‘Alternative Fuels’ or ‘Koolaid’?: Maintaining Focus and Perspective When Considering Options for Future Naval Fuels

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Synopsis

INEC 24’s core theme is ‘lean, mean and green’ navies, embracing the concept of reduced carbon emissions through new fuels. Literature abounds with shallow claims that navies must comply with IMO edicts or otherwise demonstrate ‘net zero’ performance. This is misleading, as legitimate as claiming that navies need do nothing. Navies adopting new fuels need navigate a sensible course, and avoid replicating the naïve, largely unconditional adoption of MARPOL regulations in the 1990s, a legacy saddling many navies with unnecessary regulatory burdens offering minimal environment protection while emasculating capability. Selection of future fuels must be based upon engineering evaluations, but reliance upon technical assessments in isolation would be inadequate. Effective, focused and technically literate naval engineering policy must always form the bedrock underpinning naval engineering deliberations, including for considerations pertaining to new fuels.

Warships, and the navies that operate them, exist for one fundamental reason – to fight and win at sea. There is no virtue in being ‘cleaner and greener’ if the fight is lost. No government will thank their navy for losing a ship and crew while doing so with lower carbon intensity than the adversary. This is an inviolable, and for some perhaps inconvenient, truth.

Amid societal expectations and the pursuit of ‘net zero’, in concert with an anticipated decline in diesel availability, navies must, in time, consider alternatives, preferably where there is parallel operational advantage. Fuels suitable for commercial use can be inappropriate for military applications. Realisation of the diminishing ubiquity of diesel should be the primary driver inducing navies to consider alternative fuels; any intent specifically related to emissions reductions should be subordinate, and any perceived benefit or temptation for ‘virtue signalling’ should not dictate the calculus. Whether naval transition is undertaken in an objective, informed manner, or in a less orderly and dysfunctional way in response to externalities may determine navies’ operational effectiveness and logistical overheads for decades to come. Navies are now at or approaching that threshold of decision, as warships currently in design are those that will be built into the 2040s and 2050s. Powertrains and energy sources are clearly a critical consideration for warship design. In the absence of any evident replacement for diesel, most navies are compelled to reply upon current fuels for new designs, or else significantly modify or prematurely decommission extant and nascent ship classes.

Technical assessments need to be bounded within objective engineering policy frameworks, in-turn linked to capability intents. Any ‘opportunities’ for alternative fuels adoption that may present as technically feasible must be rigorously evaluated in terms of the unique and exacting naval requirements. ‘Net zero’ does not mean ‘zero’, and the span of the ‘net’ need not be limited to fleet units. This gives opportunity and licence to develop innovative means of reducing carbon emissions while maintaining superior naval capability.

This paper explores how effective navy engineering policy can improve carbon efficiencies while safeguarding naval capability. Any quest for ‘net zero’ must be about what a navy needs to do, not what it could. Engineering policy must be in the vanguard of navies’ pursuits of alternative fuels, so that any aspired ‘green’ future does not render a navy as an ‘inconsequential and vanilla’ outfit rather than a ‘formidable and responsible’ maritime force.

Keywords: ‘net zero’; fuels; alternative fuels; IMO/environmental compliance; capability; navy mission; naval engineering policy

1. Proceed with caution: ‘Lean, mean and green’ or ‘fighting fit and fit to fight’?

> *I want to lead a Navy that ..... is a ready, agile, resilient and lethal fighting force .... that stands ready to execute our mission to ‘Fight and Win at Sea’.*
>
> (Noonan 2018)

Navies exist for one fundamental reason – to fight and win at sea! All else is secondary or peripheral. The maritime fighting service that fails to ‘think like a fighting navy’ (Noonan 2018) will significantly compromise its likelihood of success against the only metric that really matters if and when the need arises.

INEC 2024’s ‘lean, mean and green’ theme should be considered with reference to a navy’s purpose:

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 https://doi.org/10.24868/11171

'Lean' has merit, especially if resources do not match needs. 'Lean', not malnourished, is valid if it is an indicator of efficient and effective resource use in the realisation of maritime capability, as and when directed by government.

A 'mean navy' is likely to be one to give pause to nascent adversaries, capable of controlled and targeted aggression when necessary and as directed.

…….. but a 'green navy'! This concept borders on woolly-headed thinking and a dislocation from any serious navy's mission. It may be indicative of an organisation overly focused on social credentials and manifestation of a zeitgeist, embodying insouciant aspirations that would evaporate rapidly when lethality and survivability matter more than aggregate emissions. 'Environmentally responsible' certainly – but 'green' aspiration as anything but a lower order priority is a distraction and largely inimical to mission.

From oars and sail, to coal and steam through to diesels and gas turbines, the historic arc of naval propulsion and energy sources has invariably been one where new technologies generate improved performance and reliability and enhanced warfighting capabilities. The emerging paradigm of 'low' or 'no net' carbon risks being one where the step into the new realm may be retrograde!

No responsible navy should step blindly into alternative fuels, with all their implications, besotted or distracted by some desire to reduce carbon emissions, a singular focus upon peacetime taskings and diplomatic subtleties, or overwhelmed by ill-informed external forces insistent on change while heedless of the consequences for the navy mission, its ships and the men and women who serve in them. History suggests this sort of outcome is not only plausible but should be expected in some quarters, where understanding of core mission has been blurred, if not lost, in the seductive fog of competing, ill-conceived distractions diluting what naval forces really need to exist for. This 'pull' needs to be countered and whatever 'alternative fuels' potentially adopted, with their concomitant ramifications for naval designs and operations, should at least maintain, and preferably improve, capability. Navigating this complex maelstrom requires corporate fortitude abetted by robust naval engineering policy.

Naval engineering policy is about getting mission ready ships at the right place at the right time. A panoply of other factors and endeavours underlie that outcome, but naval engineering is an indivisible and pivotal element. By extension, engineering policy frameworks and processes need be precisely aligned with the central naval mission of fighting and winning at sea. These themes – not strictly of 'alternative fuels' and 'net zero', *per se*, but of how they need be considered and evaluated and the parallel realities – are the subject of this paper.

2. The legacy of heedless adoption of merchant ship marine environment protection rules and practices

The international community, chiefly via the International Maritime Organization (IMO), recognises the myriad threats to the environment from shipping. Accordingly, the IMO has introduced controls on multiple aspects of ship design and operation, spanning the life spectrum from design to disposal. These regulations, as reflected in parallel national legislation and classification society rules, are in constant flux, as the IMO deals with emerging marine environment protection (MEP) priorities or exploits evolving technologies. Most of these rules occur within the *International Convention for the Prevention of Pollution From Ships* (MARPOL), with parallel conventions dealing with allied matters, such as anti-fouling paints and ballast water. The IMO, as per its charter, does not regulate warships.

In its original 1973 iteration MARPOL concentrated upon oil pollution, expanding by the 1990s to also include, *inter alia*, regulations for garbage and later sewage. Thus, in the first part of the 1990s the only substantive intersection of MARPOL with warships could be distilled as ships needed an oily water separator and the disposal to sea of plastic was prohibited. All simple to understand and to abide – at that time. It was within this context that most navies first developed pollution prevention and 'MARPOL compliance' policies, signalling the intent to observe MARPOL regulations. For example, the first formal Royal Australian Navy (RAN) ship waste management policy, promulgated in 1994, committed the RAN to:

> *.... comply .... unless operational capability will be significantly compromised. These ... require that ship operators meet international maritime* (environmental) *regulations at all times.*
>
> (RAN 1994)

This 1994 policy is reflective of just about any other contemporary navy. From these 'humble', unadorned and expedient 1990s undertakings to observe 'MARPOL' not much has changed in the policy arena, either in the context of stated compliance aspirations or in guidance related to the nuance of ' …. *unless operational capability will be significantly compromised* …… ' and the employment of those caveats. While naval policies have remained static, the span, depth and complexity of IMO MEP edicts have expanded exponentially, compounded by their accelerated rate of change. Yet, navy policies have not matured in concert with the IMO's deliberations and obstinately and naïvely remain largely wedded to the anachronistic and simplistic concept of 'full compliance'. United Kingdom policy, for instance, commits the Royal Navy (RN) as follows:

 https://doi.org/10.24868/11171

The default position is that within the UK we comply with all applicable ... environmental legislation.

(UK MoD 2024)

The sub-text of this edict is that the subject navy is bound to comply even if the potential or perceived 'risk' to the environment associated with any particular aspect of commercial ship design or operation is irrelevant to warships or compromises design and operational imperatives. In essence, these standard policy precepts commit navies to complying with commercial ship regulations, rather than protecting the environment.

These compliance commitments are largely unreserved in practice and thus at variance with the IMO's own expectations. All IMO environment conventions expressly exempt warships and naval auxiliaries, but rather seek consistency albeit only to the extent resonant with warship imperatives. MARPOL states:

> *The present Convention shall not apply to any warship, naval auxiliary ..... and used .... only on government non-commercial service. However, each Party shall ensure by the adoption of appropriate measures not impairing the operations or operational capabilities ..... that such ships act in a manner consistent, so far as is reasonable and practicable, with the present Convention.*

This language is replicated in all other IMO environment conventions. While navies may volunteer to comply, or may be compelled by their governments to do so, warship compliance is not a given and was never intended.

Initial undertakings to 'comply with MARPOL' stemming from the halcyon archetype of observation essentially by the simple expedient of keeping plastic garbage separate have now morphed into a far more intrusive and demanding set of compromises. This historical legacy still saddles many navies with avoidable regulatory burdens emasculating capability while often, ironically, offering minimal protection to the environment. Examples abound of penalties where it may be considered that hubris exceeds practicable outcomes when balancing environment protection with warship exigencies. The chronicles of navy attempts to 'fully comply with MARPOL' are replete with ill-conceived excursions into ship design and fit:

- Protected fuel tanks: Rules formulated upon merchant ship designs and operations and subsequent inherent risks of oil fuel release in the event of merchant ship collisions and groundings have been shoehorned into warships. This is despite combatant warships not embodying the risk factors intended to be countered by the intricate IMO design rules, but which the advent of results in warships designed with different tank systems and/or reduced capacity – veritable 'frankentanks'. This is a patent example of 'engineering the rule' rather than engineering the risk. These modified designs generally require warships to refuel or conduct tank transfers more regularly - ironically the main reasons why warships lose fuel to the marine environment. Thus, application of a rule not intended for warships, inappropriately addressing an item of minimal risk, amplifies risks to the environment, in parallel with compromising operational effectiveness. This is an irredeemably perverse outcome (Polglaze 2018), arrived at under the banner of 'full compliance'.
- NO_x Tier III emissions systems: The most valuable commodity in a surface combatant is top weight margin. Sensors, weapons, countermeasures and other key elements of the combat suite are invariably mounted at or above main deck level. It is these systems that ensure a warship is lethal and can survive. Anything which occupies top weight or compromises its utility without contributing to combat capability disproportionately detracts from effectiveness. This very space is where standard NO_x Tier III emission control systems, weighing tens of tonnes for frigate-sized ships, must be located. As a result, designers are forced to forego inclusion of sensors and weapons, and top weight reserves which could be conserved for capability upgrades are sacrificed in the pursuit of inconsequential NO_x reductions. Some surface combatants have squandered top weight margin in preference to NO_x systems only rarely and intermittently used, yet the loss of combat capability is persistent.

The observation of MEP regulations is not always incompatible with warships, but in some cases strict adherence is discordant with a warship's *raison d'être*. This compels navies to evolve agile, nuanced, risk-informed approaches, applying lateral thinking presaging innovative, fit-for-purpose solutions. Much of the current debate surrounding alternative naval fuels is naive, ill-informed, poorly defined, ambiguously framed, and unjustifiably optimistic. This does not augur well that the past mistakes in futile pursuit of 'full compliance' will not be repeated. Examples given above provide salutary lessons about the folly of unfettered, myopic and dogmatic warship compliance. Smart navies, the ones that 'think like fighting navies', will avoid repeating these mistakes when considering energy efficiency options and alternative fuels.

3. 'What fuel?': Pivotal and fundamental naval engineering policy precepts

We will see a lot more disruptive solutions ..... and ..... we need to accommodate the challenge of green fuels, ... some are toxic, some are explosive, some take up more space, all of which will change design a lot too.

Einar Vegsund, Kongsberg Maritime (in McClellan 2024)

 https://doi.org/10.24868/11171

Diesel has established itself as the standard naval fuel for good reasons. Realistically, however, it is not going to be available indefinitely in the manner and price range to which navies have become accustomed. Evolving technical and logistical factors mean that it is incumbent upon navies to consider how they intend to respond to this emerging shift in availability and utility. Rather than any simple technical questions or carbon-intensity assessments, however, the response to the anticipated supply constraints needs to consider a wide spectrum of factors, each of which needs to be anchored in the 'why' and 'what for' of a nation's navy. To this end, it is instructive to consider why diesel has become the ubiquitous naval fuel. This may be summarised as: availability, affordability, stability, transferability, storability, reliability, predictability, flexibility, low volatility, practicality, effectuality, and commonality.

Energy efficiencies and emissions reduction opportunities extend beyond the ambit of fuels alone, with avenues existing to realise efficiency gains by means other than novel fuels. IMO precepts include:

- clean hulls;
- proceeding by the most direct, optimal routes;
- proceeding at (constant) most economical speed;
- mandated maximum speeds; and
- installed engines with minimum power reserves.

Merchant ships have predictable and stable operating profiles: load, sail, steam at *x* knots for *y* hours, go alongside, unload (and refuel/plug in!); turn around; repeat: this poses a different set of requirements for merchant ship energy sources in comparison with warships. The commercial shipping world is assessing, testing and trialling at varying levels of technical maturity a range of technologies and energy sources in the quest for low emissions. These include, variously, hydrogen, ammonia, LNG, methane, electrification, 'hull lubrication', sails and on-board carbon capture systems. Some of these may offer potential for collateral operational advantages for warships, in terms of improved thermal or radiated underwater noise signatures, or simplified maintenance and logistics. Overall, it is difficult to reconcile the IMO energy efficiency construct with warship requirements. It is not suggested that warships should not optimise energy use, as doing so will enhance endurance, but any intent of adherence to IMO energy efficiency rules as an objective in itself is a futile proposition and a damaging distraction.

Whether alternative fuels may be suitable for warship application can only be determined when measured against criteria unique to or accentuated in the case of warships. These attributes encompass:

- Good energy density
- Flexible in application across engine types
- Employ manageable and maintainable machinery
- Effective over a range of environmental conditions
- Low volatility
- Low toxicity
- Affordable
- Available
- Able to be transported, stockpiled and transferred in bulk
- Suitable for rapid replenishment, including between ships at sea
- Not require extensive upperdeck allocations

Actual 'greenhouse' efficiency of any diesel replacement must be properly balanced with these attributes. Although consideration of alternative fuels may have a technical nucleus, deliberations must be leavened by considerations broader than those nested in climate change responses. They need to consider consequences for ship mobility, lethality, survivability, supportability, utility and flexibility, as well as fuel affordability and availability. Such evaluations and the decisions which stem from them must be founded upon disciplined application of objectives and the policy and doctrinal frameworks which coalesce and express these. This ultimately translates to getting the policy settings right, and given its inherent technical character, questions of alternative fuels and all that may go with them should primarily be distilled, harmonised and reconciled through the articulated prism of naval engineering policy, not navy environment policy.

4. 'Net zero' does not mean 'zero'

> *Net zero emissions are achieved when anthropogenic emissions of greenhouse gases to the atmosphere are balanced by anthropogenic removals over a specified period.*
>
> (IPCC 2018: 535)

Beyond the platitudes and clichés, little is rudimentary in the 'net zero' sphere. Even the concept of any purported 'net zero' solution is typically contestable, if not controversial, once 'whole of life', 'scope two and scope three emissions', second and third order implications, and longer-term outcomes are taken into account. For

 https://doi.org/10.24868/11171

example, an electric car charged from a grid powered by fossil fuels is not a utopian paragon of 'net zero' aspirations. So while in some cases driving an electric car may be a sop to the virtuous, much beyond the facade of sustainable energy use should not be considered as any universally accepted *fait accompli*. Accordingly, any quest or claim for 'net zero' operation of any ship, and not just any warship, should be recognised as involving intricacies, assumptions and contested claims. Any proposed 'net zero' solution is likely to represent some degree of compromise purely within the domain of it *really* being 'net zero', notwithstanding the implications for the ship's design, operation and ultimate effectiveness as a warfighting platform.

It is also clearly evident that 'net zero' should not be considered to mean that any individual ship should herself be required to be operated, let alone be built and sustained, with no net greenhouse gas emissions resulting from her use and upkeep. This provides latitude, elasticity and opportunity for innovative, indirect, novel and holistic approaches to 'net zero' that avoid detracting from capability. If this particular nettle is grasped boldly, shrewdly and effectively, enhanced scope should materialise in which navies can demonstrate energy efficient operations, even if not actually 'net zero', while limiting deleterious, if not catastrophic, effects upon warship effectiveness.

It is misleading to use commercial shipping as the yardstick by which navy 'net zero' performance or options should be measured. Effective, distributable fuels are required in a wide array of sectors, such as agriculture, mining, isolated settlements, and vessels operating locally from remote locations. Alternatives developed for commercial shipping and other applications are unlikely to be universally effective for these other uses, suggesting that some form of liquid fuel similar to diesel will need to be available to many users over an extended term.

If intended to have a 'net zero' fleet, then a navy should take the opportunity to think laterally and imaginatively. Superficially, 'net zero' warship operation may present as operating any individual warship with fuels that, purportedly at least, result in no ensuing increase in greenhouse gas emissions, with whatever design and operational penalties and impositions such an approach would inflict. This would represent a constraint on thinking and an orthodox and likely inappropriate approach – a 'green navy' at the expense of a 'mean' one.

The innovative navy will seek, develop, promote and exploit opportunities to have effective warships which nevertheless integrate desired energy efficiencies, consistent with the need to be able to fight and win at sea. Efficiency gains of this ilk can include elements such as: maintenance of a clean hull and propellers, with concomitant tactical benefit; use of low energy systems and fittings, such as solar absorbent paint, energy efficient lighting, and energy scavenging systems; and low drag above water profiles. None of these approaches detract from warship capability, but rather embody collateral benefit.

Expanding the form and reach of the 'net' provides further prospects. One foundation element could be to seek 'net zero' fleets in aggregate, rather than through the lens of individual fleet units, where low emission or 'net zero' units could be used to discount or offset the emissions of fleet units and naval activities which cannot sensibly be operated with low emission profiles while remaining credible warfighting platforms. Possible approaches of wider scope and span in the endeavour for a 'net zero' or 'near zero' navy may include, for example:

- Specialised support and general purpose harbour craft, such as tugs and launches, employing orthodox 'net zero' approaches, where activities are local and predictable and where compromises in design and operations would have no tangible affect upon a navy's overall combat capability.
- Naval auxiliaries dedicated to specific and predictable missions employing orthodox or otherwise palatable 'net zero' or low emissions design approaches.
- Ensuring shore supply services are of 'net zero' or 'net negative' origin, in parallel with ensuring that fleet units connect to shore supply as much as realistically achievable. Considering that a typical surface combatant is underway for only about 20% to 25% of total lifetime (compared with 80% or more for a typical merchant ship), the potential for realisation of greatly reduced aggregate emissions over a ship's lifespan by this measure alone cannot be understated.
- Navies linking with carbon capture and storage enterprises. This may include contributing to reforestation enterprises, or commercial arrangements with future carbon capture ventures. This would be a reversal of history, given that in times of sail navies managed forests as sources of ship materials, but in future it could be for carbon sequestration.
- Adopting a wider 'whole-of-government' or 'whole-of-nation' approach to the aggregation of total emissions accounting and the calculation of resultant net emissions. This approach would recognise the reality that a serious nation that wishes to have a serious navy cannot amortise 'net zero' down to individual fleet units or the navy in general, and that acceptance of net positive emissions by a navy in pursuit of the national good warrants emissions offsetting across the broader national economy.

Instead of defaulting to a base position of needing to find alternative fuels as a means of reducing emissions, a better option may be to pursue substitute 'net zero' sources for the same type of fuel. For example, diesel equivalent to that obtained from petroleum sources can be synthesised. Obviously more difficult to obtain at present and more expensive than the non-renewable alternative. In time, however, with sufficient demand – especially if like-minded navies approach the market collaboratively - and improvements in technologies and processes it is difficult to conceive that price would not decline as availability improved. Whatever additional cost which may be borne

 https://doi.org/10.24868/11171

through purchase of this likely more expensive alternative would be offset significantly by the savings to be realised in not having to decommission and dispose of current diesel storage and distribution facilities and infrastructure, nor the delays and enormous costs which would need to be incurred in replacing them, even if we knew just 'what' they may need to be replaced with!

In reality, the 'overall net zero' navy will likely employ a combination of those options considered above, plus emergent opportunities, determined by factors such as fleet size and composition, operating tempo, mission profiles and operating areas. A critical determinant of the ultimate outcome will also be a navy's risk appetite in alerting government, partner nations, and the wider public, to the incontrovertible fact that a nation can have an effective navy or a 'clean and green' one but most unlikely both. This requires a navy to step back from the comfort of 'group think' and to seek and stimulate, not shy away from, informed and objective, and likely robust, debate and discussion, drawing from a font of sensible, carefully formulated and pragmatic naval engineering policy.

The airline industry provides an exemplar for navies. Consider that alternative aviation fuels are not yet viable but a 'net zero' goal is sought through an assortment of means, such as carbon offsets, forestry, tailored technologies and modified procedures. Simultaneously, airlines are working towards Sustainable Aviation Fuels for long-haul flights and short haul aviation is innovating in hydrogen fuels and electric. A multi-pronged approach across industry is the model that is most likely to yield useful results. There is no suggestion that individual aircraft types will simply and rapidly switch to green fuels.

What is also obvious is that navies will need to shed any misapprehension that they should anticipate or be expected to 'go it alone'. The serious, mission-focused navy, resolutely committed to being 'mean', possibly also 'lean', but only 'green' to the extent of consistency with maritime warfighting capability, cannot internalise 'net zero' or 'low emissions' endeavours. Government agencies - executive and legislative - at levels beyond the boundaries of a navy or its wider defence portfolio, and by extension the taxpaying public, need to be educated and informed clearly and soberly of the risks and implications of naval pursuit or expectation of 'net zero'.

It may be expected that not all observers and commentators – especially purists - may agree with such approaches to a low emissions navy, but it should be accepted as axiomatic that whatever solution may be adopted will invariably have its detractors, benefits and disbenefits. It is therefore critical that navies also control the narrative on this and temper expectations, rather than be caught up in the hubris and 'group think' which may ultimately lead to disappointment as and when the reality dawns that navies can either be effective maritime fighting forces or green warriors, but most unlikely both.

This all points back to the inviolable necessity of a solid naval engineering policy foundation. Clearly, it is essential that the naval engineering policy framework of 'mission first' is established and consistently maintained, and that all proposed 'net zero' approaches be rigorously evaluated through this lens.

5. When should or must decisions be made?

The IMO's vision is that zero / near -zero emission technologies will represent at least 5% (but striving for 10%) of the energy used in international shipping by 2030.

(Przytulski 2024)

The year 2030 is barely five years beyond INEC 2024, yet warships being built now are those designed 10 or 20 years ago! Indeed, warships being designed today will be built in 10 to 20 years' time, or more, with some only newly into service by 2050.

Transition to CO_2-free fuels might increase the main dimensions of future new buildings.

Kristian Knappi, Deltamarin (in Reinikainen 2024)

In the absence of anything beyond speculation, it is not possible to design today the 'net zero' or alternative fuel warship. Any attempt to do so would represent significant technological, project and financial risk, notwithstanding the likely compromises of capability. Given that energy sources and associated systems and their layouts and configuration, as well as weight and space requirements, set many of the fundamental parameters of a warship's design and fit, it is difficult to design the 'alternative fuel' warship today as would be necessary to start building in around 2035.

A rough, indicative timeline of a theoretical pathway to the design and build of an alternative energy warship may be derived. Assuming alternative fuel technologies for shipping, and their associated infrastructure recapitalisations, distribution networks and market supply capacities and resilience are not resolved until, say 2035, no clear guidance would be available to the future warship designer until that time at the earliest. Any attempt to design and build a 'net zero' warship before this juncture would invariably represent risk and more than likely result in a warship of qualified utility, if not a dead-end in design concept. Assuming an ambitious 10 year surface combatant design timeframe, followed by a five year build for the lead ship, suggests the prospect of a navy's lead, and hence only 'net zero class' surface combatant in commission by 2050. This, patently, is far short of any goal for a 'net zero navy' if intended to be coupled to the IMO's schedule for commercial shipping transition.

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Given the usual warship lifespans, the obsessively determined ‘net zero’ navy may have half of the fleet at ‘net zero’ in the 2060 to 2065 timeframe, and maybe full ‘net zero’ by around 2075 to 2080. This hypothetical, and optimistic, timeline illustrates the unrealistic proposition that any serious navy could achieve a ‘net zero’ fleet posture in a manner synchronous with the IMO’s ambitions for commercial shipping. Furthermore, such ambition would invariably be realised by prematurely decommissioning other fleet units, with the sunk costs and inherent energy imposts and inefficiencies incumbent upon such a proposition – all detracting from and contradictory to the ostensible goal of ‘net zero’.

6. Conclusion

This paper does not purport to provide technical commentary about alternative fuels for warships. Rather, this paper springs from the precept that navy technical pursuits may be essentially meaningless, if not counter-productive, if they are not anchored to the purpose of developing, maintaining and sustaining naval capability and the pillars upon which that exists – lethality, survivability, supportability. Nowhere in these cardinal tenets does, or should, reside as key drivers facets such as ‘environmental responsibility’, ‘zero emissions’, ‘clean and green reputation’ or similar. These may be valid as collateral subordinate aspirations, but they cannot be fundamental drivers, or else the core navy role will be dislocated, if not dissolved. It is within this context that it is critical that effective, focused and informed navy engineering policy is developed and implemented to ensure that however navies may venture into alternative fuels, it is done so with the primary objective of delivering effective naval capability – not the pursuit of green credentials or emissions targets.

This paper is not advocating nor suggesting that navies need nor should do nothing about participating in the global pursuit towards ‘net zero’. Rather, it advocates that any intended responses be based upon lateral thought and sober, dispassionate, holistic analyses, and that any adopted responses be modulated and carefully calibrated to be synchronous with the core naval mission.

We really have no idea what technologies may emerge and be substantiated and refined in the next 15 to 25 years. The alternative fuel warship is not yet conceived, and certainly not built and proven, so any vision of a ‘net zero’ fleet by 2050 is arguably delusional. Navies would be better served by focusing upon mission, while recognising that whatever energy efficiency gains may be realised will not conform with the IMO’s timetable.

Ultimately, there is no virtue or solace in losing the fight at sea but doing so at a lower carbon intensity than the victor. Any rational government will not thank a navy for that, nor will the wives, husbands, mothers, fathers, sons and daughters of those who may be lost in vain in the process.

7. Acknowledgements

The author thanks Darren Burrowes and Michel Fontaine for their advice in the development of this paper. The views expressed herein are those of the author.

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9. Glossary

IMO: International Maritime Organization

LNG: Liquefied Natural Gas

MEP: Marine Environment Protection

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