



*THE MARKET FOR SYSTEM INTEGRATION OF HYBRID AND ELECTRIC  
PROPULSION SOLUTIONS*

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*May 2023*

## About this document

Menon Economics has conducted an assessment of the green transition in the European maritime sector and the role of system integrators in delivering hybrid and electric propulsion solutions.

We find that the market for hybrid and electric propulsion solutions has a significant growth outlook, and that system integrators will play an increasingly important role in this market. This holds implications for how market players can position themselves in order to sustainably deliver value.

In this white paper we present developments and findings related to the green maritime industry, and a deep dive into the system integrator's role in this market today and going forward.

Menon Economics is a research-based analysis and consultancy company at the intersection of business management, economics and business policy. We offer analysis and advisory services to companies, NGOs, municipalities, counties and ministries. Our main focus is on empirical and strategic analyses of economic policy, and our employees have economics expertise at a high scientific level. Menon is Norway's leading provider of analyses of the maritime industry – to both Norwegian and international customers.

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May 2023

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## Green maritime trends

*In this section, we discuss the European market for green maritime (i.e. hybrid and electric propulsion) newbuilding projects. We first define a scope for the relevant market. We then illustrate and comment on the size and composition of the this market.*

## The green transition will drive significant transformation in the maritime sector relating to use of hybrid and electric propulsion solutions.

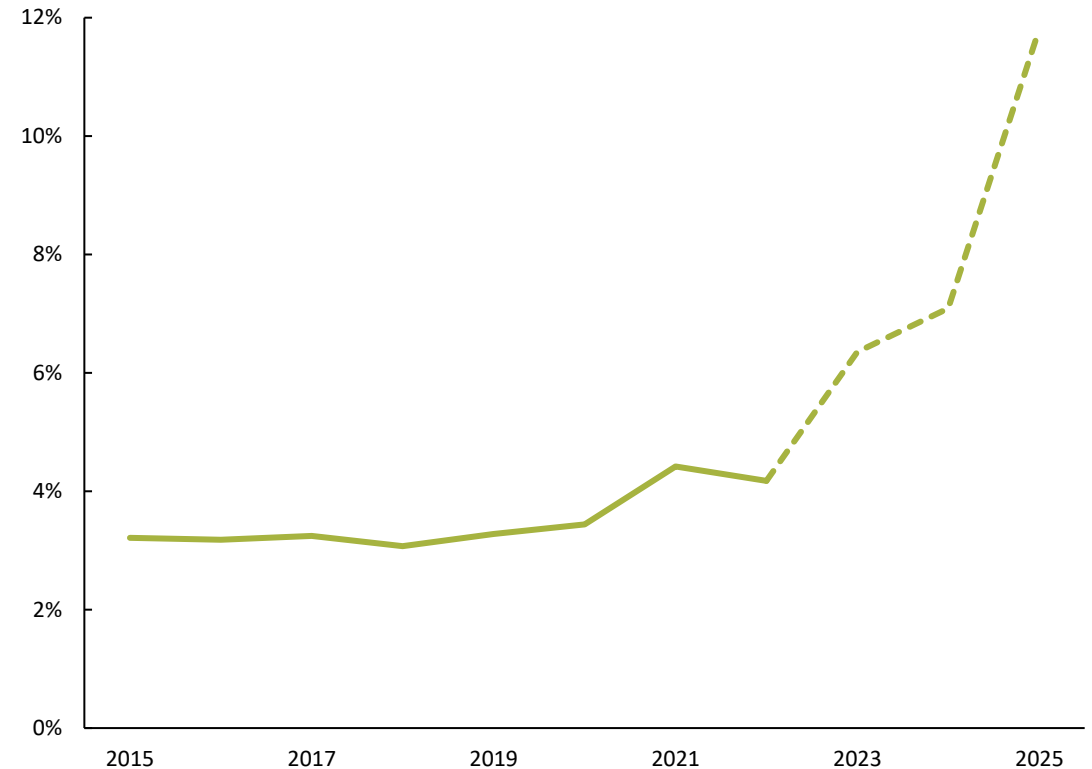
To achieve the goals of the Paris Agreement, which involves limiting global warming to below 2°C, significant changes are needed in both the production and use of energy. The global shipping industry contributes to a significant share of emissions globally. Reducing emissions from shipping activities will play a crucial role in achieving the climate targets. The global orderbooks indicates that a large-scale transformation is well underway. However, there is still much work to be done. The transition from fossil fuels to low- and zero-emission solutions in marine vessels has the potential to create significant changes in the structure of the maritime value chains, creating room for new market positions. Development of new business models is therefore a key task in achieving sustainable development for the shipping industry and the entire maritime sector.

This transformation is already underway. According to global fleet and orderbook data, deliveries within hybrid and electric ships will increase significantly in the years to come, from constituting approximately 4 % of global deliveries in 2022 to just below 12 % in 2025. Menon analyses indicate that this trend will continue in the long term.

*‘The introduction of stricter environmental requirements for international shipping by the International Maritime Organization (IMO) will result in growing global demand for environmental and climate technology in the years ahead’*

- Norwegian Government

**Hybrid and electric vessels in Europe as a share of global ship deliveries (2015-2022) and expected share of hybrid and electric vessels in orderbooks (2023-2025). Source: Menon Economics, Clarksons World Fleet Register.**



# Through applying two boundaries to global shipping data, we get an overview of the European market for green propulsion solutions (i.e. the relevant market in scope)

The global shipping industry consists of over 155 600 vessels, and the current global orderbooks encompass more than 6 100 vessels. In order to make considerations related to the European market for hybrid and electric vessels, we apply two boundaries to our data – a geographical scope and a technical scope, described below.

As a result, the relevant market on the global fleet comprises approximately 2 700 vessels, while the current orderbooks features 470 vessels. This translates to approximately 1.7 % and 7.7 %, respectively.

The difference between 1.7 % to 7.7 % illustrates the substantial shift in the market going forward in the short term, where the European hybrid/electric market as a share of the total shipping market will make up an increasing share. These changes are expected to have a significant impact for the market and its composition of players.

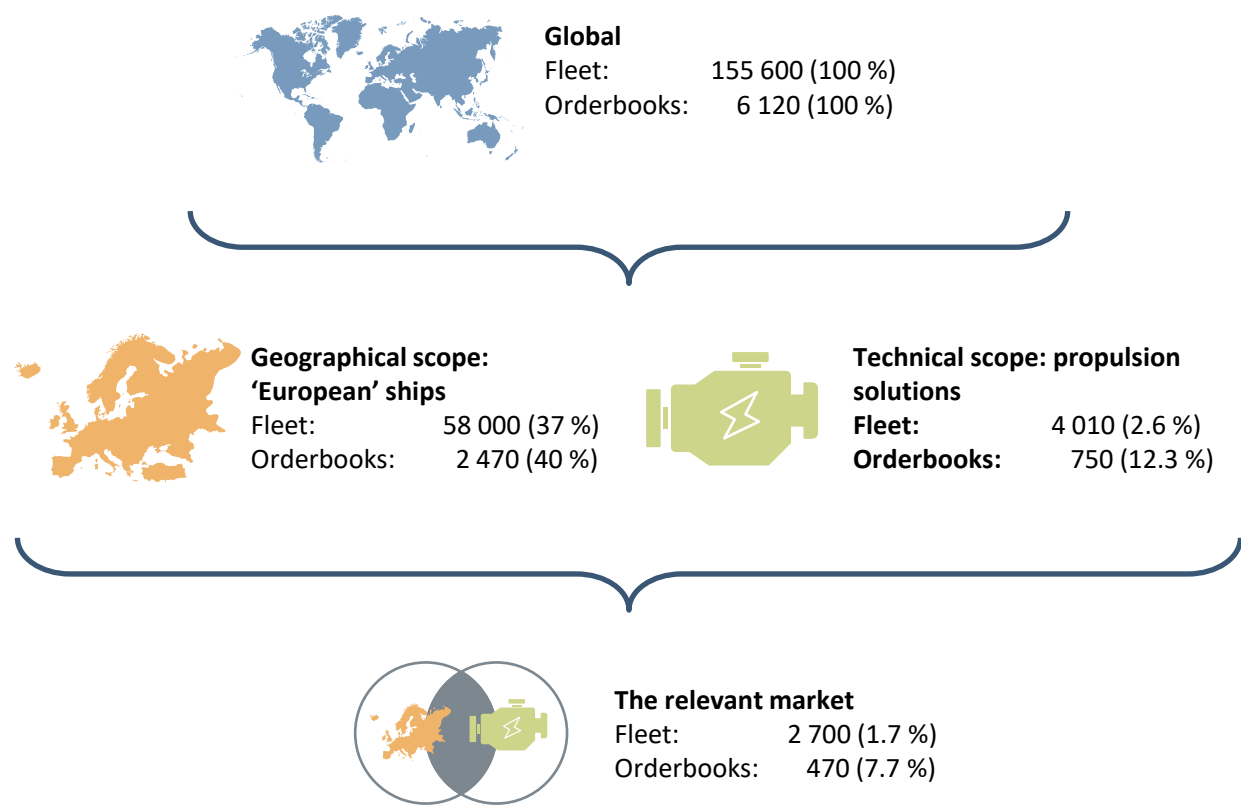
**Geographical scope: 'European' ships**  
 Defined as ships that are either:

- ✓ Built **in** Europe, but may be owned anywhere
- ✓ **Owned by** a European shipowner, but may be built anywhere

Note: Europe includes Turkey

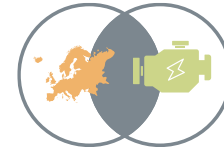
**Technical scope: propulsion solutions**  
 Defined as vessels that use one of the following propulsion solutions:

- ✓ Internal combustion engines (ICE) & Electric (e.g. diesel electric engines)
- ✓ ICE & Batteries
- ✓ Batteries Propulsion
- ✓ Fuel cells Propulsion



\* Data based on Clarksons World Fleet Register. Data retrieved on the 30<sup>th</sup> of march.

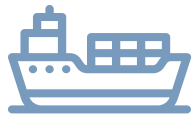
# The relevant market is currently dominated by diesel electric vessels. The orderbooks indicate significant change in the coming years



### The relevant market

Fleet: 2 700 (1.7 %)  
Orderbooks: 470 (7.7 %)

There will be a significant change in the composition of the different propulsion solutions in Europe over the coming years. As illustrated to the right, the current fleet of hybrid and electric vessels in Europe is dominated by vessels fitted with ICE Electric propulsion solutions (in turn dominated by Diesel-electric solutions). As the current orderbooks suggest, this trend is expected to change dramatically, with the increasing use of batteries and zero-emission solutions, such as fuel cells for the propulsion solution.\*

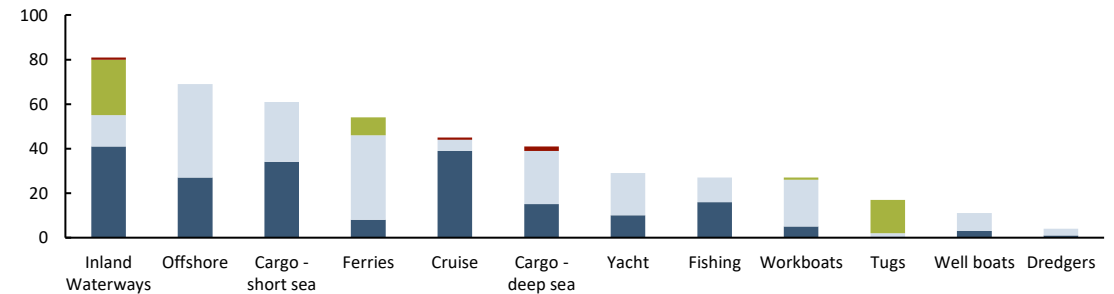
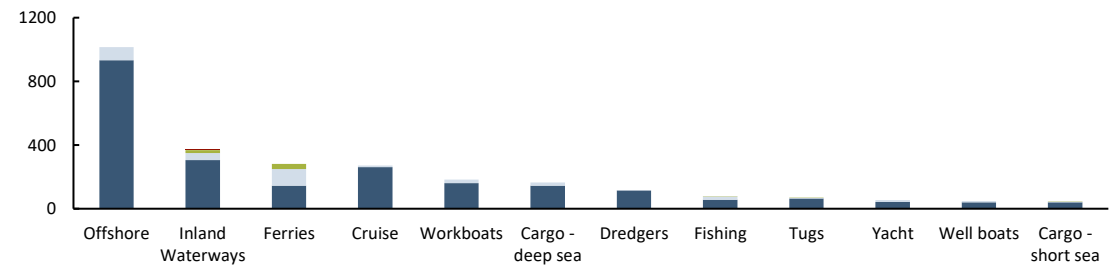


The shipping industry is composed of a wide range of ship segments. Each segment has its own set of unique characteristics that affect their level of complexity. The complexity varies based on their size, purpose, routes and other factors. Therefore, understanding the key characteristics of the different ship segments is important. The figures to the right illustrate what ship segments this analysis includes.



**ICE Electric:** Source of energy is from an internal combustion engine. Uses electric motors to drive propellers.  
**ICE & Batteries:** Source of energy is from an internal combustion engine. Stores excess energy in batteries (can also be rechargeable). Uses electric motors to drive propellers.  
**Batteries Propulsion:** Source of energy is from rechargeable batteries. Uses electric motors to drive propellers.  
**Fuel Cell Propulsion:** Source of energy is from a fuel cell. Uses electric motors to drive propellers

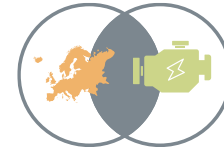
Figure: Number of vessels in the fleet (top) and orderbooks (bottom) in the relevant market by ship segment and propulsion solution. Source: Clarksons World Fleet Register



■ ICE Electric    ■ ICE & Batteries    ■ Batteries propulsion    ■ Fuel Cell propulsion

\* Data based on Clarksons World Fleet Register. Data retrieved on the 30<sup>th</sup> of march.

# The majority of the market is vessels built in European yards on behalf of European shipowners



### The relevant market

Fleet: 2 700 (1.7 %)  
Orderbooks: 470 (7.7 %)

The relevant market is defined geographically by two criteria – ships built at European shipyards, or ships owned by European shipowners. This implies that vessels can be either built or owned outside Europe. 60 % of the market are ships both built in European shipyards and owned by European shipowners. In the following we break down the geographical scope in terms of the builders’ and owners’ perspective, respectively.

#### Vessels built in Europe:

**Current fleet:** 79.9 % of the vessels in the relevant market in the current fleet is built in European yards and the remaining 20.1 % is built in yards outside of Europe.

**Orderbooks:** 76.4 % of the vessels in the relevant market in the current orderbooks will be built in European yards and the remaining 23.6 % in yards outside of Europe.

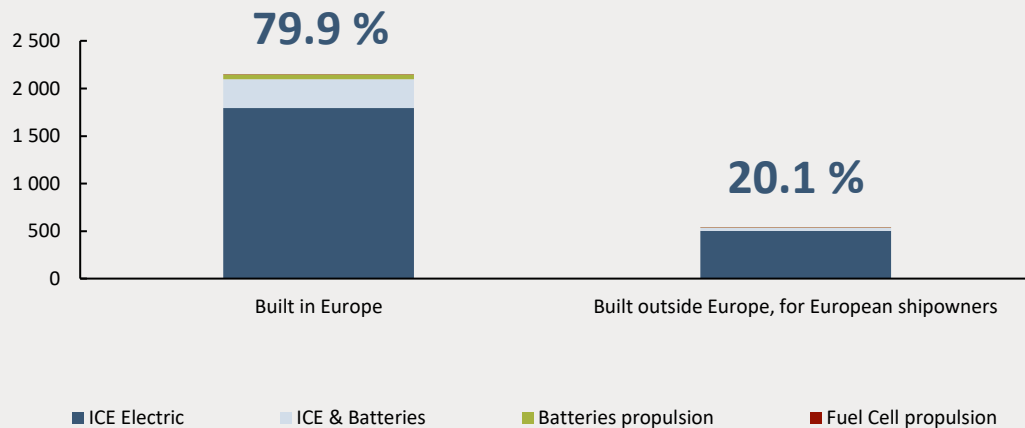
#### Vessels owned in Europe:

**Current fleet:** 80.4 % of the vessels in the relevant market in the current fleet is owned by European shipowners and the remaining 19.6 % are owned outside of Europe.

**Orderbooks:** 84.5 % of the vessels in the relevant market in the current orderbooks will be owned by European shipowners and the remaining 15.5 % are owned outside of Europe.

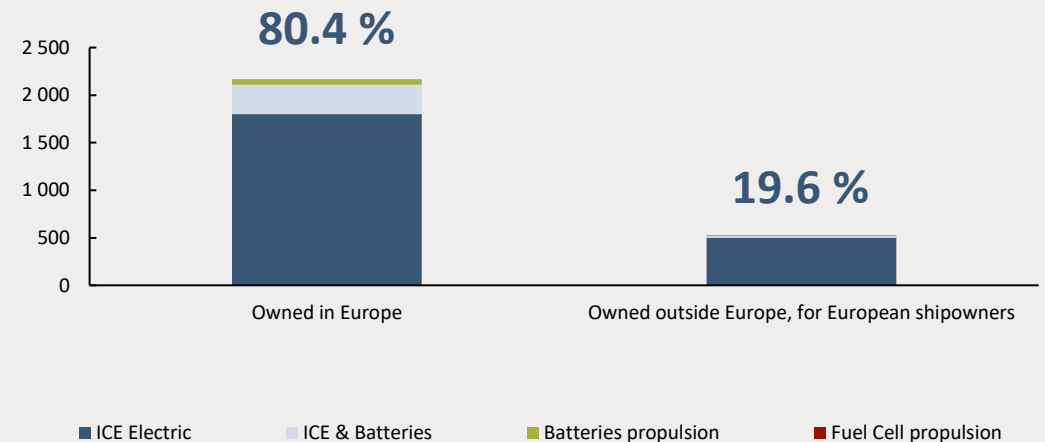
### Builders perspective: Current fleet

Majority of vessels were built in European yards

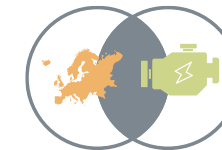


### Owners perspective: Current fleet

Majority of vessels are owned by European shipowners



# Norway is the largest builder country within the relevant market in the current world fleet. The Netherlands are dominating the current orderbooks



### The relevant market

Fleet: 2 700 (1.7 %)  
Orderbooks: 470 (7.7 %)

Figure: The largest builder countries in the relevant market in the world fleet by propulsion solution. Source: Clarksons World Fleet Register

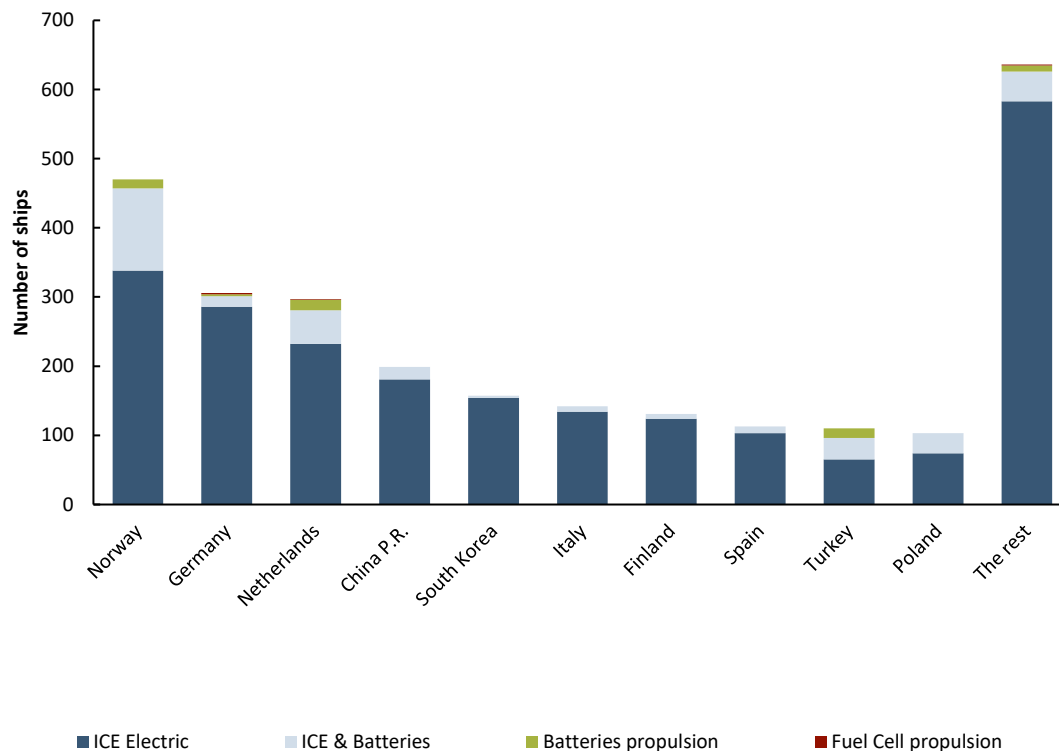
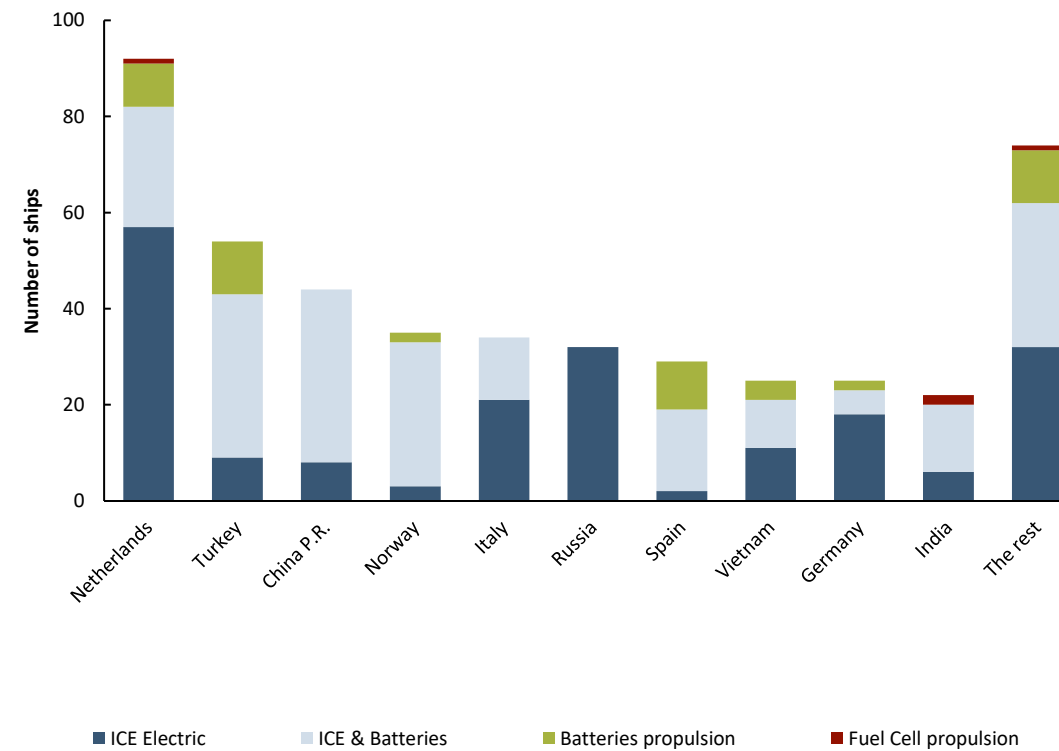


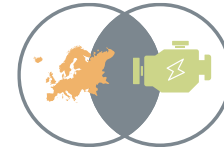
Figure: The largest builder countries in the relevant market in the current orderbooks by propulsion solution. Source: Clarksons World Fleet Register



\* Data based on Clarksons World Fleet Register. Data retrieved on the 30<sup>th</sup> of march.



# Norway is the largest owner country within the relevant market on the current world fleet *and* in the orderbooks



**The relevant market**

Fleet: 2 700 (1.7 %)  
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Figure: The largest owner countries in the relevant market in the world fleet by propulsion solution. Source: Clarksons World Fleet Register

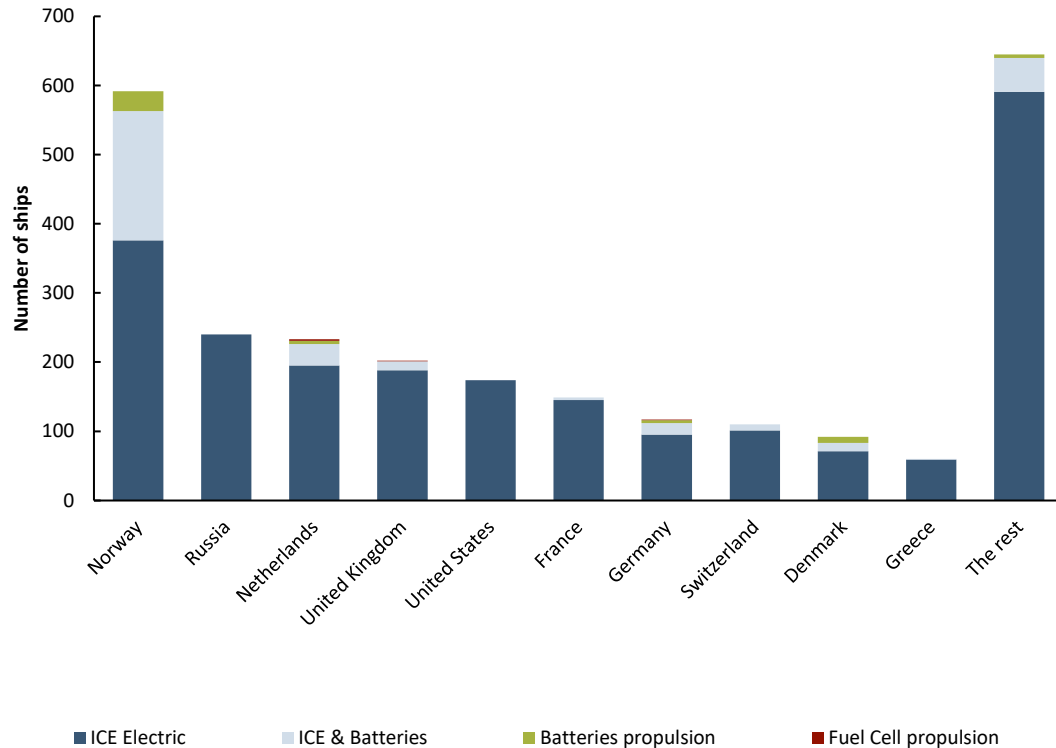
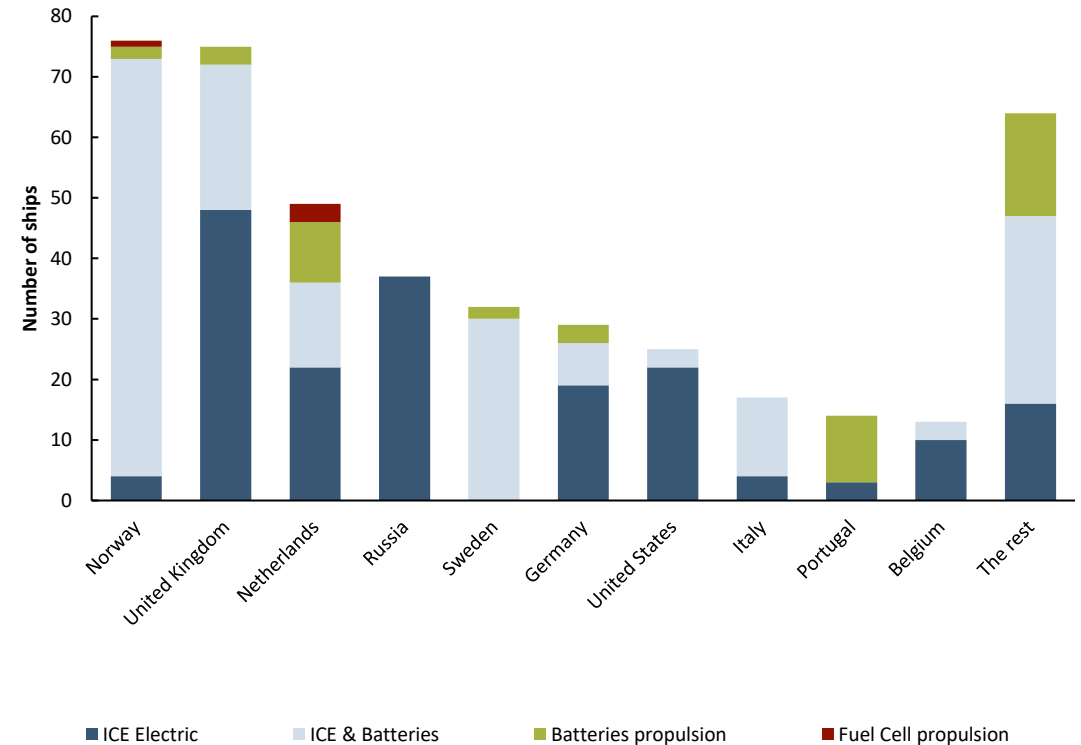


Figure: The largest owner countries in the relevant market in the current orderbooks by propulsion solution. Source: Clarksons World Fleet Register



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## The role of system integrators

*In this section, we discuss the market for system integration. We begin by discussing the emergence of system integration as a discipline in light of increasing complexity in hybrid propulsion solutions, and introduce a framework to understand system integration as a way of ensuring a set of 'jobs' are conducted. We then discuss findings and considerations from interviews with relevant market players.*

## System integration can be understood in terms of coordinating and ensuring that four different functions (or ‘jobs’) are delivered in newbuilding

The introduction of hybrid and electric propulsion solutions, and with it the increased complexity in ships’ power management systems, has driven the market for system integration in newbuilding (retrofitting is excluded from this analysis). However, there is no precise definition of what system integration does and does not entail. To understand the market we have deconstructed system integration into four different ‘jobs’ that all need to be solved by the system integrator. These jobs can be conducted by the system integrator itself, or be outsourced to others. The integrator will however need to coordinate all of these functions. The ‘jobs’ are described in the following.



**Hardware:** A hybrid propulsion solution depends on a wide range of physical equipment. In addition to conventional equipment, vessels with hybrid propulsion solutions are installed with battery packs, specialized heat exchangers, switchboards, inverters and converters, various sensors and an extensive length of cables. The system integrator does not need to be the producer or supplier of all this equipment, but has the key function of integrating all the equipment into the overarching system.



**Software:** Data collected by sensors on a range of different hardware is used to monitor and control equipment\* on board the vessel. All these different ‘equipment specific’ software systems can be viewed as *sub-systems*, whereas the system integrator integrates all these different sub-systems into an overarching system. These overarching software solutions are known as *Integrated Automation Systems* (IAS) and coordinate all the different sub-systems into one interface that lets the crew monitor and control them in a simple way.



**Ship design:** Compared to conventional propulsion solutions, hybrid solutions need more space for hardware. Additionally, the increased complexity and performance requirements of hybrid solutions makes the specific location of hardware more important. Consequentially, the energy design needs to be considered in the overall design of the ship – from drawing up the hull to the finalization of the ship design.

The extent to which system integrators stress that close and good relations to ship designers is a key feature to be competitive underlines the importance of ship design in the delivery of system integration services.



**Installation & service:** The installation of all necessary hardware and software needs to be done or overseen by the system integrator. A significant part of the system integration service is also the commissioning of the vessel once put to sea. Within this ‘job’ we also include the monitoring of installed systems and regular maintenance and updating of installed equipment and software.



**System integration:** Integrating all sub-systems such that these can interact with each other and be presented to give an entire picture of the vessel at any point in time.

A system integrator supplies advisory services in the design of a ship and connects all necessary hardware and sub-systems to an overarching software system to be monitored and controlled by crew members and potentially remotely

\* E.g., engines, propulsion, steering, cooling systems equipment on deck etc.

# Structuring the four jobs into a 2x2 matrix for analysis allows us to further understand market dynamics and strategic positions of system integrators

The four jobs in the market are placed into quadrants along two dimensions:

- Front-end vs. back-end: to what degree products and services are in direct contact with clients – yards and shipowners
- Tangible vs. intangible products and services: to what degree products and services are delivered physically vs. through design

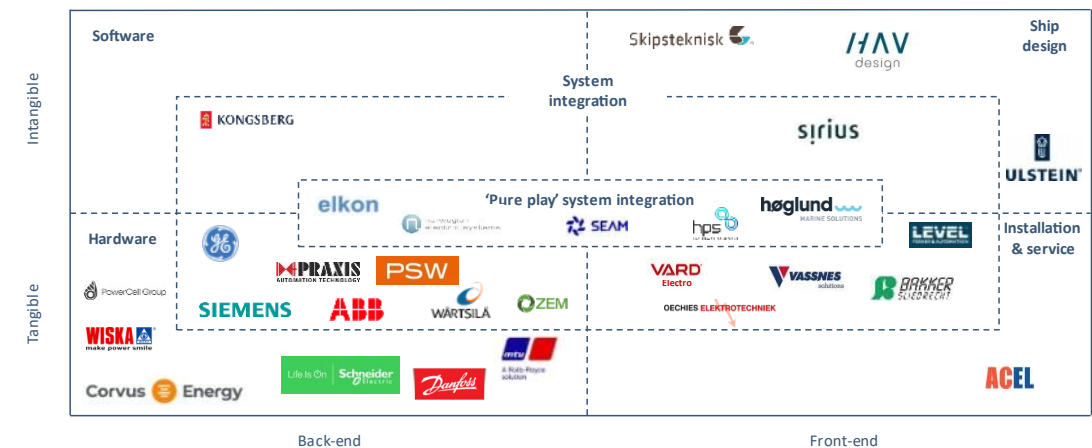
There are relatively few market players that identify solely as system integrators, and a market definition for system integration is relatively fuzzy. Instead, system integration has over time become an extended service that market players have taken into their storefront, typically in order to differentiate their market position by extending their part of the hybrid maritime value chain.

From the market, we historically see two main paths of entry into system integration, as illustrated in the market overview illustrated to the right:

- **Hardware/OEM suppliers** (the left bottom corner) that have moved into system integration as a value adding service/differentiator.
- **Electric installers and service providers** (the right bottom corner) developing more specialized services and providing system integration of more advanced propulsion systems.

In addition, some players with a background in software and ship design have moved into this market. The development of the market for maritime (hybrid) propulsion solutions has led to some market players having system integration as their main business.

**Market overview: jobs to be done related to system integration and examples of players\* that provide them. Source: Menon Economics**



\*Note that the market overview is indicative and gives an overview of types of players that provide different jobs related to system integration. Many players provide an array of services and could be placed in multiple 'boxes'. Players are categorized based on our understanding of where their main business lies.

*Traditionally, the yards and their electric installers were what you could call system integrators. This was disrupted with diesel electric systems in offshore and ferries in the late '90s. As systems have become more advanced, system integration has grown as its own discipline and market.'*

- Interview with a 'pure play' system integrator

## Through dialogue with players in the market, we find that the position of the system integrator will be key in driving the green maritime transition



**A fragmented market in rapid growth.** System integration of hybrid propulsion solutions is still a fairly young market with significant expected growth. We estimate a market size in Europe of between 1 200 – 1 400 hybrid newbuilds in the period 2023-2030. The system integrator will play an increasingly more important role in this market as it develops. Though market insiders expect increased consolidation in the system integration market looking forward, strong market growth and continuous changing market dynamics implies opportunities for value capture by new players in the short- and mid-term.



**In the long-term, technology platforms may lead to strategic lock-in.** The rapid and continuous technological progress within electrification and IT in the maritime sector results in a steadily increasing complexity in system integration. Shipowners increasingly benefit from consolidating their fleets with one uniform system integration platform in order to realize economics of scope. The increasing complexity in integration increasingly creates a ‘lock in-effect’ for shipowners to specific system integrators. Some market participants expect a trend towards more standardization looking ahead as a market response.



**Ship type matters.** System integrators can to some extent be segmented along a dimension of price and quality, who in turn to some extent correlates to ship segments. More ‘complex’ segments, such as Offshore, Yachts, Ferries and Dredgers appear to be less price sensitive. The segments Inland waterways, Fisheries and Cargo generally see higher price competition (though there are notable project specific differences).



**Establishing and maintaining good relations to shipowners and ship designers** is a key to succeed in the market. Relations to yards is of less importance. In a typical project, the system integrator is involved in the initial planning and design phase, usually prior to the choice and involvement of yards.



**Managing the four ‘jobs’ is key to a sustainable competitive advantage.** The system integrator is a key player in coordinating delivery of hardware, software, design and installation/service. Though not necessarily responsible for the completion of the jobs, the system integrator is responsible for the coordination of these functions. Thus, the system integrator needs to have an awareness of how the different jobs are conducted in order to deliver in a competitive way.

