

Accelerating Innovation and Sustainability Panel



Allan Grant Executive Vice President

Reduction of Environmental Footprint Through Electrification & Hybridization





Shipping sector sets course for zero carbon vessels, fuel by 2030

Jonathan Saul

4 MIN READ

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LONDON (Reuters) - Leading ports, banks, oil and shipping companies on Monday launched an initiative which aims to have ships and marine fuels with zero carbon emissions on the high seas by 2030, in another step by the maritime sector to reduce CO2.

International shipping accounts for 2.2% of global carbon dioxide (CO2) emissions and the U.N.'s International Maritime Organization (IMO), has a long-term goal to cut greenhouse gas emissions by 50% from 2008 levels by 2050.

Achieving this target will require the fast tracking of zero emissions fuels and commercially viable ships by 2030 as these vessels will still be part of the ocean going fleet in 2050.

Sixty commercial groups including shipping companies such as A.P. Moller Maersk (MAERSKb.CO), which owns the world's biggest container shipping line, commodities players such as COFCO International, Cargill, Trafigura, mining group Anglo American (AAL.L) as well as banks such as Citigroup (C.N), ABN AMRO (ABNd.AS) and Societe Generale (SOGN.PA) have committed to the "Getting to Zero Coalition".

The coalition is pushing for vessels and fuels to be ready by 2030 and supported by the required infrastructure.

"Decarbonizing maritime shipping is a huge task with no simple answer, but it has to be done," said Ben van Beurden, chief executive of Royal Dutch Shell (<u>RDSa.L</u>), which has also joined.

26,505 views | Aug 18, 2019, 03:01pn

The World's Largest Electric Ferry Has Completed Its Maiden Voyage



A Forbes 30U30 entrepreneur and founder of the Virtual Island Summit.

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- The ship, capable of carrying 30 vehicles and 200 passengers, is powered by a battery system with an unprecedented capacity of 4.3MWh
- The E-ferry has been designed with unique integrated battery and transmission systems that offer unparalleled operating efficiency
- "E-Ferry Ellen", the world's largest all-electric ferry, has made its maiden voyage connecting the island of Aerø, population 6,000, to
- the rest of Denmark. The route is 22 nautical miles long.
- The ferry, which now connects the Danish ports of Søby and Fynshav, was built at the shipyard on the island of Als through a partnership between Aero Municipality and the European Union. The project is part of Danish Natura, which aims to provide environmentally friendly transport for local residents. It was initiated in 2015 and was funded by the EU through the Horizon 2020 and Innovation Program.

The World's First Electric Autonomous Container Ship To Set Sail In Norway



August 23rd, 2018 by The Beam

Plans for an autonomous, purely electric container ship are making wav internationally as Norway positions itself as a global pioneer in alternative propulsis systems. The Yara Birkeland' will be the world's first autonomous electric contain ship, and will no doubt change freight transport at sea. It's been commissioned by th Norwegian fertilizer manufacturer Yara International, which plans to commute wi the freighter between ports and thus abandon use of diesel-powered trucks. Accordin to Yara International, the electric ship should able to replace a total of 40,000 tru journeys a year.



Though it's not a particularly large cargo ship, 70 meters long and 14 meters wide with 120 containers on board, the difference is there won't be any people on board, which allows for more of the space to be utilized for shipping cargo. The ship will be delivered

Press releases

Maersk to pilot a battery system to improve power production

06 November 2019



The second

t was agreed to in 2018.

IMO urged to toughen up 2030 GHG goals

that ships fuelled by liquefied natural cas (LNG) do not deliver the emissions reductions

Maritime Organization (IMO) this week. Contained in the report, which concentrates on

attacking Japan's Energy Efficiency Index for Existing Ships (EEXI) proposal, is data the

arrues that the IMO's intermediate 2030 greenhouse gas (GHG) reduction goal of 40%

ement in carbon intensity versus 2008 levels was already three-culaters met whe

required by the International Maritime Organization's initial greenhouse gas (GHG strategy, and that using LNG could actually worsen shipping's climate impacts.

this up with a 16-page policy

rving to shage the future carbon footorint of shippin



NEWS PROVIDED BY **Research and Mark** Nov 29, 2019, 10:00 ET

Marine

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DUBLIN, Nov. 29, 2019 /PRNewswire/ -- The "Electric Ships Market by Power Source, Autonomy, Ship Type, and Regio Global Forecast to 2030' report has been added to ResearchAndMarkets.com's offering.

The global electric ships market size is projected to grow from USD 5.2 billion in 2019 to USD 15.6 billion by 2030, at a CAGR of 13.2% from 2025 to 2030.

Broad adoption of fully electric passenger vessels and inland cargo ships, among others, are expected to fuel th growth of the electric ships market across the globe.

Two forecast periods, i.e., 2019 to 2025 and 2025 to 2030, are considered in this market report, as the adoption of electric propulsion systems is projected to grow at a higher rate post-2025. Increase in seaborne trade across the glob development of lithium-ion batteries, and hybrid and electric propulsion technology catering to the retrofit market, among others, are some of the factors that are expected to fuel the growth of the market.

The newbuild & line-fit segment is estimated to grow at a higher CACR during the forecast period.



The report has triggered pletty of comment from NGOS on the warpeth, taking about fake regulation and the need to make stricter triggets. 2019 to Improve vessel performance and reliability while reducing CO2 emissions.

"This trial will provide a greater understanding of energy storage that will support Maersk in moving towards further electrification of its fleet and port terminals. Maersk will continue to facilitate, test, and develop low-carbon solutions on our journey to become carbon neutral by 2050," explains Søren Toft, Maersk COO.

Propelling marine vessels with battery power alone is still years away from being a technically- and economically viable option. However marine battery systems can be used to improve the efficiency of a vessel's onboard electrical systems such as the Maersk Cape Town's generators. By maintaining the vessel's auxiliary generators at a more optimal load, and avoiding running generators when not needed, overall fuel consumption can be reduced.

ENERGY DENSITY IS THE KEY

- As with cars and other markets, energy density in batteries is the limiting factor
 - Battery electric ferries are limited to routes up to 40 minutes in length
 - Container ships produce the most emissions, but batteries have limited uses
 - Cruise ships can use them for green harbor entry and when sitting at anchor/dock
- Lithium ion batteries are becoming cheaper
- Many major companies are investing heavily in technologies to increase energy density



GLOBAL COMPETITION FOR ADVANCED BATTERIES

Extensive efforts internationally to develop high energy density batteries

- Nov. 13, 2018 German Government announced they are investing \$1.2 billion in EV and advanced battery development and production in Europe
- **Toyota:** has spent \$4B already and plans to spend a total of \$13.9B on solid state battery development early prototype available in a few years, production level available in 2030 or later
- Solid Power: Samsung, A123 Systems, and Hyundai invested \$20 million
- Sakti3: Dyson purchased for \$90 million in 2015, wrote off \$60 million in 2018
- Ionic Materials Storage: Partnerships with Mercedes and BMW, claims delivery 2026
- QuantumScape: Volkswagen invested \$100 million, claims delivery 2025
- **LIBTEC:** Joint effort between Toyota, Honda, Nissan, Panasonic



AND WE HAVE THEM!!

- 3 times the energy density of conventional Lithium ion batteries
- Large number of charge/discharge cycles
- High Depth of Discharge large increase in the available energy
- Non-flammable
- Operates at room temperature



LAVLE SECTORS





Burlington, WA

- HeadquartersAssembly and Integration Facility

Houston,TX' Sales Office Frederikshavn, Denmark Sales Office

> Tokyo, Japan • Business Office Yokohama, Japan R&D and Production

LAVLE LOCATIONS

Next Generation Battery (with 3DOM Separator)

TECHNOLOGY

- 3DOM Battery Separator key enabling technology
- The separator:
 - prevents thermal runaway
 - makes the battery inherently safe
 - makes the battery very efficient
 - is what makes advanced batteries possible
- No one else in the world has it



ADVANCED LITHIUM ION BATTERIES

Standard Lithium-ion battery architecture with improved chemistry and separator

- Compared to than other Lithium-ion batteries:
 - Lower cost
 - Cost reductions built into each component design
 - Advanced BMS provides better performance and higher level of safety
 - Advanced chemistry formulation provides good energy density and higher level of safety
 - Higher tolerance to heat provides resistance to aging at higher temperatures
 - Proven chemistry and 3DOM separator combine to increase safety
 - Standard ESS architecture, which enables the use of multiple cell chemistries
 - Facilitate rapid ESS development



ADVANCED BATTERY TECHNOLOGIES

ADVANCED TECHNOLOGY: SOLID ELECTROLYTE & LITHIUM METAL

- High performance characteristics:
 - Greater safety,
 - Higher energy density
 - Greater depth of discharge
 - Longer life
 - Higher number of cycles
 - Wider operational temp ranges
- Technology vetted extensively at Tokyo Metropolitan University, and supported by Japan's New Energy and Industrial Technology Development Organization (NEDO)



SEB/LMB: A TECHNOLOGICAL BREAKTHROUGH

Solid Electrolyte & Lithium Metal Batteries are currently in prototype phase

- Target: almost 3 times the energy density of Lithium-ion batteries for the entire battery system
 - A vessel can put almost 3 times the energy in the same space as a traditional Lithium-ion battery
- Higher depth of discharge with no effect on lifetime
 - A vessel with Lithium-ion batteries can normally only use 40% of the capacity of the battery or it will shorten the batteries' lifetime
 - Solid Electrolyte Batteries can use a much higher capacity of the battery without any effect on lifetime
- Over 3 times the number of charge/discharge cycles
 - A vessel would have 3 times as many charge/discharge cycles and so would have 3 times the lifetime
- Can be operated at room temperature or at temperatures up to 60°C (140°F) reducing the need for cooling systems
- Cannot go into thermal runaway (catch fire), which eliminates the need for a battery room and fire protection
- Can be continuously monitored for safety and performance



MANUFACTURING

Gigafactory

- Produces cells for LAVLE's Energy Storage Systems (ESS)
- \$1.3 billion and 2,000 jobs
 - Financing in place
- Working with 10 States to site the facility
- Will produce up to 10 GWh of cells per year
- Break ground in 2020, operational 2022

Expand ESS Fabrication Capacity – Burlington, WA

- Created battery development lab, with prototype manufacturing
- Creating ESS manufacturing line at the Burlington facility
- Working on design for new, larger facility

BURLINGTON FACILITIES

Engineering R&D Center - 28,000 sq. ft.



Offices and Manufacturing - 22,000 sq. ft.









HTTPS://LAVLE.COM

