Port de Barcelona

PORT OF BARCELONA ENERGY TRANSITION PLAN

Zero Emissions Port by 2050

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Port of Barcelona
Energy Transition Plan

Zero Emissions Port by 2050

Port de Barcelona

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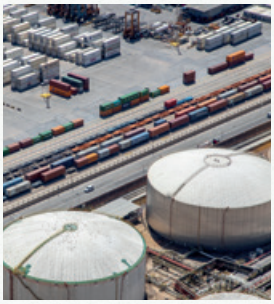

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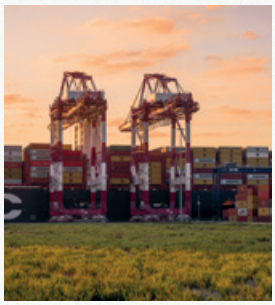

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01 INTRODUCTION

01 INTRODUCTION

The current energy transition is a shift towards a more sustainable energy model. Essentially, the transition entails replacing fossil fuel energy sources with renewable ones. However, the adoption of these low-emission renewable sources presents three main challenges: higher cost compared to fossil fuels, uncontrollable intermittency during power generation and low energy densities. Energy efficiency, demand flexibility and technological innovation are thus essential aspects of this transition.

Other changes induced by the energy transition include: the possibility of decentralising electricity generation, increasing the energy independence of territories and organisations, and introducing structural changes in current operations, especially in the transport sector. In the case of ports, this transformation is paramount, as they represent central nodes in the economy's supply chains, both for goods and for energy itself.

The Energy Transition Plan, developed below, aims to bring about a paradigm shift in port activity, currently based on fossil fuels, to introduce a new energy model based on renewable energies, sustainable alternative fuels and electrification. This new model will entail a profound change in the Port of Barcelona's entire organisational structure because it will affect many of its spheres of action, such as port planning, new infrastructure construction and conservation, the granting of concessions, the procurement of equipment and machinery, statistics on the transport of goods and the commercial

opportunities of this new energy model, among others. For this reason, this Energy Transition Plan aims to be a tool that allows all the areas and departments of the Barcelona Port Authority, as well as the port community, to align themselves with a shared, complex and ambitious objective: to fight against climate change by decarbonising port activity before 2050, while at the same time reinforcing the competitiveness of the port and the region.

Background

Among the strategic pillars in environmental sustainability included in the Port of Barcelona's **Fourth Strategic Plan for 2021-2025**, the Port defined becoming a benchmark in Barcelona, the Mediterranean and the Iberian Peninsula as a priority goal in terms of the energy transition, promoting the decarbonisation of the port's activity through the electrification of wharves, promoting the use of clean alternative fuels, increased energy efficiency and managing and producing renewable energies.

The Strategic Plan proposed four strategic objectives for environmental sustainability:

- **Develop a new energy model**
- **Decarbonise maritime-port activity**
- **Reduce pollution**
- **Increase intermodality**

The plan also set out two strategic objectives for the decarbonisation of maritime-port activity to combat climate change: **to reduce greenhouse gas (GHG) emissions by 50% by 2030, compared to 2017 emissions, and to be GHG neutral by 2050**, in line with the European Union's decarbonisation goals.

To achieve these environmental sustainability goals, the Fourth Strategic Plan proposed drafting the Port of Barcelona's Energy Transition Plan (ETP) to establish the main pathways to decarbonise maritime-port activity and become a carbon neutral port by 2050.

These assessments are also reflected in the **Enterprise Plan**, which considers environmental sustainability as a key factor in maintaining and enhancing the port's attractiveness and ensuring its future resilience.

It is worth mentioning that the Board of Directors of the Port of Barcelona approved the preparation of the **Action Plan for the Electrification of Wharves** on 29 January 2020 with the aim of contributing to reducing emissions and improving the air quality.

The main objective of this plan was, on the one hand, to establish the roadmap for electrifying the wharves and, on the other hand, to define the foundations for the installation of an existing technology, the offshore power supply (OPS), i.e. the connection of ships to the electricity grid from land. NEXIGEN, the name given to this plan, has become the main instrument for accelerating the port's decarbonisation process and one of the pillars of the Energy Transition Plan. This plan has reached a state of readiness and progress which make the Port of Barcelona a leader in the adoption of this technology.

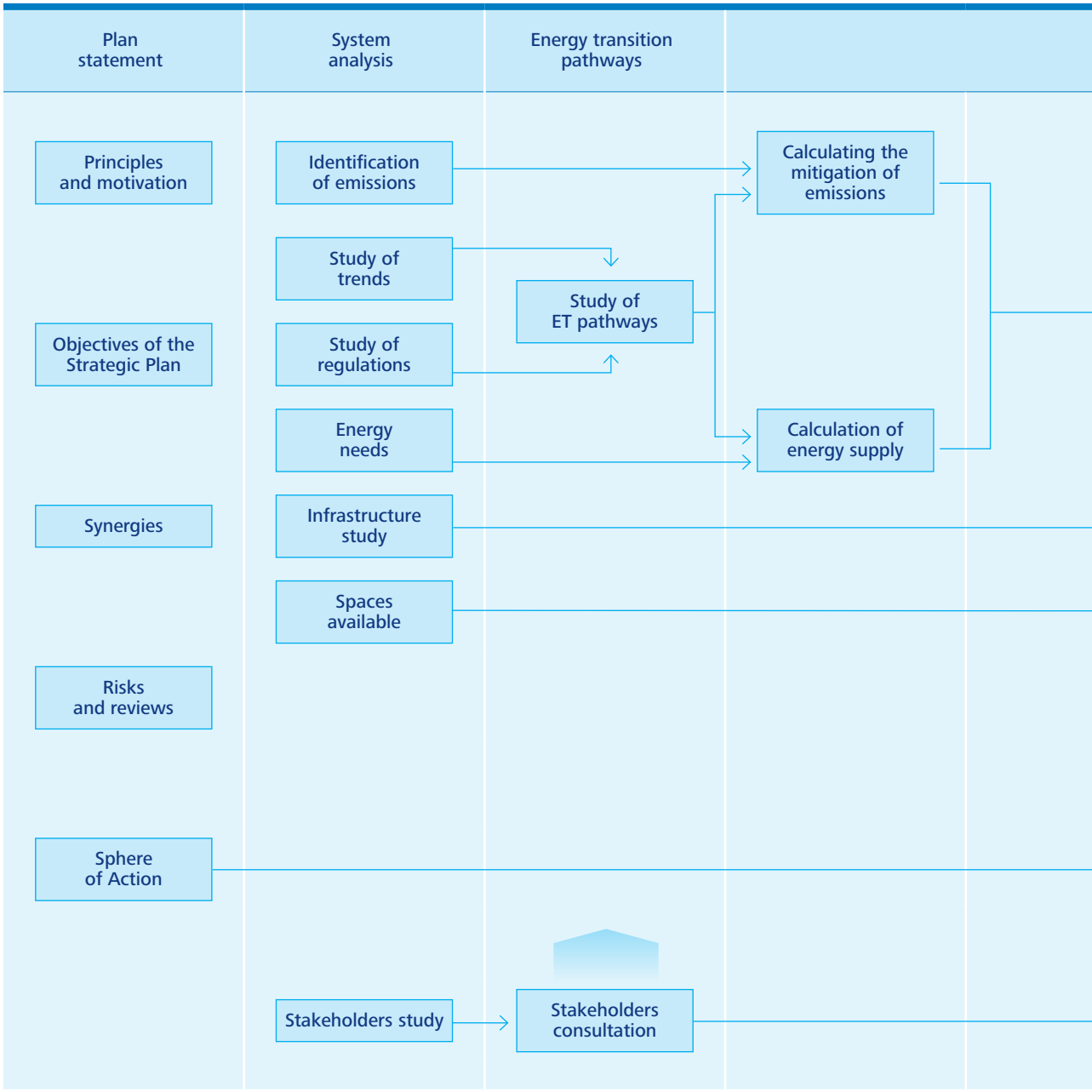
The Fourth Strategic Plan proposed drafting the Port of Barcelona's Energy Transition Plan to establish the main ways of decarbonising maritime and port activity, and to develop a new energy model.

Methodology

The Energy Transition Plan has been developed following a structure based on the 5D methodology (discovery, definition, design, development and roll out). The main objective of the development methodology has been to ensure alignment with the Strategic Plan, to obtain a comprehensive understanding of the port's energy system, to conduct a thorough prospective search of possible energy transition technologies and solutions, and to arrive at a proposal for a comprehensive energy strategy. The six main sections are as follows:

Plan statement: this section presents the context, the need for the plan, the motivation, the principles and objectives, as well as its relationship to other initiatives and actors.

System analysis: this section examines the operation of the port's ecosystem, the applicable legislation, the actors involved, the energy needs, the emissions generated and the available infrastructure and spaces.

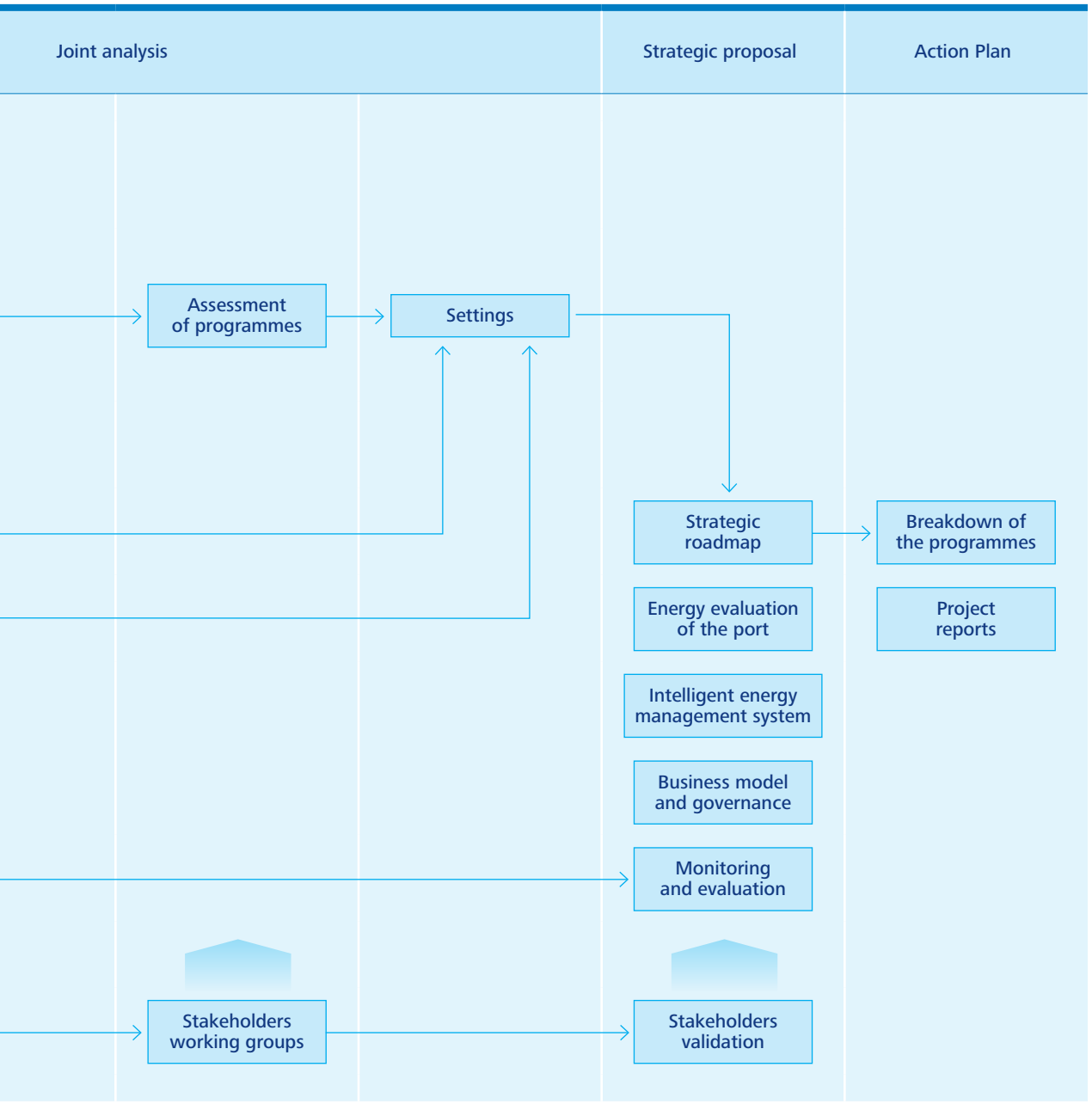


Energy transition pathways: this section identifies ten key action areas for implementing the energy transition in the port and presents possible actions to be carried out.

Strategic proposal: this section defines the strategic proposal for the Port of Barcelona's energy transition, including the institutional framework and the evolution of the overall energy picture.

Joint analysis: this section assesses the proposed actions, taking into account the synergies between them, resulting in 12 lines of development, which define the roadmap.

Action Plan: this section summarises the concrete actions to be carried out within the plan.



Global context

During the 20th century, it became clear that climate change, caused by GHG emissions, has serious consequences for humanity and the environment. The great challenge of the 21st century is to boost decarbonised economies to ensure sustainable development. Technological developments have made new renewable energy sources viable and have led to changes in the global energy profile.

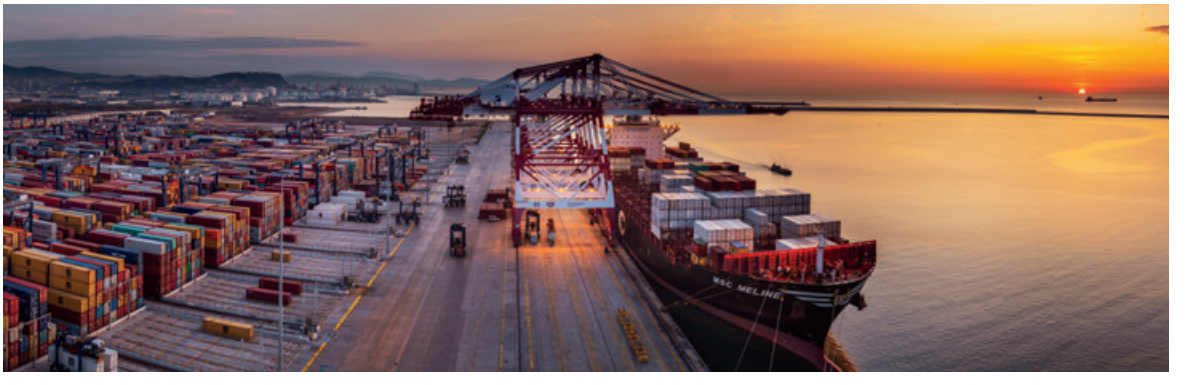
As key trade nodes, ports must play an active role in the transition to renewable energy sources. Maritime transport, which is responsible for 3% of global GHG emissions, and heavy land transport are difficult sectors to decarbonise due to their high energy needs and autonomy requirements. This is why the port community must actively work together to address climate change. Sustainability in ports is essential to guarantee the competitive standing and resilience of the productive sector and the region they serve.

Adaptation to climate change: ports must adapt to rising temperatures and extreme weather events, which affect the infrastructure and make structural resilience and planning the key to minimising the impact. Climate variability also changes energy demand and transport logistics, requiring flexible management of supplies and operations.

Disruptions/resilience: the increase in disruptive phenomena, such as climate crises, overexploitation of natural capital that accentuates the competition for resources, geopolitical tensions and technological acceleration, introduce a high level of uncertainty in supply chains and energy security. Technological and commercial interdependence also increases the system's vulnerability. This global scenario requires resilience-building strategies to ensure operational and economic stability.

Innovation/adoption: Port energy management is being redefined by emerging technologies such as artificial intelligence (AI), 5G, digitalisation and renewable energy. Sensorisation and big data make it possible to optimise energy consumption, while green hydrogen and battery roll out help to make decarbonisation possible. Ports need to foster an innovation ecosystem that facilitates the rapid adoption of these technologies to maintain their competitiveness.

New energy system/positioning: the global energy transition to renewable sources is transforming geopolitics and supply chains. Clean energy improves energy security and reduces the dependence on fossil fuels. Ports will be key centres in the production, storage and distribution of new energy vectors, such as hydrogen and hydrogen derivatives. Adaptation to this new model will determine the future competitiveness of ports. Investments in infrastructure and technology will be essential to maintain their strategic position.



Key motivations for the plan

The Port of Barcelona is aware of the need to adapt to a constantly changing world where energy transition is a global priority. With the climate emergency situation, the Port of Barcelona, as an essential infrastructure, is bound and committed to transforming the current energy model to become a benchmark in sustainability and innovation.

Therefore, in defining and developing this plan, the port's motivations and foundational principles have been central to designing a strategy aligned with its ambition to improve the overall landscape.

Environmental awareness: the Port of Barcelona is a complex system in which a large number of actors interact, with interrelated processes of different natures. For this reason, a comprehensive analysis of the port system is being carried out in order to implement sustainable solutions and to engage the entire port community in this effort.

Economic resilience and growth: the adoption of renewable energies strengthens the port's competitiveness and enables it to reduce energy costs, foster sustainable economic growth and attract partners committed to sustainability.

Adaptive risk management: diversification of energy sources is key to addressing the volatility of energy prices and potential supply disruptions to ensure greater resilience to a changing energy environment.

Technological leadership: the Barcelona Port Authority remains committed to innovation, integrating new technologies and fostering an ecosystem of disruptive entrepreneurship to promote sustainability and the energy transition, with the aim of maintaining the port as a centre of innovation.

Community commitment and collaboration: the energy transition requires the collaboration of the entire port community and dialogue with the public to ensure harmonious coexistence and transparency in the port's initiatives.

Global energy paradigm shift: the transition to cleaner energy across the world marks a new global scenario. The Energy Transition Plan envisages integrating this change and positioning the Port of Barcelona as a leader in the adoption of emerging business models based on sustainable energy.

As strategic infrastructure, the Port of Barcelona plays an active role in the energy transition to generate an innovative and sustainable ecosystem to help serve its region and community.

Outfitting inside the port

The Port of Barcelona's Energy Transition Plan is part of a broad process of economic and energy transformation on a global scale, in which simultaneous changes are taking place. Its success depends on close cooperation between the different actors of the port system. This coordination is essential to ensure that it is effectively implemented and to make the most out of the opportunities offered by the energy transition. As such, the following elements are key:

Coordination: energy optimisation and resource use. The overall energy efficiency of the port can be improved with a **comprehensive and collaborative vision**. For example, this can be improved by coordinating photovoltaic power between concessions with energy surpluses and energy deficits, or by sharing thermal resources between different facilities to reduce waste. This comprehensive approach will lead to greater efficiency and cost savings.

Port community and collaboration networks: the Port already promotes collaboration through the Port Community Governing Council, which makes it possible **to coordinate among various agents and to promote initiatives** for decarbonisation and the use of renewable energies. This cooperation also facilitates knowledge transfer between innovative companies and other actors in the sector.

Public administration and regulatory framework: many actions will depend on support from local, regional, state and European public administrations, either in the form of funding or regulation, or data needed to carry out the project. Close links must therefore be established with entities such as the Barcelona City Council, the Government of Catalonia, the Spanish Government and the European Union.

Role of the APB: the APB must spearhead the integration of the plan's objectives within all its areas and departments. This means ensuring that sustainability is a central guideline in the procurement of construction and services, concessions, trade promotion and strategic plans. In addition, internal communication will be vital to ensure that the proposed measures are implemented in a cross-cutting manner.

Complex systems and digitalisation: the Port is a complex ecosystem with multiple actors interacting to provide services to their customers. In addition, the interconnection of processes can generate synergies and new opportunities. To manage this complexity, digitalisation and the creation of a **digital twin** for the port will be essential, as they will enable real-time information to be analysed and decision-making to be optimised.

External collaborations and global learning: the Port of Barcelona is one of the most innovative ports in the world, which is why it must be connected to other international ports and institutions. Collaboration with networks such as the International Association of Ports and Harbours (IAPH), the European Sea Ports Organisation (ESPO), the C40 (global network of cities committed to climate change) as well as European projects such as the PIONEERS (Portable Innovation Open Network for Efficiency and Emissions Reduction Solutions) international consortium can provide innovative solutions and enable the development of **green corridors** for more sustainable logistics, for example.

Guiding principles

TO CONTRIBUTE TO REDUCING THE RISE IN GLOBAL TEMPERATURES

The decarbonisation of port and maritime activities is necessary to meet the public's ambitions and the European Union's objectives to address the climate emergency.

SUSTAINABLE ENERGY AS A STRATEGIC FACTOR

Energy is a fundamental element for human activity, and thus occupies a strategic position. In order to ensure the future viability of the port and its environment, access to energy must be guaranteed, and this must have a sustainable origin.

THE PORT OF BARCELONA AS AN ENERGY HUB

The Port of Barcelona is an important part of the goods transport system, and energy is an asset with cross-cutting value that can be channelled through the port to enable its supply and enhance the region's competitive standing.

ENSURING COMPETITIVENESS

The energy transition must strengthen the port's positioning in an increasingly demanding global market. The incorporation of sustainable energy solutions will optimise costs, improve operational efficiency and ensure adaptation to new environmental standards.

LEADERSHIP IN THE LOGISTICS CHAIN

The Port of Barcelona occupies a central role in the transport of goods and people, but it is one of many parts of a long logistics chain that ensures that economic activities can operate properly. For this reason, the Port's efforts cannot be isolated from those of the rest of the chain and can even serve as a catalyst for extending the energy transition throughout the logistics chain.

MISSION

To ensure an environmentally and economically sustainable energy supply to the community.

To the best of its ability, the Port Authority must ensure that the entire community (made up of the port community, including concessions, operators, shipping companies, and more, but also the hinterland: the public and the business sector) has access to energy in a competitive manner, and must work daily to ensure that this energy supply is increasingly environmentally respectful. Successful completion of the mission will contribute to combating climate change, promoting technological innovation and ensuring community energy resilience.

VISION

To become a leading energy hub, a **Smart Energy Hub,** where both logistics and innovative energy business models can thrive by offering sustainable, decarbonised services while ensuring a competitive energy supply.

The port's vision emphasises a leading position to become a benchmark in the sustainable energy sector. It aims to achieve an agile transformation of the port's energy model to adopt the most innovative technologies in order to attract the most dynamic companies and provide environmentally responsible services. This will open up new business channels for the port community and bring a competitive advantage to the region.

Strategic objectives

In order to structure the mission and ensure an effective progression towards the established vision, the Port has set out strategic objectives that mark the development pillars of the Energy Transition Plan.

STRATEGIC ENERGY TRANSITION OBJECTIVES

DECARBONISATION

The Port of Barcelona is committed to being an important actor in the decarbonisation of the European economy, integrating short- and long-term objectives, with the understanding that **reducing emissions** is an opportunity to develop new activities and mitigate the rise in temperatures.

RESILIENCE AND COMPETITIVENESS

The transition to a new energy model must aim to **increase the community's energy sovereignty** in order to reduce the effect of the current volatile scenario and ensure a high level of competitiveness through a guaranteed energy supply.

SUSTAINABILITY

The port's energy transition cannot be limited to reducing emissions, it must also be sustainable. Concepts such as **circular economy, local sourcing, energy efficiency** and eco-design, along with avoiding duplication with other infrastructure/ services, should be assessed throughout the numerous projects in the plan.

ENERGY INNOVATION

The energy transition can also be seen as an opportunity to incorporate the technological innovations that are constantly appearing in the energy sector and thus develop **new sustainable business models**, thereby contributing to the growth of the port and its hinterland.

The Port of Barcelona is a clean energy hub, promoting green logistics solutions that foster the development of new activities and sustainable business models, thus reinforcing the growth of the port and its hinterland.

HINTERLAND
PORT DE BARCELONA
FORELAND

01.03 SPHERES OF ACTION

When defining the scope of the plan, the region managed by the APB is the area where most of the actions will take place, both in terms of the APB's degree of impact and the influence that it can exert. However, in order to sponsor the new energy models that are being created, APB cannot limit itself to carrying out actions within the scope of its region or within the organisation itself. Certain initiatives extend beyond the port area, such as in the hinterland or on the main maritime routes to and from the Port of Barcelona (foreland). The spheres of action of the Energy Transition Plan are divided into the following categories:

PORT OF BARCELONA

The main scope of work consists of all activities carried out within the region under the jurisdiction of the Port Authority. It is a specific area under the APB's responsibility where it thus has a greater ability to influence activity and guide planning in order to reduce the impact on the environment and the public. In parallel, reliable data can be obtained to monitor the implementation of the energy strategy.

The main actions will be aimed at promoting the reduction of emissions in the concessions, transforming the port machinery, generating renewable energy locally, building the necessary infrastructure, and reinforcing intermodality services and electrifying the wharves.

HINTERLAND

The Port of Barcelona is a key node in a large number of logistics chains. The APB strives to maintain an active role in the transition within the region it serves. By promoting certain activities in the port, as well as investment in the region, the aim is to contribute to the decarbonisation of transport and industry, make economic activity more resilient and enable the development of new business models in the energy sector.

Logistics chains: the main actions will be to reduce the negative externalities of heavy transport, optimise logistics operations, increase the supply of maritime motorways, as well as increase the use of the railways through the logistics platforms which are owned by or associated with the port.

Activities in the hinterland: facilitate the presence of the necessary ecosystem to boost the increase of renewable energy traffic in the energy wharf and thus foster green energy for industry and mobility. Collaboration can also be explored to increase the energy efficiency and sustainability of activities in the vicinity of the port.

FORELAND

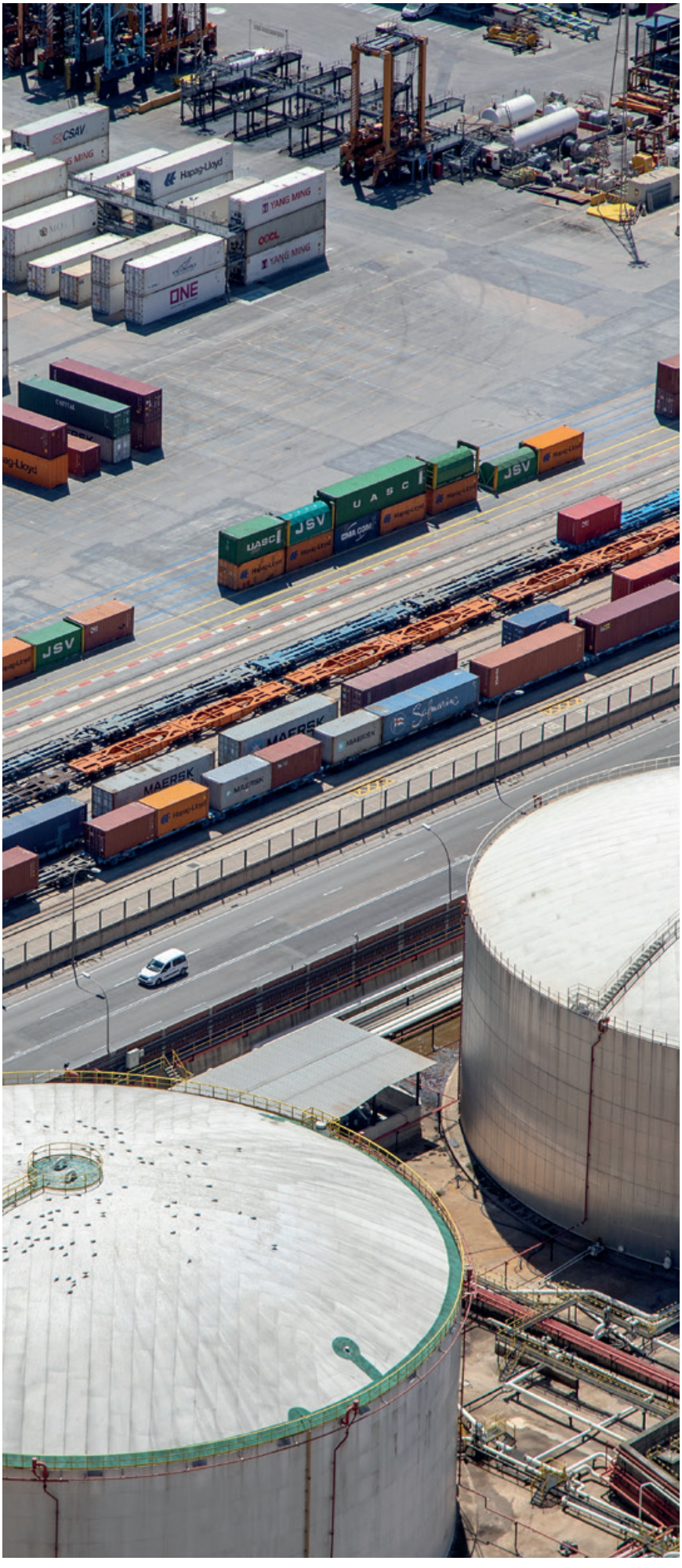
The plan aims to promote the decarbonisation of the maritime sector, seeking collaboration with shipping lines and other ports, and generating new opportunities in the energy sector, which, in turn, can increase the resilience of port activities by bringing fuel production and supply closer to the port.

Some of the required actions entail the construction of infrastructure to supply and store sustainable fuels, the creation of the necessary ecosystem for alternative fuel bunkering or securing the supply chain of these fuels through production plants in the hinterland or import-export facilities.

The actions will be carried out in the ports and in the surrounding area. They will be aimed at promoting the reduction of greenhouse gas emissions from ships during navigation, while monitoring will be carried out on the emissions from the ships on routes that call at the Port of Barcelona.

SYSTEM ANALYSIS

02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02 SYSTEM ANALYSIS

After having carried out the analysis of the global context and having defined the strategic framework, scope and sphere of action of the plan, a study of the system will be conducted in order to define the most appropriate ways to achieve the target objectives. An in-depth knowledge of the port system from an energy point of view is essential in order to identify and plan the different actions that will enable an effective and agile energy transition to be carried out in the port.

It is vital to understand the port system, as well as the infrastructure available and the legislation to which it is subject. Similarly, the actors that make up the port community and their needs and interests must be identified. It is also necessary to know what developments are taking place in the energy sector in its different dimensions: across the globe, in Europe, and in Spain, as well as the developments specific to the maritime and port sector. The most important parts are diagnosing the energy needs of the activities taking place and the emissions they generate. Finally, the availability of space within the port and how it fits in with port planning must be assessed.

02.01 DESCRIPTION OF THE PORT

The Port of Barcelona is Catalonia's main transport and services infrastructure and a leading port in the Mediterranean. It covers approximately 1,100 hectares of land area, 5,400 hectares of water surface and some 23 km of wharves, where more than 480 organisations and more than 40,000 people work. It is part of the Trans-European Transport Network (TEN-T) in its foundational category, the most strategically important in the European Union, and stands out for its intermodality, connecting maritime, rail and land transport.

The port's size is medium-large within the European port system, and is made up of a wide range of activities that give it a highly diversified profile. It focuses mainly on the logistics dimension with certain industries located within it. On the other hand, the metropolitan area of Barcelona boasts an intense concentration of industrial activity, as well as large population centres, which gives the Port a powerful immediate demand.

Its strategic location positions it as a key logistics hub in the Mediterranean and Southern Europe. This is complemented by its proximity to an international airport and the networked port strategy, which has developed extensive intermodal connectivity with the region by establishing inland maritime terminals and the motorways of the sea.

The Port is directly adjacent to the city centre of Barcelona, which increases the level of environmental requirements and allows it to benefit from the city's dynamic character as a hub for science and innovation and a centre for international trade fairs that attract companies and investors on a global scale.

The Port of Barcelona is a vital infrastructure not only for trade and logistics; it also plays a key role in the energy sector, acting as a strategic node for the import, storage, distribution and supply of various types of fuels and energy.

CURRENT ENERGY-RELATED ACTIVITIES IN THE PORT

They serve a total of more than 80 concessions that can be grouped according to their activity:

Port terminals: concessions dedicated to maritime transport.

Logistics warehouses: concessions whose main activity entails providing storage and inland logistics for goods in large warehouses or empty container depots.

Industrial concessions: concessions that carry out industrial processes (production processes) as their main activity.

Port-city: nautical, sporting and leisure activities for the public.

Port services: the activities that cover the Port of Barcelona's needs, such as land management, maintenance, waste treatment and cleaning.

Current energy infrastructure

ENERGY WHARF

The Port has a well establish network for handling and storing bulk liquids. The storage area has 714 tanks with a total of 3 million m^3 for petroleum products and 0.75 million m^3 for LNG.

With the aim of progressively using alternative fuels, the Port is adapting to these new demands, especially with methanol. There is a current capacity of 30,000 m^3 with the possibility to increase it by an additional 20,000 m^3.

ELECTRICITY GRID

The Port of Barcelona has two electrical power distribution grids, one operated by **Endesa**, located to the north of the old Llobregat riverbed, and a second operated by **Naturgy**, located to the south. The current contracted power for all activities exceeds 136 MW.

GAS NETWORK

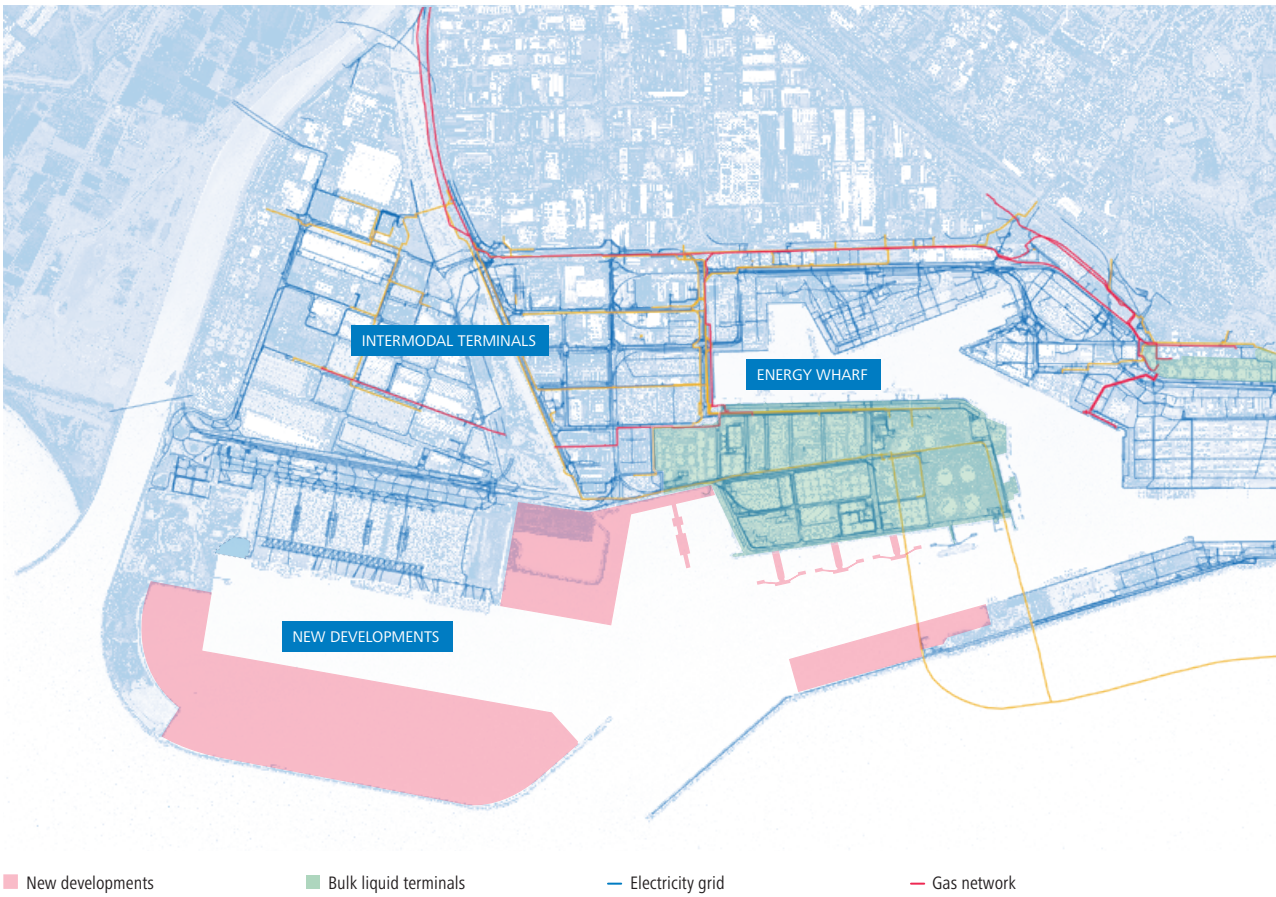
Furthermore, the Port boasts a natural gas distribution network, including the high pressure network of the gas system, which distributes natural gas from the **ENAGAS** regasification plant and the distribution network, which supplies industrial companies, among others, which have a high thermal demand for their processes.

The ENAGAS regasification plant has a capacity of 760,000 m^3, divided into 6 LNG tanks.

BULK LIQUID NETWORK

The Port is directly connected to the national pipeline network managed by Exolum. This network enables hydrocarbons and refined products to be transported from the terminals located at the energy wharf to various points in Spain.

ENERGY NETWORKS AND THE SOUTHERN EXPANSION



Port planning

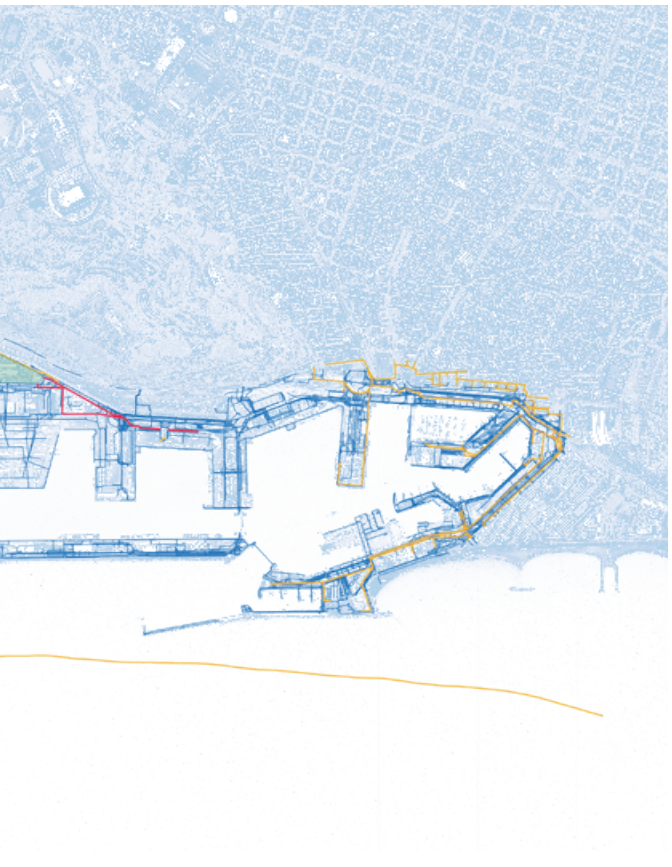
The space available in the **Port of Barcelona** is quite limited, more than 95% of the land is currently under concession and the area is one of the most sought-after in Europe. This space constraint makes it necessary to plan ahead to introduce new activities needed to achieve the objectives of the Energy Transition Plan. However, the Port still has potential for growth, thanks to the development and reorganisation of the southern area. This growth is planned to be implemented between 2025 and 2035, and was included in the **Strategic Plan for 2021-2025.**

The expansion will involve a **reorganisation of the Port's current uses** to maximise efficiency and better capitalise on the synergies between the different activities, bringing about a significant reduction in current externalities.

This includes:

- The construction of a new **container terminal adjacent** to the southern dike, opposite the BEST terminal, along with two container depots, which will concentrate this activity in the part furthest from the city and relieve congestion on the Litoral ring road.
- The construction of new railways and **intermodal rail terminals,** as well as new accesses.
- New wharves and storage facilities for **fuels at the Energy wharf**.

Port planning will be essential to integrate these decarbonisation initiatives and develop new sustainable energy-related traffic. This reorganisation will require the project time scales to be properly managed and the necessary services to be correctly located. The availability, planning and reorganisation of new and existing areas, together with the energy transition, will be the Port of Barcelona's main challenges over the next ten years.



— Bulk liquid network

665 km
of electrical grid

67 km
of gas network

36 km
of bulk liquids network

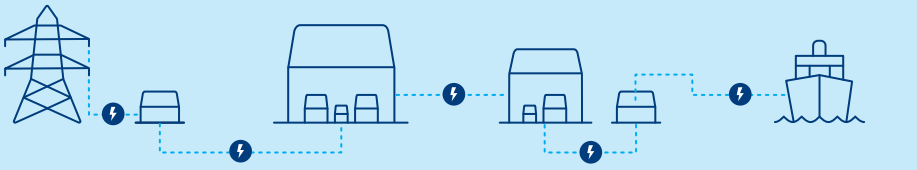
NEXIGEN

NEXIGEN is the plan to electrify the wharves of the Port of Barcelona using OPS (onshore power supply) technology, with the aim of decarbonising maritime operations, improving air quality and moving towards climate neutrality by 2050.

Promoted by the Board of Directors in February 2020, the plan was created as a firm commitment to reduce emissions from ships during their stay in the Port, which currently represent 47% of the total emissions generated in the port area. NEXIGEN is thus the main mechanism for eliminating these emissions and transforming the Port's energy model.

OPERATION OF THE OPS SYSTEM

Through the use of OPS technology, ships can be supplied with electricity from renewable energy sources and can switch off their engines during their time in port.



Connection to the power grid

Power conditioning

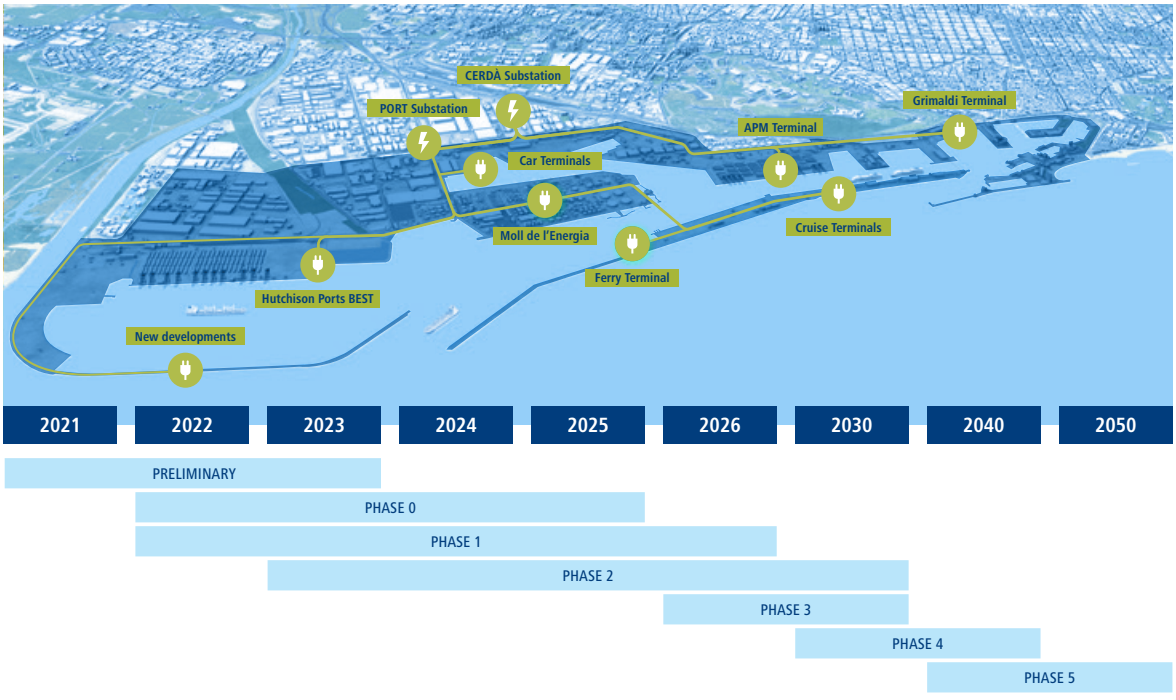
Management of cables and dock-ship connection

Receiving ship

In parallel, the European and Spanish regulatory framework sets forth the obligation for ports to make progress in the roll out of sustainable alternative fuel infrastructure and electrification. The Port of Barcelona has stayed ahead of these requirements with the roll out of the wharf electrification plan.

The NEXIGEN plan is structured in several phases, which order the progressive roll out of OPS technology in the various areas of the port, following guidelines of environmental priority, technical feasibility and alignment with European regulatory timetables. The phases already completed and those currently under implementation are financed by European programmes such as the CEF-Transport and Next Generation EU funds.

NEXIGEN PROJECT PHASES



Phases	Actions
Preliminary	• Feasibility studies and preliminary projects in order to implement OPS in the Port of Barcelona. • Design of the roadmap. • Application for and processing of permits for access and connection to the power grid (80 MW at the Cerdà substation, 220 kV from REE).
Phase 0	• Development of 2 OPS pilot projects: Hutchison Ports BEST terminal (container ships) and Grimaldi Terminal Barcelona (ferries) to draw conclusions on how to develop the new OPS infrastructure more efficiently.
Phase 1	• Design and construction of the Port substation to transform electrical energy (80 MW from the Cerdà ESS) from 220 kV to 25 kV. • The roll out of the medium voltage network that will transport power to the Adossat wharf and the implementation of the 1st OPS system for cruise ships.
Phase 2	• Progressive construction of OPS installations in the different cruise terminals of the Adossat wharf, using the electrical power distributed from the Port's ESS.
Phase 3	• Roll out of the medium voltage network and OPS facilities in the remaining ferry and container terminal wharves.
Phase 4	• Roll out of OPS facilities at car terminals.
Phase 5	• Roll out of OPS facilities at bulk terminals.

02.02 REGULATORY CONTEXT AND SYNERGIES

Global scope

At the international level, the United Nations (UN) agreed on an action plan, called **Agenda 2030 for Sustainable Development**, to improve people's quality of life, respect and protect the planet and the environment, as well as to ensure access to justice and promote peace.

The Energy Transition Plan is in line with the actions envisaged with these objectives, with a particular focus on the ones that promote environmental sustainability and economic development.

In the framework of the United Nations Conferences of the Parties (COP), countries meet annually to push for climate change mitigation. At the 2024 meeting in Baku, far-reaching consensus was reached that will enable climate finance, as well as the definition of a future global emissions reduction market (article 6 of the Paris Agreement).

The International Maritime Organization (IMO), the regulatory body responsible for shipping in international waters, has a key role to play in the implementation of the maritime sector's decarbonisation objectives. The organisation works in cooperation with Member States at the United Nations and with entities within the shipping industry to improve maritime safety and prevent and reduce marine pollution, and has established a GHG reduction strategy.

Climate change has been addressed by the IMO since 2011 through the adoption of mandatory energy efficiency regulations for ships under MARPOL Annex VI **(EEDI, EEXI, SEMP)**; as well as the **DCS and CII,** which regulate the monitoring of GHG emissions and the reduction of the carbon intensity of shipping. A historic milestone was reached in April 2025 with the adoption of new technical and economic measures, which could be likened to a combination of the EU ETS Maritime and FuelEU Maritime regulations.

As an action plan, the IMO has set a target of zero net emissions from the sector by 2050, with indicative checkpoints:

- Reduction of absolute emissions by at least 20% by 2030 (aiming for 30%).
- Reduction of absolute emissions by 70% by 2040 (aiming for 80%).
- Reduction of the carbon intensity of all ships by 40% by 2030, compared to 2008 baseline levels.
- Zero or near-zero GHG emission technologies, fuels and energy sources will have to account for 5% of the energy consumed by international shipping by 2030 (aiming for 10%).

European level

In December 2019, the European Commission presented the **European Green Deal** with the aim of achieving climate neutrality by 2050, thus meeting the EU target agreed in the Paris Agreement, signed by 195 countries (limiting global warming to below 2°C, with efforts not to exceed 1.5°C).

The **European Climate Law**, adopted on 24 June 2021, legally sets the goal of climate neutrality by 2050 and a **55% reduction in GHG emissions by 2030** (compared to 1990). To this end, the EU has promoted the **Fit for 55** strategy, which adapts legislation in areas such as climate, energy and transport to reduce emissions.

Within this Fit for 55 legislative package, the following directives or strategies are the most relevant for the port sector:

↓

FuelEU Maritime, the carbon intensity of the energy consumed should be progressively reduced, starting in 2025 and reaching 80% less by 2050.

↓

Alternative Fuels Infrastructure Regulation (AFIR), which sets concrete targets for installing energy infrastructures in the trans-European transport network, electric recharging points, AF supply and OPS in ports.

↓

Carbon Border Adjustment Mechanism (CBAM), a mechanism to avoid carbon leakage due to the cost of GHG emissions.

↓

RePowerEU, a plan to end the energy dependence on Russia by accelerating the energy transition and increasing energy efficiency.

↓

Emissions Trading System (EU ETS), inclusion of maritime transport in the European carbon market based on a Cap&Trade system to establish the polluter pays principle.

↓

RED III, which stipulates measures to increase the use and production of energy from renewable sources and sets out guidelines for alternative fuels.

Fit for 55 establishes a regulatory and financial framework essential for developing clean technologies, generating aggregate demand and achieving economies of scale. This mechanism guarantees the economic viability of decarbonisation in strategic sectors, consolidating infrastructure and new business models to meet European climate targets.

Domestic level

Spain has boasted its Strategic Energy and Climate Framework since 2019, which is key to achieving the decarbonisation of the economy, providing a regulatory environment that gives legal certainty to the measures adopted, encourages investment and boosts the development of regions affected by the energy transition. Notable instruments from the Strategic Framework closely linked to the Energy Transition Plan (ETP) include:

The **Climate Change and Energy Transition Act** sets out the rules of the game to combat climate change. The objectives are set out in the integrated National Energy and Climate Plan (NECP), which include:

- A 23% reduction in GHG emissions by 2030 (compared to 1990).
- Final renewable energy consumption of 42% by 2030.
- Ensure that 74% of an electricity system comes from renewable generation.
- Improve energy efficiency by 39.5%.
- Climate neutrality by 2050.

The **Long-term Strategy for 2050** foresees a number of environmental objectives such as:

- A 90% reduction of GHGs by 2050 (compared to 1990).
- Achieving 97% renewable energy for final consumption and 100% for the electricity sector.
- Electrifying 50% of the economy and reaching 250 GW of renewable power.

Spain features several public aid mechanisms that finance projects, such as the Strategic Projects for Economic Recovery and Transformation (PERTE), which is a public-private partnership instrument, falling under the Recovery, Transformation and Resilience Plan, which aims to transform the Spanish economy.

Port area

The **State Ports and Merchant Marine Law (TRLPEMM)** defines the Spanish port model according to current needs and establishes an institutional framework that enables efficient management to benefit society. Revisions have been made to the legislation to adapt to the globalisation of the economy and trade, the consolidation of the EU internal market and the development of a common transport policy, as well as to promote the sustainability of maritime and port activity.

Ports represent 1% of GDP, channel 80% of imports and 60% of exports, and are key hubs for the economy and trade. **The Spanish Port Management Agency, Puertos del Estado, has drawn up a strategic framework** for the port system. The key objectives for the Spanish ports are: sustainability, intelligence, connectivity, efficiency and safety. The strategy includes the promotion of land-based infrastructure, the use of renewable energy, the development of smart ports and inter-port cooperation.

The electricity supply is regulated within the framework of the **Spanish Electricity Sector Law,** which establishes the basis for electric power generation, transmission, distribution and commercialisation throughout Spain. This law directly affects the Port of Barcelona, as it is an area with a high degree of economic activity and high energy demand, and specifically impacts aspects such as energy supply to the wharves (OPS), self-generation and self-consumption, along with access and connection to the grid. As a result of this overriding position, new regulations already exist and are being developed to enable electrification.

In this regulatory context, the Port of Barcelona is developing strategic initiatives such as the **Energy Transition Plan (ETP),** which is aligned and reinforced with different strategic and operational plans of the APB, thereby creating a framework of synergies that promotes a more sustainable, innovative and efficient port model:

STRATEGIC PLAN

The ETP is structured around the principles of the Strategic Plan, which prioritises environmental, economic and social sustainability.

WHARF ELECTRIFICATION PLAN, NEXIGEN

The NEXIGEN plan is integrated within the ETP as a key element for the decarbonisation of the port energy model.

INNOVATION PLAN

The combination of technological innovation and sustainability are the basis for integrating the smart port and blue economy vision.

AIR QUALITY IMPROVEMENT PLAN

The ETP projects bolster the actions designed to improve environmental health and quality of life in the port environment.

Global and European level

Globally, and especially within the European Union, energy policies are in line with the objectives of the Paris agreements. This commitment has taken shape in a set of initiatives that form a structural response to three major challenges: the climate emergency, energy insecurity resulting from dependence on external sources, and the opportunities offered by technological advances.

RENEWABLE ENERGY SOURCES

With the state of readiness of PV technology, this energy source worldwide has grown exponentially, from 50 GW added in 2015 to 600 GW in 2024. In total, the share of solar and wind in electricity generation has risen from 4.4% in 2015 to 15% in 2024. This growth is driven not only by environmental reasons, but above all by favourable economic dynamics, as can be seen in the generation cost graph (1st graph on the next page). In fact, in 2016, global investment in clean energy surpassed the investment in fossil fuels for the first time, marking a clear turning point.

At the European level, the **European Union (EU)** has taken an active leadership role in the energy transition, reducing fossil electricity generation by 22% between 2019 and 2023, and increasing renewable generation by 46%. In 2024, more than half of the electricity comes from solar and wind sources. Between 2020 and 2023, the increase in PV energy doubled annually.

ELECTRIFICATION

Currently, the global level of electrification is **20.6%; it has grown by 17% since 2010** . If the current policies stay the same, the share could reach 25% by 2030, according to the International Energy Agency.

For the EU, the increase has been more modest, from **20% in 2010 to 21% in 2023**. However, the European Commission's minimum projection foresees a 29% increase by 2030 and 35% according to the RePowerEU initiative. The main drivers of electrification will be climate control in the transport sector and low- and medium-temperature thermal processes in industry.

Today, as can be seen in the graph below, electricity generation in the EU is still heavily dependent on fossil fuels. However, according to Det Norske Veritas (DNV), certain projections show that fossil fuels will account for less than 5% of the energy mix by 2050.

SUSTAINABLE FUELS

The use of fossil fuels (coal, oil and gas) is expected to decline sharply from 2030 onwards, driven by increasing electrification, the competitiveness of renewable energies and decarbonisation policies, as well as energy security. In the EU, coal consumption has decreased by 30-40% compared to 2010, while natural gas consumption has declined by 25%. With electrification policies in the transport sector, such as the roll out of the EU ETS II, a 30% reduction in fuel consumption is expected by 2030. Although Europe seeks to reduce energy dependence on fossil fuels by 61%, the sectors that are most difficult to decarbonise will continue to require fuel. As such, the projections call for increased development of hydrogen and hydrogen derivatives, biofuels and other synthetic fuels.

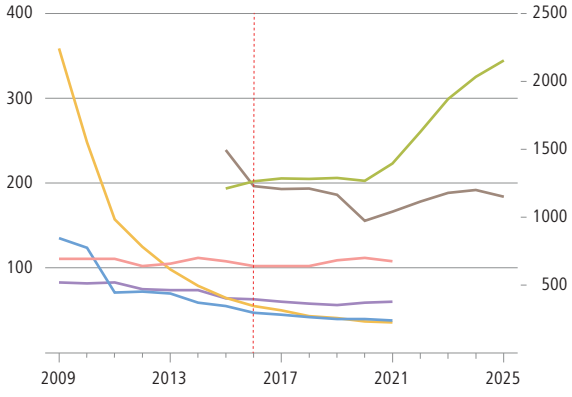
ENERGY EFFICIENCY

One of the main objectives set by the Fit for 55 and increased by the RePowerEU is to increase energy efficiency, aiming for an 11.7% reduction in energy consumption in 2030 referenced to 2020. One of the main ways to achieve this goal is the electrification of the economy, which should lead to an increase in energy efficiency, reaching 25% by 2030 and 40% by 2050.

COMPARATIVE GRAPH OF PRICE AND INVESTMENT DEVELOPMENTS BY ENERGY SOURCE

Left axis: USD/MWh. Right axis: billions

Source: Lazard

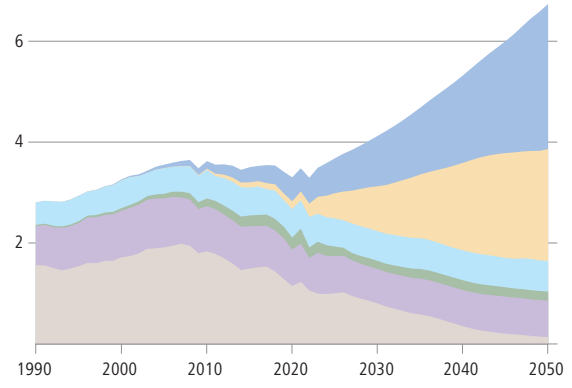


- Natural gas
- Clean energy
- Wind
- Fossil fuels
- Solar
- Coal

PROJECTED ELECTRICITY GENERATION CONNECTED TO THE EUROPEAN GRID

PWh/year

Source: DNV

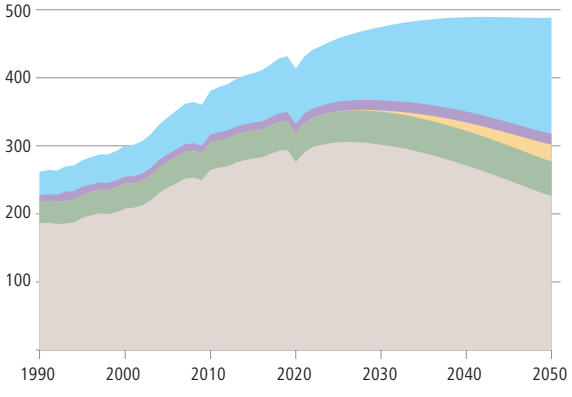


- Wind
- Solar
- Hydroelectricity
- Bioenergy
- Nuclear
- Fossil fuels

FINAL GLOBAL ENERGY DEMAND BY ENERGY VECTOR

EJ/year

Source: IEA WEB (2023)

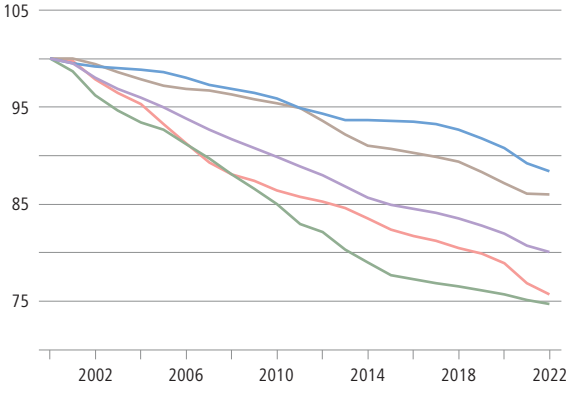


- Electricity
- AFs
- Bioenergy
- Direct heat
- Fossil fuels

ENERGY EFFICIENCY DEVELOPMENTS BY SECTOR

In percentage

Source: Odyssee



- Services
- Transport
- Total
- Industry
- Residential


enagas
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STORAGE CAPACITY

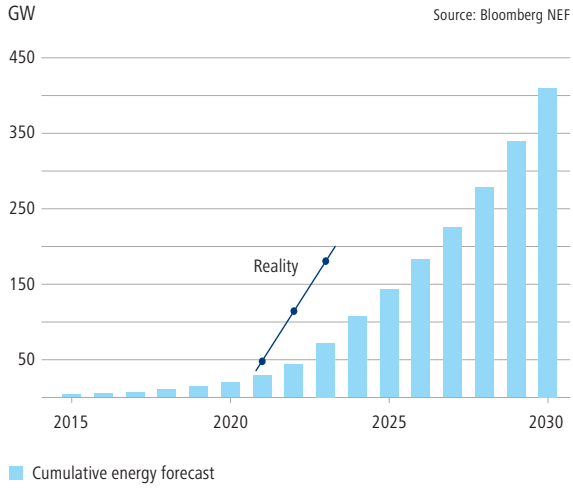
To enable a greater spread of renewable energies, storage sources must be integrated into the energy system to manage the wind and solar intermittency, and to bring flexibility to the grid.

The reduction in storage cost is rapidly accelerating roll out, with annual growth doubling in the last three years to 375 GWh installed by 2024.

DIGITALISATION

Digitalisation is transforming the energy system, making it smarter, more efficient and flexible. This makes it possible to achieve better integration of renewable energies, thus improving the management of their variable production and adjusting their demand. In addition, the increased use of artificial intelligence, cloud services and data centres are increasing electricity demand, especially in developed countries. According to certain projects, by 2030, data centres could consume between 4% and 6% of the world's electricity. To address this challenge, the EU is investing in grid modernisation and digital infrastructure.

PROJECTED GLOBAL STORAGE CAPACITY



The energy transition is no longer only a response to the fight against climate change: it is a complex process, comprised of several trends, where technological development has made renewable energies more competitive options than fossil fuels, and has led to structural changes in energy systems and supply chains.

Maritime and port area

High seas navigation requires a lot of energy to move all the goods, as well as a great deal of autonomy to be able to cover the long distances of the trade routes. Given that it is difficult to decarbonise, the maritime and port sector is facing a profound structural change to adapt to global climate objectives. The two main pathways identified to achieve the objectives are:

Energy efficiency and fuel switching, which emerge as deeply interlinked core solutions. On the one hand, reducing overall energy consumption through technological and operational improvements reduces emissions and, on the other hand, makes it more viable to replace fossil fuels with more sustainable alternatives.

CARBON CAPTURE

Carbon capture on board ships is a technology that has not yet reached a sufficient degree of readiness for commercial development, but there are several pilot tests and it is expected to be one of the building blocks for achieving the reductions envisaged by the IMO (International Maritime Organization). The roll out will require the establishment of facilities and services associated with ports to manage the discharge of and subsequent destination for carbon (storage or reuse).

NUCLEAR ENERGY

Although the use of nuclear power in shipping is not new, the maturation of Generation IV reactors has led to a renewed interest in this energy source by commercial fleets.

It remains to be seen whether it will be part of the package of solutions to meet decarbonisation targets, but several projects are currently under development in Europe.

ENERGY EFFICIENCY

Since 2008, global maritime trade has grown by 50%, while its energy consumption has grown by only 5%. This is explained by increased energy efficiency, which stands at over 30% reduction in carbon intensity, as a result of technological improvements in engines, the growing application of measures in ship design, the increase in the size of ships, the reduction in speed, the use of heat and the use of wind for propulsion.

Some of these are not yet economically viable on a large scale, but will become increasingly attractive with the implementation of new regulatory frameworks, such as the CO_2 permit price and the CII (carbon intensity indicator).

In parallel, the electrification of the sector plays a key role in this transformation process, with the development of OPS (onshore power supply) systems, which make it possible to reduce the consumption of fossil fuels and local pollution while in port.

FUEL SWITCHING

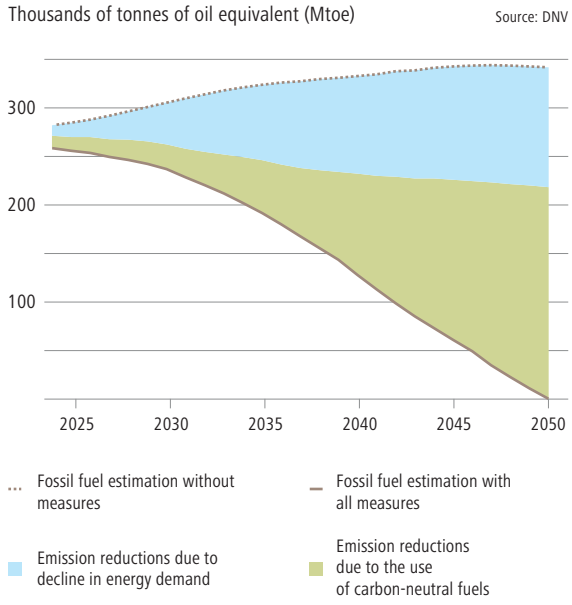
Today, oil is still the main source of energy in maritime transport; however, a two-fold energy transition is foreseen by 2050. In a first phase, LNG (liquefied natural gas) could reach 50% of consumption, while bioenergy, electro-fuels and electricity are gradually introduced. This will allow an initial reduction of CO_2 emissions. In a second phase, which is essential to achieve net zero, LNG will become less important and e-fuels, especially methanol and ammonia, will become the main fuels, with an almost complete elimination of fossil fuels.

The effects derived from the maritime-port sector are difficult to mitigate and will require heavy investments in sustainable fuels and in energy and operational efficiency measures, where fleet renewal and digitalisation are the pillars of decarbonisation.

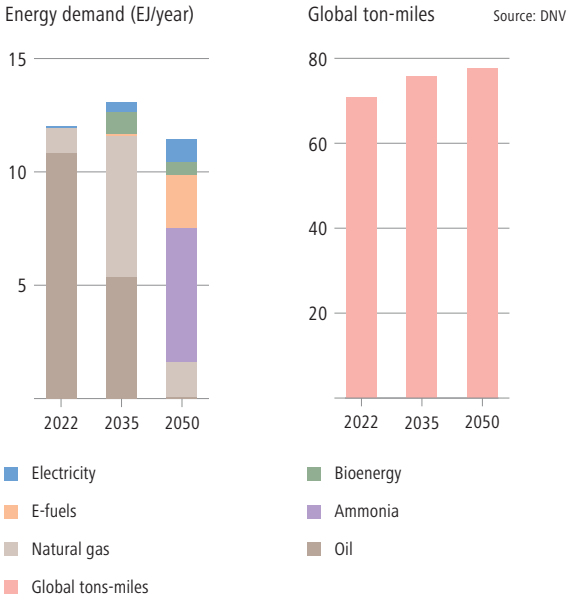
However, methanol is now gaining ground due to its technological readiness, safety and ease of logistics, a fact that is reflected in new ship orders. In parallel, the availability of renewable fuels, such as green hydrogen, will increase significantly by 2050, thanks to sources such as solar, wind, hydro and carbon capture and storage (CCS).

Another possible source shift will be the adoption of hybrid systems for regional trade, which could transition to all-electric systems depending on how technologies evolve.

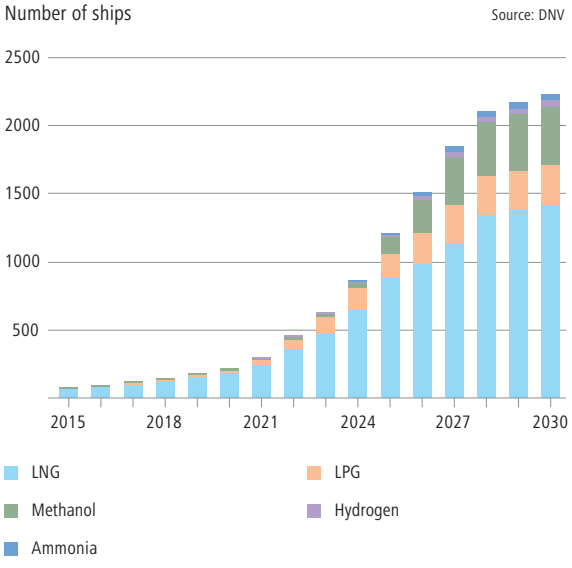
ESTIMATION OF FUTURE DEMAND FOR MARINE FUELS



GLOBAL MARITIME INDICATORS



DISTRIBUTION OF THE NUMBER OF SHIPS WITH AFS (CURRENT + FUTURE ORDERS)




KONECRANES

02.04 RELEVANT ACTORS

The scope of the plan is not limited to the Port Authority, rather it encompasses the entire port community and even goes beyond, seeking to impact both the hinterland and the foreland. Therefore, a large part of the plan's actions will have to be led by actors from the port community. It is essential to seek the collaboration of the stakeholders to get to know their objectives and barriers, and to determine their relevance for successfully developing the plan.

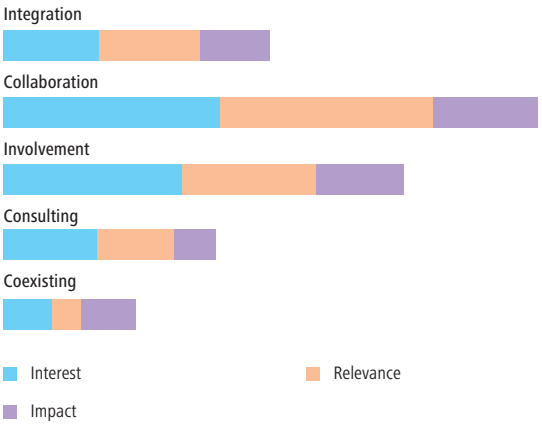
HOW DO WE KNOW WHO IS RELEVANT TO THE ENERGY TRANSITION IN THE PORT?

In order to effectively engage the relevant actors in the port's energy transition, the first essential step is to identify them correctly. This requires not only a thorough knowledge of the local port and energy sector, but also of all relevant transition initiatives.

Once identified, clear criteria must be established to define which actors have greater strategic weight and who might put up significant resistance, in order to classify them according to their potential to work together with APB. Fifty-eight identified stakeholders have been evaluated according to their interest, influence and impact; their role (as managers, suppliers or operators), and the dimension of their activity within the port. The result of the classification with the number of actors for each is as follows:

RESULTS OF THE RELEVANT ACTORS FOR EACH LEVEL OF ENGAGEMENT

Source: APB

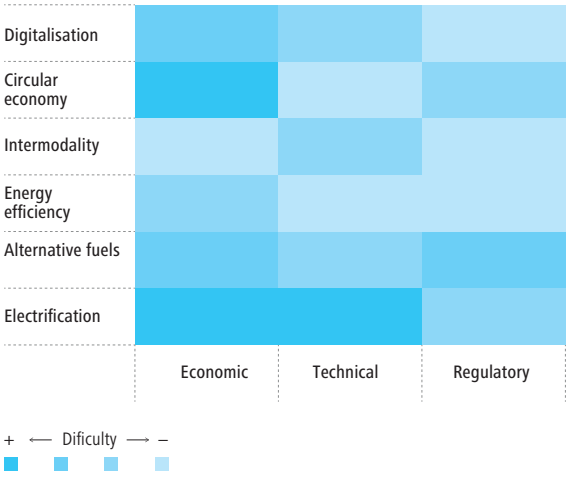


WHAT ARE THE MAIN BARRIERS TO DECARBONISATION IN THE PORT?

Based on surveys of the port's main stakeholders, we identified the most relevant barriers to decarbonisation. This heat map shows the areas where the most difficulties are concentrated according to each policy area.

HEAT MAP OF THE MAIN BARRIERS BY AREA

Source: APB



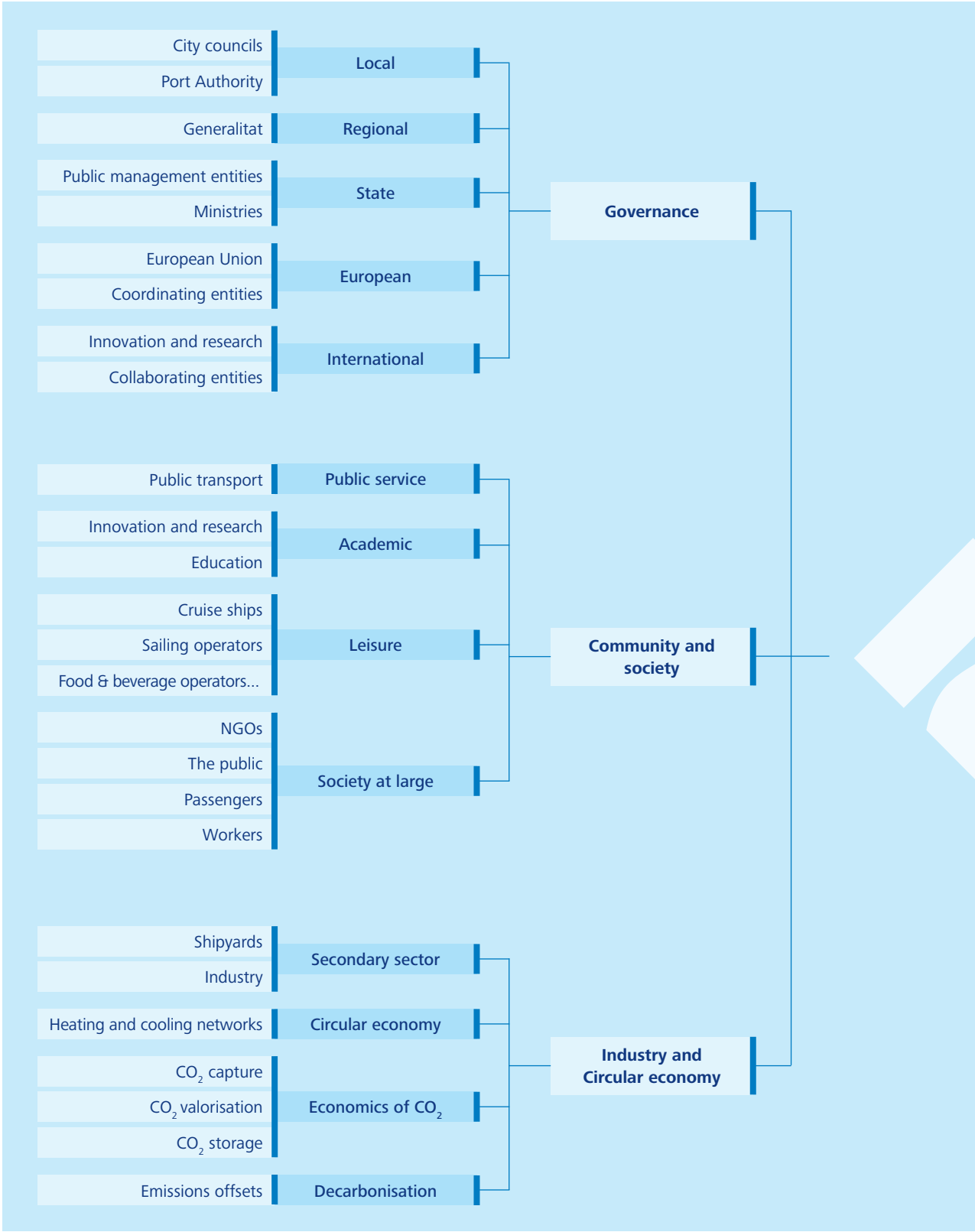
OBJECTIVES OF PARTICIPATION

- To enrich the plan with new perspectives
- To keep the community informed
- To connect key actors

BENEFITS OF HARMONISING INTERESTS

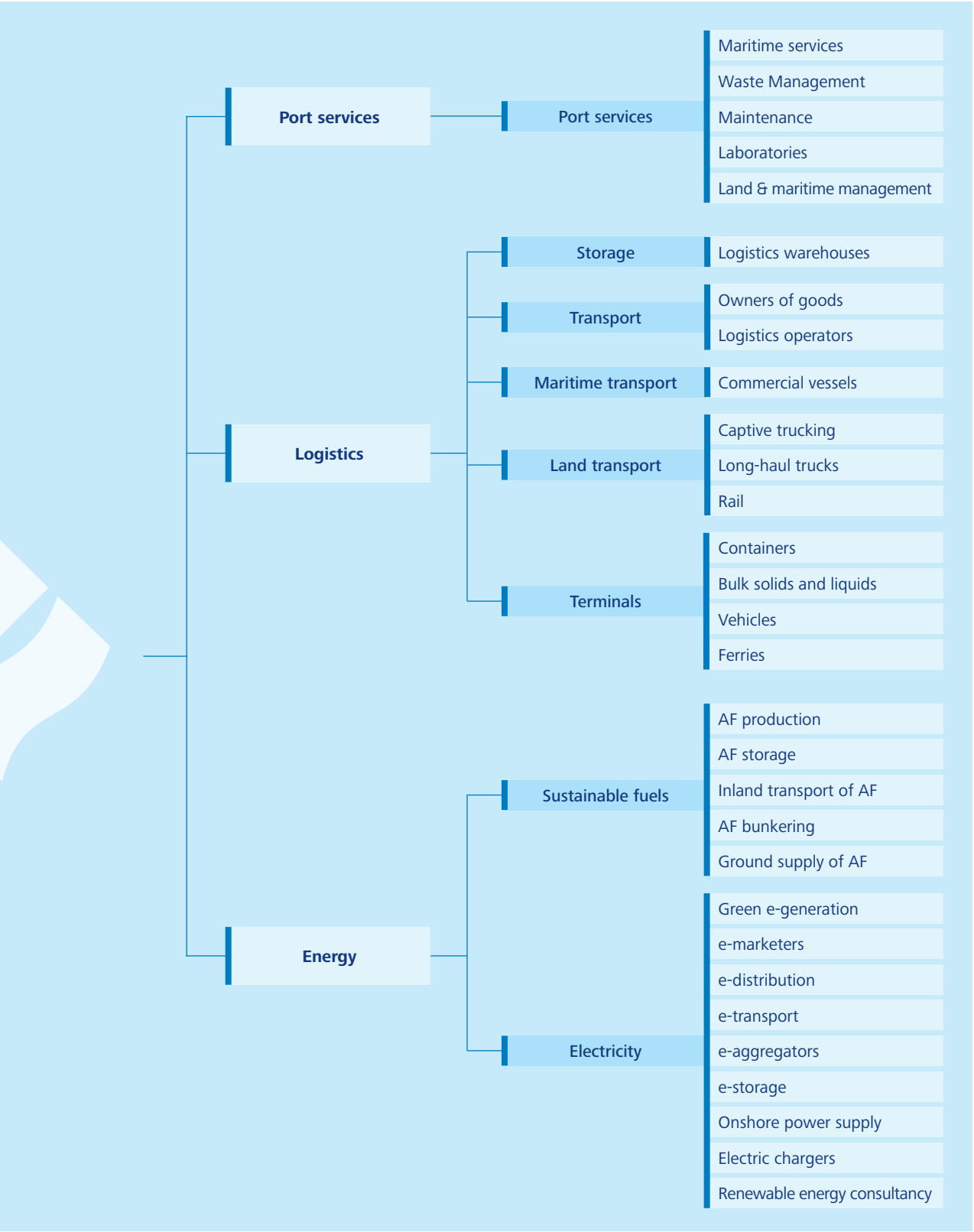
- Less resistance, more action
- Better use of available resources
- Ability to react to obstacles

MAP OF RELEVANT ACTORS IN THE PORT



FORMS OF STAKEHOLDER ENGAGEMENT IN THE PORT

- Surveys
- Sustainability workshops
- Port community working groups



Energy consumption

The Port of Barcelona boasts a great diversity of activities, which translates into a wide variety of energy demand profiles for each one. One of the key points to reach the 50% emissions reduction milestone by 2030 entails characterising the energy profile of the port community.

In order to compile all the energy data of the port community, the APB is asking for the collaboration of the port concessions by means of an energy data survey. This study makes it possible to plan projects to reduce emissions and improve energy efficiency. The quantification of consumption and emissions in the port is summarised in the following infographic: first the graphic shows the energy consumed by each activity, corresponding to 2022, while the following page highlights the emissions generated by this energy usage.

GWH CONSUMED

Ships
1,156

At berth	838
While manoeuvring	195
While anchored	65
Auxiliary	57

Concessions
810

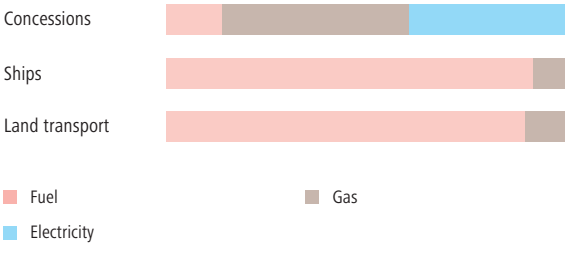
	Gas	Electricity	Fuel	Total
Industrial	334	56	-	390
Terminals	-	83	68	151
Bulk liquids	27	81	12	120
Other	22	65	26	113
Logistics	-	27	9	36
Total	383	312	115	810

Land transport
56

Terminals	42
Passengers / employees	11
Railway	3

CONSUMPTION BY TYPE OF ENERGY SOURCE FOR EACH ACTIVITY

Source: APB



52.2% GO adoption rate

2,022 GWh of total consumption

Resulting emissions

The availability of a rigorous, certified carbon footprint calculation is essential in order to understand how the emissions that the port generates are distributed and to establish clear decarbonisation priorities. For this reason, within the framework of this plan, the Port of Barcelona's has had its carbon footprint certified for the first time, integrating the emissions generated by all port activities into its own emissions, thus establishing the Port and not the Port Authority as the subject of the footprint.

Having a methodology endorsed by international standards such as ISO 14064 ensures the reliability of the data, thus allowing comparisons to be made and providing a solid basis to effectively plan actions.

This exercise will be carried out on an annual basis. By continuously monitoring emission trends it will be possible to assess the real impact of the measures implemented, identify trends and adapt specific decarbonisation strategies.

TONS OF CO_2-EQ RELEASED

Ships		Concessions		Land transport		Waste		Construction	
315,619		**145,658**		**14,869**		**11,417**		**7,155**	
At berth	232,795	Industrial	74,800	Terminals	11,312	Marpol	11,417	Materials	4,530
While manoeuvring	50,028	Terminals	44,227	Passengers / employees	2,845			Consumption	2,260
While anchored	17,294	Port city	11,271					Transport	365
Auxiliary	15,502	Logistics	9,058	Railway	711				
		Port services	6,302						

EMISSIONS BY TYPE OF ENERGY SOURCE

Source: APB

Fuel
Gas
Electricity
Other

495,000 t CO_2-eq
of total emissions


ECO LNG

Distribution of the port's energy consumption and emissions in 2022

The following Sankey diagram shows the distribution of the port's energy consumption according to the energy source of the system activities and the resulting emissions in 2022.

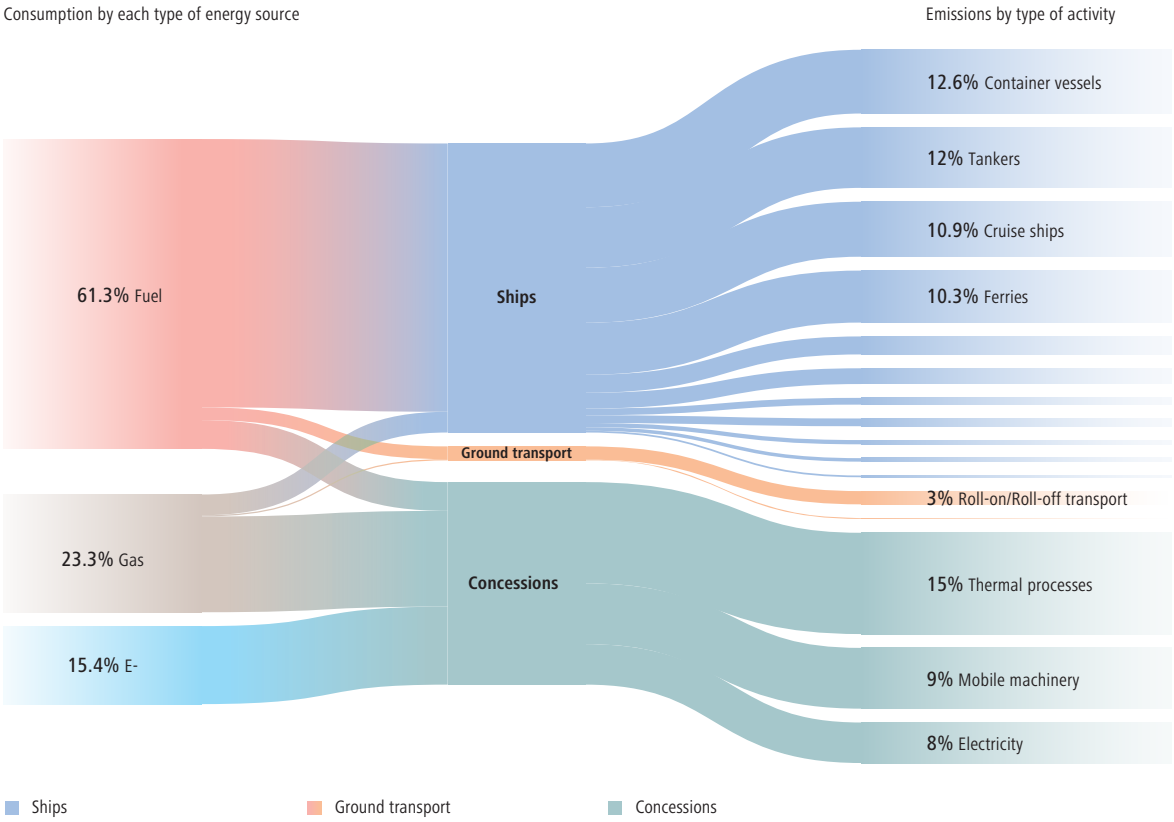
Fuel oil, which is the main source of energy, is almost entirely used by ships, thus contributing the largest share of total emissions. Electrification plays a key role as a tool for decarbonisation in the mooring phase at the wharf. On the contrary, it has limitations during anchoring and manoeuvring, highlighting the need to explore the adoption of **alternative fuels**.

The second source of energy is gas. Its use is focused on concessions, mainly in thermal processes, an area with potential for **electrification**. It is worth mentioning that part of it is used in the form of LNG by ships, as a result of the Port's efforts to improve air quality.

The final source is electricity, which is entirely consumed by the concessions and which results in low emissions thanks to the high degree of use of **guarantees of origin from renewable sources (GO)**, which represents 52% of the total. The current rather linear structure is expected to experience an increase in crossovers between sources and activities, thanks to the incorporation of new technologies, increased electrification and the introduction of alternative fuels.

ANNUAL CONSUMPTION AND EMISSIONS DATA (2022)

Source: APB



02.06 RISK AND SWOT ANALYSIS

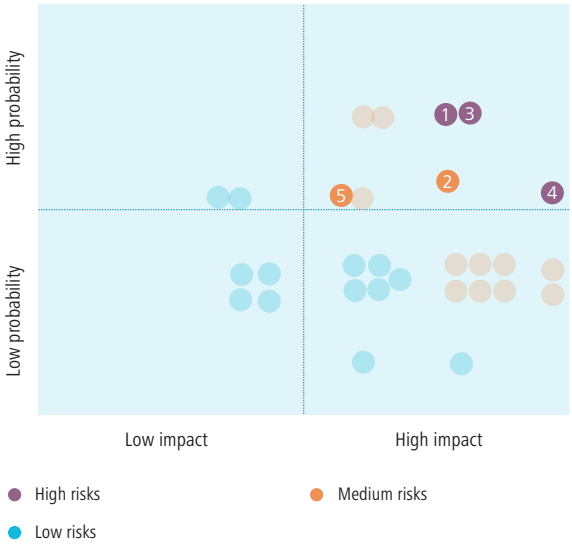
During a change of model, there are external factors that can jeopardise the strategies that have been planned. The most relevant events are presented below with their estimated probability of occurring as well as the degree of impact on the implementation of the plan.

Dimensions considered in the analysis:

- Environmental
- Financial
- Operational
- Political
- Social
- Technical

This analysis has made it possible to identify and assess the risks according to the probability that they may occur and the degree of impact on the port's energy transition, as shown in the following matrix diagram.

RISK AND SWOT ANALYSIS Source: APB

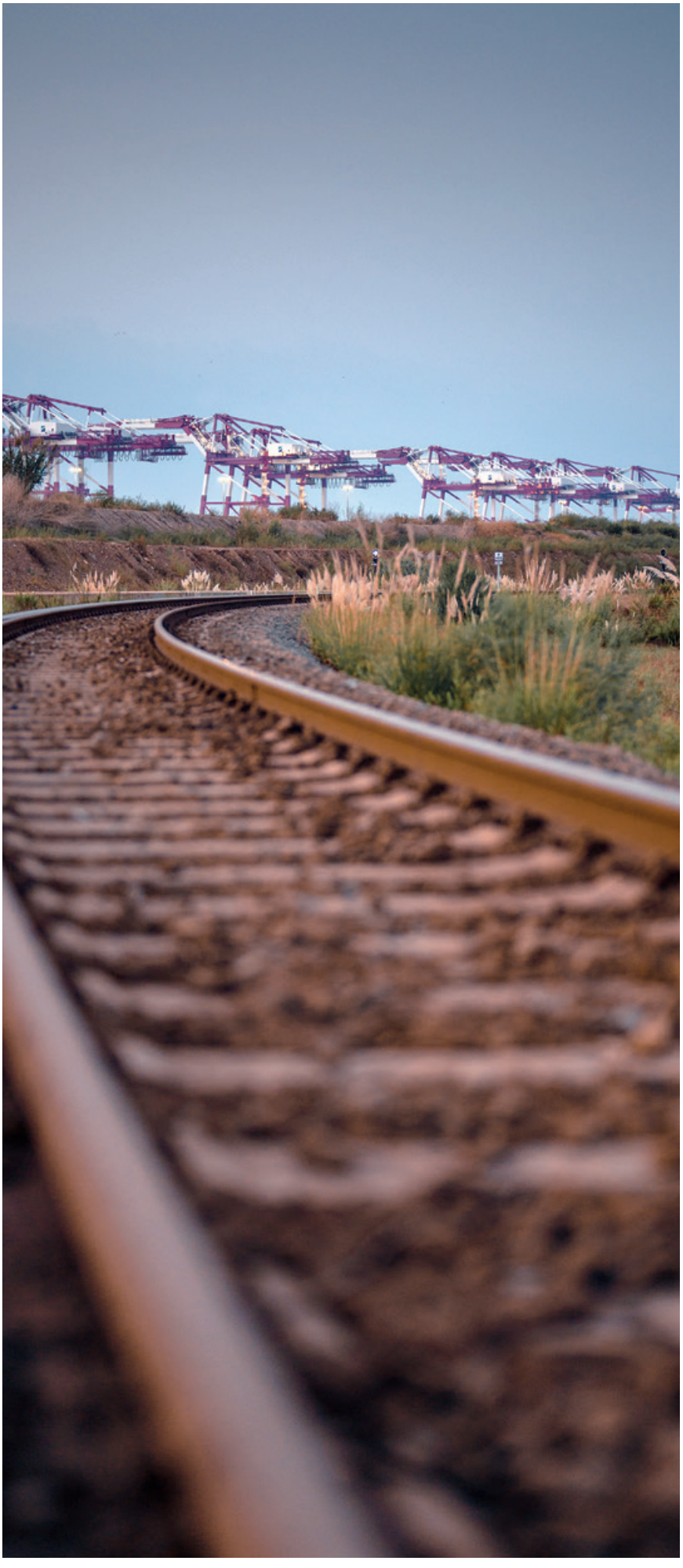


	EVENT	EFFECT	PREVENTIVE / REACTIVE ACTION
1	**Lack of mobilisation by businesses**	Delay in the execution of the strategic pathway, due to the lack of alignment in the direction of the concessions with the APB.	Establishment of energy transition clauses in concessions to ensure alignment with the strategy.
2	**Disruptions in supply chains**	Reduced traffic volume and project delays due to lack of materials, equipment or the pace of AF adoption.	Seek local material sources, promoting the circular economy, and develop AF production plants linked to the port.
3	**Lack of renewable energy generation**	Dependence on and increasingly expensive, less stable external energy supply.	Invest in energy storage (batteries, tanks) and jointly invest in local renewable energy generation.
4	**Technical restrictions on electricity**	The electricity grid does not support the increased consumption, limits new connections and makes investments less attractive.	Develop an electricity plan and forecast of electricity needs, and collaborate with REDEIA to adapt the infrastructure.
5	**Disruptive technologies**	Potential for technologies to evolve much faster than predicted and for projects set out in the strategic roadmap to become obsolete.	Be aware of and attentive to innovations that emerge over time (observatory) and update the plan accordingly.

	Internal origin	External origin
	WEAKNESSES	**THREATS**
Weaknesses	**W1** **Port without a chemical plant**, the absence of a chemical plant limits key industrial activities for the energy transition.	**T1** **Rail connection**, an undersized rail infrastructure in the region hampers the logistics chain.
	W2 **Lack of space to grow**, physical space is limited and hinders the development of new projects.	**T2** **Congestion of the BCN electrical grid**, increased electrification can strain the grid and therefore hamper new projects.
	W3 **Proximity to the city**, urban proximity generates land use conflicts and environmental and industrial restrictions.	**T3** **Self-consumption restrictions**, regulations limiting the adoption of renewable and decentralised technologies.
	W4 **There is no wind resource**, the lack of wind and the proximity to the airport make it difficult to use wind energy.	**T4** **Renewable energy sources restricted to the region**, bureaucracy and the NIMBY mentality hold back the implementation of green energy.
	W5 **Congested bulk liquids**, the saturation of facilities limits efficiency and growth.	**T5** **Compromised autonomy**, little flexibility in rates and rebates limits competitiveness and sustainable incentives.
	W6 **Bunkering location not considered geostrategic for bunkering**. Other ports closer to transoceanic routes.	**T6** **Water supply risk**, the high pressure on water resources can affect industrial operations and the environment.
Strengths	**S1** **NEXIGEN**, the APB is leading OPS with an ambitious strategy to reduce emissions from ships while in port.	**O1** **Collaboration with the Port of Tarragona**, synergies that can improve competitiveness.
	S2 **LNG Bunkering** , the Port is a key LNG bunkering hub with consolidated infrastructure.	**O2** **Abundant solar radiation** opens up opportunities for large-scale solar energy projects.
	S3 **Bulk liquid ecosystem**, high storage capacity adaptable to new AFs.	**O3** **European H_2 logistics**, H2med can position Barcelona as an important hub in the distribution of green hydrogen in Europe.
	S4 **Engaged port community**, firm commitment to sustainability and energy transition with active collaboration.	**O4** **BCN innovation hub** , Barcelona's innovative ecosystem can accelerate the energy transition.
	S5 **Short sea shipping**, strategic connections to reduce emissions and improve connectivity.	**O5** **Circular economy**, through waste recovery to generate energy, processes (both cooling and heat) and by-products (CO_2) in collaboration with other sectors.
	S6 **Zona Franca and the Metropolitan Area of Barcelona industrial sector**, synergies for innovation and the adoption of new sustainable energy vectors.	**O6** **Spain, a producer of AF**, the high potential for generating renewable energies ensures the port's energy supply.
	STRENGTHS	**OPPORTUNITIES**


Hapag-Lloyd

03 ENERGY TRANSITION PATHWAYS



03 ENERGY TRANSITION PATHWAYS

As the system analysis has shown, the energy transition is a fully cross-cutting project. Therefore, in order to decarbonise the port's activity, projects must be implemented in differentiated areas.

In order to identify all potential actions, a comprehensive survey of existing and developing technologies, solutions, innovations and policies has been carried out. In order to carry out this prospective search, ten themes relevant to the port energy transition have been defined as "Energy transition pathways", which will be used to draw up a list of actions that are potentially applicable to the port.

ENERGY EFFICIENCY

Energy efficiency is a key pillar of the EU's climate strategy and energy independence. Higher efficiency reduces the energy demand for the same level of activity, thus strengthening the resilience of the system. In the port sector, it is essential to reduce emissions, mitigate energy market volatility and optimise operating costs. In addition, this can generate economic savings through investments at a low cost per tonne of CO_2 mitigated.

How can energy efficiency be implemented in the port?

- Port planning
- Electrification of consumption
- Preventive maintenance
- Environmental rebates

Benefits	Challenges
• Reduction of operating costs • Grid congestion attenuation • Emission reductions • Reducing energy dependence	• Complex implementation • High initial investment • Return on OPEX reduction not evident • Difficulty in sharing data

ALTERNATIVE FUELS

Alternative fuels can reduce emissions in sectors that are difficult to electrify, such as maritime and land transport. These are produced in a renewable manner and can achieve a final balance of zero emissions between production and consumption. The Port of Barcelona is committed to becoming a clean fuels hub in order to contribute to the decarbonisation of the merchant fleet and strengthen the clean energy supply to its hinterland.

How can the adoption of alternative fuels be promoted in the port?

- Import/export infrastructure
- Develop the supply chain
- Local production
- Clear supply and regulation

Benefits	Challenges
• Emission reductions • Alternative energy source for difficult-to-electrify sectors • Promote the circular economy • Operational vs. electrical versatility	• Power supply security • Technological uncertainty • Lower energy density • Security risks • Pending regulation • High cost

HYDROGEN

Hydrogen (H_2) is viewed as an innovative and sustainable solution to reduce emissions and move towards a cleaner energy model. It is one of the key alternative fuels, and it will play an essential role in transforming production processes, transport and logistics operations within the port, with the aim of significantly reducing the port's carbon footprint. It will also act as an energy vector and raw material in industry.

How can the hydrogen economy be developed?

- Transport of H_2
- Local green H_2 production
- Distribution at terminals
- Supply and regulation

Benefits	Challenges
• Seasonal storage • Raw material for AF • Sustainable fuel • Renewable chemical energy for industry • It does not generate pollutants • It can be produced locally	• High cost of production • Low energy density • Technology in a state of readiness • Security risks • High water consumption • Difficulty in transport

SUSTAINABLE TRANSPORT

A port is a key node in the freight and passenger transport network, with a fundamental role in the logistics of the hinterland. In Europe, the transport sector is responsible for 25% of GHG emissions, so an action plan to combat climate change, improve air quality and increase economic efficiency is essential.

How is it possible to move towards sustainable port transport?

- Electric vehicles / AF
- Rail intermodality
- Motorways of the sea
- New mobility models

Benefits	Challenges
• Emission reductions • Increased vehicle utilisation • Reduction of transport externalities	• High autonomy requirements • New supply networks • Dependence on external pathways in the port • Limited availability of rail tracks for goods trains • Restrictive security standards • Need for data exchange

In Europe, the transport sector generates 25% of greenhouse gas emissions, and represents one of the major challenges for progress towards decarbonisation.

ONSHORE POWER SUPPLY (OPS)

Emissions of pollutant gases generated by ships are one of the main causes of air quality disturbances in port areas close to the city. One solution to reduce this impact is the use of OPS technology, which consists of connecting ships at berth to the port's electricity grid, thus replacing the need to burn fuels. It also allows the Port of Barcelona to reduce GHG emissions, given that the energy supplied will be 100% renewable. It also reduces the noise of the ships' auxiliary engines and thus the noise impact.

How is it possible to boost wharf electrification with OPS?

- Pilot tests
- Development of a private smart grid
- Public-private investment and regulation
- Consolidation of an optimal business model

Benefits	Challenges
• Reduction of GHG emissions • Use of electricity from renewable sources • Reduction of externalities • Improved air quality	• Very high electrical power requirements • High initial investments • Technical complexity in the construction and integration of the facilities • Definition of a business model • Ability to adapt to technological developments

GREEN ENERGY GENERATION

Renewable energy generation is a key pathway for the transition to a more sustainable model. This option involves the creation of local infrastructure that produces clean energy, such as photovoltaic solar, wind, wave or tidal energy. Local generation has a direct impact on the decarbonisation of the port, fosters energy innovation and strengthens energy security.

How is it possible to move towards sustainable port transport?

- Assessment of available resources
- Assessment of energy needs
- Port generation sharing model
- Public investment in local generation

Benefits	Challenges
• Energy independence • Decarbonisation and sustainability • Long-term economic benefits • Use of non-operational space • Decongestion of the electricity grid • Flexibility in power generation	• High initial investments • Fluctuation in energy production • Geographical and meteorological constraints • Resistance to change and technological adaptation • Rigidity of electric power distribution in the port

DIGITALISATION

In an increasingly connected society, digitalisation is key to improving efficiency, productivity and competitiveness. In the case of ports, making progress towards smart ports involves introducing advanced technologies, automating processes and making mass use of data to improve the efficiency of maritime-port systems.

How is it possible to spur the digitalisation of port systems?

- 5G roll out
- Roll out of sensors
- Digital environmental data platform
- Automation of processes

Benefits	Challenges
• Improved safety and security • Increased operational efficiency • Better energy management and greater emissions reduction • Ease of creating simulations	• Complexity in monitoring and tracking data • High investment cost • Cyber danger • Greater dependence on the electricity grid • Reluctance to share data

SMART ENERGY SYSTEM

Smart energy management systems (SEMS) are advanced platforms that optimise energy use in a system by integrating consumption and production data obtained through digitalisation. In the port environment this means coordinating the energy flows of ships, port machinery, mobile equipment cargo and storage through the local power grid. The result is a flexible and adaptable system that enables a more optimal and sustainable use of energy.

How can energy management be optimised in the port?

- Energy use study
- Synergies between sectors
- Storage
- Sensorisation of consumption/generation

Benefits	Challenges
• Improved energy efficiency • Improved decision-making • Optimisation of renewable resources • Energy resilience • Reduced peak demand	• High cost of implementation • Complexity of integration • Technological dependence • Ongoing maintenance and updates

CIRCULAR ECONOMY

The circular economy concept aims not to understand by-products as waste, but rather as potential raw materials or resources for other processes. The port generates by-products both from the associated industrial activity and from the ships that unload their goods during their calls at port. On the other hand, there are a variety of processes with different heat requirements that could be exploited (e.g. heating and cooling networks).

What applications can this have in the port?

- Thermal by-products map
- Waste management and recycling
- Biomethane production
- Energy optimisation

Benefits	Challenges
• Waste and pollution reduction • Resource savings • Economic benefits • Boost in AF production	• Difficulties in coordinating the stakeholders • Lack of incentives and regulation • Currently insufficient thermal infrastructure • High cost of network integration

CO_2 CAPTURE

Certain processes are unlikely to be fully decarbonised and achieve carbon neutrality. The proposed solution is to use CO_2 capture technologies and offset mechanisms. Carbon dioxide valorisation offers the possibility of developing a new economy around it. This is already used in industry while new applications (e.g. as a coolant) are being developed. If it is of biogenic origin, it will be a valuable raw material for the production of AF.

What is the route in the port?

- Mitigation certification system
- Recovery of marine habitats
- AF raw material production
- Transport and storage network

Benefits	Challenges
• Reduction in the carbon footprint • Boost in the production of alternative fuels • Improved circularity	• High investment and operating costs • Dependence on industrial demand • Need for CO_2 management and logistics infrastructure • Technological readiness


LNG
HAUGESUND KNUTSEN
LNG

03.02 JOINT ANALYSIS

Studying the energy transition pathways has made it possible to create an inventory of potential actions to be developed in the port. Specific criteria have been defined to systematically and objectively assess each action and ensure decision-making in line with the objectives of the energy transition.

IMPACT

The size of the resulting positive effect, in terms of mitigation of GHG emissions and sustainable energy supply.

EFFORT

The level of resources required to implement it.

PERIOD

The estimated period of time when it could be carried out.

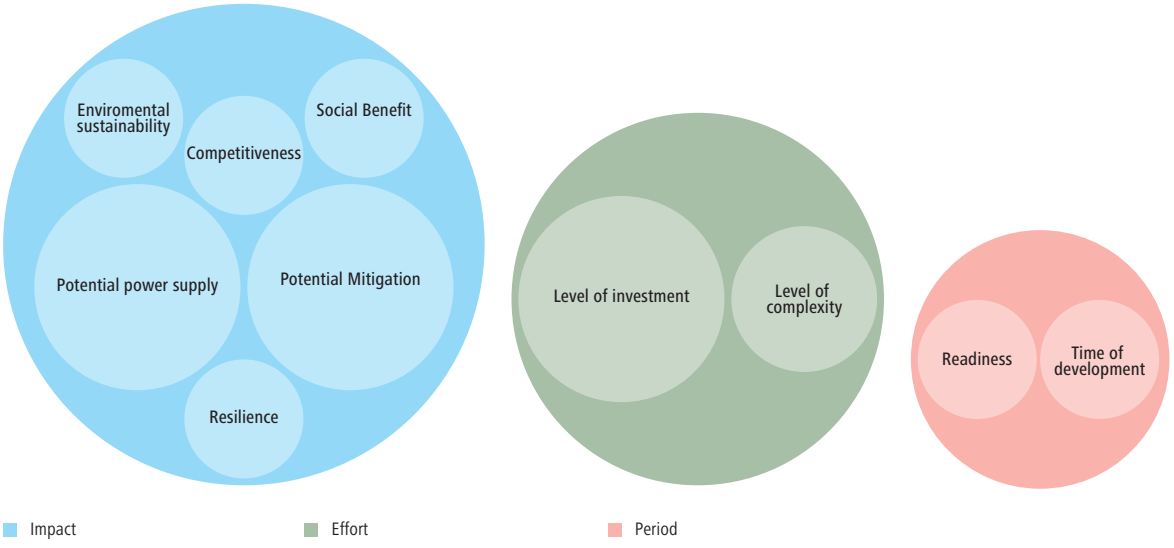
These criteria are constructed on the basis of the following factors:

- Mitigation potential: the GHG emission mitigation potential it can contribute.
- Energy supply potential: the potential energy that this action can contribute to the port system.
- Level of investment: the estimated amount of investment required for the action.
- Level of complexity: number of different actors involved, regulation and level of acceptance.
- Technology readiness level (TRL).
- Development time [years]: estimated time to develop the action.
- Alignment with the objectives of the Energy Transition Plan and the Strategic Plan: **resilience, competitiveness, environmental sustainability and benefits for society at large.**

The priorities are evaluated is based on the results of this analysis and are complemented by the conclusions drawn from the previous chapters on the regulatory framework, the main actors involved, the trends in the sector, the constraints identified and the benefit obtained by the port community and the hinterland.

FACTORS AND CRITERIA FOR THE ASSESSMENT OF EACH ACTION

Source: APB



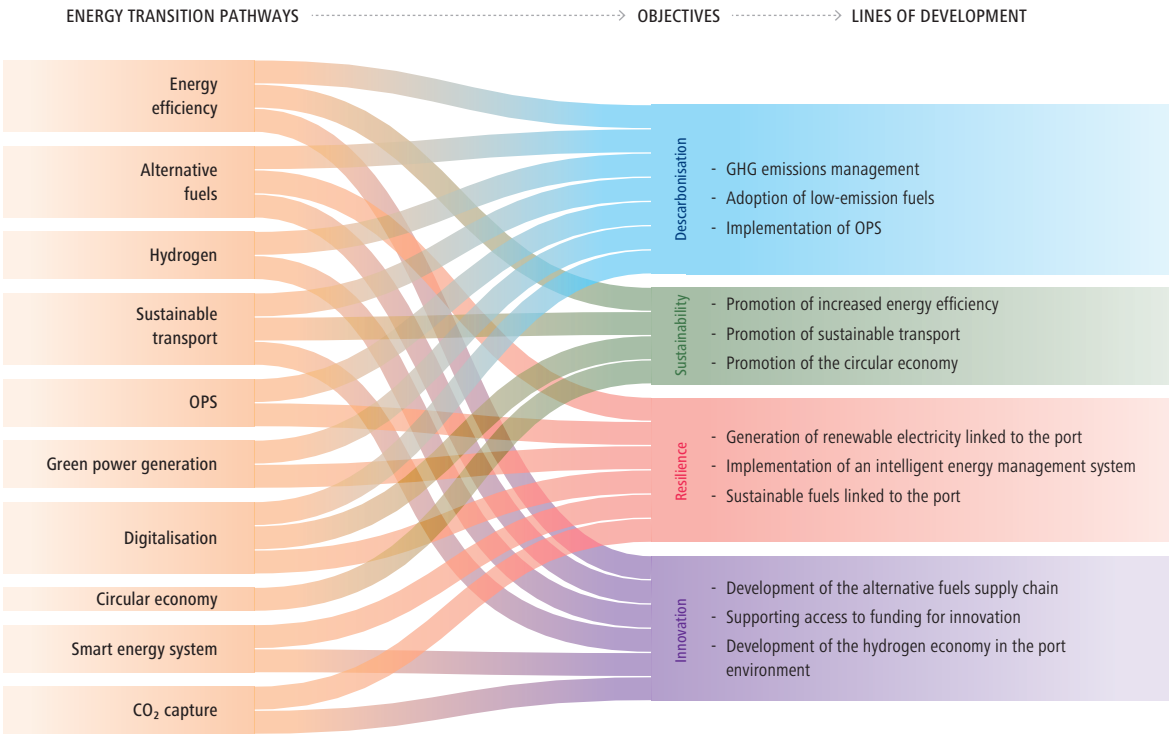
The energy transition pathways identified have been useful to carry out a prospective future plan for potential actions. However, these pathways do not respond to a single strategic objective, making it difficult to shape a coherent roadmap. Faced with this reality, the Port has chosen a **reorganisation** based on a **results-oriented** planning logic, prioritising what is to be achieved (objectives) over how it is achieved (transition routes).

For each strategic objective, three lines of development (LoD) are set forth that group together the actions that have the greatest impact on the objective and area of the LoD. This makes it possible to combine actions that may have synergies or be dependent in a way that would otherwise not be linked, defining a set of effective action programmes.

These elements form the backbone of the roadmap that should make it possible to realise the mission and vision of the Energy Transition Plan. The strategic proposal of the plan is the result of the synthesis of the strategic framework that was initially established, the system study and the analysis of potential actions.

RESTRUCTURING OF THE ENERGY TRANSITION PATHWAYS IN AN APPROACH BASED ON LINES OF DEVELOPMENT

Source: APB




ZERO EMISSION IN PORT
GRIMALDI HYBRID RoRo

STRATEGIC PROPOSAL

04


MAERSK
MAERSK

04 STRATEGIC PROPOSAL

The study of energy transition pathways along with the joint analysis with the maritime and port energy system defines the strategic proposal to position the Port of Barcelona as a fully decarbonised and sustainable smart energy hub, while reinforcing its competitive standing.

The proposal focuses on four objectives linked to the plan's principles, which constitute the fundamental pillars for the creation of the port energy transformation roadmap.

This approach includes the vision to be achieved, as well as how to achieve it. In this sense, the project is not limited to the transformation of infrastructure and operations, but also establishes the active role of the Port of Barcelona as a driving force for change.

04.01 POSITIONING

The Port of Barcelona understands energy not as a resource, but as a strategic factor, and therefore takes on an active role in ensuring a competitive, resilient and sustainable port energy system. This entails a courageous and transformative mindset that strives to contribute decisively to the energy transition of the logistics system and port activity. By offering itself as a space for technological innovation and making a modern energy infrastructure adapted to the new vectors available, the Port will enable the development of advanced and adaptable solutions to current environmental and economic challenges.

The strategic proposal builds on this positioning, with the aim of becoming a driver of change that goes beyond reducing emissions and moving towards cleaner energy sources, and will also strengthen the security and competitiveness of the energy supply. This approach is embodied in an ambitious and transformative vision: to consolidate the Port of Barcelona as a **Smart Energy Hub**, a benchmark in leading energy activities. The aim is to foster an environment in which new energy business models can prosper thanks to the offer of decarbonised, sustainable services with a guaranteed competitive supply, promoting collaboration with the different actors in the port community and its hinterland: companies, operators, institutions and the public.

VISION 2040

The Port of Barcelona's energy transition is a complex process that requires a sound, coordinated strategy. Vision 2040 represents the future scenario towards which the Port is advancing in order to realise its strategic positioning, integrating innovation, digitalisation and cooperation as fundamental pillars.

ENERGY VISION FOR 2040

Scope	Vision 2040
Role of the port	The port is a strategic energy and smart logistics node, fully integrated into the region and the energy value chain.
Energy model	Fully electrified energy system, with storage capacity and integrated with SEMS, heating/cooling network.
Mobility	100% connected, autonomous and integrated mobility, with digital coordination and optimised logistics.
Land transport	Predominance of rail, electric trucks and digitalised logistics with coordinated autonomous vehicles.
Activity in the terminals	Fully digitalised operations, which are electrified and synchronised with the rest of the port via the cloud.
Industry	Sustainable circular industry, with energy symbiosis and intelligent management of resources and emissions.
Logistics chain	Highly efficient, fully sensorised, automated and synchronised logistics with minimal emissions.

CHANGES TO PROMOTE

In order to make progress towards this vision, the plan has identified three fundamental pillars of structural transformations in the current energy model which have been drawn from studying the energy transition pathways.

Switching from fossil fuels to renewable energy sources: This consists of substituting fossil fuels with clean and renewable energy sources for work, heating and electrical needs. The most comprehensive way is through the electrification of consumption, with a proprietary production capacity and infrastructure ready to supply renewable energy to the entire port community.

Reduction of the carbon intensity of energy: The reduction of carbon intensity is achieved by consuming fuels or electricity with lower greenhouse gas emissions over their life cycle. This involves adopting low-emission fuels, contracting electricity with renewable electricity guarantees and deploying carbon capture or offset technologies.

Improved energy and operational efficiency: reduced energy consumption, without compromising productivity. This can be achieved through equipment design (e.g. evolution of engines or thermal insulation) or operational optimisation through digitisation and coordination between actors (e.g. big data, heat networks or intermodality).

SOLUTIONS TO BE DEVELOPED

These changes must be carried out in a cross-cutting manner throughout the entire logistics chain across the port and for all related activities. The solutions that make it possible to be implemented have been identified below and are at the root of all the actions envisaged in the plan to achieve its objectives.

SOLUTIONS TO BE DEVELOPED FOR EACH OF THE AREAS OF ACTION

Areas of action	Energy source	Carbon intensity	Energy or operational efficiency
Ships	• OPS • eBunkering	• AF bunkering • AF availability • Carbon capture	• JIT port calls • Design • Renewal
Land transport	• Charging stations	• Hydrogen refuelling station	• Intermodality • Autonomous vehicles • Congestion management
Terminals	• Electrification of mobile machinery	• GO • Photovoltaic • H_2	• Digitalisation • Waste heat/cold recovery
Industry	• Electrification of heat	• GO • H_2 • Carbon capture	• Waste heat/cold recovery
Construction at the port	• Batteries	• AF • Materials	• Transport of materials
Waste Management	• Biogenic • Electrification of heat	• H_2 • Carbon capture	• Recycling • Bioenergy

ROLE OF THE APB

To implement the solutions listed in the table above, the APB plays a key role as facilitator, promoter and enabler (infrastructure), both in the port environment and in its logistics hinterland, guaranteeing the values in the SMART philosophy.

S	M	A	R	T
Sustainable	Multimodal	Agile	Resilient	Transparent

The Port of Barcelona's commitment is not limited to this role of "mediator", rather it goes one step further to become a developer and investor, enabling it to develop more ambitious initiatives. This approach is set out in a list of ten principles that govern the main lines of action to meet the strategic objectives detailed below:

TEN MAIN LINES OF ACTION

01 **Ensure the energy supply within the port area:**
- Development of on-site renewable energy generation and establishment of power purchase agreements (PPAs).
- Strengthen the capacity to receive, store and distribute alternative fuels (AF).
- Enable the bunkering of alternative fuels by developing specific regulatory frameworks, safe operational protocols and provisioning points for barges.
- Modernisation and digitalisation of the port electricity grid to facilitate the efficient and safe distribution of clean, local energy.

02 **Promote the supply of renewable molecules in the hinterland**, ensuring the integration of the energy logistics chain beyond the port's boundaries to enable the adoption of sustainable fuels in the hinterland.

03 **Boost the demand for clean energies in port activities**, by allocating space for their supply, by rewarding the adoption of clean energies or by providing operational advantages to the early adopters.

04 **Enable the implementation of operational optimisation through digitalisation.**
- Integration of emerging technologies such as 5G, sensorisation, artificial intelligence and port planning platforms.
- Optimisation of logistics processes and energy management in real time.

05 **Maximise the use of sustainable transport modes**, with special emphasis on rail intermodality, electric mobility and connection via motorways of the sea.

06 **Encourage electrification and energy efficiency in operational facilities and services** through investment programmes, rebates and public-private support instruments.

07 **Stimulate collaborative and circular economy projects**, favouring industrial symbiosis, the reuse of residual energy and the valorisation of waste in the port ecosystem.

08 **Facilitate innovative solutions and technologies**, providing regulated test environments, offering and supporting access to funding, collaboration with research centres and start-ups, raising awareness about relevant innovations and providing training for professional development.

09 **Mainstream sustainability as a fundamental value**, including ESG (environmental, social and governance) guidelines in the government and port community, which impact strategic decision-making as well as tendering and contracting processes.

10 **Report frequently and transparently**, establishing a robust system for tracking and communicating the performance on sustainability issues, with key monitoring indicators, regular reporting and public transparency tools.

SPHERES OF ACTION

In order to implement these ten lines of action, the Port relies on a series of tools listed below:

Development of key infrastructures to facilitate the adoption of clean technologies, promote intermodality and ensure an efficient and competitive energy supply.

Investing in port energy and innovation in order to lead the energy transformation and generate new business opportunities.

Port planning: reserve spaces for energy, logistics and circular activities; establish environmental guidelines for new concessions, and promote the deployment of activities aligned with decarbonisation.

Facilitating projects by acting as an integrating agent between companies, institutions and energy suppliers, encouraging coordination and ensuring that strategic projects are developed in an efficient, safe and consensual manner.

Rewarding sustainable change: through rebates and other operational benefits, the Port can reward operators that adopt clean technologies, improve energy efficiency or reduce greenhouse gas emissions.

Services of general interest provided by the APB: such as energy data management, communication of key indicators, information services and secure spaces, making it possible for port users to optimise their operations.

Regulation: develop regulations and contractual conditions, define standards for the use of clean energy and regulate new operations such as the bunkering of sustainable fuels or connection to the OPS.

04.02 ROADMAP

In order to implement the vision and carry out these functions, a roadmap is defined to align the actions with the strategic objective on which the actions have the greatest impact.

This roadmap is structured in **Lines of Development (LoD)** that respond to the different strategic objectives. The LoDs are made up of 4 associated programmes, which drive the action planning.

The roadmap for each objective follows a common structure that allows the development to be viewed clearly. Each line includes its motivation and main objective, as well as the programmes associated with the implementation and the expected results in each phase. The roadmap also integrates a detailed calendar in parallel, outlining specific milestones, which are structured to rigorously measure progress and ensure that the energy transition objective is fulfilled.

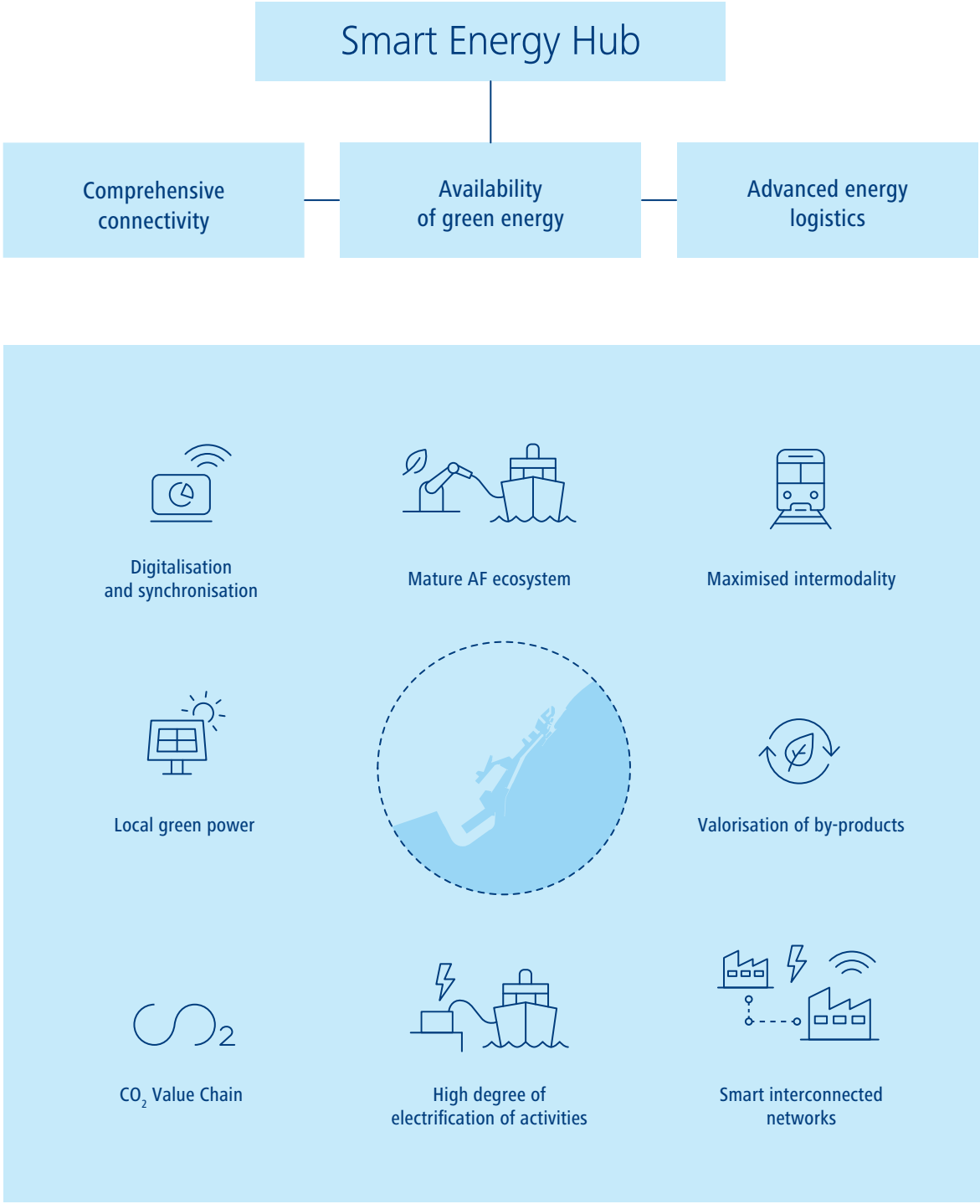
DECARBONISATION	
ETODC-1	Emissions management
ETODC-2	Adoption of low-emission fuels
ETODC-3	Implementation of the OPS - NEXIGEN

SUSTAINABILITY	
ETOSU-1	Promote increased energy efficiency
ETOSU-2	Promotion of sustainable transport
ETOSU-3	Promotion of the circular economy

RESILIENCE	
ETORE-1	Generation of renewable electricity linked to the port
ETORE-2	Implementation of an intelligent energy management system
ETORE-3	Establishment of plants producing new fuels linked to the port

INNOVATION	
ETOEI-1	Develop the alternative fuels supply chain
ETOEI-2	Support access to innovation funding
ETOEI-3	Develop the hydrogen economy in the port environment

FUTURE SCENARIO FOR 2040

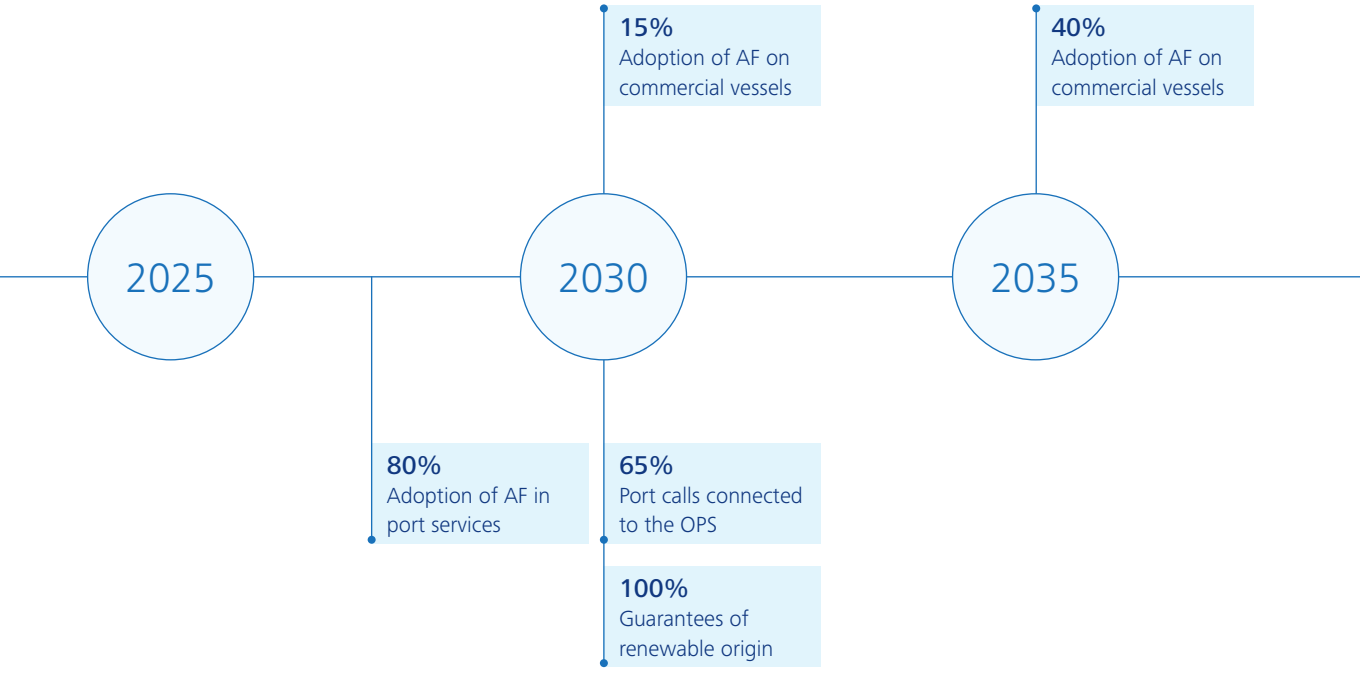


Decarbonisation

Climate change is the greatest environmental threat that humankind faces and the decarbonisation of the port is thus a primary objective in order to make a significant contribution to the fight to mitigate its effects.

Achieve an emission neutral port by 2050, and reach a net balance of zero

ETODC-1	Emissions management
Active management of the emissions generated in the port is essential to move towards a more sustainable future. This means measuring emissions accurately, ensuring that the measurements are reliable, incorporating digital technologies and integrating them into decision-making.	
Main objective: 50%/85%/100% GHG emission reduction by 2030/2040/2050	
Programmes	**Expected results**
• Mainstreaming environmental sustainability • Digitalisation of consumption, emissions and calculations • Port energy management system • Low-emission certificate systems	• Sustainability guidelines integrated into decision-making processes • Platform to centralise energy and emission data • Port GHG emissions monitoring system • Adoption of certified low-emission electricity and natural gas (GO)



ETODC-2	Adoption of low-emission fuels

Transport in the port is still largely dependent on fossil fuels. Replacing them with more sustainable options, such as LNG or methanol, would help reduce emissions. The plan therefore promotes incentives and infrastructure to facilitate the adoption of these fuels.

Main objective: Reduce the carbon intensity of fuels to 244 kg CO_2-eq/MWh by 2030

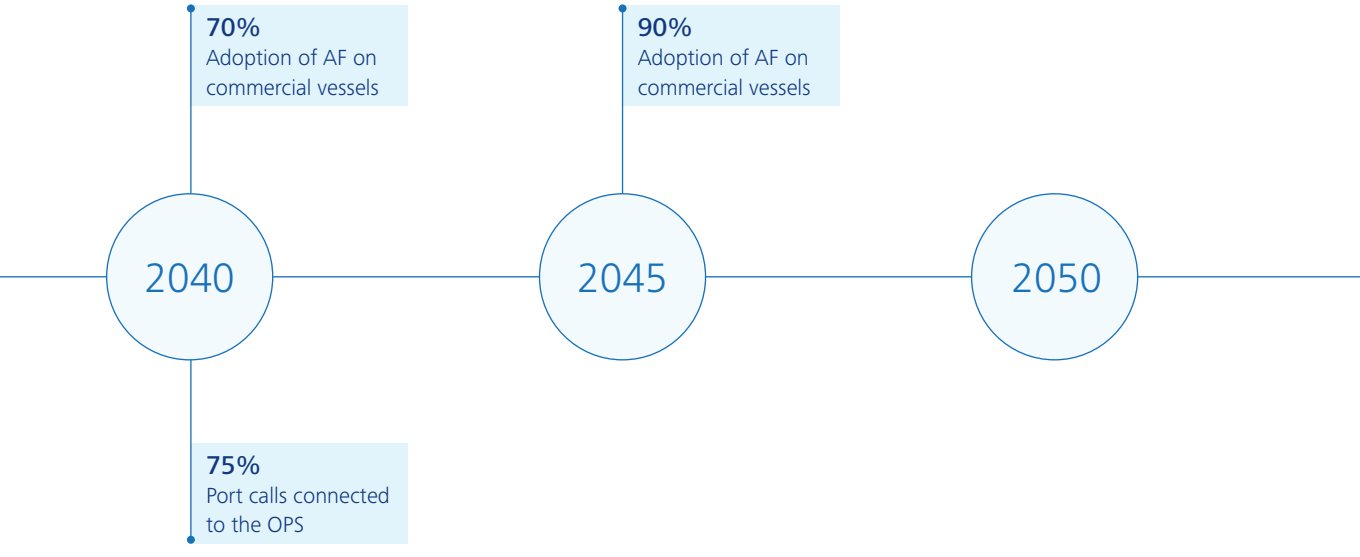
Programmes	Expected results
• Decarbonisation of port machinery • Sustainable navigation • Incentivise truck fleet changeover • Ships linked to sustainable port services	• Substitution of fossil fuel machinery with eco-friendly machinery • Establishment of strategic green corridors • Availability of the necessary equipment for eco-friendly trucks • Creation of a critical mass of demand for AF

ETODC-3	Implementation of the OPS - NEXIGEN

Electrification is key to decarbonisation; the onshore power supply system (OPS) allows ships at berth to stop using auxiliary engines. To make this possible, a new electricity grid needs to be deployed in the port area to ensure the capacity and reliability of supply.

Main objective: Electrify 65% of ship calls by 2030 and a minimum of 90% by 2050

Programmes	Expected results
• Infrastructure development: Electrical substation (ESS) at the port and a smart grid • Creation of an OPS management company • Operation of OPS systems • Electrification of the wharves • Governance and financing for NEXIGEN • Electron bunkering	• Increased electrical power capacity in the port • Business model for commercialising green electricity on moored vessels • Connection capacity for moored vessels • Establishment of the necessary procedures • Analysis of the status and feasibility of electric recharging services for ships

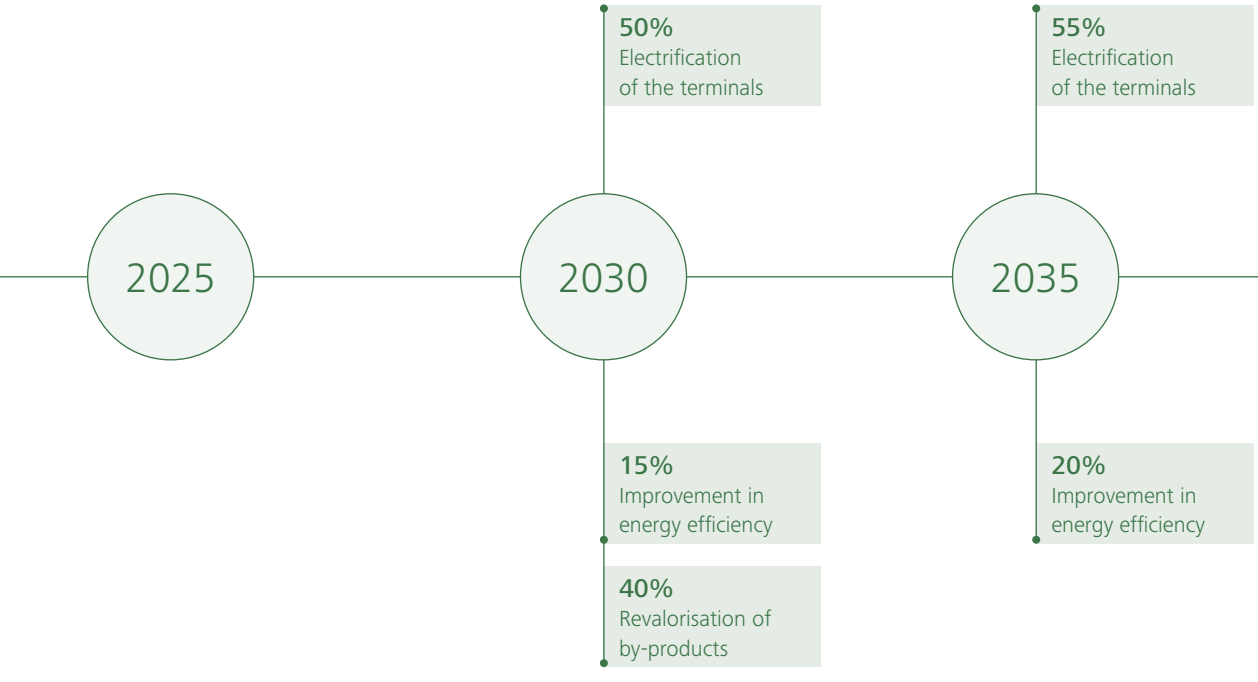


Sustainability

The port's energy transition and emissions reduction must be carried out in a sustainable manner. It is essential to consider principles such as circular economy, local sourcing, energy efficiency and eco-design, and to avoid duplication of infrastructure and services in the territory.

Reduction of the port's overall energy consumption

ETOSU-1	Promote increased energy efficiency
Energy efficiency makes it possible for the port to reduce consumption without affecting its activity, save materials and resources, and contribute to a more sustainable activity. Electrification and process optimisation through digitalisation help to reduce emissions and operating costs.	
Main objective: 50% port electrification rate by 2030	
Programmes	**Expected results**
• Promote the electrification of port activity • Energy regulation • Incentivise energy efficiency measures • Digitalisation, interconnection and autonomous vehicles	• Replacement of chemical energy sources with electrical energy sources • New energy transition clauses for concession tenders, procurement and purchasing • Increased energy efficiency of the port system • Development and integration of new digital tools



ETOSU-2	Promotion of sustainable transport

Increased use of the intermodal transport network, by improving the use of rail and other sustainable alternatives such as motorways of the sea and public transport, reduces energy consumption, noise pollution and land use.

Main objective: New rail access and terminals to be completed by 2035

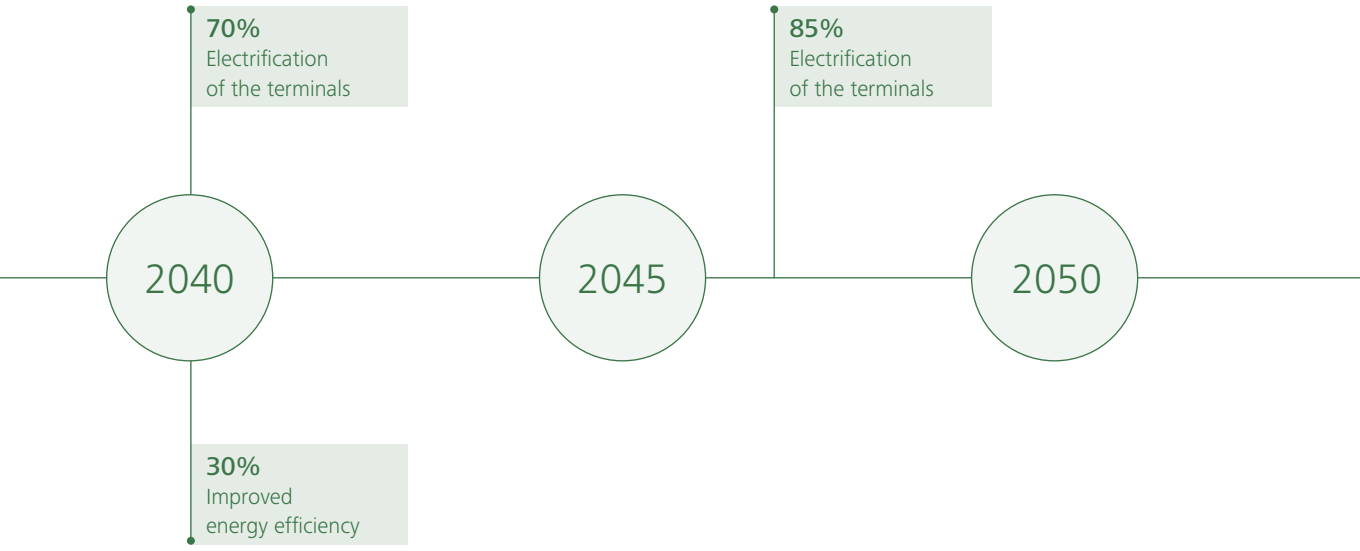
Programmes	Expected results
• Increase of rail intermodality • Synchromodality • Reinforcing the motorways of the sea / short sea shipping • Improving mobility in the port	• Construction of the new rail and road accesses in the southern part of the region • Improvement in traceability and reduction of uncertainty in the supply chain • More robust motorways of the sea model • Increased sustainable mobility in the port

ETOSU-3	Promotion of the circular economy

Transforming by-products into resources for other processes, thereby reducing waste and the need to extract new raw materials, can help manage the waste that has been generated, such as MARPOL V garbage from ships, while thermal resources as waste heat/cooling can also be harnessed.

Main objective: Revalorisation of 40% of by-products by 2030

Programmes	Expected results
• Waste heat/cold recovery • Revalorisation of port by-products • CO_2 value chain • Improvement of the water cycle	• Reduction of waste heat released to the environment • Energy recovery of organic MARPOL waste in the form of biomethane • Development of new activities related to the use of CO_2 • Reduction of the water footprint of the port's activities



Resilience

The transition to a new energy model must enable energy self-sufficiency for the community, minimise the impact of the instability of current markets and ensure competitiveness through a reliable and steady energy supply.

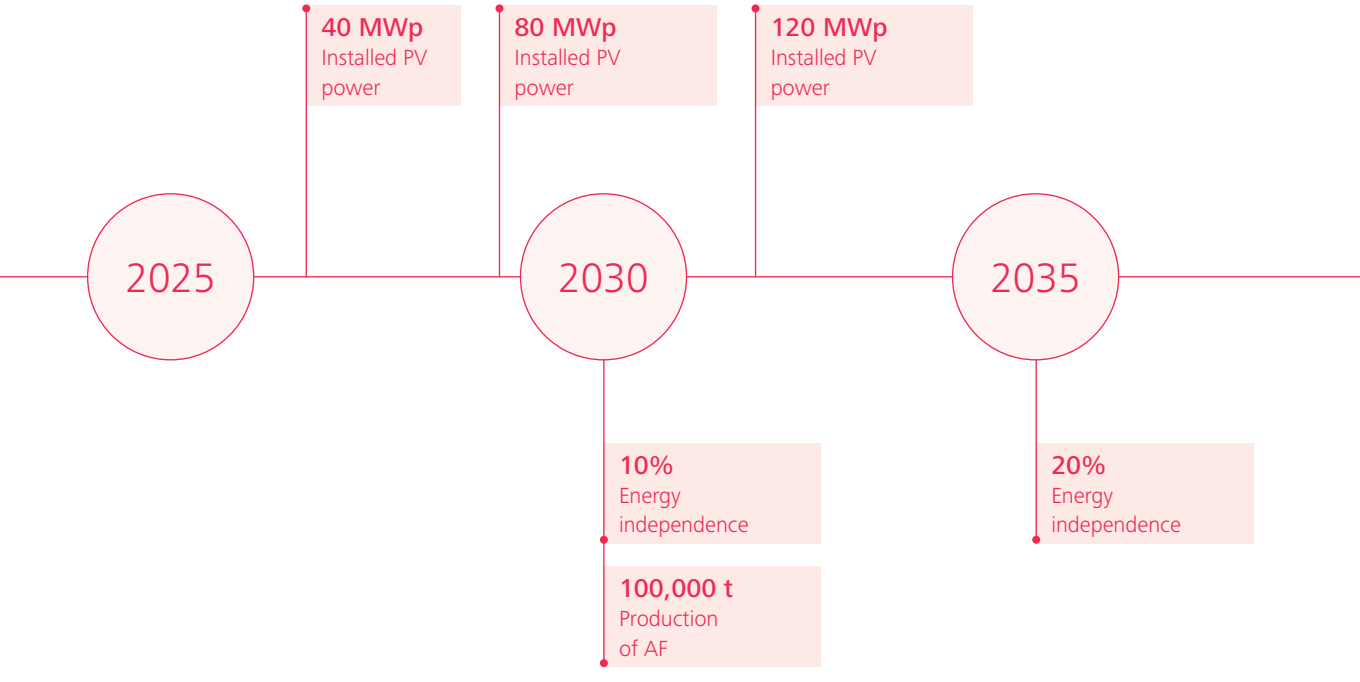
Maximise the energy independence of the port system

ETORE-1	Generation of renewable electricity linked to the port

In order to cope with the increased energy demand resulting from electrification, local renewable electricity generation capacity will be developed. The port area will focus mainly on solar energy, while wind energy collaborations are being promoted in the hinterland.

Main objective: Installation of 100 MWp from photovoltaic panels by 2030

Programmes	Expected results
• APB as an energy manager • Implementation of photovoltaic panels in the port • Enable new renewable energy sources • Port-related energy development	• Have a company that enables strategic energy management • Accelerate the mass implementation of photovoltaic panels in the port • Feasibility study of all renewable sources • Agreements (PPAs) with wind generation in the hinterland



ETORE-2	Implementation of an intelligent energy management system

Create a smart energy management system makes better use of the energy generated, increases efficiency and sustainability, and maximises profits, while promoting self-consumption, competitiveness and cooperation between concessions.

Main objective: Smart energy management system (SEMS) implemented by 2030

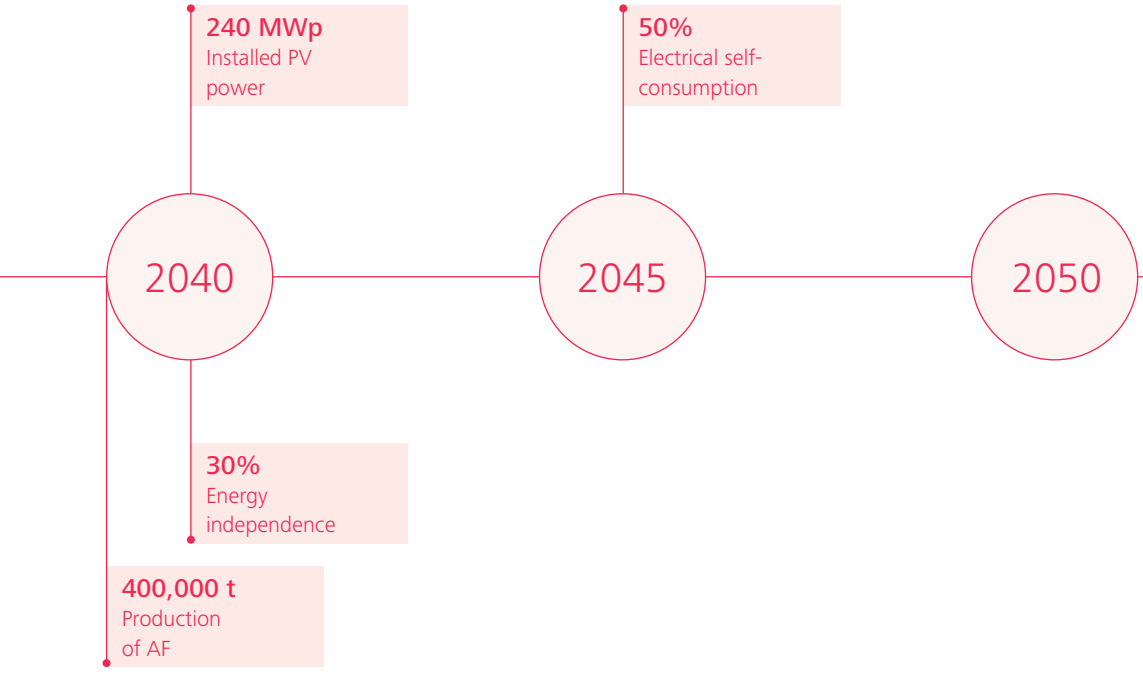
Programmes	Expected results
• Develop intelligent energy management systems in the port sector • Develop the port sector's proprietary electricity grid • Energy flexibility measures • Maximise port self-consumption	• Energy company that manages generation and commercialisation • Integrated consumption/generation management, maximising competitiveness and sustainability • Increase of self-consumption and reduction of costs • Reinforce the energy autonomy of the port community

ETORE-3	Establishment of new fuels plants linked to the port

The local production of alternative fuels (AF) will guarantee the supply to ships, attract more sustainable fleets and make the port more attractive. This also increases energy independence and reduces risks associated with economic and geopolitical crises.

Main objective: Production of 100,000 t of sustainable fuel by 2030

Programmes	Expected results
• Local production of biofuels • Local production of green methanol • Availability of raw materials • Sustainable fuels in the hinterland with a link to the port	• Guaranteed availability of zero-emission fuels for sustainable ships • Ensuring power supply to the first ships to use methanol • Development of the ecosystem related to future fuels (biogenic CO_2) • Ensuring power supply to strengthen the position as a clean energy hub



Innovation and new energy models

The energy transition offers the opportunity for pioneering ports to foster the development of new sustainable business models that will drive the growth of the port and its hinterland.

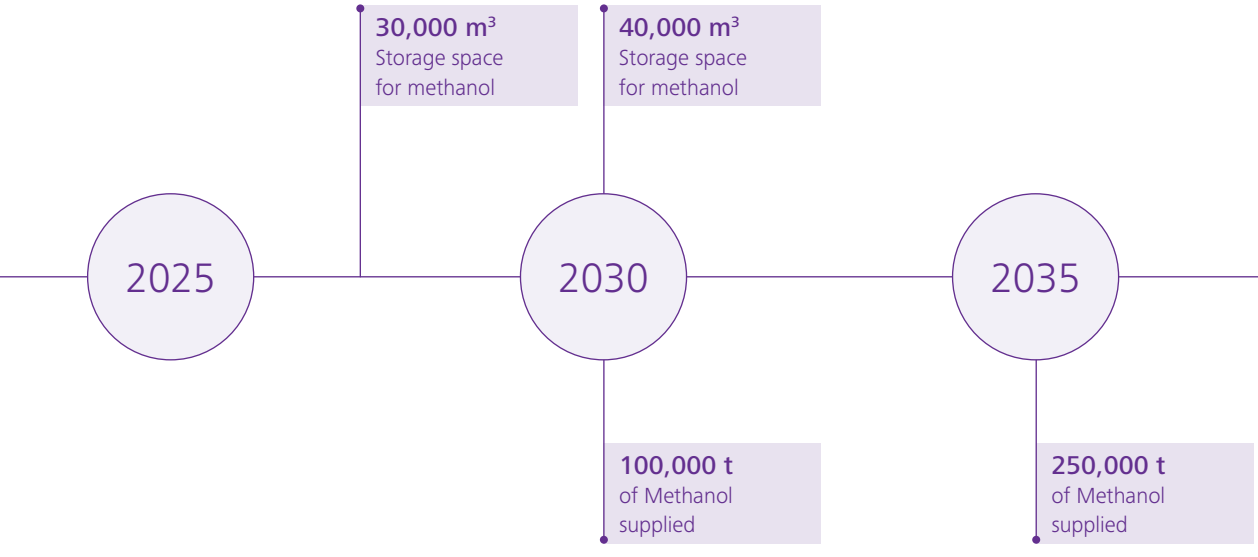
Enable new business models business models to become a clean energy hub

ETOEI-1	Develop the alternative fuels supply chain

Storage, loading and transport infrastructure; clear regulation; attracting demand; and developing human capital are key to the adoption of these fuels and to consolidating the Port as a clean energy hub.

Main objective: Regulation of methanol and ammonia bunkering by 2030

Programmes	Expected results
• Alternative fuels (AF) storage • Regulations for AF bunkering • AF loading and unloading infrastructure • AF bunkering in the port	• Develop storage capacity • Safe, transparent and flexible regulation of alternative fuel bunkering • AF loading and unloading capacity and streamlined operation • Availability of supply barges, effective operations



ETOEI-2	Support access to innovation funding

In order to remain competitive and be a pioneer as a port, funding will be made available for projects that further the strategic objectives, seeking pilot testing sites and collaborating in European innovation projects.

Main objective: Maritime green corridor with ships using sustainable fuels by 2026

Programmes	Expected results
• Participation in European projects • Support projects with an impact on the port • Energy Sandbox • Marine energy	• Promote access to the numerous channels of research and innovation funding • Strengthen the innovation ecosystem in energy and port issues • Ensure that innovations can evolve TRLs and reinforce knowledge • Contribute to the development of the Mediterranean blue economy

ETOEI-3	Develop the hydrogen economy in the port environment

Promoting the local demand for hydrogen through the development of infrastructure for production, reception, compression, transport and storage has a growing interest as the port seeks to position itself as a central European hub in the hydrogen economy.

Main objective: Connecting H2med by 2030

Programmes	Expected results
• Strengthen the local ecosystem • Availability of green hydrogen at the port • Local green hydrogen production • Hydrogen logistics	• Development of all the elements of the hydrogen logistics chain • Ensure access to green hydrogen for the port community at a competitive price • Provide the necessary infrastructure for the development of the hydrogen economy • Empower the necessary actors in the initial phase of development of this new market

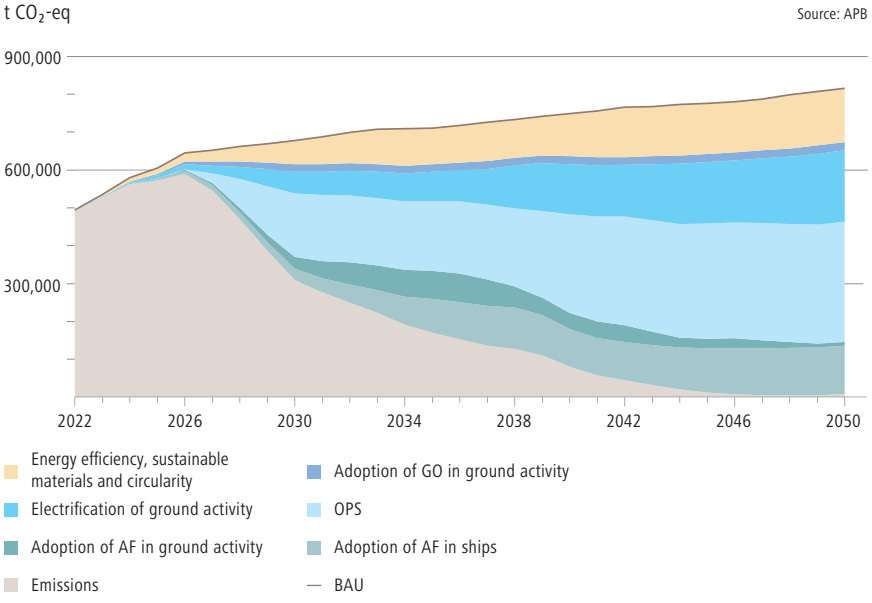
2040 2045 2050

04.03 ENERGY AND EMISSION EVALUATION

Based on traffic predictions and current trends, the Port has calculated reference scenario, or business as usual (BAU), characterised by a relatively stable emissions trajectory with a steady increase over time due to expected growth.

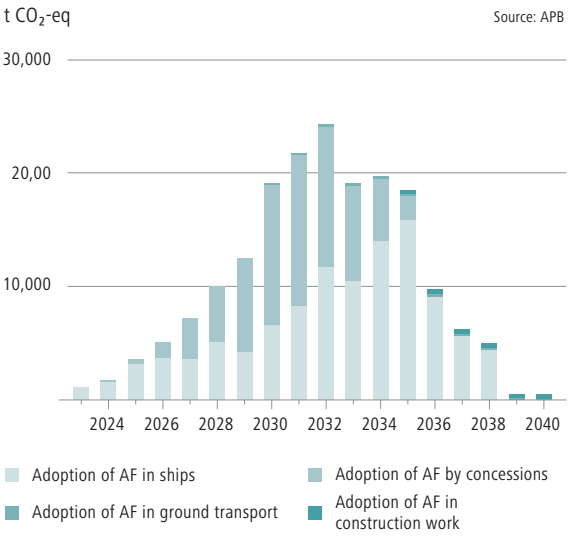
The roadmap sets out actions to mitigate emissions. Until 2030, this entails electrifying wharves, adopting renewable guarantees, improving energy efficiency and adopting alternative fuels; from 2030 to 2040, adopting sustainable fuels; and from 2040 to 2050, electrifying mobile equipment, transport and industry.

STRATEGIC EVOLUTION OF GHG MITIGATIONS

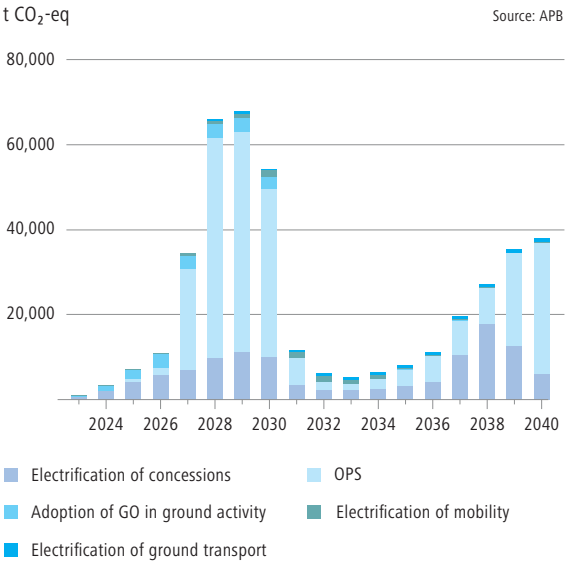


The mitigation by spheres may vary over time, as certain actions are initially more relevant and then replaced by more efficient ones. For example: the transition from alternative fuels to electrified systems.

DISTRIBUTION OF MITIGATIONS DUE TO THE ADOPTION OF AF

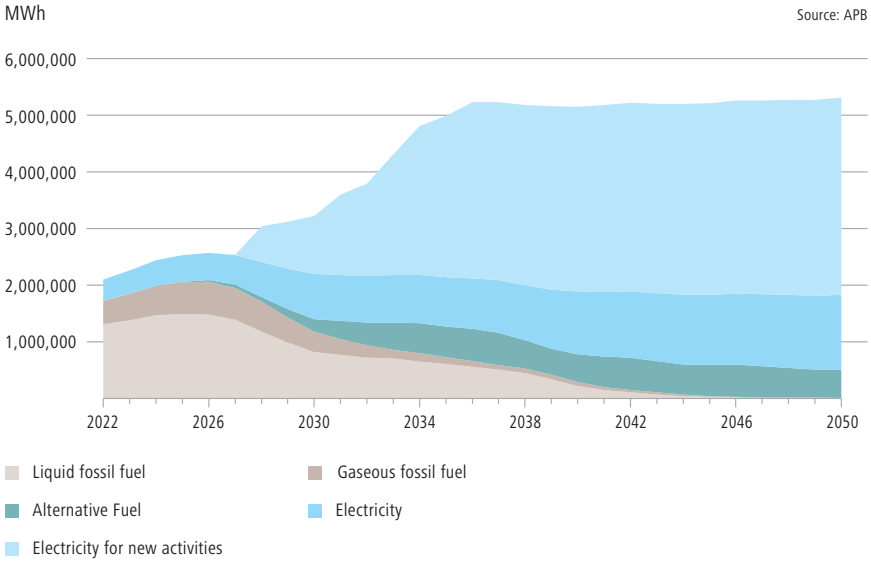


DISTRIBUTION OF ANNUAL MITIGATIONS DUE TO ELECTRIFICATION

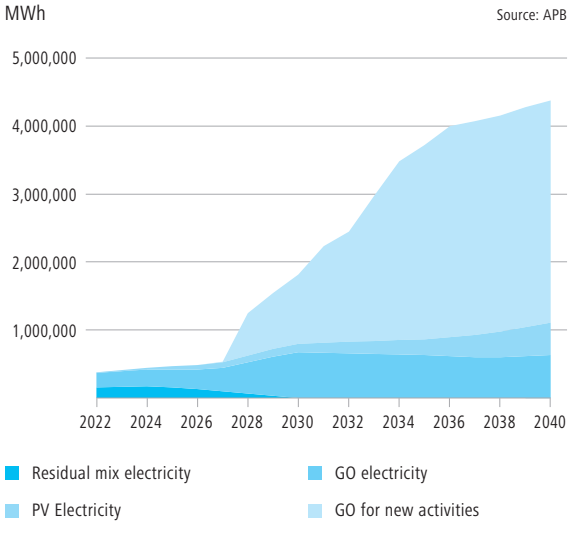


Electricity will take on an increasingly central role and will enable a large part of the decarbonisation

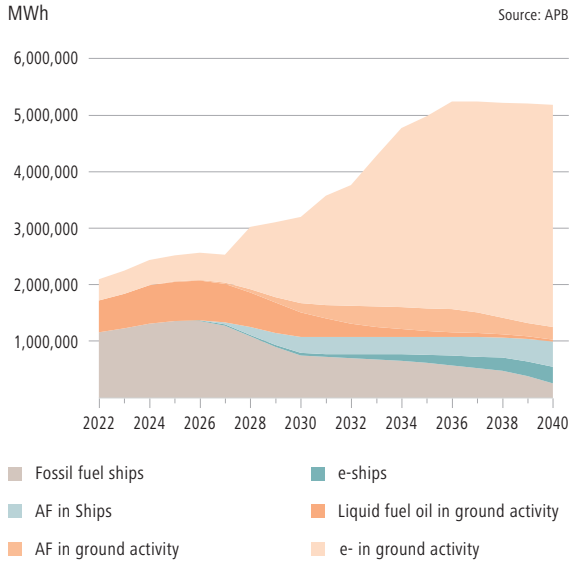
EVOLUTION OF FINAL ENERGY CONSUMED



ELECTRICITY CONSUMPTION DEVELOPMENTS



CONSUMPTION DEVELOPMENTS BY ACTIVITY AND SOURCE



One of the key initiatives to achieve the degree of electrification envisaged is the implementation of photovoltaic generation in the port. This source is estimated to have a potential generation capacity of around 500 GWp. This capacity would come from different types of surfaces, such as rooftops, car parks and large operational esplanades.

Hence, the panels are expected to be implemented over time; some areas can be developed in the short term, others in the medium or long term. Other areas to generate power, such as the marine or inland pathways, may be considered in the future.

DEVELOPMENTS IN PHOTOVOLTAIC PANEL ROLL OUT

Source: APB

2030

2030-2035

2035-2040

2040-2050

PHOTOVOLTAIC PANEL ROLL OUT BY ZONES

Source: APB

Rooftops

Pergolas

Under study - Large spaces

Under study - Others

04.04 MONITORING OF THE PLAN

A comprehensive and wide ranging plan such as this, which is to be applied to an asset with a highly changing nature (energy), requires rigorous monitoring to continuously evaluate that the plan is implemented correctly and that the objectives have been achieved. This plan thus proposes defining a series of indicators for each of the lines of development (LoD) in order to assess the progress towards the plan's objectives.

↓

Indicators for each LoD will be published annually to ensure transparency as well as to quantify the progress towards established objectives, identify areas for improvement and ensure the efficient management of resources.

↓

The plan shall undergo a review every five years to ensure that it remains effective over time and to adjust the strategy in the event of significant changes, to ensure alignment with strategic objectives and to adapt to changing environmental conditions.

↓

Establish an observatory to monitor new solutions, regulations and/or events that affect the initial proposals set out in the Energy Transition Plan (ETP). This observatory will compile information to carry out the proposed revisions. In the event that any element that could significantly affect the established roadmap is identified, an extraordinary revision shall be carried out.

ASSIGNMENT OF KEY PERFORMANCE INDICATORS TO EACH OBJECTIVE

DECARBONISATION (annual t CO_2 of the port)	
ETODC-1	% of electricity with GO
ETODC-2	CO_2-eq intensity of the fuel consumed
ETODC-3	% of connected ships

SUSTAINABILITY (GWh consumed in the port/year)	
ETOSU-1	% of energy consumption from electricity sources
ETOSU-2	average energy/t-mi
ETOSU-3	MWh reused

RESILIENCE (MWp of installed renewable electrical power)	
ETORE-1	MWh renewable generated
ETORE-2	% of energy consumed from local sources and/or PPAs
ETORE-3	MWh of AF produced linked to the port

INNOVATION (% AF of energy traffic)	
ETOEI-1	MWh of AF supplied to ships
ETOEI-2	€ innovation funding
ETOEI-3	H_2 port readiness level

ACTION PLAN 05

05 ACTION PLAN

Based on this strategic proposal, the Action Plan specifies the way to make this vision a reality by defining concrete, implementable actions. As a result of rigorous analysis and collaborative work, more than 150 actions have been grouped according to their most closely aligned line of development and have been organised into coherent action programmes.

These actions have also been assessed according to their impact, the complexity involved in implementing them, the investment required and the expected time horizon; a clear order of priorities has been established, thus allowing efforts to be targeted effectively and available resources to be optimised.

05.01 ACTIONS TO DECARBONISE THE PORT

ETODC-1 Emissions management	Priority	Period			
Integrating sustainability at all levels	↑	2025	2030	2035	2040
Annual certification of the port's CF	↑	2025	2030	2035	2040
Digital environmental data platform	↑	2025	2030	2035	2040
Implementation of ESI II	↗	2025	2030	2035	2040
Promote guaranteed renewable electricity	↗	2025	2030	2035	2040
Automation of the vessels' CF calculations	↗	2025	2030	2035	2040
Sensorisation of electricity consumption	→	2025	2030	2035	2040
APB's ES and ET policy concerning investments and procurement	→	2025	2030	2035	2040
Sensorisation of natural gas consumption	→	2025	2030	2035	2040
Promote the use of biomethane certificates	→	2025	2030	2035	2040
Automation of CF calculations for roll-on/roll-off transport	↘	2025	2030	2035	2040
Quantification of truck transport externalities	↘	2025	2030	2035	2040
System for calculating the CF of construction at the port	↘	2025	2030	2035	2040
More sustainable building materials	↘	2025	2030	2035	2040
Evaluate ISO 50001 implementation at port level	↓	2025	2030	2035	2040
Emission offset credits	↓	2025	2030	2035	2040

ETODC-2 Adoption of low-emission fuels	Priority	Period			
Establish green corridors - Cruise ships	↑	2025	2030	2035	2040
Electric chargers for trucks at the port	↑	2025	2030	2035	2040
Maritime environmental rebate scheme	↑	2025	2030	2035	2040
Truck-mounted hydrogen refuelling station with on site production	↗	2025	2030	2035	2040
Priority lane for eco-friendly trucks	↗	2025	2030	2035	2040
Establish green corridors - short sea shipping	→	2025	2030	2035	2040
Incentivising sustainable vehicles	→	2025	2030	2035	2040
Retrofit/overhaul of shunting locomotives	→	2025	2030	2035	2040
Use of AF by thermal processes	→	2025	2030	2035	2040
Establish green corridors - Vehicles	→	2025	2030	2035	2040
Sustainable boat visits	→	2025	2030	2035	2040
Support for the electrification of truck transport	↘	2025	2030	2035	2040

ETODC-2 Adoption of low-emission fuels	Priority	Period			
Zero emission tugboats	↘	2025	2030	2035	2040
Establish green corridors - Container ships	↘	2025	2030	2035	2040
Rebates for sustainable truck sourcing / loading	↘	2025	2030	2035	2040
Land-based environmental rebate scheme	↘	2025	2030	2035	2040
Zero emission moorings	↓	2025	2030	2035	2040
Incentivise the adoption of AF for mobile machinery	↓	2025	2030	2035	2040
Hydrogen truck pilot	↓	2025	2030	2035	2040

ETODC-3 Implementation of the OPS - NEXIGEN	Priority	Period			
OPS pilot test for ships and railways (implementation and connections)	↑	2025	2030	2035	2040
Grid connection (REE): obtaining position, access and connection	↑	2025	2030	2035	2040
Commissioning of the Port ESS (energisation)	↗	2025	2030	2035	2040
Roll out in other terminals (complete container terminals)	↗	2025	2030	2035	2040
Construction of the internal MV electrical network	↗	2025	2030	2035	2040
Creation of an (energy) management company to develop the OPS	↗	2025	2030	2035	2040
Construction of Port ESS transformer and high-voltage line	↗	2025	2030	2035	2040
Roll out in other terminals (cruise terminals)	↗	2025	2030	2035	2040
Roll out in other terminals (complete ferry terminals)	↗	2025	2030	2035	2040
OPS rate setting and billing	↗	2025	2030	2035	2040
Energy management of the Port ESS	→	2025	2030	2035	2040
Funding programmes	→	2025	2030	2035	2040
Definition & validation of OPS operational procedures (during pilot tests)	→	2025	2030	2035	2040
Raising awareness about the electrification plan	→	2025	2030	2035	2040
Maintenance and operation of the Port ESS	→	2025	2030	2035	2040
Study of electrifiable maritime routes	↘	2025	2030	2035	2040
Strategic European and international partnerships	↘	2025	2030	2035	2040
Quantification of emission reductions	↘	2025	2030	2035	2040
Incentivise the use of OPS	↘	2025	2030	2035	2040
Evaluation of battery recharging for zero-emission ships in port	↘	2025	2030	2035	2040
Management and integration of data in the digital platform	↘	2025	2030	2035	2040
Feasibility study of loading ships with electric capacity	↘	2025	2030	2035	2040
Roll out in other terminals (vehicle terminals)	↘	2025	2030	2035	2040
Roll out in other terminals (bulk terminals)	↓	2025	2030	2035	2040

1. Electric chargers for trucks at the port
2. Truck-mounted hydrogen refuelling station with on site production
3. Priority lane for eco-friendly trucks
4. Sustainable boat visits
5. Zero emission tugboats
6. Zero emission moorings
7. OPS pilot test for container ships and ferries (execution and connections)
8. Commissioning of the Port ESS (energisation)
9. Roll out in other terminals (cruise terminals)
10. Roll out in other terminals (vehicle terminals)
11. Roll out in other terminals (bulk terminals)

Approximate locations of the highlighted actions

05.02 ACTIONS AS A SUSTAINABLE PORT

ETOSU-1 Promote increased energy efficiency	Priority	Period			
Energy efficiency clauses in future concession tenders	↑	2025	2030	2035	2040
Environmental emissions ordinances	↗	2025	2030	2035	2040
Electrical straddle carrier pilot test	↗	2025	2030	2035	2040
Replacement of lighting with LEDs	↗	2025	2030	2035	2040
5G roll out	↗	2025	2030	2035	2040
Support for the electrification of horizontal load shifting	→	2025	2030	2035	2040
Conceptualisation of a digital port twin	→	2025	2030	2035	2040
Support for the electrification of passenger and worker mobility	→	2025	2030	2035	2040
Re-organisation of activities to optimise overall operations	→	2025	2030	2035	2040
Incentivise energy efficiency improvements in machinery	↘	2025	2030	2035	2040
Support for the electrification of thermal processes	↘	2025	2030	2035	2040
Green façades	↓	2025	2030	2035	2040
Cold pavement and rooftops	↓	2025	2030	2035	2040

ETOSU-2 Promotion of sustainable transport	Priority	Period			
New southern accesses	↑	2025	2030	2035	2040
New multimodal terminals	↑	2025	2030	2035	2040
Reinforce the increased number of motorways of the sea	↗	2025	2030	2035	2040
Land-based green corridors	↗	2025	2030	2035	2040
APB-ADIF collaboration: Train Port Barcelona	→	2025	2030	2035	2040
Just in time (JIT) port calls	→	2025	2030	2035	2040
Ferroutage terminal	→	2025	2030	2035	2040
Integration of the rail service in the digital twin	↘	2025	2030	2035	2040
Feasibility study on the incorporation of PMV and cycle paths	↘	2025	2030	2035	2040
Sustainable Mobility Plan	↘	2025	2030	2035	2040
Emission reduction certification for the motorways of the sea	↓	2025	2030	2035	2040

ETOSU-3 Promotion of the circular economy	Priority	Period			
Waste-to-energy recovery	↑	2025	2030	2035	2040
Mapping of organic waste in the port environment	↗	2025	2030	2035	2040
Study of the maritime and port CO_2 value chain	↗	2025	2030	2035	2040
Waste heat and cooling map	↗	2025	2030	2035	2040
Map of heating and cooling needs in the port	→	2025	2030	2035	2040
Sensorisation of water consumption	→	2025	2030	2035	2040
Waste heat recovery	→	2025	2030	2035	2040
Evaluation of water pressure from port activity	→	2025	2030	2035	2040
Recyclable constructions (cradle to cradle)	↘	2025	2030	2035	2040
Waste cold recovery	↘	2025	2030	2035	2040
Facility for discharging the CO_2 captured on ships	↘	2025	2030	2035	2040
Posidonia meadows on the coast to capture CO_2	↘	2025	2030	2035	2040
CO_2 capture and storage processes - capture in the environment	↓	2025	2030	2035	2040
CO_2 capture and storage processes - depots	↓	2025	2030	2035	2040

1. Electrical straddle carrier pilot test
2. Replacement of lighting with LEDs
3. Re-organisation of activities to optimise overall operations
4. Support for the electrification of thermal processes
5. New southern accesses
6. New multimodal terminals
7. Reinforce the increased number of motorways of the sea
8. *Ferroutage* terminal
9. Waste-to-energy recovery
10. Waste heat recovery
11. Facility for discharging the CO_2 captured on ships

Approximate locations of the highlighted actions

05.03 ACTIONS AS A RESILIENT PORT

ETORE-1 Generation of renewable electricity linked to the port	Priority	Period			
Establish a port energy company	↑	2025	2030	2035	2040
PV panels on conventional rooftops	↑	2025	2030	2035	2040
Wind power in the hinterland	↗	2025	2030	2035	2040
Definition of the green power generation model in the port	↗	2025	2030	2035	2040
PV panels on pergolas in car parks	→	2025	2030	2035	2040
PV panels in terminal structures	→	2025	2030	2035	2040
PPAs with positive local impact, featuring community participation	→	2025	2030	2035	2040
Energy generation synergies with neighbouring actors	↘	2025	2030	2035	2040
PV panels on pergolas in truck parking areas	↘	2025	2030	2035	2040
PV panels on road spaces	↓	2025	2030	2035	2040
Mini wind power development	↓	2025	2030	2035	2040
Tidal power plant	↓	2025	2030	2035	2040

ETORE-2 Implementation of an intelligent energy management system	Priority	Period			
Electricity master plan	↑	2025	2030	2035	2040
Platform for enabling comprehensive energy management system (EMS)	↗	2025	2030	2035	2040
Maximise self-consumption	↗	2025	2030	2035	2040
Future power forecast for REE planning	↗	2025	2030	2035	2040
Electricity generation-consumption study at hourly level	→	2025	2030	2035	2040
Electricity storage needs study	→	2025	2030	2035	2040
Potential configuration model for use of energy that is generated	→	2025	2030	2035	2040
Feasibility study of a shared CHP	→	2025	2030	2035	2040
Incorporate processes that involve energy accumulation into the EMS	↘	2025	2030	2035	2040
Smart energy contracts (blockchain)	↓	2025	2030	2035	2040
Integration of demand response in port concessions	↓	2025	2030	2035	2040

ETORE-3 Establishment of plants producing new fuels linked to the port	Priority	Period			
AF production plant (green methanol)	↑	2025	2030	2035	2040
Land-based H_2 connection network	↗	2025	2030	2035	2040
Biomethane production plant	↗	2025	2030	2035	2040
Linking the port to AF production plants in the hinterland	↗	2025	2030	2035	2040
Organic matter aggregation for biofuels	→	2025	2030	2035	2040
Local biogenic CO_2 aggregation	→	2025	2030	2035	2040
Collaborating with other poles of AF consumption/generation	↘	2025	2030	2035	2040

1. PV panels on conventional rooftops
2. PV panels on pergolas in car parks
3. PV panels on pergolas in for truck parking areas
4. AF production plant (green methanol)
5. Land-based H_2 connection network
6. Biomethane production plant

Approximate locations of the highlighted actions

05.04 INNOVATION ACTIONS IN THE PORT

ETOEI-1 Develop the supply chain for alternative fuels	Priority	Period			
Methanol bunkering regulation	↑	2025	2030	2035	2040
Increased methanol storage capacity	↑	2025	2030	2035	2040
Increased capacity for AF loading and unloading	↑	2025	2030	2035	2040
Methanol bunkering: barge availability	↗	2025	2030	2035	2040
AF transport pipelines at the energy wharf	↗	2025	2030	2035	2040
Ammonia bunkering regulation	→	2025	2030	2035	2040
Ammonia bunkering: barge availability	→	2025	2030	2035	2040
Demand forecast for methanol	→	2025	2030	2035	2040
Ammonia handling regulation	→	2025	2030	2035	2040
Barge berth fitted for the supply of AF	→	2025	2030	2035	2040
Ammonia handling training	↘	2025	2030	2035	2040
Increased ammonia storage capacity	↘	2025	2030	2035	2040
Wharf for alternative fuel barges	↘	2025	2030	2035	2040
Refurbishment of bulk liquids equipment	↓	2025	2030	2035	2040

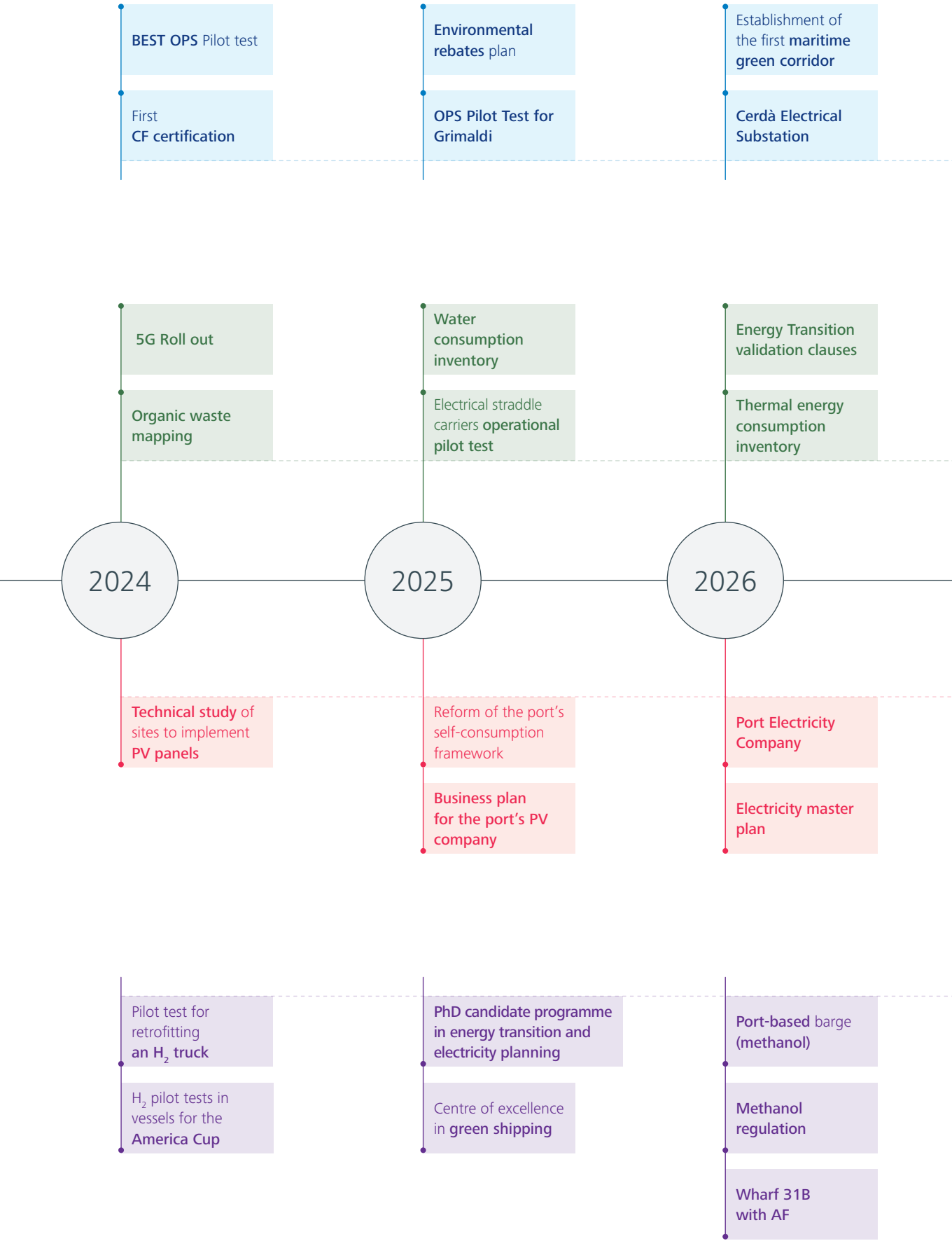
ETOEI-2 Support access to innovation funding	Priority	Period			
Support for energy efficiency innovation projects	↗	2025	2030	2035	2040
Define characteristics for an energy innovation space	↗	2025	2030	2035	2040
Promote the blue economy	↗	2025	2030	2035	2040
Participation in maritime-port decarbonisation centres	→	2025	2030	2035	2040
Centre of excellence in green shipping	→	2025	2030	2035	2040
PIONEERS	→	2025	2030	2035	2040
Test regime for electricity billing for maritime consumption	→	2025	2030	2035	2040
Doctoral research cooperation programmes	→	2025	2030	2035	2040
Roll out of stationary CO_2 capture systems	↘	2025	2030	2035	2040
Mini wind power pilot	↘	2025	2030	2035	2040
Cultivation of algae for energy use	↓	2025	2030	2035	2040
GHG calibration/continuous GHG monitoring systems	↓	2025	2030	2035	2040

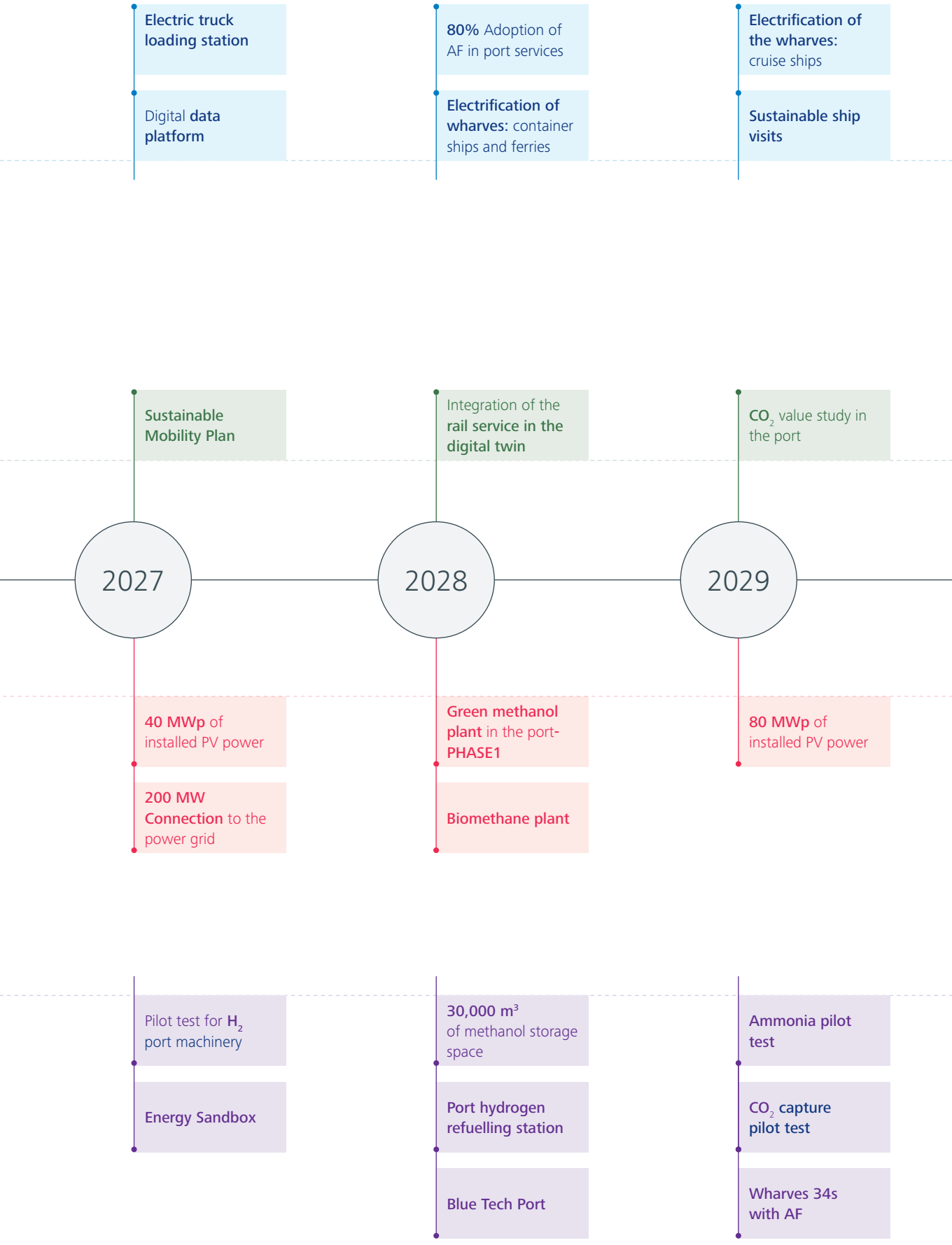
ETOEI-3 Develop the hydrogen economy in the port environment	Priority	Period			
H2med construction	↑	2025	2030	2035	2040
Leadership of the Hydrogen Valley of Catalonia	↗	2025	2030	2035	2040
H_2 production plant	↗	2025	2030	2035	2040
Hydrogen refuelling stations for land transport	→	2025	2030	2035	2040
H_2 stations for machinery	→	2025	2030	2035	2040
H_2 import/export facilities	→	2025	2030	2035	2040
Projected demand for H_2	→	2025	2030	2035	2040
Port distribution of H_2	↘	2025	2030	2035	2040
Promote H_2 trucks	↘	2025	2030	2035	2040
Connection by H_2 maritime network	↘	2025	2030	2035	2040
Support for other H_2 production technologies - SuPORT	↓	2025	2030	2035	2040
H_2 recharging stations outside the port	↓	2025	2030	2035	2040

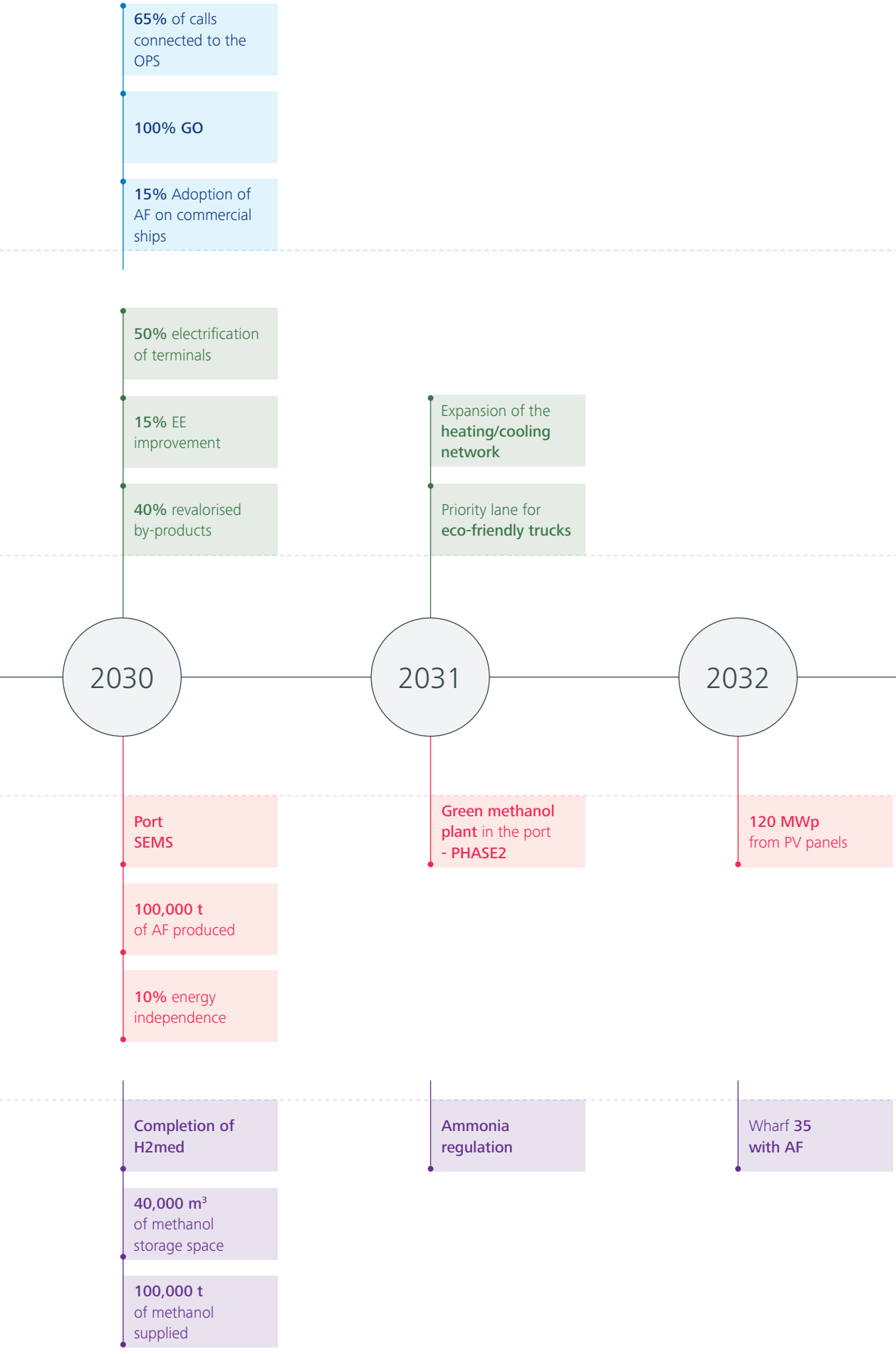
1. Methanol bunkering regulation
2. Increased methanol storage capacity
3. Increased capacity for AF loading and unloading
4. AF transport pipelines at the energy wharf
5. Barge berth fitted out for AF supply
6. Wharf for alternative fuel barges
7. Refurbishment of bulk liquids equipment
8. H2med construction
9. H_2 production plant
10. Hydrogen refuelling stations for land transport
11. H_2 stations for machinery
12. H_2 import/export facilities
13. Connection by H_2 maritime network

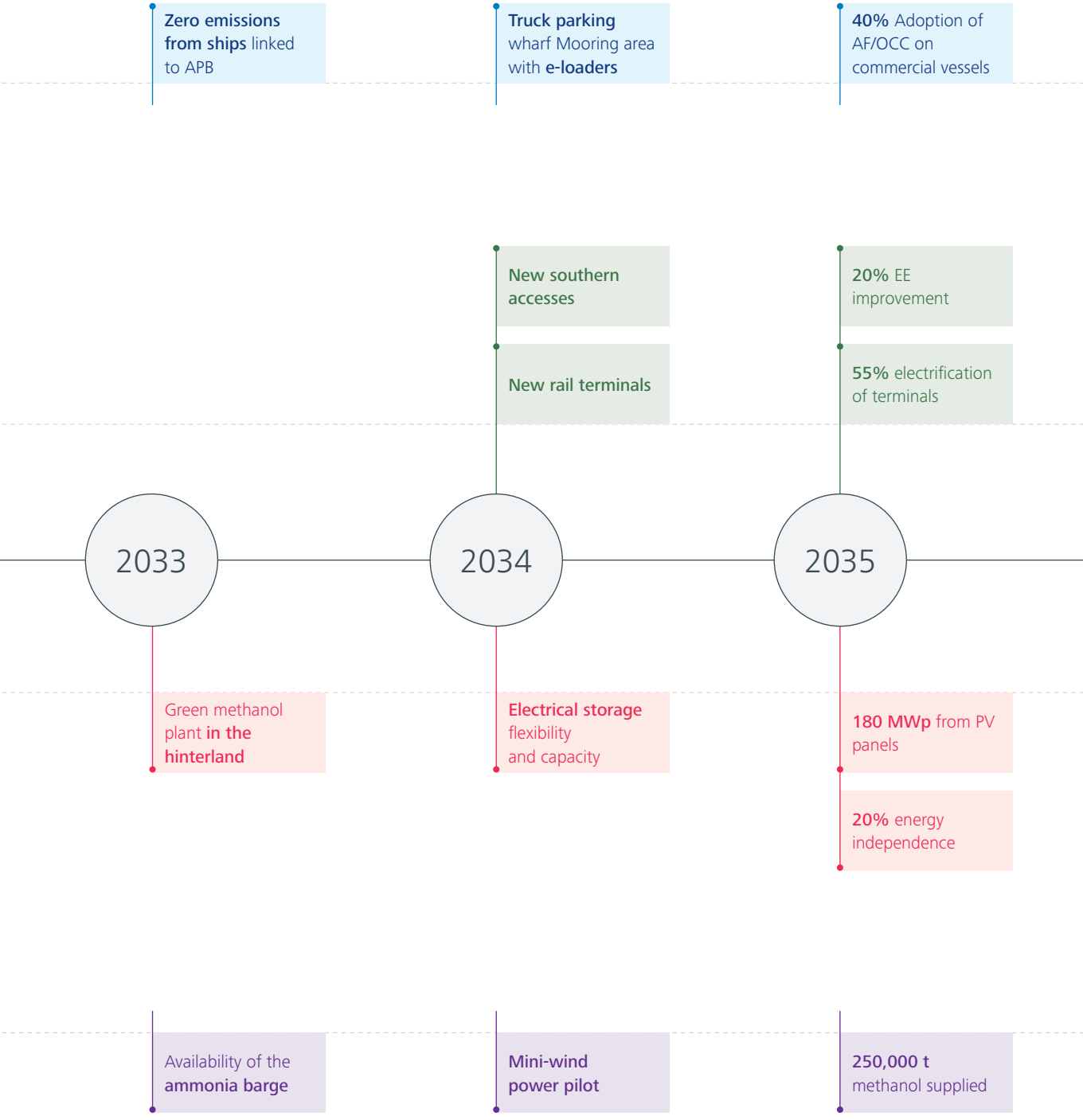
Approximate locations of the highlighted actions

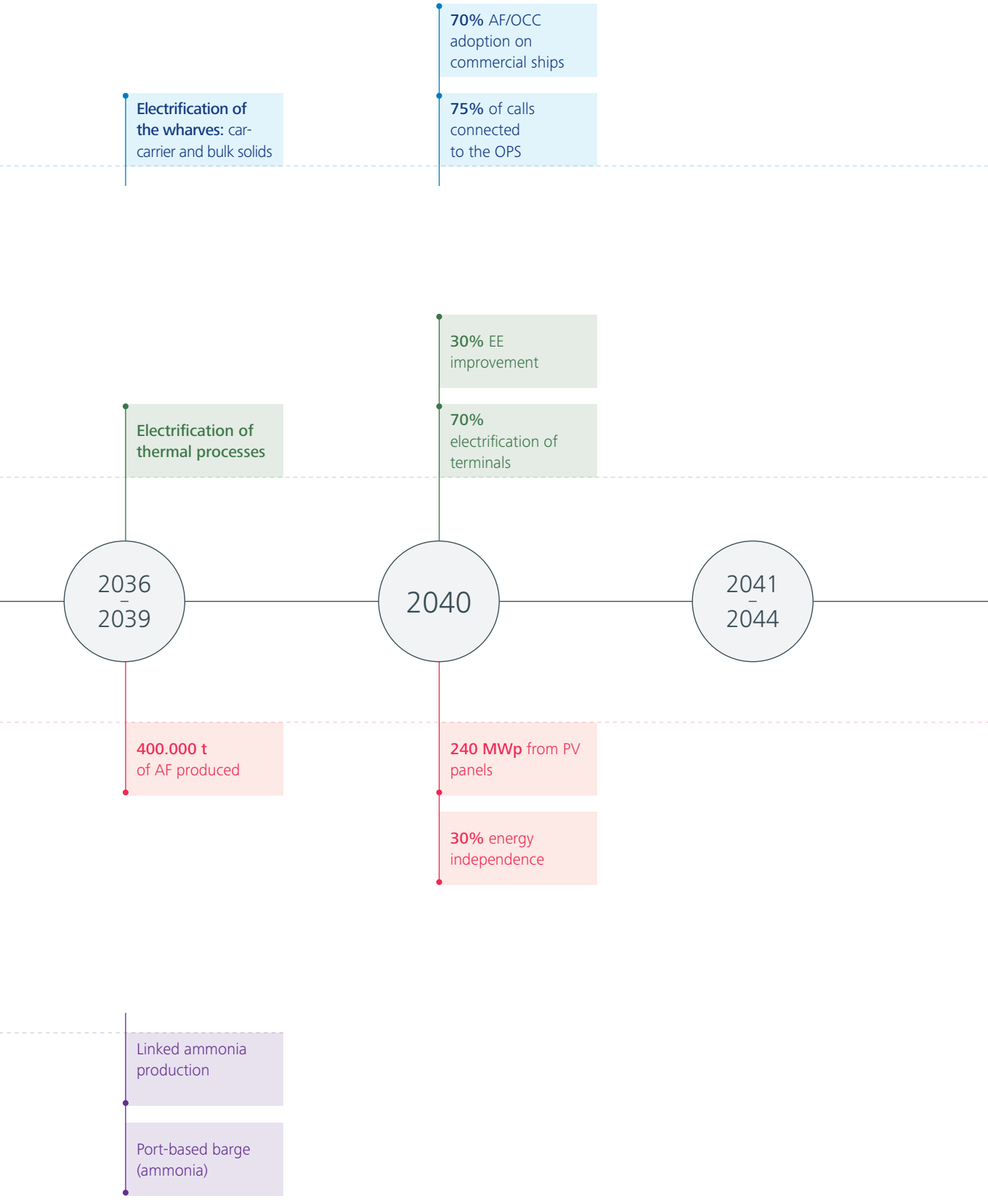
05.05 STRATEGIC CALENDAR

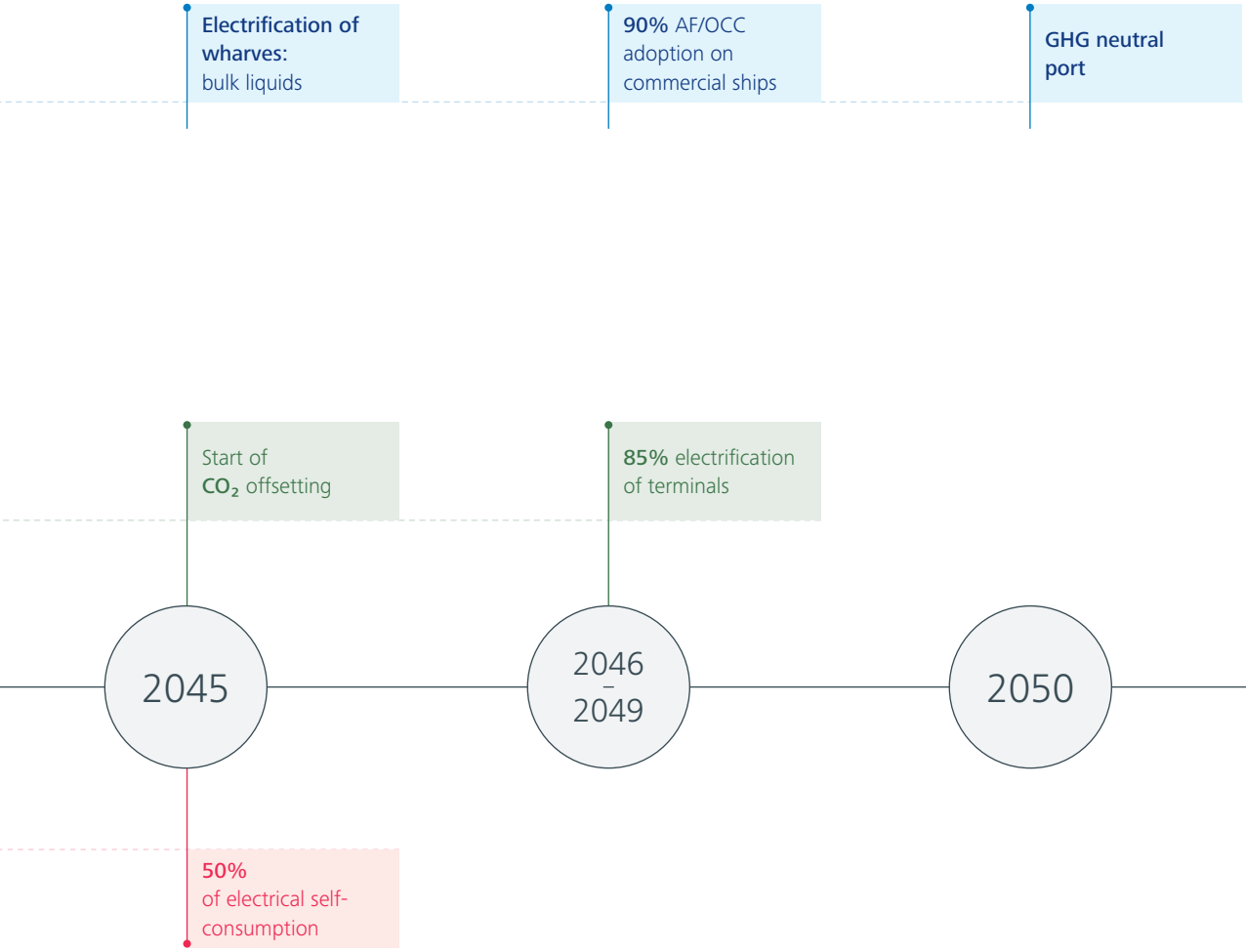



Electric truck loading station
Digital data platform
80% Adoption of AF in port services
Electrification of wharves: container ships and ferries
Electrification of the wharves: cruise ships
Sustainable ship visits
Sustainable Mobility Plan
Integration of the rail service in the digital twin
CO2 value study in the port
2027
2028
2029
40 MWp of installed PV power
200 MW Connection to the power grid
Green methanol plant in the port- PHASE1
Biomethane plant
80 MWp of installed PV power
Pilot test for H2 port machinery
Energy Sandbox
30,000 m3 of methanol storage space
Port hydrogen refuelling station
Blue Tech Port
Ammonia pilot test
CO2 capture pilot test
Wharves 34s with AF


65% of calls connected to the OPS
100% GO
15% Adoption of AF on commercial ships
50% electrification of terminals
15% EE improvement
40% revalorised by-products
Expansion of the heating/cooling network
Priority lane for eco-friendly trucks
2030
2031
2032
Port SEMS
100,000 t of AF produced
10% energy independence
Green methanol plant in the port - PHASE2
120 MWp from PV panels
Completion of H2med
40,000 m³ of methanol storage space
100,000 t of methanol supplied
Ammonia regulation
Wharf 35 with AF


Zero emissions from ships linked to APB
Truck parking wharf Mooring area with e-loaders
40% Adoption of AF/OCC on commercial vessels
New southern accesses
New rail terminals
20% EE improvement
55% electrification of terminals
2033
2034
2035
Green methanol plant in the hinterland
Electrical storage flexibility and capacity
180 MWp from PV panels
20% energy independence
Availability of the ammonia barge
Mini-wind power pilot
250,000 t methanol supplied


70% AF/OCC adoption on commercial ships
Electrification of the wharves: car-carrier and bulk solids
75% of calls connected to the OPS
30% EE improvement
Electrification of thermal processes
70% electrification of terminals
2036 – 2039
2040
2041 – 2044
400.000 t of AF produced
240 MWp from PV panels
30% energy independence
Linked ammonia production
Port-based barge (ammonia)



The Action Plan defines specific and implementable actions, with a solid and coordinated strategy, to make the Port of Barcelona's energy transition a reality and achieve carbon neutrality.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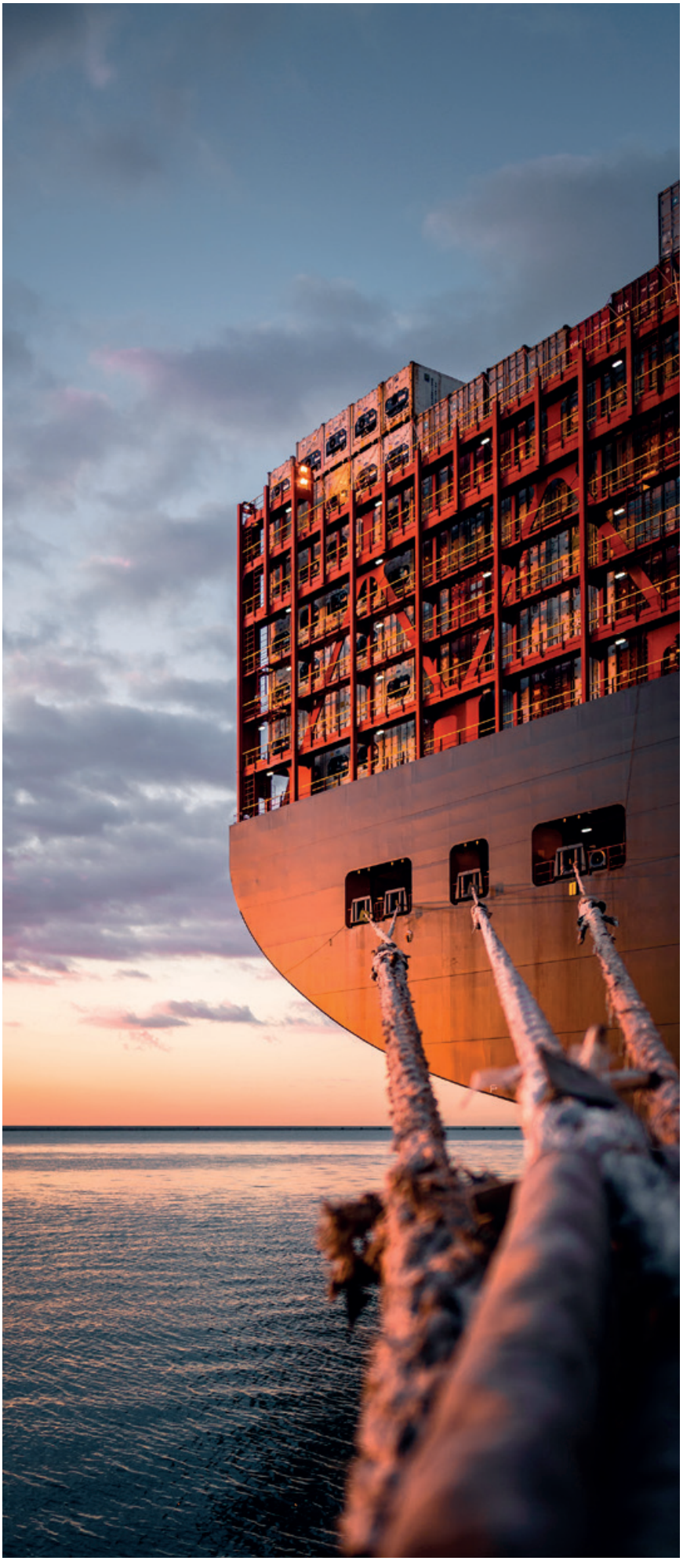

SUMMARY

The Port of Barcelona's Energy Transition Plan represents a firm commitment to a more equitable and sustainable future. This document sets out the main lines of a profound transformation strategy that not only addresses global environmental challenges, but also positions the port as a benchmark in sustainability, energy innovation and a model of resilience in the Mediterranean and in Europe.

The decarbonisation of port activity, the promotion of renewable energies, the electrification of infrastructure and the promotion of alternative fuels are fundamental pillars of this strategy. But beyond concrete actions, the Energy Transition Plan is a commitment: to build an energy model through consensus and collaboration that guarantees the competitiveness of the port and the well-being of future generations while preserving our environment.

This commitment is not new. It is the result of years of shared work, strategic vision and collective responsibility. With this plan, we reaffirm the Port of Barcelona's commitment to continue ambitiously and coherently leading the energy transition of the maritime and port system.

GLOSSARY

Acronym	Meaning
AF	alternative fuel
APB	Barcelona Port Authority
CF	carbon footprint
CHP	combined heat and power
CII	carbon intensity indicator
CO_2	carbon dioxide
DCS	data collection system
e-	electricity
EE	energy efficiency
EEDI	energy efficiency design index
EEXI	energy efficiency existing ship index
ES	environmental sustainability
ESG	environmental, social, and governance factors
ESI	environmental ship index
ESS	electrical substation
ET	energy transition
ETODC	energy transition objectives for decarbonisation
ETOEI	energy transition objectives for energy innovation
ETORE	energy transition objectives for resilience
ETOSU	energy transition objectives for sustainability
ETP	Energy Transition Plan
GHG	greenhouse gases
GO	guarantee of origin
GPMP	green port master plan
H_2	hydrogen
H2med	green hydrogen corridor project connecting Spain and France
IMO	International Maritime Organization
JIT	just in time (port logistics model)
LNG	liquefied natural gas
MV	medium voltage
NIMBY	not in my back yard

Acronym	Meaning
OCC	onboard carbon capture
OPEX	operating expense
OPS	onshore power supply
PMV	personal mobility vehicles
PPA	power purchase agreements
PRL	port readiness level
PV	photovoltaic
REE	Red Eléctrica Española (electricity grid operator)
SEMS	smart energy management system
SME	smart management energy
SSS	short sea shipping
SWOT	strengths, weaknesses, opportunities and threats
TRL	technology readiness level

Port de Barcelona

Port of Barcelona Energy Transition Plan 2025-2050

Zero Emissions Port by 2050