SHIP ZERO 26

POLICY BRIEF

KEY STATEMENTS

- International shipping is well situated to catalyse decarbonisation across many heavy industries through ports;
- Zero emissions ship technology is market-ready;
- Finance is poised to invest but requires regulatory assurance;
- National governments must implement policy measures to unlock investment and rapidly accelerate the transition to zero emissions shipping in line with 1.5°C warming.

"World governments can act decisively in an emergency and climate change has escalated to the level of crisis. Policy response must therefore be accelerated to crisis response level, bringing in emergency measures at regional levels, as was done for Covid-19." **Madadh MacLaine**, Secretary General, ZESTAs.

Breaking down silos at COP26 Ship Zero workshop

The Ship Zero workshop on 1-3 November in Glasgow broke down the silos of the shipping industry and brought together stakeholders from across the supply chain. Throughout the brainstorming sessions and panel discussions it was evident that **the technology to achieve true zero emissions in shipping is ready** to be scaled up to meet global demand. The financial mechanisms are in place but policy is required to create the economic environment for large scale investment. A clear signal must be sent to the industry that zero emissions shipping must replace fossil fuels by 2040.

ZESTAs. SHIP ZERO

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Hydra is the world's first vessel to be powered by liquefied hydrogen

"This was the first event in my maritime career that brought together not only academics, shipowners or technology providers, but the entire value chain of shipping stakeholders in the same platform, including ports, policy makers and financiers to work on the same goal: to accelerate and realise true zero emissions shipping." - Prof. **Osman Turan**, Marine Design, The University of Strathclyde.

Shipping's growing climate problem

International shipping's contribution to global anthropogenic GHG emissions is roughly equivalent to Germany, at 2.89% in 2018 and up 10% since 2012 (Faber et al., 2020). Absolute GHG emissions are set to rise 50% compared to 2018 if action is not taken. While some sectors can expect significant GHG reductions going forward, **shipping is travelling in the wrong direction.**

The need to curtail and eliminate emissions from shipping is urgently required to halt the climate crisis. Despite the complexity in decarbonising this sector, a transition for shipping will provoke major knock-on effects in decarbonising global heavy industry.

With a membership of over 30 cutting-edge technology providers, ZESTAs is the voice of leading first-movers in maritime zero emissions innovation.

Technology to achieve true zero emissions in shipping is proven and ready for upscaling

Marinised zero emission **Technology Readiness Levels** (TRLs)*

Marine battery solutions are at TRL 9

Ampère battery-electric passenger and car ferry entered service in 2014;

Bastø Electric: 400 passengers & 200 cars or 24 trucks with 4 MWh battery (DNV, 2021);

Aurora & Tycho Brahe: each carry 1,280 passengers and 240 cars with 4.1 MWh batteries;

72 battery-electric ferries are expected in Norway by 2022 (Norled AS, 2019) and 23 are under construction for Kochi, India (Berry, 2020);

Two electric bunker tankers were ordered by Asahi Tanker Co. Ltd with 3.5 MWh batteries to enter service in 2022 (MI News Network, 2020)

Port electrification is at TRL 9

Shift PwrSwäp: subscription-based business model for modular shore and vessel power (Perry, 2021)

Skoon Energy: containerised batteries for shore and vessel power (Skoon Energy BV, 2021)

Marinized hydrogen fuel cells are at TRLs 5 to 9

200 kW systems in operation at TRL 9, scalable to over 3.2 MW at TRL 8, scalable to over 23 MW at TRL 5 (IEA, 2021)

Energy Observer: research vessel in operation since 2017 using wind and solar energy for batteries and gaseous hydrogen production (Energy Observer SAS, 2021);

Sea Change launched by Zero Emissions Industries in 2021 with three 120kW fuel cells (IEA, 2021);

Norled's Hydra is to be retrofitted in winter 2021 with a liquefied hydrogen tank and two 200 kW PEM fuel cells (Westcon Group, 2020; Norled AS, 2021);

Hydrogen bunkering is at TRL 8

LH2 TRL8: Unitrove bunkering facility, 500 L/min (Lua, 2021).

Moss Maritime is developing a bunkering tanker containing two IMO Type C tanks, each 4,500 m3 in volume, carrying a total of 500 tons of liquefied hydrogen with a loading rate of 500 m3/hour and unloading rate of 300 m3/hour (IEA, 2021)

LH2 transport by sea is at TRL 8

Suiso Frontier is ready to carry 1,250 m3 and has been approved by ClassNK (KHI Ltd., 2019).

Wind propulsion is at TRL 9

Various wind technologies are in operation with proven fuel savings of 8-12% and potential to deliver 20-30% of the global fleet's energy requirement (IWSA, 2021). Operational devices include Flettner rotors, suction wing sails, hard wing sails, soft wing sails, Dynarigs, kites and traditional soft sails (square and bermuda rigs).

© Shift Clean Energy

Aurora is a fully-electric ferry carrying 1,280 passengers

Emerging green hydrogen maritime supply chains

Mass production and exportation of cheap green hydrogen from developing countries is expected by 2025. Chilean Energy Minister, Juan Carlos Jobet, stated that by 2025 **Chile** will be able to export green hydrogen at a price of $1.50/kg, which has been verified by Mckinsey and the Government of **Japan** (Aviles, 2021). The Government of **Namibia** just approved a $9.4b project for 3 GW green hydrogen production, expected to be exported at around $2.00/kg starting 2026 (Collins, 2021). Emerging green hydrogen producers, which also include **Australia** and **Norway**, are looking for guaranteed large-scale and long-term demand, which shipping can provide, as long as governments take action (ZEM-Tech, 2021).

Finance calls for assurance from decision makers

The Poseidon Principles, launched in 2019, now has 28 major bank signatories with **$200b of shipping loan portfolios** aligned with the IMO decarbonisation trajectory. Unaligned shipowners will find it challenging to obtain financing, as banks, who dominate maritime lending, de-risk their portfolios by screening clients based on emissions performance. Transparency is required to implement this effectively (Taylor, 2021).

© KHI - Suiso Frontier is the world's first liquefied hydrogen tanker

*TRLs, as defined by the European Commission's Horizon 2020 Programme, range from 1 (basic principles observed) to 9 (actual system proven in operational environment).

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Cargo owners are also forming global partnerships with shipowners to invest in zero emission vessels and technology. The Sea Cargo Charter establishes a framework for bulk ship charterers to measure and report emissions. With 24 major charterers committed to this initiative, the IMO decarbonisation trajectory gains essential support from the demand side of the maritime industry. It is significant that these initiatives are not waiting for more regulatory or technological progress (Rehmatulla, 2021).

"Making emissions reporting transparent will really speed up investment" **Paul Taylor**, Vice Chairman of the Poseidon Principles, Managing Director & Global Head of Shipping and Offshore, Société Generale

Shipowners are ready to transition to zero emissions fuels but **government regulation is required** to de-risk investment in commercial alternative fuel production at scale (Takahashi, 2021).

An estimated $6 trillion (Lloyds Register; UMAS, 2019) of investments is needed between now and 2030 to align with the current IMO trajectory, including investment in infrastructure for shipping fuels. Hence, the steps taken thus far to facilitate sustainable public and private ship finance, including the Poseidon Principles, represent a small fraction of the capital required.

National fossil fuel subsidies in shipping mean that **GHG emissions are not internalised in the price of maritime shipping** (OECD 2019). The G20 countries offered direct subsidies on coal, oil, gas and fossil-fuel power worth more than $3.3 trillion between 2015-2019. Meanwhile, electricity in ports is taxed in all cases. This is not compatible with 2°C warming, let alone 1.5°C (BloombergNEF, 2021).

Policy must catch up with innovation

Decarbonisation of the global fleet requires a combination of regulation on both global and regional levels, shipowner-charterer partnerships, scaling of alternative fuel supply chains, installing clean auxiliary power systems and operational efficiency measures (UNEP, 2020).

IMO and EU policies are not in-line with Paris Agreement 1.5°C warming. The proposed Clydebank Declaration is a step forward, but we need a leap. Shipping is the ideal vector for accelerating the COP26 Breakthrough Agenda. Market distortions that favour fossil fuels must end. Individual countries must create incentives, increase regulations, and investments to accelerate green technology uptake.

Policy must use Life Cycle Analysis (LCA) to estimate and regulate Well-to-Wake (WTW) CO-equivalent emissions (CO2e), in line with the Paris Agreement target to meet 1.5°C. This means absolute zero emissions by 2040, paired with immediate emissions reductions this decade (Comer, 2021).

LCA WTW prevents emissions from being transferred to other sectors and eliminates fossil fuel loopholes (Comer, 2021);

Regulating for CO2e will eliminate all GHGs. Under the current system there are methane and NOx loopholes: from 2012 to 2018 methane emissions grew by 150%, directly related to the growth of LNG powered ships and the use of internal combustion engines that have low NOx emissions but high methane slip (IMO, 2021). Methane's 100-year Global Warming Potential (GWP) is estimated to be 29.8 and its 20-year GWP is 82.5, according to the IPCC's 6th Assessment Report, meaning that it absorbs approximately 30 times more heat than the same amount of CO2 over a 100-year period and more than 80 times over 20 years (US EPA, 2019).

Absolute zero will eliminate loopholes associated with 'net' zero,such as offsetting (SourceMaterial, 2021).

Governmental Actions required to reach Zero Emissions Shipping

- Adopt a target for True Zero by 2040;
- Implement command and control regulations that mandate a transition to true zero emission vessels on a timescale consistent with achieving the Paris Agreement temperature goals;
- Support current proposals for a global carbon levy at the IMO to accelerate decarbonisation;
- Mandate transparency of emissions monitoring, reporting, and verification via the IMO fuel oil Data Collection System (DCS);
- Adopt consistent and coordinated global carbon pricing mechanisms;
- Mandate port electrification and eliminate tax on electricity from renewable energy dedicated to shipping.

Zero Emissions Maritime TECHnology

University of Strathclyde Glasgow

Polar Research & Policy Initiative

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APPENDIX

State of Technology

The first section of this appendix clarifies the current state of technology.

BATTERIES

SHIFT + 2 Clean Energy

"Shift provides customers with a safe, reliable and affordable way to electrify making low and zero emissions operations a reality today" - Shift 2021

Shift is a marine battery solutions provider, making possible the electrification of ships, ports and inland waterways. It offers two types of battery services: fixed or the new swappable concept.

- **Fixed batteries are installed as the vessel's main propulsion, charging in between trips.**
- **Swappable batteries (PwrSwäp): Interchangeable ESS chartiges like units, easily transported & swapped within 12 minutes.**

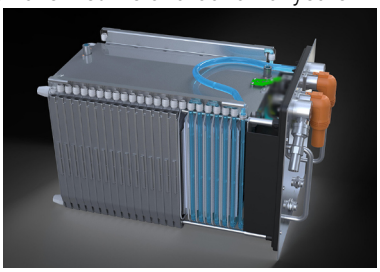
PwrSWäp functions as a pay as you go subscription service, charging customers only power they use, meaning no capital investment has to be done by the customers/users.

Product liability is ensured via a cloud based service, at which E-pods are connected.

This service can easily be adapted to ships and ports.

"PwrSwäp system is ready to help industry, corporations, small communities and other institutions to use clean energy for their operations and achieve climate action goals, while also saving them money on day one." - Brent Perry (Shift CEO)

Shift states that its batteries have lifetime of around 10+years



Safety:

There has been scepticism about the safety of batteries, however SHIFT states that their batteries will "never catch fire". This is a futile statement without action, however, SHIFT backs it up with their technology. Within their batteries, SHIFT uses an integrated cooling system (CellCool), which enables all cells to consistently operate at the optimal temperature, and reverse any thermal runaway incident. Each cell is encased in its own cooling channel creating a system that can pull heat out faster than the lithium chemistry can generate it, in turn, creating a system that is fire-proof. (Perry, 2021)

Zero Emission Services

Provider of containerised battery systems.

As of the 6th September 2021, Zero Emission Services (ZES) Alphenaar, became the "first Dutch inland vessel to use interchangeable battery containers (ZES Packs), supplied by Wärtsilä, for propulsion. The Alphenaar sails between Alphen aan den Rijn and Moerdijk transporting beer for HEINEKEN, ZES's first end customer. Not only this, but CCT and Heineken have agreed to a 10 year contract with ZES.

"Since then, Wärtsilä has been working on assembling and testing the next generation of ZES Packs, which are equipped with safety and communication systems, and 45 battery modules totalling 2 MWh – comparable to the capacity of around 36 electric cars." (Zero Emission