



MARKET INSIGHTS

"California and Shanghai team up to promote green shipping corridor"¹

California and Shanghai have held a forum to advance the development of a Green Shipping Corridor, with the aim of reducing emissions on one of the world's busiest trade routes. The meeting, held at the Port of Long Beach, was attended by California state agencies and representatives from the ports of Long Beach, Los Angeles and Shanghai, as well as entities such as the California-China Climate Institute, ICCT and C40 Cities.

During the meeting, key issues such as the need for specialised infrastructure, aligned regulations and financial models to make the transition to low-emission fuels feasible were addressed. Port authorities highlighted the importance of international cooperation, while a recent report underlined that while the business case for these corridors is improving, economic and operational challenges remain for large-scale implementation. However, the energy transition also opens up new opportunities for ports, including attracting clean technology investments, developing infrastructure for sustainable fuels, and creating jobs specialising in logistics and renewable energy.

Analysis of the Fundación Valenciaport

Ports play a **fundamental role** in **global energy trade**. More than half of the oil is transported by sea, while the percentage for natural gas and coal is around 15%. This role is further complemented by the presence of **refining facilities** in port areas, both directly on port land and in the surrounding areas.

In this sense, the **crucial role** of the **maritime-port sector** in the **energy market** is directly linked to **logistical aspects**, where the **efficiency** and **low cost** of maritime transport are essential in a market where large distances exist between production and consumption centers. For this reason, the **refining industry** is also often located in port areas or nearby, making many ports not only logistical hubs but also **industrial centers specialized** in the **energy sector**.

In this context, the **strategic location** of the world's **main refineries** in **port areas** (Table 1) not only **facilitates** the **transport** of **energy products** but also **strengthens** their **key role** within the **global energy chain**. This proximity to ports and integration with efficient logistical infrastructures are decisive factors for the continuous flow of fossil fuels and renewable energy, positioning ports as crucial elements in the transition towards a more sustainable energy matrix.

¹ Original news published by "Port Technology" y disponible en "California, Shanghai unite to drive green shipping corridor - Port Technology International"

Table 1. Location and characteristics of the world's major refineries

Refinery	Location	Refining Capacity	Characteristics / Remarks
Jamnagar Refinery (Reliance Industries)	Jamnagar, Gujarat, India	>1,200,000 barrels/day	The world's largest refinery, with impressive capacity and a coastal location that facilitates the import and export of crude oil.
Complejo de Refino de Paraguaná (PDVSA)	Península de Paraguaná, Venezuela	>900,000 barrels/day	Includes Amuay and Cardon, key to Venezuela's energy sector, located in a strategic port area.
Ras Tanura Refinery (Saudi Aramco)	Ras Tanura, Provincia Oriental, Arabia Saudita	>550,000 barrels/day	Key Saudi Arabian refinery, located in the Persian Gulf, of vital importance for the region's and the world's energy supply.
Ruwais Refinery (ADNOC)	Ruwais, Abu Dhabi, Emiratos Árabes Unidos	400,000 500,000 barrels/day	Advanced facilities, crucial to the Gulf's energy strategy, benefiting from its proximity to port facilities.
Port Arthur Refinery (Motiva Enterprises)	Port Arthur, Texas, EE.UU.	>600,000 barrels/day	One of the largest in the US, located on the Gulf coast, optimising logistics and shipping.
Baytown Refinery (ExxonMobil)	Baytown, Texas, EE.UU.	>500,000 barrels/day	Located near the Houston Ship Channel, it stands out for its high operational capacity and strategic port location for energy trade.
Pulau Bukom Refinery (Shell)	Jurong Island, Singapur	500,000 barrels/day	Part of a key industrial complex in Asia, with excellent logistics connections and proximity to a major port.
Ulsan Refinery (SK Energy)	Ulsan, Corea del Sur	840,000 barrels/day	Key refinery in South Korea, located in a port city crucial to energy security and the petrochemical industry.
Yeosu Refinery (GS Caltex)	Yeosu, Corea del Sur	360,000 barrels/day	Complements South Korea's refining capacity, located in a high-end industrial and port area..
Dalian Refinery (Sinopec)	Dalian, China	240,000 300,000 barrels/day	Strategically located in a key port city in Northeast China, it reflects the growing importance of the energy sector in the region.

Source: Own elaboration

An important part of the **energy transition process** involves **electrification** and **self-generation**, so the **importance** of this trade and the **strategic role** of these **industrial hubs** will decrease. However, it is unrealistic to think that all applications currently using fossil fuels will be electrifiable, so it will also be necessary to rely on **renewable fuels** (solid, liquid, and gaseous) and, therefore, on an **associated production and distribution chain**. Although ports that are currently energy hubs have a significant advantage in participating in this future trade, as many of the expensive infrastructures used to manage fossil fuel sources will also be useful for some renewable fuels, it is

important to note that some **renewable fuels currently** considered may **require** the **development of new infrastructure**. On the one hand, the **regions of production** will **change**, although some areas have potential for both fossil and renewable sources, this is not the case in all situations. On the other hand, the **storage and transportation conditions** of some renewable fuels **differ** significantly from those of traditional fossil fuels, so it will be necessary to either adapt existing infrastructure or build new facilities for the distribution of alternatives.

To illustrate this paradigm shift, it is interesting to consider the **case of ammonia**, a substance that is expected to play a **fundamental role** in a **renewable energy system**, as it can be produced from raw materials that can be found almost anywhere, such as electricity, water, and air; it is, along with molecular hydrogen, the only renewable fuel that does not contain carbon in its composition (meaning it does not release CO₂ when combusted), and it also contains a high amount of hydrogen in its composition, so it can be used as a carrier in a future hydrogen market. **Currently**, the **main use of ammonia** is as a **raw material** for **fertilizer production**, which means there are **already** many **production facilities** worldwide and a large **fleet** of **ships** for its **transport**. However, most of the ammonia produced today is obtained from natural gas, known as gray ammonia. For this reason, its **production depends** on **access to low-cost natural gas**, and **many of the most important plants** are located **in natural gas-producing countries** or those with access to **low-cost natural gas** (Table 2).

Table 2. Main ammonia production plants

Plant	Location	Production capacity (tonnes per year)	Availability of natural gas	Owner
Qatar Fertiliser Company (QAFCO)	Qatar	3.8 millions	Abundant and low-cost	Industries Qatar
Yara Sluiskil	The Netherlands	1.3 millions	Imports of natural gas	Yara International
JSC Acron	Russia	2.6 millions	Abundant	Acron Group
Sabir (Jubail Industrial City)	Saudi Arabia	1.9 millions	Abundant	Saudi Aramco, SABIC
Orascom Construction	Egypt	1.4 millions	Accessible and affordable	OCI N.V.
CF Industries (Donaldsonville)	United States (Louisiana)	1.3 millions	Abundant and affordable	CF Industries
Indian Farmers Fertiliser Cooperative (IFFCO)	India	1.1 millions	Accessible and affordable	IFFCO
TogliattiAzot (ToAZ)	Russia (Togliatti)	2.3 millions	Abundant	TogliattiAzot
KazAzot	Kazakhstan	0.8 millions	Accessible and affordable	KazAzot

Source: Own elaboration

Gray ammonia is not a suitable compound for this renewable and decarbonized future, as it uses a fossil fuel for its production, which results in CO₂ emissions higher than those from the direct use of other fossil alternatives. However, if a different production method is used, based on **green hydrogen** and **renewable energy**, we would be talking about a fully renewable substance with no associated CO₂ emissions, generally known as **green ammonia**. To produce this ammonia at a low cost, a large amount of low-cost renewable electricity and water is necessary. Since the use of **seawater** does not entail significant additional costs for desalination, if the production plant is located on the coast, the key factor will be the availability of renewable electricity. **Areas with high renewable potential** do not necessarily coincide with regions rich in fossil fuels, which will open opportunities for ports located in these areas. A clear example is **Chile**, which, although it produces few fossil fuels and does not have large-scale ammonia production plants, has significant renewable potential. Major projects such as the **HyEx Project** in the **Mejillones** area or the **Magallanes Project** in southern Chile (Illustration 1) are creating opportunities for ports like **Mejillones** or **Punta Arenas**.

Figure 1. Chile's potential for renewable energy generation



Source: Asunción Borrás & Pablo Wallach, HyEx: Green Ammonia

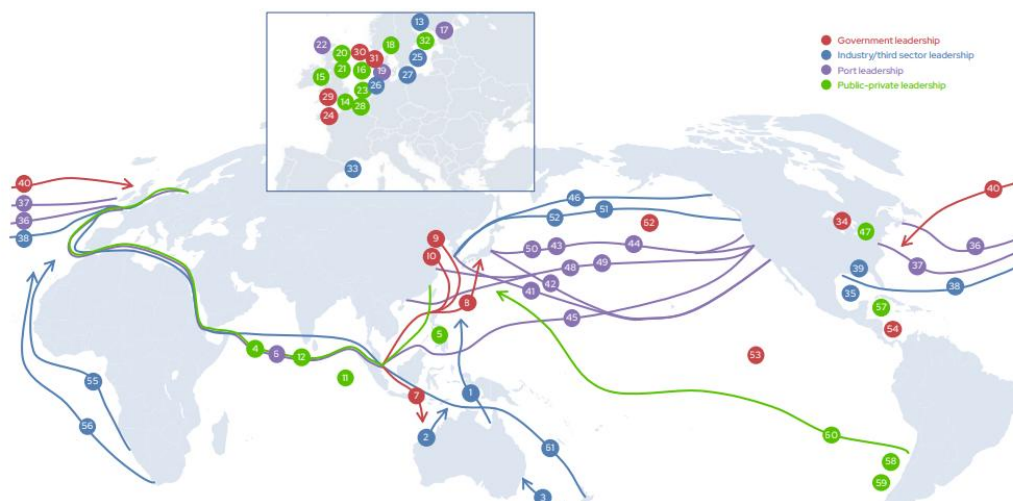
In addition to ammonia, many other **renewable fuels**, **energy carriers**, and **other compounds** will generate opportunities in ports, such as **biofuels** from **residual raw materials**, **renewable methanol**, **solid biomass**, **hydrogen carriers**, or **captured CO₂**. To kickstart the development of this new energy model, the **deployment** of **green corridors** will play a **fundamental role** in facilitating the construction of production and supply infrastructure in the ports that are part of these corridors.

In this regard, **ports**, which have historically been strategic nodes in the distribution of fossil fuels, can transform into **essential logistical centers** within these corridors. By **integrating infrastructure adapted** for **handling and distributing** clean fuels like **green methanol**, **renewable ammonia**, or **biofuels**, ports can play a crucial role in reducing emissions in both the maritime and land transport sectors. Additionally, the electrification of port operations and **the implementation of renewable energy** in

these centers will contribute to making green corridors a viable and efficient alternative within the new global energy model.

Illustration 2 shows the **active corridors at the end of 2024**, with a **total of 62. Ports** that **are part** of these corridors will have **development opportunities** as **energy hubs**, driving innovation in infrastructure, the use of sustainable fuels, and attracting investments in clean technologies.

Figure 2. Green corridors active by the end of 2024



Source: Getting to Zero Coalition – Global Maritime Forum

A **key element** in this transformation is **port infrastructure** specifically designed for the **refueling** and **supply of vessels** powered by **clean energy**. In this regard, some ports are already working on the future supply of renewable fuels, such as the initiatives led by the Port of Singapore. This port has been a pioneer in developing infrastructure for LNG refueling of vessels and is exploring solutions based on green hydrogen and renewable ammonia as part of its strategy to reduce emissions from the maritime sector. Additionally, Singapore is implementing electrification technologies and renewable energy in its port operations, positioning itself as a leader in the transition to a more sustainable and decarbonized maritime transport model.

Furthermore, the **digitalization** and **automation** of logistical processes in these corridors will optimize transportation efficiency and minimize the environmental impact associated with port operations. **International alliances** between **ports, shipping companies**, and **governments** will be key to standardizing practices and developing regulations that promote the growth of these green corridors, facilitating global trade in renewable energy and ensuring a coordinated and effective energy transition.

In addition to the opportunities associated with the development of corridors and/or production and distribution chains for alternative fuels, **other opportunities** for ports will emerge in the coming years as a result of the massive installation of renewable energy. The evolution of these renewable energy sources will generate new logistical

opportunities both in terms of the supply chain for materials and in the **processes of installation, operation, maintenance and recycling** of associated systems.

In the context of **photovoltaic energy**, for example, the expansion of solar installations is driving the creation of specialized logistical infrastructure for **handling, transporting, and installing solar panels**. The demand for materials such as silicon, glass, and rare metals requires efficient logistical management, not only to ensure continuous supply but also to reduce the costs associated with the **global distribution** of these components. Similarly, the **transportation of solar panels**, which must be handled carefully due to their fragility and size, presents additional logistical challenges. Installing photovoltaic systems, both on large solar fields and in smaller areas, requires a logistical approach that optimizes time and resources involved, ensuring efficiency in the construction of solar parks.

In this regard, and according to Mordor Intelligence, the solar energy market is expected to reach 1,840 gigawatts (GW) by 2024 and grow at an annual compound rate of 28.82% to reach 5,080 GW by 2029. Moreover, Fortune Business Insights projects that the global solar panel recycling market will be valued at \$274.21 million in 2024 and will reach \$2,489.52 million by 2032, exhibiting an annual compound rate of 31.75% during the forecast period. These figures reflect significant growth in both the adoption of photovoltaic solar energy and the increasing importance of solar panel recycling, aspects that have direct implications on the logistics associated with handling, transporting, installing, and recycling these components.

On the other hand, **wind energy**, both **onshore** and **offshore**, also faces similar logistical challenges. The installation of onshore **wind turbines** requires managing the transportation of large components such as **towers, blades, and generators**. Due to their size and weight, these elements require specialized transportation, utilizing optimized logistical routes and **heavy machinery**. Installations in remote or hard-to-reach areas demand the **construction of additional infrastructure**, such as temporary roads, to allow access for transport equipment and cranes.

Offshore wind energy, although presenting greater logistical challenges due to marine conditions, is experiencing considerable expansion. Installing offshore wind turbines requires **specialized vessels** to transport components to offshore locations, as well as **floating platforms and large-capacity cranes** for assembly. Furthermore, the **operation** and maintenance of **offshore wind farms** involves complex logistics, including the use of vessels and helicopters to ensure quick access, especially when repairs or component replacements are necessary.

According to data from *Global Market Insights*, the onshore wind energy market was valued at \$77.9 billion in 2023 and is expected to grow at an annual compound rate of 11.3% from 2024 to 2032. Meanwhile, the global offshore wind energy market was valued at \$32.41 billion in 2024 and is expected to reach \$38.15 billion in 2025, with an annual growth rate of 17.7% until 2033. These figures reflect significant growth in both onshore and offshore wind energy, highlighting the importance of addressing the associated logistical challenges to ensure efficient and sustainable sector expansion.

Finally, managing the **waste** generated by the decommissioning of offshore wind turbines also requires **detailed logistical planning**. This waste must be transported to ports for recycling or proper disposal. The logistics of this process, which involves specialized equipment and large cranes, must be efficient to minimize environmental impacts and reduce operational costs.

With all of this, **ports** play a **key role** in the **energy transition**, potentially consolidating as **strategic hubs** for the **distribution of renewable fuels** and **the logistics of new energy sources**. In this framework, green corridors will be a **crucial lever** for this transformation, facilitating the necessary infrastructure for the supply of sustainable fuels and reducing emissions in maritime transport. However, their impact will not be exclusive. **Other opportunities arise** with the growth of the renewable sector, such as the expansion of solar and wind energy, which requires efficient logistical chains for the installation, maintenance, and recycling of equipment. Additionally, the production and distribution of alternative fuels like green ammonia, hydrogen or biofuels will generate new trade dynamics in ports.