COMMERCIAL WIND PROPULSION SOLUTIONS: PUTTING THE 'SAIL' BACK INTO SAILING

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ABSTRACT

We have seen a wind change in the industry over the last 4-5 years where it comes to shipping efficiency and this has gone hand in hand with a strong growth in commercial wind propulsion projects. This has however been matched by a very cautious and gradual change in perceptions over wind propulsion in the industry, nonetheless momentum has been building and this presentation will place that change into perspective, focusing on the change drivers, the barriers to that, the International Wind Ships Association approach to creating a wind propulsion sector and how we are pushing drivers and tackling barriers. We will also give examples of new build and retrofit projects to watch.

Keywords: Wind Technology, International Wind ship Association,

1. INTRODUCTION

The IWSA paper will cover three main areas; first a quick overview of where wind technology has come from, the challenges we are facing and the technologies still under development, followed by a quick snapshot of the barriers/challenges and viability of wind from International Wind Ship Association's (IWSA) perspective. We will then go into detail on how we are collaborating across the industry to meet those challenges. Finally we will speak of some of our achievements over the last 12 months.

The International Windship Association was established in 2014 by 15 wind propulsion projects, plus a supporters network, that put aside competitive drive to establish a body that would promote and help facilitate the industries transition to lower carbon shipping by harnessing the wind; utilising the wide range of technologies and systems that our members are proposing and increasingly bringing to market.

IWSA is a member driven association made up of some 30 projects and technology providers, supported by a network of academics, NGOs, research organisations and numerous industry supporters, seafarers etc.

Our main objectives are to promote the use of wind for propulsion in commercial shipping and to consolidate wind propulsion stakeholders into a sector. In the past 18 months, we have seen a significant shift within the industry towards engagement. The question has changed from 'should we use wind' to 'we understand that it will be part of the propulsion mix in the future, but how do we get there?' We are looking for this, gaining further momentum at Paris COP21 in December.

As noted, there are a multitude of technologies and designs covering a wide range of sizes, cost and flexibility – retrofit and new-build, traditional and cutting edge technologies, from fishing boats and local ferries to bulkers, containers and roro.

So, where has wind propulsion come from? How has wind been harnessed for the best part of 6,000 years? Most people know much about this history, so not to dwell on this, except to say that we have a huge trove of knowledge and inherent understanding of the wind. Wind propulsion built the trading networks and much of the economies we see today. The Flying Cloud clipper ship set the world's sailing record for the fastest passage between New York and San Francisco, 89 days 8 hours, in 1854, setting a record that lasted for 136 years. The Flying Cloud record helps us to remember that the era of wind propulsion isn't just a 'romantic past' but a clean, efficient and sustainable future for shipping.

Moving into the modern era, there have been numerous innovations – from the proven Flettner rotors and Dynarig system to the rigid JAMDA sails successfully installed on 8 Japanese tankers just before oil prices plummeted in the 80's. The 80's through to the noughties saw a steady trickle of projects, but over the past 5 years we have seen a swell of wind propulsion projects, in part driven by the cost of fuel but also in reaction to the shifting regulatory environment and climate change.

We say shipping, but perhaps we should be talking about the 'logistics' industry –

- Regulation & Compliance Costs (SOx, EEDI, SEEMP etc.)
- Future Regulatory Framework? (CO2, NOx, Noise)
- Regional Legislation (EU, US)
- Volatility in Fuel Prices & Energy Security
- Split Incentives for Efficiency Investments
- Next Generation Fuels
- Technology Selection
- Over Capacity
- Future Trade Patterns & Prediction
- Crewing & Training
- And so on.....

There are a lot of variables playing into complex supply chains. These challenges need to be addressed in harmony with all stakeholders – from ports to cargo owners and consumers. IWSA is working on global, implementable solutions; rather than dwelling on further refining and analysis of these challenges. We are preparing a toolbox of technologies and systems to support an industry that is finally waking up to the need for change. We are here to assist the shipping industry in making that necessary paradigm shift.

We have seen a piecemeal approach to date, focusing on areas that will have decreasing returns or simply solve one pollutant problem while leaving others little changed, Or in some cases increasing pollutant at either end of the supply chain, especially when we consider CO2:

- Making ships compliant with current regulations.
- Reducing fuel use through operational adjustments or increased size.
- Reducing SOx Emissions - Scrubbers, Move to distilates, LNG etc.
- Improving Efficiency – with piecemeal changes and improvements on current equipment or technologies.

However, there is another option; WIND PROPULSION systems can:

- Be retrofitted to existing vessels or incorporated into new build design.
- Reduce dependency on fossil fuels and deliver increased energy security.
- Deliver 10-30% fuel savings as retrofit and around 50% for new builds.
- Help make vessels compliant with existing regulation and prepare for future scenarios.
- Increasingly be viewed as a credible, viable and cost-effective alternative.

The critical point here is that wind is a stable, abundant and 'free' source of energy, that allows ship owners to de-risk and be certain of a high percentage of their 'fuel' costs for the life of the vessel, regardless of what happens in the increasingly volatile/transitional fuel markets. Also, this goes beyond compliance, allowing ship owners to get back to the business of shipping cargo (or passengers) rather than perpetually considering the costs, technology selection etc. to meet the next efficiency increment.

2. WIND PROPULSION OPTIONS

Flettner rotors are for both retro-fit and new builds. They are generating a lot of interest at present, with our member Norsepower having successfully trialled their rotors at sea, on the M/V Estraden. The E-ship 1 owned by Enercon has been operating well at sea for the past 5 years. They have collected a wealth of experience and data, but it is being held closely by the company. They are hoping to recoup the capex from the single prototype, rather than it being the initial front runner for 20 additional production vessels, as was their initial intent. We will see a third player, our member MARIKO, an R&D collaboration in Emden, Germany, trialling their Eco-flettner technology next year aboard the Fehn Pollux vessel. Other innovations on the theme include collapsible and telescopic variants, such as the Magnuss Voss system from the US (another IWSA member)

Soft sails and Dynarigs are closer to the 'classic' sail. There are many projects developing large and small variants. All of the versions are high tech, highly automated designs, requiring no additional crew. Four of the IWSA projects are in the final stages of R&D and approaching the demonstration vessel build/installation stages of development – an especially challenging transition period but moving ahead.

Hard sails is a rather catch all terminology. The four IWSA hard sail projects are in various stages of maturity, but the technologies are well under development:

- The Solar sail is in operation on ferries in Australia and Hongkong, the Suction wing was prototyped in the 1980's as the promising Turbosail on Cousteau's Alcyone vessel.
- Wing + Wind technologies is ploughing ahead with testing of small ferries in San Fransisco.
- The Windchallenger consortium in Japan (including University of Tokyo, NYK, Class NK among others) have completed land trials of a scaled retractable rig and is pushing ahead with a 2017 demonstration vessel production schedule.

We are all aware of kite systems and their potential for substantial fuel savings by retrofit. The Irish Navy has recently released a statement that they will be trialling the technology aboard their vessels. We expect a renewed interest moving forward, especially (as with all of the wind propulsion technologies) when oil prices start rising again and regulatory pressures increase.

The wind propulsion segment is a hotbed of innovation. We are seeing new takes on old, proven technologies, as well as projects that have the capacity to radically change the way we view ship design. Vindskip is certainly one of those, as here the hull is shaped like a symmetric hydrofoil that captures the energy of the wind. So, how viable is wind propulsion?

- Technology – Most of the commercial wind propulsion technologies are based on tried and tested systems.
- Demonstration Vessels – there are still a lack of commercial demonstration vessels, however this will be changing rapidly.
- Costs vs Benefits – The ROfis dependent on fuel prices. Other benefits are important – security, lower future compliance costs, stability etc.

The Diagram (Figure 1) was drawn up for the UN affiliated International Renewable Energy Agency (IRENA) in the middle of last year and published early 2015.

SUMMARY TABLE: RENEWABLE ENERGY APPLICATIONS AND THEIR POTENTIAL FOR SHIPPING

Renewable energy type		Retrofit (RF)/ New Build (NB)	< 400 tonne e.g., recreation, artisanal/small fishery, tourism, passenger, break, landing craft, barges, research, coastal patrol and security	400 – <10,000 tonne e.g., large landing craft, small-medium fishery, domestic Ro-Ro, break bulk, bulk, container, tanker, tramp	10,000 – <50,000 tonne e.g., Ro-Ro, deep sea fishery, bulk, container, tanker, car carrier, cruise liner	>50,000 tonne e.g., Very Large Crude Carrier (VLCC), Panamax, Aframax, large container ships
Wind	Soft sails	RF	√√√	√√√	√√√	√√
		NB	√√√	√√√	√√√	√√
	Fixed wings	RF	√√	√√	√√	√
		NB	√√	√√√	√√√	√√
	Rotors	RF	√√	√√	√√	√√
		NB	√√√	√√√	√√√	√√
	Kites	RF/NB	√√	√√	√√	√
	Turbines	RF/NB	√	√	√	√
Solar photovoltaics	Main propulsion	RF	N/A	N/A	N/A	N/A
		NB	√	N/A	N/A	N/A
	Auxiliary propulsion	RF	√√	N/A	√	N/A
		NB	√√	N/A	√	N/A
	Ancillary power	RF/NB	√√	N/A	√	N/A
Biofuels	1st Generation	RF	√√	√√	√√	√
		NB	√√	√√	√√	√
	2nd Generation	RF	N/A	N/A	N/A	N/A
		NB	√√√	√√√	√√√	√√
	3rd Generation	RF	N/A	N/A	N/A	N/A
		NB	√√√	√√√	√√√	√√
Wave	Main propulsion	NB	√	N/A	√	N/A
	Auxiliary propulsion	NB	√	N/A	√	N/A

CURRENT APPLICATION	
	In commercial use
	Proven
	Proof of concept
	Design
	Concept
	Uncertain

POTENTIAL APPLICATION	
√√√	High potential (scores well on all three metrics: economic, environmental and social metrics)
√√	Medium potential (scores on two of three metrics)
√	Limited (scores on one of three metrics)
N/A	Uncertain

Figure1: Current Wind Technology Development (1)

It is an attempt to provide a snapshot of where renewable energy options for shipping stood in the summer of 2014 - it is already out of date, with significant R&D developments across the board and the trialling of Flettners. This 60-page document was pulled together with a wide range of collaborators. What it shows us is that there is a pipeline of development across the wind propulsion sector. Smaller vessels are naturally the low hanging fruit. Here, substantial gains can be made fairly quickly. This is laying the groundwork for larger vessels to follow.

3. CHALLENGES/BARRIERS

The adoption of wind propulsion faces many challenges; some are market based, others non-market. The LR wind propulsion report(2) released in the Spring gives a good overview of those challenges:

- Industry structure – the split incentive, charter party clauses
- Solution - new mechanisms e.g. SSI2040 Save as you Sail, Clean Shipping Index
- Perception - There is a psychological barrier on a potential solution that is so visible. Solution – increasing the number of demonstration vessels
- The promises – the need to 'prove' savings.
- Solution – more demo vessels, independent verification process, pooling of information, (IWSA)
- Capital intensity for working demonstrators – The cost of technology reaching the market. Solution – increasing cooperation/pooling resources (IWSA), ship efficiency finance & potential for the development of a tech cluster.
- Lack of technology transfer – from the offshore and yacht sectors.
- Solution – increasing transfer is underway, incubation/innovation support (IWSA)
- Operational & technical – route specific savings, compliance, cargo handling etc.
- Solution – working with class, designers & industry engineers on technical issues, sophisticated weather routing, automated systems, operations management etc.
- Barrier summary taken from Lloyds Register: Wind-powered shipping - review of the commercial, regulatory and technical factors affecting uptake of wind-assisted propulsion.

4. IWSA ACTIVITIES

IWSA will be increasingly engaging with many bodies, including: class societies, shipping companies, researchers, designers, engineers, policy makers and communications experts to challenge these barriers. Network development, Promotion and Education have all been central to our first 18 months of operations, but we have also been building the capacity to facilitate and incubate projects, and accelerate the wind propulsion sector in general.

Promotion has been a key activity and priority over the last 12 months, informing industry, policy makers and researchers of our existence. We are pulling together the sector which is increasingly speaking with one voice on a range of important issues. We are forging important relationships with the media and are in development of IWSA events and seminars as well as generating professionally published materials.

As the IWSA network grows and best practices are shared. The network development is critical to the success of the association and has seen a stable growth over the past 12 months. Membership is growing, the relationships and interaction between those members has strengthened and deepened – we seek to extend that out into the wider sector.

On the education front, IWSA members have been reaching out to universities and training centers, holding seminars and lectures and we have started to bring together research papers and other sources of information. This will be an ongoing process. We are increasingly able to refer interested parties to researchers and institutions that are engaged in specific areas of work. We will also continue to lobby for research grants and government support for research to be done in the wind propulsion field, along with supporting researchers with applications and access to the IWSA network.

IWSA staff or executive members have attended, presented or led roundtable discussions at, and quite a number of these have had IWSA as an official supporting organisation.

IWSA will have a booth at SMM 2016, renowned as "the worlds largest shipping conference" (http://www.smm-hamburg.com/en/) We will also run a series of seminars at the exhibition hall and presentations at the main forum.

In 2016, IWSA will be an official supporting organisation at

- CMA 2016, http://www.cmashipping2016.com/
- GST 2016, http://www.greenshiptechnology.com/
- Motorships Propulsion & Emissions, http://www.propulsionconference.com/
- Greenport http://www.greenport.com/congress
- LISW 2016 https://www.londoninternationalshippingweek.com/.

These events give the association and our collaborators access to an increasing number of platforms from which to network as well as present their projects and research, raising the profile of members supporters and wind propulsion at large. We have a growing number of supporters and associate members from academia and the R&D field, and their input to the IWSA work-streams and collaboration between them on wind propulsion activities will be very important moving forward.

Helping incubate wind propulsion initiatives whether project based, technical, training, research or market development is an important next step. IWSA has already helped to secure funding for research, initiated project collaborations and assisted members with grant and funding applications – we will be developing services further for members as funding and capacity allows. Finally in the area of facilitation, the finance and policy work-streams and development of the IWSA network, the foundations for these advocacy activities and development of common approaches is already underway, we very much look forward to developing those aspects of the IWSA further in the coming months.

The IWSA work streams are a key area of engagement and participation for our members and are where the goals, and strategies required to reach those goals are under development. The work-streams have been established, but work has been constrained due to limited resources. Members are currently volunteering time and resources but we hope to remunerate work-stream activities in the coming year.

WS1: Policy – industry, regulator & govt. advocacy.
WS 2: Technical Standards, Rules, Certifications – regulator & class collaboration
WS 3: Finance – supporting & building incubation, R&D and development funding mechanisms.
WS 4: Communications – developing public & B2B wind propulsion message.
WS 5: Market Transformation – market analysis, B2B & consumer labeling.

Each of the work-streams have fairly ambitious targets. But these are based on previous work in the field. By coordinating efforts, we reduce repetition and amplify individual member actions within each of the work-streams. There is a lot to be done but we project to have a set of deliverables in the communications, technology and market transformation work-streams in the coming months. Progress in policy, advocacy and finance will be further developed in collaboration with external bodies working in those fields.

The technology work-stream is a good example of how IWSA is looking to collaborate with other organisations to develop usable, practical solutions that benefit our members and the industry as a whole. We are working on the development of rules and regulations that are clear, concise and fit for purpose. This will facilitate tech providers, ship owners and class societies in achieving deliverable wind-propulsion solutions.

The technical work-stream goals include:

Task 1: Establish generic certifying procedure for Windship projects;

1. starting from the existing rules;
2. identifying the problems inadequacies… in existing rules,
3. recommend mitigating actions.

Task 2: wind propulsion systems fuel saving calculation needs standardisation to enable an objective comparison. Therefore, aim is to put together a generic check-list of the steps required to calculate the fuel saving

Participants: TU Delft, Marin, Norsepower, UT Windchallenger, Dykstra, Propelwind, Neoline

Open questions

- Define how Technology interfaces with IMO
- Create a complete list of existing wind-ships, SOLAS certified, in as much detail as possible
- Create (new) list of airdraft restrictions worldwide (bridges, HV power lines, …)

Class Engagement

- Liaise with short-listed Classification Societies: LR, DNV/GL, BV, NK
- Examine rules applied to past projects (1980's and later)
- Clarify the certification procedure

This work-stream's purpose is not to write rules i.e. Class and IMO but to promote, guide and actively monitor the work of Class and any other regulatory bodies.

IWSA is conscious of the need to work at multiple levels to enable the development of the sector, from small to large vessels and retrofit to new-build. IWSA is supporting work towards the development of clusters and centers of excellence to move that agenda forward. R&D and academic work will be rooted in the market and supported by political and regulatory frameworks. A good example of this approach is already underway in the South Pacific and IWSA will continue to support these developments, firstly in Europe, then in the US and Asia.

Task 3: Policy Work Stream

In the area of policy there is much to do. The IWSA policy work stream has spent some time in identifying a number of key areas affecting our members and the uptake of wind propulsion technologies, some of which are naturally shared with other renewables and low carbon/efficiency technologies.

There is a general feeling that compliance to existing regulation, adapting existing regulation or extending regulations to other geographical areas or operational areas is important and impact is achievable with limited resources, rather than lobbying for 'New' regulation. The target ideas fall roughly into 3 categories:

(i) Policy-Finance

Need for increased financial policy incentives for technology uptake: Examples:

1. Fuel quality requirements, which aim at reducing the emissions of shipping and which lead to higher fuel prices and promote auxiliary wind propulsion through better payback periods for the technology than currently (e.g of such requirement is the sulphur directive at the SECA area).
2. Capping of vessel emissions (through EEDI and/ or emissions trading), which force the vessels to use technologies like auxiliary wind propulsion.
3. Governmental subsidies for investments in auxiliary wind propulsion or similar environmental investments, which create better payback periods for the technology than currently.
4. Extension of ECA to Mediterannean region
   Tackling Split Incentives - focused on the split incentives faced by ship owners.
5. Establishment of carbon trading standards for wind propulsion (new & existing vessels)
6. Stranded Assets & Risk Management – working on the creation of scenario trajectories/long-term and aspects of asset management from a strategic point of view - Risk management & Insurance focus.

(ii) Policy-Technical

1. Address non-compliance with current regulations (such as SOLAS visibility and/or COLREGS). The existing regulations are not designed for wind-assisted ships and there are significant technical challenges to overcome e.g. demonstrating (via robust technical substantiation and risk assessment) the safety equivalence of alternative arrangements (such as cameras and advanced sensors).
2. Small commercial sailing vessel restrictions – analysis and lobbying for removal of specific barriers– returning traditional vessels into the sector, short sea and inland waterway traffic.
3. Impact and opportunities of upcoming technical regulation for windship technology and shipping industry – analysis of costs/benefits for retrofit and new build.

(iii) Policy–Communication/Education

1. Industry Information - One of the key barriers is the lack of access to market/technical information especially in the tanker\bulker market.
2. Survey of IMO representatives (shipping industry players) on what they need to happen to become wind propulsion advocates.
3. Member state audit (previously Flag state audit) will become mandatory in 2016. How will that affect IWSA members?

(iv) Instruments/Activities

1. The tone/style of lobbying activities is a key consideration and the W/S discussion will continue regarding appropriate collaborators, partners and pitfalls to avoid.
2. Laying groundwork & start application process for an IMO observer seat
3. Representation on IMO through either joining or collaborating with existing coalitions.
4. Presentation of IWSA at MPEC side event in the coming year.
5. Get access to IMO mailing lists/discussion groups.
6. Engagement with shipping industry and cross industry 'logistics' groups (BIMCO, ICS, IACS, IAPH, SSI etc.) e.g. input into SSI 2040 vision
7. Presentations/representations at major shipping (and other) conferences (GST, Motorships, SMM, COP21, OECD etc.)
8. Production of policy materials package – available for IWSA members – standard presentation, talking points, market analysis, etc.
9. Continued meetings with EU / MEP's to discuss developing the wind propulsion sector

5. CONCLUDING REMARKS

As we have already seen, membership and network development has been solid and there has been a sustained engagement with industry forums especially in the communications and promotional fields. We expect to see this develop further, specifically with a widening of associate members. Ports and low emissions (non-wind) equipment providers have been showing increased interest to join and engage with the network and we expect that trend to continue.

As mentioned previously, the bottom line is growth in financial support and expanded partnerships. We have developed the program frameworks that will channel resources to the necessary development areas, which will facilitate an increasingly professional and credible interface for the industry, policy makers, researchers and the media to access the information, funding and support they need.

IWSA is consolidating a viable wind propulsion segment within the shipping industry. This will support the paradigm shift to sustainable, low carbon shipping networks. However, this can only be achieved if;

- regulation is clear, stable and transparent,
- finance is equitable and long term,
- new technologies are stimulated and brought to market,
- and the systems required are developed and delivered methodically, hand in hand with the industry.

Then, and only then, can we expect to see shipping operate as part of a holistic logistics chain, with cradle-to-cradle considerations.

IWSA was born out of collaboration among projects and their supporters. It has grown by developing structures that allow us to engage with the multitude of stakeholders in the industry and beyond. IWSA will be increasingly relevant as those collaborative structures intensify and begin to deliver practical outcomes that help create an environment where low carbon shipping is incentivised and can thrive.

6. REFERENCES

(1), Irena Publications, www.irena.org/

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