT sensors are used to monitor real-time variables such as temperature, humidity, power consumption, and the presence of people or vehicles. Additionally, RFID readers (scanning tunnels or arches) are deployed to automate the inbound and outbound flow of goods, reducing errors and handling times.

- Automated Building Controls: They also integrate automatic control systems for lighting, climate, and doors, which adapt based on environmental conditions or detected presence to reduce energy consumption in less active zones.

- Digital Dashboards: All of this is centralized into digital dashboards that offer a comprehensive, real-time overview of warehouse activity, facilitating informed decision-making.

7.4.2. Other Energy and ICT-Related Topics

- High Energy Availability: High power availability for operating automation systems, conveyor belts, and robotics.

- Redundant Power Supply: Redundant energy supply equipped with backup generators or dual electrical feeds to prevent operational disruptions.

- Renewable Energy Integration: Solar panels and energy recovery systems to offset operational energy consumption.

- On-Site Infrastructure: Space for local database servers & AI.

- Fiber optic and 5G readiness for real-time connectivity of the WMS (Warehouse Management System) and IoT. Due to IT security regulations, many end clients do not allow third-party systems (vendors) to connect to their network. For this reason, it is necessary to plan independent connections (via fiber optics) to allow vendors data access to their own systems and cloud connectivity.

- Cybersecurity: When designing ICT infrastructure, it must also be taken into account that the infrastructure needs to be resilient against external cyberattacks. Strict control must be maintained over installed components, ensuring that certified elements are always used.

7.4.3. Building Information Modelling (BIM)

BBIM plays a key role in the digital transformation of immologistics, as it allows for the design, construction, and operation of logistics spaces in a more efficient, connected, and sustainable manner.

Through digital models, it facilitates coordination among stakeholders, optimizes construction, and reduces errors. Once operational, BIM can be integrated with systems such as the BMS, WMS, or IoT to become a Digital Twin, improving energy management, maintenance, and operational adaptability. Furthermore, it provides portfolio-wide standardization and traceability.

7.5. Sustainability as a Sector Pillar: Results and Trends of BREEAM Certification in Spain (2011–2024)

The Logistics Real Estate sector as a whole has undergone a substantial transformation over the last decade, marked by growing demands for sustainability from investors, developers, operators, and end clients. In this context, environmental certifications—especially the BREEAM® stamp—have taken on a leading role as an effective tool for measurement and differentiation in an increasingly demanding market.

7.5.1. BREEAM®: The Building Sustainability Standard

BREEAM® (Building Research Establishment Environmental Assessment Method) is one of the most internationally recognized sustainability assessment systems. In Spain, its application within the immologistics sector allows both new constructions and buildings in use to be evaluated under parameters of energy efficiency, environmental impact, health, innovation, and management.

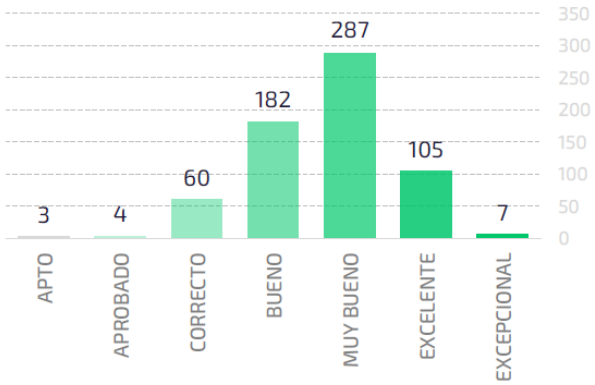
7.5.2. BREEAM® Results in the Immologistics Sector

Between 2011 and 2024, numerous BREEAM® certificates were issued for immologistics assets in Spain. The data reflects the sector's commitment to sustainability criteria:

- 61.6% of certified projects achieved a rating of "Very Good" or higher, surpassing the general average of 51.7%.

- The "Excellent" rating was achieved by a significant number of assets, standing at 75.03%.

- However, achieving the "Outstanding" (Excepcional) category remains a challenge, reached by only 0.77% of real estate projects, compared to 3.8% of all sectors analyzed.



n.º de certificados inmologísticos emitidos
por clasificación obtenida en el periodo 2011-2024

BURB: BREEAM® ES Urbanismo / BNC: BREEAM® ES Nueva Construcción / BUSO: BREEAM® ES En Uso

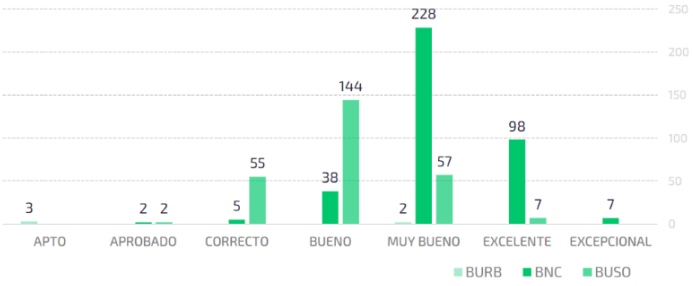
These figures reflect a clear commitment within the immologistics sector to align itself with sustainable standards, but they also highlight the need to continue deepening efforts in areas that require improvement.

7.5.3. Analysis by certification schemes

The BREEAM®ES methodology comprises different schemes, including:

- BREEAM®ES New Construction (BNC): where assets achieve higher scores thanks to the incorporation of sustainability criteria right from the design phase.

- BREEAM®ES In-Use (BUS): focused on already operational buildings, this scheme shows lower market penetration. Only 6.1% of BUS certificates have addressed Part 2, which is aimed at optimizing management, maintenance, and operations.



n.º de certificados inmologísticos emitidos
por clasificación/esquema en el periodo 2011-2024

- Operational Performance Gap: This low rate of operational improvement suggests a critical area for action: sustainability must not be limited to the initial design, but must encompass the entire life cycle of the property.

7.5.4. Conclusion

The Spanish immologistics sector has made notable progress in adopting sustainable practices, with BREEAM® certification playing an increasing leadership role across its assets. However, the path toward excellence in sustainability requires ongoing effort, particularly in post-construction management and in overcoming the barriers that hinder the achievement of the highest ratings.

We can therefore assert that the evolution of the immologistics sector should not only be measured in built square meters or logistics profitability, but also in its active contribution to a more sustainable and responsible development. BREEAM® has established itself as a strategic ally in this endeavor.

8. INNOVATION

8.1. Decarbonization and NetZero. Transition to a low-carbon economy

The construction sector as a whole, which includes logistics buildings (warehouses, distribution centers, cross-docking facilities, etc.), is one of the main contributors to global greenhouse gas (GHG) emissions worldwide. Several studies place this responsibility between 38% and 40% of total energy-related CO_2 emissions.

8.1.1. The climate challenge of the real estate sector

This considerable carbon footprint is fundamentally broken down into two components:

- Operational Carbon: Derived from energy consumption during the building's operational phase (lighting, heating, cooling, etc.), representing approximately 28% of the global total.

- Embodied Carbon: Associated with materials and construction processes throughout the entire life cycle of the building (raw material extraction, manufacturing, transport, construction, maintenance, and end-of-life), constituting the remaining 10% to 12%.

The magnitude of these figures underscores the sector's leading role in the fight against climate change and the urgency of implementing innovative and effective decarbonization strategies.

8.1.2. European regulatory framework and evolution towards NetZero logistics buildings

The sector's relevance as a key catalyst has placed it firmly on the European Union's legislative agenda in recent years, leading to the development of a set of directives and plans that push developers, owners, and users of logistics buildings toward a new standard:

- EED: Energy Efficiency Directive.
- RED: Renewable Energy Directive.
- ETS2: New Emissions Trading System.
- RRF: Recovery and Resilience Facility, at the heart of the NextGenerationEU plan.
- REPowerEU Plan.
- EPBD Recast (2024): Most notably, the revised Energy Performance of Buildings Directive.

The 2024 EPBD strengthens the regulatory framework with more ambitious targets, granting member states the flexibility they need to manage their building stock by establishing:

- As of 2028 (public buildings) and 2030 (all other buildings), all newly constructed buildings must be zero-emissions on-site.

- A step forward is taken from "Nearly Zero-Energy Buildings (NZEB)" toward NetZero or Zero-Carbon Buildings, which will have a direct impact on new logistics platforms and last-mile hubs.

8.1.3. Regulatory situation in Spain. Ambiguity for logistics properties NetZero

In the Spanish context, there is still no official definition or mandatory compliance framework for NetZero buildings

applicable to the logistics sector. The CTE (Código Técnico de la Edificación / Technical Building Code) and the RITE (Reglamento de Instalaciones Térmicas en los Edificios / Regulation for Thermal Installations in Buildings) include general references to decarbonization by the year 2050, but they lack specific targets that can be directly applied to immologistics assets.

Compliance with these objectives remains subject to the interpretation and initiative of the developer, or to alignment with voluntary certifications such as LEED, EDGE, or ILFI Zero Carbon. BREEAM, which is still under review, does not clearly define the NetZero standard.

8.1.4. Principles for the Development of NetZero Carbon Logistics Warehouses

Although a detailed regulatory framework is lacking, there is a general technical consensus on the actions to be implemented in order to reduce emissions within the immologistics environment:

- Reduction of the Building's Energy Demand: Utilizing passive design strategies such as orientation, airtightness, thermal insulation similar to or higher than recommended by the CTE, as well as solar control and natural ventilation to reduce thermal load.

- Use of Low-Carbon Construction Materials:
  - Such as recycled and recyclable materials that promote recircularity.
  - Incorporation of biogenic carbon CO_2 naturally sequestered by wood) through the use of mass timber structures (GLT, CLT, etc.).

- Energy-Efficient HVAC Systems: Installing energy-efficient climate control equipment, prioritizing electricity as the main power source, and promoting the use of heat pumps with natural, low-GWP (Global Warming Potential) refrigerants such as CO_2, ammonia, or propane.

- Maximization of On-Site Renewable Energy Production:
  - Installation of photovoltaic panels on roofs and canopies.
  - Energy storage (in batteries) for self-consumption.

- Off-Site Renewable Energy: Production of nearby off-site renewable energy and/or contracting 100% renewable energy backed by GOs (Guarantees of Origin). Long-term PPA (Power Purchase Agreements) contracts can be utilized to ensure stability and traceability.

- Offsetting Residual CO_2: Offsetting remaining emissions through the purchase of carbon credits—such as CERs (Certified Emission Reductions) or VERs (Voluntary Emission Reductions)—primarily in CO_2 sequestration projects (landfills and forestry) or local renewable energy projects, or, if not viable, in developing countries.

8.1.5. Opportunities and challenges of NetZero in immologistics

This innovative model—which also enjoys financing benefits, such as improved terms for green projects compared to conventional ones—is a powerful driver for generating opportunities:

- Value-added and differentiation for investors and operators.

- Long-term reduction of operational costs.

- Early compliance with future regulatory framework requirements.

However, it is not without significant short-term challenges:

- Higher initial investment (although amortizable during operations).
- Lack of standardized regulatory approval.
- Need for alliances with other actors who are experts in sustainability.

8.1.6. Conclusion

The decarbonization of the logistics stock is not only a necessity resulting from the climate emergency, but also a strategic opportunity to reposition the immologistics sector as a benchmark in efficiency, innovation, and environmental responsibility. Although regulation is still in the development phase, the NetZero approach is being innovatively integrated into the design, construction, and operation of logistics warehouses to maintain their competitiveness and meet climate neutrality goals by 2050.

8.2. Life cycle analysis (LCA). Keys for a green immologistics

Growing pressure from investors, logistics operators, governments, and consumers in general to reduce environmental impact has put the immologistics sector under the spotlight. Given the high construction volume, resource-intensive nature, and operational footprint of logistics assets, quantifying their environmental impact throughout their useful life has become critical and necessary.

In this context, the Life Cycle Assessment (LCA) has established itself as an indispensable tool to comprehensively evaluate the carbon emissions associated with logistics warehouses, from construction through to demolition once their service period is exhausted.

8.2.1. What is LCA applied to logistics buildings?

LCA measures the environmental impacts derived from all phases of a building's life cycle, in accordance with standardized methodologies (EN 15978, ISO 21930, and EN 15804+A2), evaluating categories such as:

- Global Warming Potential (GWP): expressed in kg CO2
- Ozone Depletion
- Soil Acidification
- Water Eutrophication
- Smog Formation

In logistics construction, this means quantifying everything from the footprint of structural materials (concrete, steel, aluminum, copper, etc.) to the energy consumed by HVAC, lighting, or automation systems over decades of operations.

8.2.2. Methodological Approach and Reference Frameworks

The life cycle assessment is aligned with recognized European frameworks such as:

- *Level(s)*: A voluntary assessment framework developed by the EU that provides a common language to assess and report on the performance of sustainable buildings regarding

carbon emissions, among other sustainability indicators, based on compliance with specific requirements.

- Eu Taxonomy: A regulation that establishes a valid classification system, offering investors a common language to determine which investments can be considered "green."

The scope of a typical LCA in logistics would cover the following phases:

- Embodied Carbon Phases:
  - A1–A3: Production (Cradle-to-Gate)
  - A4: Transport
  - A5: Construction
  - B4–B5: Refurbishment / Replacement
  - C1–C4: End-of-Life (deconstruction, demolition, and transport to landfill).
  - D: Resource recovery (benefits and loads beyond the system boundary) – usually represented in graphs and tables, but excluded from the total calculation.

- Operational Carbon Phases:
  - B6–B7: Operational energy and water use – included whenever data is available.

- Biogenic Carbon: (CO_2 sequestered and stored in materials like wood) is represented visually in graphs and tables, but is not included in the total calculation except for justified exceptions. If the materials containing it are not incinerated, it can be deducted from phases A1 and A3 without being added back in phase C.

- Scope of Works: All building construction chapters are computed, excluding furniture, other movable assets that the owner or tenant must add to the property under study, and non-structural mobile equipment.

- Reference Service Life: The standard useful life of the building is established at 50 years (in accordance with the EU Taxonomy).

8.2.3. Key LCA Results in Logistics Warehouses

According to studies applied to logistics buildings, the largest percentage of emissions reflected in Life Cycle Assessments comes from the concrete and steel used in foundations, civil works, structure, floor slabs, and pavements. This data emphasizes that decisions made in this area have a decisive impact on the carbon footprint of a logistics center.

- Approximately 60% of total LCA emissions come from the concrete and steel used in the structure and foundations.

- Approximately another 15% corresponds to building systems such as HVAC, lighting, and other technical installations.

8.2.4. Decarbonization Strategies Applied to LCA in Logistics

To reduce embodied carbon, priority actions include the selection of low-carbon footprint materials:

- Utilization of Type IIa and even Type III cements in concrete for foundations, civil works, structures, floor slabs, and pavements.

- Use of certified steel in structural sections and rebar with a high percentage of recycled content.

- Optimized design featuring prefabricated structures and modular solutions.

- On-site installation of other recycled materials, such as ballast with CDW (Construction and

Demolition Waste) aggregates and reclaimed asphalt.

Meanwhile, to reduce operational carbon, the strategy focuses on finding combined synergies between:

- Maximum Energy Efficiency: Passive design, optimized thermal envelopes, solar control, and natural daylighting.
- Full Electrification: Complete electrification of HVAC consumption and DHW (Domestic Hot Water) production using heat pumps.
- Smart Lighting Systems: Smart-controlled lighting systems equipped with dimming functions for periods of non-occupancy or when natural light enters.
- On-Site Renewable Energy Generation (Photovoltaic): Taking advantage of extensive roofs and outdoor spaces. A single photovoltaic panel can save up to 10 times more CO_2 over 25 years of service than was emitted during its manufacturing, making it an ideal solution for logistics platforms with large amounts of available surface area.
- Automation and Smart Management: Automated control of technical installations using a BMS (Building Management System) equipped with sensors, consumption meters, and AI-driven controls.

8.2.5. Conclusion

Using Life Cycle Assessment as the foundation for Green Immologistics is not merely a calculation and evaluation tool, but a strategic element to guide design, construction, operation, and renovation decisions within the sector. This approach enables companies to:Comply with green certification requirements (LEED, BREEAM, DGNB).Align projects with the EU Green Taxonomy.Increase the market value of sustainable logistics assets.Mitigate regulatory risks and attract institutional ESG investment.n-site installation of other recycled materials, such as ballast with CDW (Construction and Demolition Waste) aggregates and reclaimed asphalt.

8.3. Sustainability in real estate construction. Circular principles, materials and strategies

In a current context of increasing regulatory, social and environmental pressure, logistics building plays a key role in the decarbonization of the construction sector.

To face this challenge, improving sustainability parameters is closely linked to the principles of the circular economy collected by taxonomy in the following categories:

- Mitigation and adaptation to climate change.
- Sustainable use and protection of water and marine resources.
- Transition towards a circular economy.
- Pollution prevention and control.
- Protection and restoration of biodiversity and ecosystems.

8.3.1. Materials

Biologically based

Although it is not a common solution in real estate, the structural use (mainly in the roof structure) of wood from sustainably managed forests, in different

formats such as cross-laminated timber CLT or glued laminated timber GLT, is emerging as an alternative to concrete and steel. Its advantages include:

- A lower impact on production compared to conventional materials, with reductions of up to 60%.
- The capacity to store biogenic carbon captured by trees during their growth (each m3 of solid wood stores up to 900 kg of CO_2).
- Suitability and ease of prefabrication, which can optimize construction processes. However, it is crucial to ensure the sustainability of the forest source (with FSC or PEFC seals) and consider the impact of transportation.

Low-emission concrete

Since cement production is the main source of emissions from concrete, the fundamental strategy is to reduce its content. This is achieved by replacing a significant portion of the Portland cement clinker with supplementary cementitious materials known as SCMs, such as fly ash (a byproduct of coal-fired power plants) or granulated blast furnace slag (a byproduct of the steel industry). Reductions of between 40% and 50% can be achieved while maintaining equivalent performance.

The use of recycled aggregates from demolition also helps reduce its impact. Research into Ultra-High Performance Concrete (UHPC) aims to develop slimmer, lighter, and more durable structures, thereby reducing the total amount of material required.

Additionally, carbon storage strategies in concrete are being developed, such as CarbonCure (utilizing direct CO2 mineralization) or by the company Paebbl (incorporating sequestered CO2 into olivine rock as a partial aggregate replacement).

Recycled SteelSteel

Steel has a high recyclability rate. Prioritizing the use of steel produced via Electric Arc Furnace (EAF) routes, which allow for a high content of recycled scrap metal, significantly reduces its impact compared to the Blast Furnace-Basic Oxygen Furnace (BF-BOF) route.

Supporting the steel industry's transition toward low-carbon primary production processes, such as those based on green hydrogen, is also fundamental.

Other Innovative Materials

Numerous alternatives exist, such as hybrid systems that combine the advantages of different materials (e.g., the Hybrid Timber Floor System (HTFS), which integrates timber, steel, and concrete), a wide range of building materials manufactured from recycled content, and bio-based materials (cork insulation, cellulose, wood fiber, etc.).

8.3.2. Principles of sustainable and circular design in logistics

Design principles play a fundamental role in minimizing the carbon footprint and enabling circularity:

- Efficient and Optimized Design: Applying structural design principles that minimize the total volume of material required to meet safety and functional criteria, avoiding over-dimensioning. In this regard, the excellent ratio between structural rigidity and lightness offered by timber can be a distinct advantage.
- Design for Longevity and Adaptability: Conceiving robust and durable buildings with flexible spaces that can easily adapt to changes

in use or future needs without requiring major interventions or premature demolitions.

- Design for Disassembly (DfD): This is a core principle of the circular economy. It involves designing the connections between components (for example, bolted mechanical joints instead of adhesives or welds) and selecting standardized, modular components so that the building can be deconstructed at the end of its life, enabling the reduction or recycling of its materials and elements with the highest possible recovery value.

Implementation of the Circular Economy in Immologistics

The broader approach of the Circular Economy seeks to overcome the traditional linear model of "extract, manufacture, use and dispose" according to the *Cradle to Grave* system. In construction, the circular economy promotes keeping materials and products in use for as long as possible, extracting their maximum value and regenerating natural systems (the *Cradle-to-Cradle* system). Its key principles applied to the sector include:

- **Reduce**: Minimizing the consumption of virgin resources through efficient design and the optimization of material usage.

- **Reuse**: Prioritizing the rehabilitation and adaptation of existing buildings over demolition and new construction, thereby preserving the embodied carbon in the pre-existing facility.

- **Actively promoting the reuse** of components and materials recovered from deconstruction processes on *brownfield* logistics plots is a common practice; after soil decontamination, aggregates derived from demolition waste are used as bases or subbases for the new building's platform.

- **Recycle**: Incorporating materials with a high recycled content into new projects, and ensuring the selective collection and high-quality recycling of construction and demolition waste (CDW) that cannot be directly reused.

Site Management with a Circular Approach

Implementing practices to reduce and minimize waste generation during the construction phase is essential. This includes factory prefabrication, construction with modular components, precise planning and material estimation (facilitated by tools such as BIM), and the proper segregation and management of waste generated on-site. Waste audits can further help identify opportunities for improvement.

Verification Tools

Basing material selection on verified data—such as Environmental Product Declarations (EPDs)—is an essential tool for making nformed decisions, as they provide quantitative, third-party certified data on the environmental impact of specific products.

8.3.3. Conclusion

Sustainability in the immologistics sector is both a regulatory imperative and a competitive advantage. The circular economy and decarbonization must be integrated from the asset's conception phase through to the end of its useful life.

8.4. Wellbeing and Comfort in Immologistics: Industrial Spaces That Care for People

Traditionally, logistics parks have been viewed as purely functional spaces, focused on operational sophistication and efficiency. However, in recent years, the immologistics sector has been experiencing a quiet but profound transformation in which human wellbeing has begun to play a leading role.

And for good reason: it is estimated that we spend nearly 90% of our time in indoor spaces, including work environments, which have become one of the most decisive factors in our overall wellbeing. In this context, why not innovate and design logistics facilities that also promote the health, comfort, and motivation of those who work in them?

8.4.1. Designing More Human-Centric Logistics Spaces

A logistics building can be much more than a mere transit and storage facility for goods and, therefore, must feature:

- Enhanced Ventilation: Both natural and mechanical, to ensure clean air and reduce risks such as allergies or fatigue.
- Efficient LED Lighting: With tones that mimic natural light and designed specifically for the different uses within the warehouse, thereby increasing safety and reducing eye strain.
- White-Toned Interiors: Which expand the perception of space, bringing brightness and promoting an atmosphere of serenity.

Prologis Parklife.

These technical interventions not only improve physical wellbeing but also have a direct impact on productivity and the reduction of workplace absenteeism.

8.4.2. Common Areas Designed for Disconnection and Socialization

Wellbeing in logistics also involves providing spaces for rest and recreation, with the goal of creating more positive human and community experiences:

- Shaded Outdoor Areas: Equipped with tables and benches where employees can eat or relax away from the hustle and bustle of indoor operations.
- Sports and Exercise Areas: Ranging from fitness kits to soccer fields or basketball courts, ideal for releasing tension during shifts.
- Landscaped Spaces or Community Gardens: Which foster contact with nature, cooperation among colleagues, and a commitment to sustainability.
- Workplace Cafeterias and Dining Areas (Canteens): Where a warmer and more relaxed environment can be recreated.

8.4.3. Sustainable Mobility and Healthy Daily Habits

In addition to functional physical design, logistics spaces can help promote a more active and healthy lifestyle by introducing measures such as:

- Bike Parking: Including canopies for sun protection and charging stations for electric mobility.
- Strategically Distributed Water Fountains: Encouraging regular hydration, especially during the hottest months.
- Smoke-Free Zones: With designated smoking areas located away from entrances and common spaces.
- Clear Signage and Safe Pedestrian Walkways: Ensuring proper and conflict-free coexistence between people and vehicles within the work premises.

8.4.4. A New Standard for the Sector

The leading developers and promoters in the sector are driving this transformation with specific proposals to integrate wellbeing and comfort into every new immologistics development. The key lies in understanding that these spaces are not merely containers for merchandise, but work environments where dozens or hundreds of people spend a major part of their day.

Investing in their wellbeing not only improves employee health and satisfaction, but also strengthens corporate image, facilitates talent attraction and retention, and enhances the operational sustainability.

Through requirement-based scoring systems like the WELL Building Standard—which identify, measure, monitor, and accredit features built upon human health and wellbeing in buildings across varying levels of stringency—companies can obtain a globally recognized certification.

8.4.5. Conclusion

The immologistics of today and tomorrow is no longer measured solely in terms of operational efficiency, but also by its ability to generate more human-centric, safe, and stimulating environments. A healthy workplace is a

powerful tool to increase productivity, showcase sustainability, and help improve quality of life.

8.5. Deploying the Potential of BIM Methodologies in Construction

In the immologistics sector, innovation has ceased to be an option and has become a strategic obligation. In this high-demand, constantly transforming landscape, BIM (Building Information Modeling) methodologies have established themselves as a key tool for redefining how we conceive, design, construct, and manage our real estate assets, as noted in previous chapters. Despite its growing adoption, there is still a long way to go to fully deploy and exploit its potential.

The increasing sophistication and demands of delegated developments (built-to-suit/turnkey projects), combined with expertise in specialized construction, have transformed and propelled BIM from a simple technology or collaborative environment into a true digital ecosystem that comprehensively improves project efficiency.

This methodology is applied transversally: from the earliest phases of planning and conceptual design to asset delivery and subsequent operation by the end user. Every stakeholder involved takes part in this process, including marketing teams, office technicians, construction managers, and on-site operators.

8.5.1. Structured Collaboration: The Heart of BIM

One of the critical factors for successfully deploying the full potential of BIM lies in collaborating with partners and various stakeholders who not only understand the methodology but also operate within a standardized framework.

Data interoperability and consistency depend directly on a well-defined BIM Execution Plan (BEP). This document acts as an operational and technical guide for all participants, properly structuring information and establishing guidelines for naming conventions, parameterization, file architecture, version control, Levels of Development (LOD), and information exchange criteria.

The absence of this framework can turn even the most advanced and powerful BIM model into an inefficient tool.

8.5.2. Beyond 3D: The Value of BIM Dimensions

The true value of BIM lies in its ability to integrate its multiple dimensions into constantly evolving projects. In addition to the three-dimensional (3D) geometric representation, other dimensions bring added value, such as:

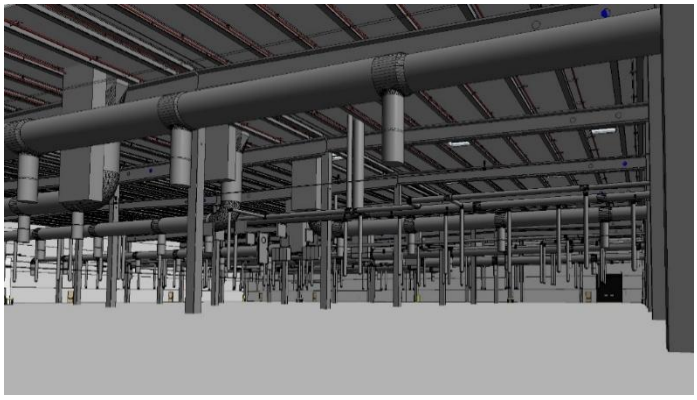
- 4D: Time scheduling and construction simulations.
- 5D: Cost estimation and control.
- 6D: Sustainability and energy efficiency analysis.
- 7D: Facility management and asset maintenance throughout its useful life.
- 8D–10D: Dimensions related to safety, the industrialization of construction processes, and traceability.

Ideally, the developer should decide from the initial phase which dimensions will be activated and with what level of detail, aligning the model with the building's operational, return on investment (ROI), and sustainability objectives.

8.5.3. The 7D Challenge: Operation and Maintenance

A real-world case is that of Onilsa engineering, which has intensively deployed BIM during the design and construction phases, achieving measurable results in terms of quality control, cost optimization, and incident reduction. However, they are fully aware that the true disruptive leap lies in the operations phase.

A properly developed 7D model, linked to data schemas such as COBie and connected to CMMS (Computerized Maintenance Management System) platforms, can transform into the building's Digital Twin—a dynamic replica that allows for real-time asset monitoring, maintenance scheduling, error anticipation, and data-driven decision-making.



This approach is still in its early stages within the logistics sector, but it represents a strategic opportunity for players who commit to a complete asset life cycle that is digitalized from its very inception.

8.5.4. Costs, learning curve and digital maturity

Implementing BIM involves a significant additional investment and effort, especially in the initial stages. It requires skilled human resources, continuous training, new tools, and a change in habits. However, the benefits of its application far outweigh these costs thanks to the reduction of errors, less re-engineering work, more precise planning, and higher quality in the building's execution.

As an organization matures within its BIM culture, processes become standardized, workflows streamline, and sustainable, recurring returns are achieved across every new project. This maturity is key to competing in an increasingly demanding market.

8.5.5. BIM as a leverage for sectoral innovation

The immologistics sector is being transformed by forces such as digitalization, automation, and artificial intelligence. In this context, BIM should not be viewed merely as a technical methodology, but as an enabler of profound innovation. It is the foundation for connecting 3D models with predictive analytics, IoT technologies, big data, and energy management systems.

Adopting a BIM culture is not simply about using digital tools; it means embracing a new way of thinking, designing, and building through a collaborative, sustainable, and efficient way.

8.5.6. Conclusion

Fully deploying the potential of BIM requires a strategic vision, organizational commitment, and cross-sector collaboration—because the future of the immologistics sector will be digital, or it simply will not be.

8.6. Innovation in logistics Buildings Construction: Materials, Systems, and Processes

The digital revolution, environmental pressure, and the accelerated transformation of e-commerce have raised the standards for design and execution in immologistics construction. The competitiveness of the sector now depends, more than ever, on the ability to innovate at every phase of the construction process.

In this context, sustainable materials, advanced technical installations, and greater industrialization across all processes emerge as fundamental pillars—a reality that offers a technical overview of the most cutting-edge solutions applied to the building of logistics platforms.

8.6.1. Industrialization: efficiency, sustainability and economy

The industrialization of construction processes allows the traditional construction model to be transformed into a coordinated, reproducible and optimized system, both in terms of costs and deadlines.

Promoted by initiatives such as the Industrialized Construction Cluster of Catalonia, this approach is based on the integration of off-site processes (prefabrication, assembly and erection on site) and collaborative planning. The benefits are obvious:

- Reduction of environmental impact.
- Superior quality control.
- Greater job security.
- Reduction of waste and emissions.

In addition, standardization and modularity allow us to respond quickly to the needs of the real estate logistics sector, where delivery times are critical and operational requirements are increasingly technical.

8.6.2. Innovative materials and circular economy

The commitment to sustainability in logistics construction includes the use of recycled materials and land improvement techniques, highlighting the following solutions:

- Soil stabilization with lime and cement, improving the bearing capacity of the land and reducing the need to transport materials.
- Recycled aggregates from construction and demolition waste (CW), used in esplanades and subbases.
- Recycled asphalt materials and steel by-products that contribute to a lower carbon footprint in the execution of pavements and platforms.

In this circular economy framework, the selection of materials is not limited to mechanical or structural criteria, but integrates environmental parameters, such as LCA (Life Cycle Analysis) and its environmental footprint.

8.6.3. High-performance technical flooring

Flooring is one of the most critical elements in a logistics platform, both due to its impact on operations and its overall cost. The most advanced solutions include:

- High-flatness interior slabs with high surface regularity: Designed for both guided and unguided forklift traffic, ensuring precise tolerances for racking systems and automated guided vehicles (AGVs).

- Jointless continuous industrial flooring (such as TEQTON - Teqbase + Teqplan): Offering high resistance to dynamic loads and reducing long-term maintenance requirements.

- Surface additives and densifiers: Which increase the durability and wear resistance of concrete floors.

- External pavements (such as OPTIPAVE): Designed for maneuvering yards and heavy traffic, combining structural efficiency with material cost-effectiveness.

Regarding quality and execution control, a probabilistic approach is beginning to be adopted instead of the classic deterministic method. This evaluates performance metrics—such as the compressibility modules of the subgrades, the modulus of subgrade reaction of granular subbases, and slab thicknesses—from a statistical logic that improves reliability and minimizes risks.

Tordera.

8.6.4. Intelligent technical installations and coordinated design criteria

The operability and efficiency of a logistics platform depend heavily on the proper planning of its technical systems. Alongside digitalization and energy control, functional and structural design plays a fundamental role in the technical and economic viability of the project. Some best practices and innovative solutions include:

- Fire protection and emergency ventilation.
  - ESFR K34 sprinklers: These allow for the protection of logistics warehouses with heights of up to 16.80 meters according to FM Global standards, eliminating the need for in-rack sprinklers and simplifying high-level fire protection installations.
  - SHEVS (Smoke and Heat Exhaust Ventilation Systems): Through building-specific computational studies (such as CFD analysis), the exact number of required roof vents (exutores) can be adjusted, optimizing the installation without compromising safety or regulatory compliance.
- Optimized hydraulic infrastructure.
  - Use of PVC-O pipes as an innovative alternative to the usual HDPE in outdoor hydrant networks. PVC-O offers advantages in terms of resistance, durability and ease of installation, and is an advanced technical solution with a lower economic impact.
  - Suspended Manifolds: Whenever the design permits, the fire protection main network can be suspended indoors, thereby avoiding unnecessary excavation and earthmoving.
- Photovoltaic installation as a strategic asset. Solar energy is integrated into logistics warehouses projects thanks to the collaboration with a specialized partner. This approach allows:
  - Optimizing costs through self-consumption or sale of energy.
  - Adapting the design to the needs of each user through customized technical studies.
  - Directly managing procedures with marketers and distributors, accompanying the developer, owner or operator throughout the entire utility contracting process.
- Tailored electrical systems:

- Medium Voltage (MV): Conducting detailed demand and load studies to optimally size the electrical installation and guarantee permanent power supply from the moment of building delivery, thereby avoiding administrative delays in the connection of the transformer substation (TS).

- Low Voltage (LV): Special attention is paid to the design of interior and exterior lighting using high-performance LED systems. These designs combine:

  - Versatility and energy efficiency.
  - Adaptation to the specific requirements of each logistics operator.
  - Compliance with environmental certifications such as BREEAM.

- Collaborative design with structure and architecture:

  - Structural Support Optimization and Coordination with Building Services: It is highly recommended to integrate elements such as MadreMax-type purlins during the design phase. These allow for the easy anchoring of suspended installations, reducing support costs and improving execution timelines.
  - Predefined Pipe Chase: for office areas, standard dimensions are suggested (160x70cm for one floor and 200x70cm for two floors) if an engineering definition is not yet available, which avoids breakage of boards and unnecessary steps.

- Effective rainwater drainage network:

  - Gable roofs that simplify rainwater collection design, eliminating secondary safety networks and improving hydraulic efficiency.

  - Extension of the buried siphonic network as an alternative to pumping water due to problems with the terrain level, which allows to reduce civil works and other operating costs.
  - Integrated counterslopes: the installation of omega profiles with a directed slope between drains prevents blockages and facilitates perimeter evacuation.

- Optimization of Utility Connections.

  - Plumbing: a single connection per cadastral reference is recommended, with individual private meters, simplifying layouts and consumption control.
  - Electricity: Extending aluminum medium-voltage lines is always preferred over copper low-voltage lines for both technical and economic efficiency.

8.6.5. Digitalized construction processes

The integration of methodologies such as BIM (*Building Information Modeling*) and Lean Construction is marking a before and after in the execution of logistics warehouses:

- Models that not only allow for project visualization and coordination (3D), but also time scheduling (4D), cost estimation (5D), sustainability simulation (6D), and facility management (7D).

- *Lean Construction*: applied in planning and execution phases to maximize value and minimize waste.

- On-Site Digitalization: Utilizing laser scanners, drones, AI-driven tracking platforms, and digital twin models to enable precise and remote supervision.

These processes not only reduce errors and execution times, but also facilitate complete traceability of the asset from conception to operation.

8.6.6. Conclusion

Logistics Warehouses construction is rapidly evolving towards more sustainable, efficient and intelligent models. Innovation is no longer an option: it is a necessary condition to respond to the demands of modern logistics.

The integration of recycled materials, advanced technical solutions and industrialized processes not only improves the performance and performance of assets, but also anticipates a new era in logistics construction: more digital, greener and resilient.

8.7. Updates to the DB HS6 DEL CTE. Protection against Radon exposure (updated February 2025)

On February 12, 2025, the Ministry of Housing and Urban Agenda published a new commented version of Basic Document HS6 of the Technical Building Code (CTE), dedicated to protection against radon exposure. This update introduces clarifications and criteria that facilitate the correct application of the regulations, with special attention to the design, execution and verification of protection measures.

The reference level reamins at 300 Bq/m³ as an annual average, but the update reinforces the concept that this does not constitute an absolute limit. It incorporates key aspects such as requiring a correction factor of 1.4 to be applied to the screening test result in sampling zones where representative conditions of a closed building cannot be guaranteed (e.g., unoccupied buildings).

8.7.1. Alternative solutions for logistics buildings

Regarding the verification and justification of compliance with the requirement, the document emphasizes the validity of alternative solutions equivalent to those described and accepted in the DB-HS6, provided that compliance with the reference level is documentarily justified through experimental measurements of radon concentration.

This would apply to certain buildings or premises, such as logistics warehouses, where their inherent characteristics—large volume and continuous ventilation—hinder the accumulation of radon indoors.

In fact, within municipalities in Zones I and II of Appendix B, if it is verified through measured values of the annual average radon concentration obtained in accordance with Appendix C that no sampling zone exceeds the reference level, implementing radon protection solutions will not be required.

8.7.2. Protective barrier. Concrete slabs

The protective barrier can consist of a membrane or a massive structural element, such as concrete, provided it meets the conditions and characteristics described in DB-HS6. Its sizing must be based on a thickness and a diffusion coefficient such that the predicted radon exhalation through it (E) is lower than the limiting exhalation (EI).

Concrete is a relatively porous material with a higher radon diffusion coefficient than membrane-type barriers. However, because slabs are significantly thicker than

membranes, this thickness can compensate for the higher coefficient, resulting in a similar radon exhalation rate.

In specialized technical literature, experimentally obtained values for the radon diffusion coeficient D of concrete range between 0.005·10-8-130·10-8m²/s depending on the water-to-cement (W/C) ratio, density, and porosity level. For this reason, measurements on slabs under construction are currently being carried out.

8.7.3. New developments in the Determination of the annual average concentration of radon in the air of the living spaces of a logistics building

While determining the sampling phase is the responsibility of the project designer, the construction supervision team (dirección facultativa), or the control entity, when the surface area exceeds 5,000m², one sampling zone may be established for every 500m².

If passive detectors are used, when the number of detectors to be exposed in the same building is between 15 and 25, one additional detector must be placed as a control. For installations exceeding 25 detectors, an additional control detector will be added for every 20 exposed detectors. These control detectors must be located in an area of the building where a low radon concentration is anticipated.

8.7.4. Measurement entities

Commercial distributors of detectors (active or passive) that do not perform the analysis or processing of measurement records are not considered measurement entities in any case.

The requirements established in Royal Decree 410/2010 of March 31, and the submission of the responsible declaration as a testing laboratory for building quality control before the competent body of the corresponding autonomous community, are not required for measurement entities established in another member state of the European Union.

As a general rule, the placement and activation of the detectors—provided that the measurement entity supplies the necessary instructions—can be carried out by the user or property owner, the project designer, the construction supervision team (dirección facultativa), or the control entity.

8.7.5. Measurement and estimation of the annual average

The procedures for obtaining the annual average are clarified:

- The minimum exposure period for the detectors shall be two months, while the maximum period will be adjusted to each manufacturer's specifications.

- In cases where there are only one or two detectors per zone, the average concentration value will correspond to the highest measurement result.

- If ideal closed-building conditions regarding occupancy and heating are not met, the obtained average result shall be multiplied by 1.4.

- The information that must accompany the estimation is detailed, including layouts, environmental conditions, and detector identification codes.

- The measurement report must comply with a series of technical requirements, including exhaustive information on the following aspects:

- Graphical representation of the detector data, if available.
- Equipment-induced error.
- System detection limit.
- Signature of the responsible technician.

8.7.6. Conclusion

This new commented version of the DB-HS6 provides more detailed guidance for the proper assessment and mitigation of radon in habitable spaces within a building. These clarifications and guidelines reinforce the role of measurement, monitoring, and maintenance as fundamental tools to ensure an adequate level of health and safety within the logitics real estate sector.

8.8. New Fire Safety Regulations in Industrial Establishments. Main novelties of Royal Decree 164/2025

On April 10, 2025, Royal Decree 164/2025 of March 4 was published in the Official State Gazette (BOE), approving the new Fire Safety Regulation for Industrial Establishments (RSCIEI). This regulation replaces the previous one, approved by Royal Decree 2267/2004 of December 3, and officially entered into force on May 10, 2025, establishing a six-month transitional period during which its application remained voluntary.

The new regulation is updated based on an equivalent safety approach for people and intervention/emergency services, which was justified through performance-based design studies. In general, it increases the maximum areas of fire compartments and the maximum travel distances for evacuation while introducing updates and innovations compared to the previous regulation.

8.8.1. Regulatory update

The new RSCIEI adapts to technical and regulatory advances, both at the national and European level. It incorporates references to European regulations such as Regulation (EU) 2024/3110 and Regulation (EU) No. 305/2011.

Furthermore, the Regulation facilitates the application of the Basic Document on Fire Safety (DB-SI) of the Technical Building Code (CTE), promoting greater regulatory consistency regarding fire safety in industrial buildings.

8.8.2. Updates

Stricter, Periodic, and Mandatory Inspections

The new regulation establishes the obligation to carry out periodic inspections in industrial establishments, tightening the conditions for these audits:

- Increased Inspection Frequency: High-risk companies must undergo inspections at least every 6 months.
- Mandatory Review of Extinguishing Systems: Certified verification and maintenance of fire extinguishers, automatic sprinklers, and alarms are required.
- More Severe Penalties: Non-compliance can lead to heavy fines or even the temporary closure of the business activity.

Establishments built in accordance with the 2004 regulation must adapt the content and frequency of these inspections to the provisions of Article 13 of the new regulation. Establishments prior to 2004 must undergo periodic inspections at least every 5 years, limited to active fire protection systems and equipment, in

accordance with Article 22 of the Fire Protection Installations Regulation of 2017.

Another major update is the introduction of newly authorized control bodies acting as third-party reviewers.

Higher Requirements for Fire Resistance and Storage Systems

Stricter requirements are established regarding the fire resistance of construction materials and flammable product storage systems, aiming to minimize the spread of fire both inside and outside industrial establishments.

Reinforcement of Fire Prevention and Protection

The new regulation introduces more stringent measures to prevent and control fires:

- More Efficient Compartmentalization: The installation of more effective fire barriers is required to limit fire spread.
- More Sensitive Detection Systems: The sensitivity of smoke and heat detectors is enhanced to ensure early warnings.
- Improved Evacuation Protocols: New standards are set for signage, emergency lighting, and more accessible escape routes.

Introduction of New Technologies in Alarm Systems

New technologies are incorporated into alarm systems, such as voice alarm systems in accordance with the UNE 23007-32:2020 standard, adapting to new European standards like UNE-EN 54-13:2019, which regulates the interoperability of fire detection and fire alarm systems:

- Equipment Compatibility: All detection equipment must be compatible with each other and with the control panels.
- Reduction of False Alarms: More demanding criteria are established to avoid incorrect alerts in industrial environments.
- Better Connectivity with Monitoring Systems: Integration with external security platforms for a faster response

Amendments to the Fire Protection Installations Regulation

The Royal Decree introduces amendments to the Fire Protection Installations Regulation, approved by Royal Decree 513/2017 of May 22. These modifications affect the design, installation, maintenance, and inspection of equipment, systems, and components that make up active fire protection installations.

Mandatory Training for Staff

Training requirements for fire safety are tightened:

- Certified Training: All personnel must receive official training courses on fire prevention and response actions.
- Mandatory Drills: A minimum of one annual fire drill must be conducted in factories and warehouses.
- Certification of Safety Managers: Safety officers must hold an official accreditation.

Implementation of Advanced Communication Systems

The regulation focuses on the importance of implementing real-time communication systems:

- Instant Notifications: Mandatory use of alarms capable of sending alerts to mobile devices and control centers.

- Remote Monitoring: Integration of fire protection systems with 24/7 surveillance platforms is required.

- Communication Redundancy: Priority is given to using 4G and LAN technologies to guarantee connectivity at all times.

Mandatory Installation of Voice Alarm Systems

The installation of voice alarm communication systems is made mandatory in industrial buildings that simultaneously meet the following two conditions:

- Built area: Equal to or greater than 10,000 m².

- Occupancy density: More than 3 people per 100 m².

These systems must allow the transmission of local alarms, general alarms, and verbal instructions through public address (PA) and voice evacuation systems.

Update to Thermal Load Calculations

Changes are introduced in the calculation of the R reactivation coefficient of materials:

- New R values: By default, R will be taken as 1; it will be 1.4 in activities with a higher probability of starting a fire; and 1.8 when both previous conditions are met simultaneously or there are storages of combustible materials with a height greater than 5 m that occupy a floor area equal to or greater than 150 m.
- Unification of units of measurement: All caloric units have been unified in megajoules and references to megacalories have been eliminated.
- Expansion of thermal load tables: New materials and compounds have been added to the table that details the thermal load or calorific value of materials considered hazardous.

8.8.3. Impact on the logistics real estate sector

In the specific case of buildings housing logistics activities, such as distribution centers with generic multi-product storage, the proposed average **fire load** density values (for both gross and net storage) place these establishments into a High **Intrinsic Risk Level** (NRI), rather than a medium level.

Particularities of Multi-Tenant Logistics Buildings. Regarding evacuation, for a high NRI, maximum travel distances of 70 meters can be justified—provided there are alternative exits and a maximum distance of 40 meters for dead-end travel paths (travel paths without alternative). This implies that in buildings with a depth greater than 110 to 120 meters, it may be necessary to construct a closed, surface-level corridor or gallery for evacuation purposes.

The most determining aspect is the maximum size of the fire sectors within each of the establishments (one per tenant) into which the building is divided, and the scenarios that the new regulation allows in this regard are two:

- **Type B Configuration**: In this case, and for a high NRI, the structure of each establishment must be structurally independent by duplicating columns with a REI240 rating and creating a firewall with an EI240 rating. Within each establishment, fire compartments with an EI120 rating must be generated, with a maximum surface area based on the specific NRI of:
  - NRI 6: 8,000 m²

- NRI 7: 6,000 m²
- NRI 8: 6,000 m²
  - Provided that the detection and alarm system is connected to a remote management receiving center for continuous monitoring and verification of fire alarms.

The main elements of the prefabricated structure with a load-bearing function should have an R30.

- **AH type configuration:** In this configuration, it is not necessary to structurally separate each establishment; generating a firewall with a single EI240 wall is sufficient.

Although a shared structure may be used, the roof must be independent, and it must be technically justified that the potential collapse of the structure will not affect adjacent establishments or their fire compartmentalization.

Within each establishment, fire compartments with an EI180 rating must be generated, with a maximum surface area of 5000 m², provided that the detection and alarm system is connected to a remote central monitoring station for continuous monitoring and verification of fire alarms.

The main load-bearing elements of the prefabricated structure must have an R120 rating.

8.8.4. Fire Safety Cluster of Catalonia

This is a multidisciplinary platform that addresses fire protection from a comprehensive perspective, including active and passive protection, performance-based design, systems maintenance, and the application of BIM methodologies, among other technical and regulatory approaches.

One of the cluster's primary values is the diversity of its participants: manufacturers, maintenance providers, developers, construction companies, installers, and even fire departments. This provides a complete overview of the life cycle of protection systems and a shared understanding of the sector's challenges, especially within immologistics.

Each working group is organized around specific objectives and generates high-value technical discussions that result in useful content for the sector as a whole—such as publications, practical guides, and training initiatives aimed at continuous improvement and knowledge dissemination. Meanwhile, the diversity of the environment and its members enriches the debate around the topics of common interest related to fire protection.

8.8.5. Conclusion

This new regulation represents a significant step forward in improving fire safety within industrial establishments. It adapts to current technical and regulatory advancements, new technologies, and the actual needs of the immologistics sector, while establishing more rigorous measures for fire prevention and control.

It is essential for companies to review and update their facilities and protocols to comply with these new requirements, thereby ensuring the safety of both their workers and assets.

9. CONCLUSIONS

9.1. Decalogue

We consider it appropriate to synthesize the most relevant aspects of this White Paper into a set of ten key points. This not only summarizes the fundamental concepts of the document but also offers a structured and practical vision that can serve as a guide for strategic decision-making within the logistics real estate sector.

9.1.1. **The industrialization of construction** will gain growing relevance in the coming years, driving a profound transformation in how projects are conceived and executed. Faced with this scenario, construction companies and engineering firms will need to work in a coordinated manner, integrating advanced technologies, digital processes, and sustainability criteria.

9.1.2. **Artificial intelligence (AI) and robòtics** are rapidly transforming the logistics industry. Increasingly, warehouses are incorporating autonomous machines and robots for tasks such as sorting, picking, internal goods transport, packaging, and inventory management. The integration of both disciplines redefines the architecture and operations of logistics spaces, making them smarter, more efficient, and better adapted to the new demands of the sector.

9.1.3. **Flexibility is a key factor in the design of logistics warehouses,** especially in a context where land costs are high and operational needs evolve rapidly. To maximize profitability and efficiency, the warehouse must allow for different modulations, variations in loading docks and access points, changes in heights and mezzanines, etc., **always in alignment with what has been planned in the logistics project.**

9.1.4. **The importance of aesthetics and design combined with functionality.** The image of the logistics building serves as a brand presentation that provides security and guarantee

9.1.5. **Minimization of the timeframes required** by the Administration **for granting licenses,** placing greater trust in the technician who signs off on the project.

9.1.6. An abundance of regulations and restrictions—covering urban planning, building codes, and activity permits—governs the construction and use of a warehouse. **While this framework is highly necessary and appropriate, it must be balanced with a certain level of "simplicity"** to successfully deliver an industrial logistics warehouse that can bring real improvements to both the local population and the economy of the area where it is established.

9.1.7. **The implementation of BIM (Building Information Modeling)** provides detailed and updated information on all elements of the building. This facilitates the rapid and visual location of equipment, as well as access to manuals, maintenance histories, and technical data. **BIM has transformed maintenance management and commissioning** into a more efficient process.

9.1.8. In project drafting, contributions regarding **the environment and human well-being** have increased significantly. In recent years, there has been greater sensitivity toward these aspects, which is clearly reflected in construction works.

9.1.9. Regarding infrastructure and services, **industrial estates are increasingly better prepared,** and there is a greater willingness on the part of the Administration and its technicians to evaluate the establishment of an industrial logistics warehouse more positively.

9.1.10. **To keep innovating.** We, as Engineering firms, must persist in our task of improving technical and constructive solutions, among others. We must maintain a healthy non-conformity, both for our own professional excellence and to achieve a higher valuation of our services.

9.2. What the sector demands

9.2.1. Condis

The needs of a user company operating a logistics platform can be structured into two main areas. On one hand, the requirements established regarding the landlord or owner of the warehouse, in cases where the property is leased. On the other hand, the specific demands raised concerning the characteristics and performance of the logistics platform itself intended for distribution. Therefore, we must consider:

What does a user company expect from owning a logistics platform?

- **Customer orientation**. Every logistics operation has specific needs, and every client has its own corporate culture. It is crucial to listen to and understand these needs to provide proper support throughout the lifecycle of the contract. It is about building a relationship of trust and partnership.

- **Service-Oriented Mindset**: The property must act as a facilitator—an expert at the client's disposal. They have access to a wide range of suppliers capable of providing value-added services to their clients. This achieves two goals: it improves and modernizes the asset, and it strengthens the bond with the client, which can drive repeat business and extend their tenancy.

- **Response time**. The property must be agile enough when responding to customer requests and requirements.

What is demanded from a platform intended for urban distribution?

- **Location and accessibility**. Agile access to the city is fundamental for urban freight distribution activities. Urban distribution (DUM) platforms must be located as close as possible to delivery points. Furthermore, traffic circulation and access to the platform must accommodate a high flow of vehicles during peak hours.

- **High density of loading and unloading docks**. Urban distribution, and especially for the food sector, requires a density of docks much higher than a standard warehouse with a desirable ratio of 2 docks per 1000 m^2 or higher.

- **Commitment to sustainability**: In addition to having BREEAM sustainable construction certifications, newly built warehouses must be prepared to face the energy transition in freight distribution. They must feature pre-installations to support electric or hydrogen vehicle charging,

as well as refrigerated or frozen cargo power needs.

9.2.2. DHL

Logistics warehouses have evolved remarkably, and out of necessity, over the last two decades. This evolution has progressed at varying paces, shaped by a constantly transforming context. With a few exceptions, fifteen to twenty years ago, logistics warehouses were austere constructions, and their owners were mostly local. Today, however, we have efficient, high-quality buildings.

The logistics warehouse is a cornerstone within the supply chain and, until a certain point during this period, had played a discreet role within the industry. The term **logistics real state**, widely used nowadays, sums up the importance of these facilities, which have become the driving force behind a highly specialized real estate sector.

In recent years, several factors have driven the promotion and vast supply of new logistics warehouses, characterized by updated features:

- The obsolescence of the existing stock of warehouses.
- The increase in demand derived from outsourcing and e-commerce.
- Reduced delivery times and the need to improve efficiency in storage and distribution.
- The influence of a globalized supply chain.
- Growing interest from investors: landowners, construction companies, and developers.

In response to this new demand, investors and developers have successfully identified market needs and incorporated them into their projects:

- Both in terms of **locations** (determined by infrastructure and the availability of human resources), and in **designs**, which are more flexible, standardized and efficient, compatible with automation and digitalization.
- In improving the **materials** used, which reduce maintenance and repair needs (slabs, loading docks, or offices).
- In improving **security**, both for goods and people
- Through more **pleasant and comfortable** designs for both internal and external workers (value-added services and distribution variability have significantly increased the presence of personnel in these facilities).
- And by turning into increasingly energy-**efficient buildings** (additionally backed by international certifications that accredit them).

Today's logistics warehouse is no longer an isolated building; it is deeply connected to society, and both its location and design are fundamental to the well-being and productivity of workers, as well as the implementation of automated and digitalized processes. Furthermore, along with the rest of the links in the supply chain, it constitutes a key element in combating climate change.

Nevertheless, logistics warehouses must continue to adapt to an increasingly complex future characterized by accelerated changes. This affects not only new constructions but also existing ones.

Finally, the importance of good management must be highlighted. The relationship between owner/landlord and user/tenant should translate into a partnership that brings additional value to the investment and to the user's competitiveness.

9.3. The role of engineers and the Logistics Commission of Industrial Engineers of Catalonia

Engineers are professionals who support society by designing and implementing solutions to problems so that the general population can enjoy a better life. They provide reliability through their knowledge of different industrial sectors, evaluating opportunities for improvement with tenacity and resilience.

The Associació and the Col·legi d'Enginyers Industrials de Catalunya, as the leading corporate bodies, are committed to the professional development of engineers in the industrial field—representing them, defending the profession, and safeguarding their interests. Concurrently, they foster the advancement of engineering and deploy technical, scientific, and cultural activities through their commissions.

For this reason, they offer genuine services that accompany engineers throughout their professional careers, build high-quality networks of professional relationships, generate reflection and debate by sharing knowledge, positively influence society through the values that engineering provides, and reinforce the prestigious brand of the profession by projecting a positive image and identity for engineers while promoting the understanding and awareness of engineering.

One of the branches of industry is **logistics**, which adds value to products and services. This spans from guaranteeing a secure supply to bridging the gap to points of consumption, through various stages of packaging and customization to satisfy the needs of the final consumer.

Consequently, the core mission of the Logistics Commission of the Industrial Engineers of Catalonia is to disseminate technological and organizational updates, debate logistics-related topics of interest among the engineering community and the companies or public bodies they belong to, and emphasize the value of the logistics function within Catalonia's industrial sector—thereby improving its perception by society and public administrations. Ultimately, it acts as a multidisciplinary platform that addresses fire protection from a comprehensive perspective, including active and passive protection, performance-based design, systems maintenance, or the application of BIM methodologies, among many other technical and regulatory approaches.

The commission's scope of action thus encompasses all aspects currently comprising the so-called Supply Chain. To address them properly, work is organized into six specific working groups (WG):

- **WG TRIN**: Dedicated to **intermodal transport activities and third-party logistics operations** (3PL).
- **WG DUM**: Dedicated to **urban freight distribution activities**—commonly known as the last mile—covering both B2B and B2C sectors.
- **WG AGRL**: Dedicated to **primary sector** logistics, from the field or farm to the processing centers.
- **WG INTL**: Dedicated to **internal logistics** within manufacturing and distribution, including facility design, plant layout, and process organization.
- **WG TICL**: Dedicated to **logistics information and communication technologies**, ranging from

demand planning, inventory management, warehouse management, or transport management, among others, to distribution route control.

- Lastly, **WG IMML**, dedicated to **logistics real estate**, which is the driver and author of this White Paper. The primary objectives of this working group are to raise awareness about the availability and characteristics of location, construction, and general facilities of logistics spaces, regarding both land plots and buildings.

In short, the **Logistics Commission** aims to highlight the creation of value and employment generated by logistics activities in Catalonia, as well as to emphasize the necessity and contribution of logistics within our regional industrial context.

For this reason, it is essential to stay up to date with innovations emerging in the field of logistics and to disseminate them among fellow engineers through conferences, articles, newsletters, and other communication channels.

It is also crucial to identify synergies and common issues across the various areas of the vast logistics sector, establishing a unified perspective that enables the Industrial Engineers of Catalonia to position themselves on related matters and propose solutions through debates, roundtables, and the drafting of reports such as this one, the **White Paper of Logistics Real Estate in Catalonia**.

ACKNOWLEDGMENTS

Luis Dominguez, Real Estate Manager Iberia DHL Supply Chain

Victor Escanciano, Logistics and Systems Director, Condis Supermercats

Enrique Escribano, Industrial and Logistics associate of Cushman & Wakefield

Rafael Fernandez Bautista, Lawyer, PhD in Law, and Urban Planning Expert

Jordi Figueras, Head of Studies for the Building Department, Carbonell Figueras

Ignacio Errea, Project Director, Onilsa

Michael Loughlin, Managing Partner, MAP Consulting & Technology

Elizabeth Christmas, Partner of Sustainability, Business & Human Rights, Cuatrecasas

Cristian Oller Angusto, Vice President and Country Manager for Southern Europe, Prologis

Victor Redondo, Strategy and Production Planning Director, HAI Robotics Europe

Silvia Solanellas, Partner, Elaia Desenvolupament Sostenible

Ma Goretti Torrella, CEO of Torrella Ingeniería - Architecture

Josep Torrella, Development Director, Torrella Ingeniería - Arquitectura

Joan Josep Vallvé, President of the Logistics Commission of the Industrial Engineers of Catalonia

First edition: June 2025

EDIT

Associació/Col·legi
d'Enginyers Induatrials de Catalunya
Via Laietana, 39
08003 Barcelona
+34 93 319 23 00
www.eic.cat

DOWNLOAD THE BOOK HERE