NARRATIVE DOCUMENT

This document is designed to create a narrative thread through the pre-project and project period along with a number of insights into the continued development of the wind-assist market.

Pre-project history

State of wind propulsion in 2018/19

The WASP project was formulated in period from late 2018 to early 2019. This is less than 12 months after the IMO initial strategy on decarbonisation was adopted, and prior to any serious work had been done on decarbonisation pathways. However, it was a period of optimism on the relatively speedy uptake of short- and medium-term decarbonisation measures such as carbon pricing, design and operational measures etc. Wind-assist propulsion was at the time still in its infancy. At the moment the WASP project kicked off in October 2019, there were only six ships with rigs installed, but quite a healthy R&D pipeline was being established and a number of technologies were coming into pre-market positions.

This limited number of suppliers constricted the options for product selection, however there were enough to choose from to make the project viable, but reliant on emerging technology options for three of the ships.

Barriers in this period

As has been clearly evident throughout the project, during this period there were still significant barriers to entry. Technology dissemination was still very low both in the EU and worldwide, and there was very limited understanding of, and even resistance to wind propulsion solutions in the market and among policy makers. Indeed, part of the project deliverables were designed to not only analyse but also actively tackle these barriers. Perception of a technology is particularly difficult to quantify, however an overriding impression was that this technology basket was something from 'the past' and the industry would be 'going back to the future'.

If we look at the International Chamber of Shipping (ICS) Annual Review 2018 then there is no mention of wind-assist in the report from the largest shipping organisation globally https://www.ics-shipping.org/wp-content/uploads/2021/01/ics-annual-review-2018.pdf However, by November 2020 ICS had issued the 'Catalysing the Fourth Propulsion Revolution' report with a primary wind design concept on the front cover and a paragraph on wind-assist propulsion:

"Harnessing the power of the wind, the shipping industry's oldest propulsion system, is becoming a viable option thanks to new technology. While today's modern ships are unlikely to ever be driven exclusively by the power of nature, wind-assisted propulsion could complement systems that use zero-carbon fuel. Recently developed rigid wing sails and kites as well as the Flettner rotor that use force that derives from vertical rotors, could be further developed to provide a secondary zerocarbon propulsion system for ships or even primary propulsion on some routes. Even though existing retro-fitted wind systems can only currently supply 5–10% of a ship's energy requirements, these are likely to be further optimised and hybrid wind-electric systems are potentially attractive R&D approaches."

https://www.ics-shipping.org/wp-content/uploads/2020/11/Catalysing-the-fourth-propulsion-revolution.pdf

Project Launch/Timing

Launch timing

This project launched in October 2019, only 5 months before Europe effectively locked down in March 2020. This was designed as an interactive and installation focused project that had little time to create a project implementation and dissemination ethos in person, so opened with a rather substantial challenge.

Market size and projections
Installations were predicted to grow steadily during the period supported by in-person conferences, visits to the vessels etc. The five installations in the WASP project would effectively double the number of modern wind-assist vessels from the 2018/19 period in the space of 12 months, however through delays this was extended. It was predicted that this doubling of installations would likely continue yearly from this point, thus the development curve would see roughly a doubling of installations, with a majority of those occurring in the EU and North Sea region due to the work underway there:

Predicted growth – after the initial installation and assessment period (12 months)

2020/21 – 11 + 3 non project installations = 14 vessels in total
2021/22 – 14 newly installed vessels = 28 vessels in total
2022/23 – 28 new installed vessels = 56 vessels in total
2023/24 – 56 new vessels = 112 vessels in total

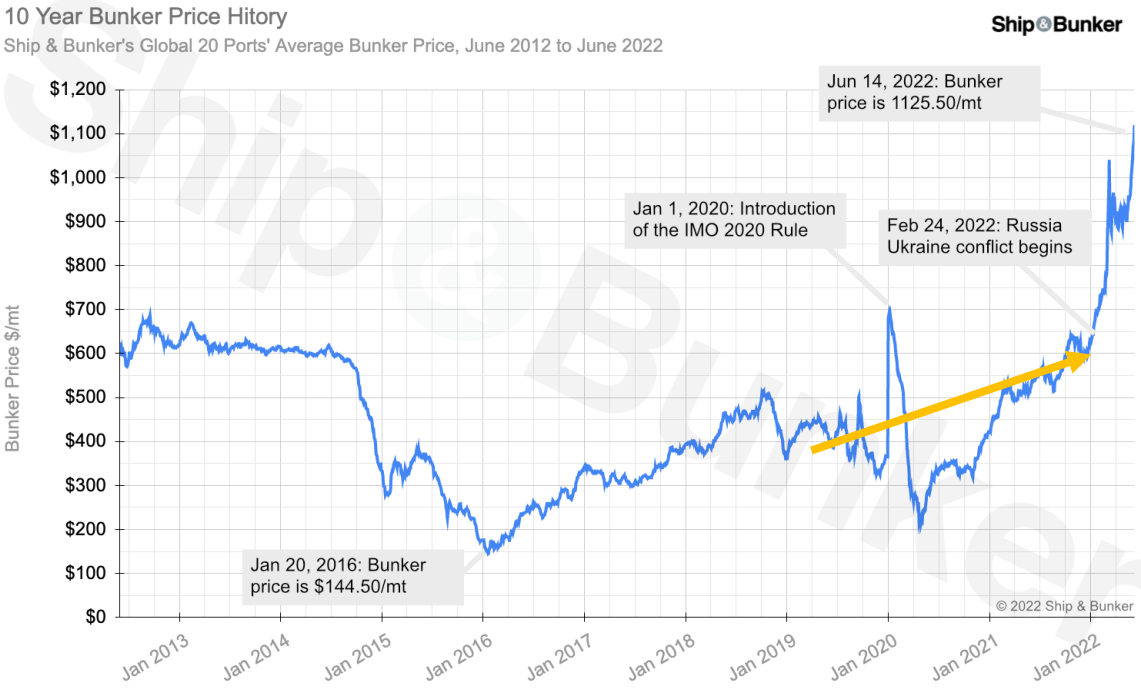
Drivers & Barriers

The project was developed with some key assumptions in place that a number of drivers would continue relatively unabated and grow during the period.

1 – Continued growth of interest in decarbonisation in shipping
This was certainly growing in the industry pre-covid, however the focus on maintaining the logistics chain and seafarer issues shifted the focus away from investments in technology for 12-18 months and then this was followed by crewing issues caused by the Russian-Ukraine conflict.

2 – Regulatory pipeline, vigour & subsidies
The regulatory work at both an international and regional EU level also drifted during the Covid period, which has seen the debate around carbon pricing, mandating greening of the sector stymied to a degree and also deflected away from total energy use discussions towards a heavily 'fuel-centric' debate on new alternative fuels, which are mid- to long-term solutions requiring vast amounts of infrastructure spend. This pivot to alternative fuels was not expected to intensify so quickly nor attract such large subsidies for R&D and increasingly deployment. A clear example of this is the rise of ammonia, a fuel that wasn't even on the radar in 2019/2020.

3 – Fuel prices continue to rise
The price of fuel was expected to continue to steadily rise as a baseline throughout the period late 2019 through to the end of 2022. However, throughout the first 9 months of the pandemic fuel prices were surpressedand only really recovered to the assumed levels in early 2022.
This had the effect of dampening the interest in energy-saving and non-fuel propulsion systems during this period. This low fuel price driver during that period was also compounded by the strong 'alternative fuel' focus in policy and industry circles which has directed attention and finance away from the non-fuel activities and this policy capture and fuel-bias has continued right up until recent months as ambitious decarbonisation targets are becoming more likely at an IMO level and to a degree at EU level with the less ambitious EUMaritime package.



4 – Europe would remain the main market developer or leader in WPT

Due to the unexpected delays in development during the covid period, this has also given an opportunity for other regions to start growing their own WPT systems and installations, thus increased numbers of non-EU based installations and projects has also to a degree decreased the focus on the North Sea and EU as an innovation driving region in this technology segment, even though it still leads in certain indicators.

5 – Timeline & innovation Diffusion

Innovation diffusion theories have many factors/drivers that are key, however a critical issue is the development of demonstrators and a number of points of reference for new technologies to have before stakeholders/customers are able to compare, contrast and the make purchase decisions. Many shipowners and other stakeholders quote the need for three points of reference for any given technology and preferably three points of reference in any specific shipping segment. As the project kicked off, rotor sails had reached the first milestone, wlthough not in any given segment. Suction wings and foils had not reached that milestone yet.

These tipping points are critical drivers and lead to significant movement in the market, away from single installations and towards fleet ones:

Three demonstrators	Overall	General Cargo	RoRo	Ferry	Bulker
Rotors	2018	2021	2023	Not yet (2)	2023
Suction Wing	2021	2021	-	-	-
Foils/Wing sails	2022	-	-	-	-

6 – Learning Curve & Economies of Scale

This is a key driver in innovation uptake, however due to delays and the industry distracted by other matters, the slower uptake of WPT also means that the technology is not as far down the learning curve as anticipated and thus costs/prices remain higher than anticipated over an extended period

of time. This has led to a less attractive disposition from financial markets towards financing systems until quite recently.

Market Growth – Projections and Drivers

Increased market uptake – 2022-2023
If we move the development curve forward 18 months to take into account the drivers and barriers listed in the previous section generated by Covid19 lockdowns and other logistics and inflationary pressures that have been strong influences in Europe during 2022, the projections and market forecasts start to align far better with the pre-project projections.

All types of WPT Worldwide

Projected		Actual	
Year	Total Installations	Year	Total Installations
2019/20	6	2019/20	6
2020/21	14	2020/21	8
2021/22	28	2021/22	17
2022/23	56	2022/23	23
2023/24	112	2023/24	49
2024/25	224	2024/25	80+

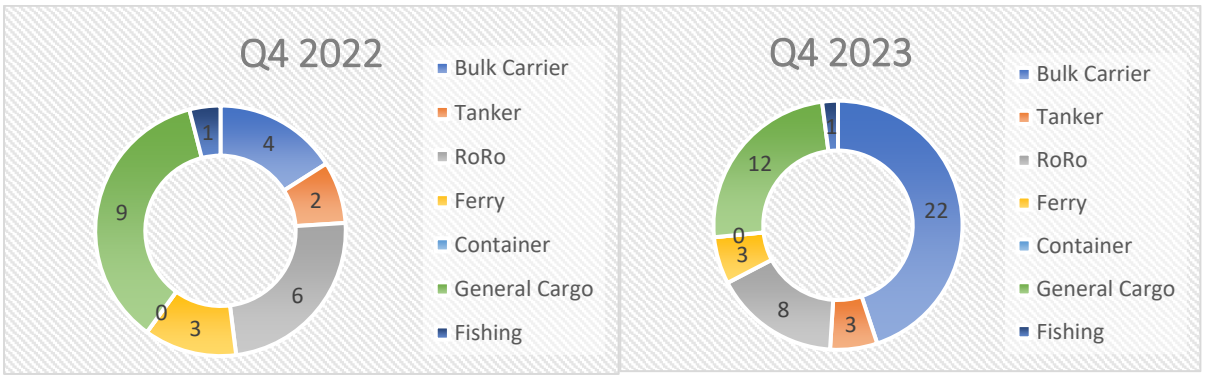
Direct Influence
Direct influence from the WASP project can be identified in increased rotor installations worldwide, especially highlighted by the Scandlines second commercial installation of a rotorsail (without any subsidy) on the MV Copenhagen sister ship the MV Berlin and the installations on two large RoRo vessels in the past 12 months. Suction wings have also been installed on two further general cargo vessels along with orders for eight more vessels, all likely to be operating in and around the North Sea region.

Indirect Influence
The WASP project was a vital intervention to both stimulate and maintain momentum in the sector during a very challenging period. The stream of information, visible installations and the contribution of the project to the research, literature and policy debate are all significant. Although anecdotal, many shipowners and technology OEMs have also expressed their appreciation and continued interest in the outputs from the project and see this as one of the key projects moving the needle in the industry.

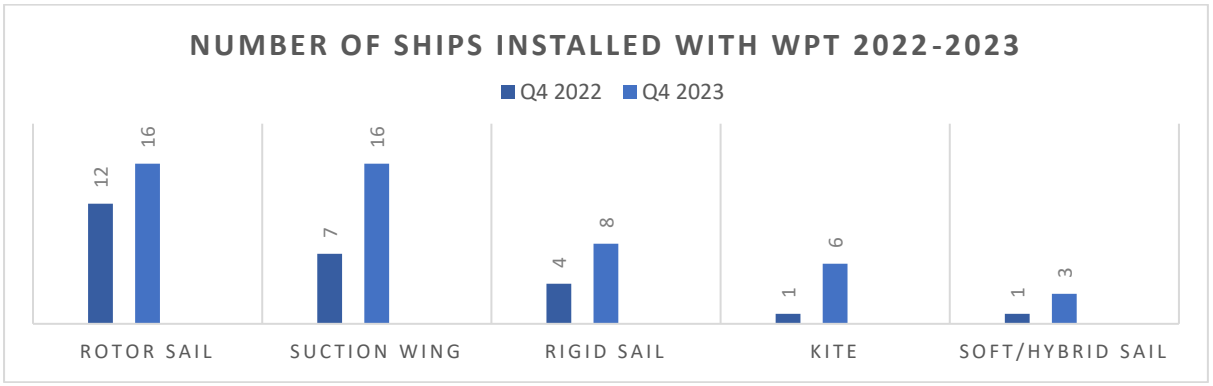
Worldwide Trends
As mentioned in the previous section, one area that has seen significant dissemination during this delayed period of growth in installations has been in the dissemination of WPT knowledge and expertise worldwide, especially in Asia and to a lesser extent the US. We have also seen a flourishing of projects in France and the UK, somewhat spurred by activities in the North Sea region and the WASP project (France developments outlined in white paper) https://www.wind-ship.fr/livre-blanc

'S' Curve outline to 2025 and onwards to 2030
The anticipated classic innovation dissemination 'S' curve appears to have engaged and growth projected for 2023 and 2024 indicates a shallow but accelerating upward tick.

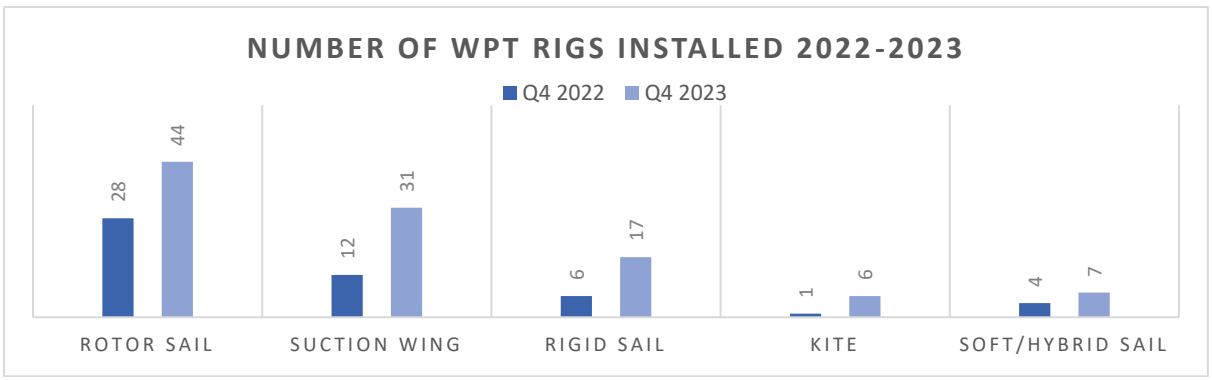
These graphs below are taken from MEPC79/Inf.21 and indicate the predicted Q4 2022 and Q42023 installations as projected forward from August 2022, and the installations up to Q4 2022 matched that installation pattern. As of writing (June 2023), there have been an additional two full installations and eight further vessels have been delivered 'wind-ready' meaning that foundations, hull/deck reinforcement and other system changes such as wiring, navigation lights and radar coverage adaptations have been made on the vessels, but they await the actual rig installation.



WPT installations by fleet category 2022-23 Source: IWSA (Aug 2022)



Ships installed by WPT category Source: IWSA Members Survey (May 2022)



Rigs installed by WPT category 2022-23 Source: IWSA Members Survey (May 2022)

Learning Curve Developments

The IWSA and other industry analysts use a broad learning curve of 10%, thus meaning that for every doubling of installations there is a 10% reduction in cost. This 10% figure is used for maritime machinery innovation and also aligns with offshore wind turbines. However, this 10% figure is the levelized number over a decade and it is expected that the greatest decreases in cost occur in the earlier iterations. Through the lessons learned in the WASP project, we have seen that production costs have been brought down through more streamlined production processes (Econowind) and also reducing the time for foundation preparation work and installation and testing times. (Norsepower)

Regulation and Standard Approach Contributions

The WASP project has been held up as an example in submissions to both the EU and IMO policy deliberations and through collaboration with the ITTC, standards for KPIs to evaluate contributions from WPTs and standard procedures for sea trials for WPT equipped vessels. These are significant contributions that reduce the barriers for further deployment and dissemination of WPT's

In 2022/2023, the policy pipeline has strengthened with shipping inclusion in the EU ETS, FuelEU Maritime in the final stages of deliberation and the EEXI and CII regulations at an international level have come into force. These will be significant drivers going forward, but mainly in the case of larger vessel, which ignores the important impact that the small vessel level (under 5,000gt) has on innovation uptake, as these are the very vessels where early installations and testing is underway and also where multiple, standardised WPT units can be deployed at scale, quickly.

Conclusion

The full and long-term impacts of the issues above are virtually impossible to quantify precisely, however, the trends are quite evident and point to a delayed but still significant impact from the WASP project.