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Wind works

Gavin Allwright of the International Windship Association considers how wind propulsion can help shipping to meet the decarbonisation challenge

What would the ideal future fuel look like? Which boxes would that solution need to tick? A very low or zero carbon footprint, safe and easy to use with existing installed engines as well as the optimised next generation of new build vessels. A fuel that requires no additional storage space, no additional handling requirements and that can be supplied to the vessel around the world. One that is affordable with a predictable cost over the lifetime of the ship and available today!

Blue sky thinking? Well in a sense, yes it is. But perhaps less 'blue' and more 'blustery', as wind-assist and primary

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propulsion solutions deliver on all but one of the criteria above, that one being that the each unit of power has a predictable cost of 'zero'.

Now, I can hear everyone hollering that wind can't possibly meet the decarbonisation challenge alone, and that is true or at least true that direct wind propulsion can't do it alone, but in combination with power/fuel solutions derived from wind energy generation offshore then it might just be up to the challenge.

The wind-assist propulsion technology toolbox can already deliver 5%-20% savings on fuel as retrofits with the potential to reach 30%, and substantially higher for optimised new builds and the various primary wind propulsion designs under development. We can easily envisage vessels with a 20%-30% wind propulsion component linked to vessel optimisation delivering 20% additional savings and operational savings from weather routing, crew training, virtual arrivals, energy management, etc., delivering an additional 20%+. This leaves a 30%-40% fuel component left to be delivered from low or zero carbon, power to X alternative fuels, a much more manageable nut to crack!

On this basis it is easy to understand why large shipping concerns and customers are engaging with wind propulsion from

shipyards such as Chantiers de l'Atlantique, Samsung & Hyundai Heavy Industries, Oshima Shipbuilding and DCIS to shipowners like Louis Dreyfus Armateurs, Maersk Tankers, Mitsui OSK Lines (MOL), DFDS, "K" Line, Viking Line, Scandlines, etc., along with other non-shipping companies such as Airbus, Drax, Renault, and so on.

What role will wind propulsion play? Well, direct wind propulsion is a primary renewable – abundant and delivered at no charge directly to the vessel at the point of use. Thus, there are few externalities that need to be priced in, such as infrastructure costs, bunkering requirements, supply chain, etc. Wind can be used to save fuel, increase or maintain speed using less engine power or used to extend range, thus giving ship operators more flexibility to bunker at ports of their choice and, finally, it can be used as the primary mover or sole propulsor of the vessel under certain operational and weather constraints.

As noted above, the adoption of wind propulsion can also help to facilitate the uptake of other secondary renewables, such as hydrogen, ammonia, batteries and biofuels. With a sizeable reduction in the fuel/power required, less onboard storage, etc., that means these more expensive, low carbon options can enter the market more economically, earlier and it

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is this hybrid system that can quickly lead to the 'carbon neutral vessel', using today's technology. Do we have a crystal ball? Of course, no one does, but that is actually the point here: wind propulsion solutions also lock in a percentage of fuel costs at zero, creating certainty where there is none. We can't foresee future fuel prices, policy frameworks, carbon pricing or rationing. All of these can't be predicted, but we can predict that all of these areas will be volatile and not risk free. However, one thing we can depend on is that the cost of the wind today and the cost in 30 years when you come to replace your vessel is fixed, helping to future proof your fleet in a period of great uncertainty in almost all other aspects of the shipping industry.

Wind propulsion also aligns well with the development of the ship as an 'energy management system'. While we can predict wind and weather conditions in a macro-sense with weather routing and satellite weather forecasting, the wind is still unpredictable and therefore delivers varied amounts of thrust to the vessel. Energy management systems are increasingly designed to cope with these variations, however, to optimise and capitalise fully on the benefits of wind-assist, then electric drive trains would seem a natural choice for new build options. These systems would also

enable further development of hybrid plug-in/plug-out modular alternative energy systems on vessels as we are seeing proposed for the next generation of zero-emissions cruise vessels for operation in the Norwegian fjords.

With electrification comes other potential benefits from wind, of course direct production of electricity from turbines or from the energy generated from the pull-on kite tethers can be fed into the system. Solar coatings and panels on sails are also being developed on a number of projects, including the 2000 passenger *Ecoship* cruise vessel project under development by Peace Boat in Japan, the Ecomarine wind and solar Aquarius project (also in Japan) and we have already seen a number of small passenger Solarsailor vessels in operation in Sydney, Hong Kong and Shanghai harbours.

Potentially the largest benefit would be for hull-mounted generators installed on vessels that can utilise more of the wind power delivered to the vessels, with these water turbines converting that access power into electricity. There are development projects that are underway, two notable ones are with the EU-backed Spanish company Bound4Blue and MOL & University of Tokyo research on the *Wind Hunter* vessel in Japan, both of which are looking to use the electricity to then produce

hydrogen or other zero-emissions fuels.

Looking at all of this potential, then on a sectoral basis it becomes obvious that wind will be an important component in the decarbonisation drive, and we have some market predictions on the scale of uptake to back that up. In 2016, the EU commissioned an independent report on the analysis of market potentials and market barriers for wind propulsion technologies for ships. The headline findings concluded that: 'Should some wind propulsion technologies for ships reach marketability in 2020, the maximum market potential for bulk carriers, tankers and container vessels is estimated to add up to around 3,700-10,700 installed systems until 2030, including both retrofits and installations on newbuilds, depending on the bunker fuel price, the speed of the vessels, and the discount rate applied. The use of these wind propulsion systems would then lead to CO₂ savings of around 3.5-7.5 mt CO₂ in 2030 and the wind propulsion sector would then be good for around 6,500-8,000 direct and around 8,500-10,000 indirect jobs.'

This market potential was analysed in 2016, quite some time before a global sulphur cap was being considered seriously and at a time when our industry was adamant that there would never be a numerical target on GHG emissions, both of which are now coming to pass. The market analysis looked at a small set of technology options and excluded numerous other markets including ferries, cruise vessels, work vessels, the fishing sector and so on, therefore the estimates could certainly be revisited and there is justification for taking the higher estimates.

This market analysis has also been echoed by the recent UK Clean Maritime Plan, published in July 2019, which has wind propulsion ranked as the second most important propulsion segment after alternative fuels by the 2050s, with a conservative market potential of £300 million per year in the 2020s rising to £2 billion per year in the 2050s.

With the clear benefits outlined here, then the question has to be asked: Where are the ships? Why aren't we seeing wholesale uptake of these technologies yet?

The quick answer is: there are a growing number of demonstrators, some commercial installations and a swathe of recent contracts being signed and orders made. We also have market and non-market developments that are supporting this momentum, however there is still a lag in installations and while technological and operational barriers have come down, the securing of finance and pathways to scale are still challenging.

Installation costs remain an important



barrier, however with fuel prices in the \$600-700 per metric tonne range, many of the wind propulsion systems reach the important three-to-four-year return on investment (ROI) threshold or better. The past month (November) has seen MGO prices hovering around the lower end of that range in Rotterdam, but significantly higher in more peripheral markets and 0.50% very low sulphur fuel oil (VLSFO) not far behind. With any form of carbon levy predicted to push

prices up further, the upward pressure would seem to be locked in. Once multiple installations are achieved, then economies of scale and system optimisation will also lower that substantially from a cost perspective, coupled with the steady rise in fuel prices. As an industry we need to be assessing technology costs at the 100th (or even 1,000th) installation, not the 1st, 2nd or 10th one. The continued development of leasing offerings or even rental of containerised or modularised

wind rig systems is also a key potential driver for market uptake and we are starting to see financial products that share or de-risk investments by paying for them out of the savings accrued rather than burdening shipowners with a heavy CAPEX upfront.

Wind propulsion technologies break down into seven main categories, with all of the large vessel systems being fully automated for ease of use, safety and efficiency. We are seeing growing interest across the board, however



Maersk Pelican – 2 x Norsepower rotors



MV Afros – 4 x movable Anemoi rotors



MV Fehn Pollux – Single Ecoflettner



Chantiers de l'Atlantique Silenseas Range



Windship Technology Carbon Neutral concept vessel



MOL Wind Challenger



Neoline 150m RoRo vessel



SGSA retrofit soft sail system



Canopée vessel: VPLP/AYRO



Airseas – Kite installation



eConowind – containerised Ventifoil system



Vindskip car carrier design

Images supplied by IWSA

the technology that is currently installed on most vessels is the Flettner rotor or 'rotorsail', mechanical sails that are rotating cylinders operated by low power motors that use the Magnus effect (difference in air pressure on different sides of a spinning object) to generate thrust. Currently there are six vessels with 14 rotors in operation commercially. Retrofit installations have fuel savings confirmed in the 5%-20% range and work is continuing to increase size, efficiency and application (moveable, hinge versions, telescopic, etc.).

These installations cover most of the main shipping segments, except container vessels where deck space is at a premium, with installations of two 30-metre (m) rotors on the 109,000 DWT *Maersk Pelican* LR2 tanker which has recently had fuel savings validated at 8.2% over a year of operation; and four movable rotors on the *MV Afros*, a 64,000 DWT bulker. The *MV Estraden* is a Ro-Ro vessel with two rotors in regular operation between Hull and Rotterdam since 2014, and the *Viking Grace* ferry/cruise vessel operates with one rotor installed in the Baltic region. We also have the new build *E-Ship 1* purpose-built with four rotors that has been operating worldwide for the last decade and a newly retrofitted general cargo vessel, the *MV Fehn Pollux*, with a single bow mounted rotor which has recently released verified 20% fuel savings in operation.

We are also seeing sizeable developments in other main segments, with 'hard' or 'rigid' sails, with more sea trials and design announcements. These include Chantiers de l'Atlantique's primary wind expedition cruise vessel designs, the Silenseas series, which are available for build now. The Silenseas 190 option is 190 m long and capable of carrying 400 passengers, making 17 knots under wind alone and operating 60%-70% of the time under wind power. MOL recently announced the go ahead for its first build installation of its collapsible rigid sail system along with Oshima Shipbuilding in Japan. The system has received a ClassNK AIP and a one sail version of the vessel will go for sea trials by 2022, with multiple sail versions to follow.

Wallenius Marine & Becker Marine have announced a newbuild car carrier with wing sails that will follow a similar build schedule as the MOL vessel. Bound4Blue, a Spanish based wind propulsion company, is currently retrofitting its collapsible wing sail on a converted bulker and fishing vessel for sea trials by the end of the year. In China, DSIC and CMES have just completed a year-long sea trial of their collapsible rigid sail system on a 300,000 DWT very large crude carrier (VLCC).

Soft Sail has a number of significant

projects underway, with Neoline, a French wind propulsion company that has signed cargo contracts with Renault, Benetau and others for a France-Canada-USA route, and they signed up with the Neopolia consortium in May to build two of the 150 m Ro-Ro vessels for that route to be commissioned in 2021 and which will operate as a primary wind vessel with high potential savings. The VPLP spin-off AYRO & Zephyr Boree announced in Oct 2019 the contract to build a 30% wind-assist Ro-Ro vessel, the *Canopée*, for the Ariane Group to transport its *Ariane 6* space rocket launch system from France to French Guyana, starting in 2021. This is being done on the back of successful trials for the Oceanwing system aboard the wind and hydrogen-powered *Energy Observer*.

'How we get installations onto ships remains a challenge, but by the end of 2020 we will have double figure installations on commercial vessels, and by the end of 2021 a number of optimised new builds will start entering the fleet'

The UK-based Smart Green Shipping Alliance is working with Drax, the largest UK energy provider, and Ultrabulk to test retrofit rigs for bulkers transporting biomass. They also recently announced a collaboration with the European Space Agency on developing satellite weather routing systems for wind propulsion.

The deployment of large dynamic or passive kites off the bow of the vessel to assist propulsion or to generate a mixture of thrust and electrical energy has seen a number of test and commercial installations in the past. There have been a series of recent announcements from the Airbus spin-off Airseas that has confirmed an installation in 2020 with Louis Dreyfus Armateurs and also "K" Line has signed an option for up to 50 installations of the kite system based on successful trials to commence in late 2020/early 2021.

Finally, suction wing technology that consists of a non-rotating wing with vents and an internal fan (or other device) that use boundary layer suction for maximum effect is also developing quickly, with the Netherlands-based eConowind having completed three successful sea trials of its ventifoil system this year, which comes in a standard fixed installation and collapsible containerised version.

In September, the company signed its first contract for the installation of a fixed version. Additional systems will be tested under the EU-backed WASP project in 2020-21.

In support of these developments we also have class societies heavily involved and work is underway to deliver comprehensive wind propulsion guidelines. In September, ClassNK publicly released its wind-assisted shipping guidelines with DNV GL following on with its guidelines published in November and another recent development was Bureau Veritas joining the International Windship Association as an associate member. Meanwhile, ABS is co-leading the Wind Ship Propulsion (WiSP) joint industry project along with MARIN and other companies working in the wind propulsion field to overcome regu-

latory barriers to technology uptake. These efforts will also be bolstered by work underway through the EU Interreg North Sea Region-funded Wind Assisted Ship Propulsion (WASP) project along with the development of the five wind propulsion hubs being established in Europe, North America, North East Asia and the South Pacific by our association.

Wind works! The industry is increasingly waking up to that fact; how we get installations onto ships remains a challenge, but by the end of 2020 we will have double figure installations on commercial vessels, and by the end of 2021 a number of optimised new builds will start entering the fleet. Perception is a continued obstacle, but a significant shift is underway and as the clamour to decarbonise rises and shipping companies see their competitors embracing wind propulsion solutions, we see that wind-change as only strengthening into the new decade.

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