

## Maritime Issues - Utilisation of LNG and Hydrogen as fuel: Beyond LNG and Hydrogen: The world's largest electric ferry by battery capacity starts regular operation

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### 【概要 : Summary】

Since GHG emissions from maritime transport are not included in the Paris Agreement, the International Maritime Organisation (IMO) is under pressure to introduce measures to reduce the maritime transport's GHG emissions. The IMO's envisaged target is a 50% reduction of CO<sub>2</sub> emissions by 2050 based on 2008 levels. Furthermore, the ship owners and operators need to meet the new sulphur limit outside emission control areas (ECAs) as of 1 January 2020. The type of alternative fuel selected and the proportion of conventional fuel substituted will have a direct impact on the vessels' emissions, including GHG, NO<sub>x</sub>, and SO<sub>x</sub>. Full "well-to-waves" emissions analysis with comparison to conventional diesel technology will be needed to understand the true global impact of converting vessels to zero emission.

To reduce the strong dependency on fossil fuels and to reduce GHG emissions as well as emissions of other pollutants in the maritime transport, the industry considers the utilisation of alternative fuels. The most commonly, Liquefied Natural Gas (LNG), Electricity, Biodiesel, and Methanol are mentioned to replace oil based fossil fuels in maritime transport. Other fuels that could also play a role like Synthetic Fuels, Hydrogen for use in fuel cells, among others, could be used either in combination with conventional, oil-based marine

fuels or they can completely replace them.

The launch of an electric ferry (e-ferry) project is a EU-supported development project with the aim of designing, building and demonstrating a 100% electric passenger and car ferry. The launch of the so far largest (by battery capacity) electric ferry in Denmark addresses the urgent need of reducing the increasing European CO<sub>2</sub> emissions from maritime transport and short-sea shipping in particular. All the electric ferries projects or vessels in service show that the electrification of maritime transport is gradually beginning to get underway.

Launched in 2015 and after some delay, the first fully electric ro-pax ferry EF Ellen has started operations in August 2019. The overall the E-ferry project objective is to apply an extremely energy-efficient design concept and to demonstrate a 100% electric, emission free, medium-sized ferry for passengers and cars, trucks and cargo in full-scale operation on longer distances than previously seen. The E-ferry project is currently the world's largest with 100% electric ferry by battery capacity. It allows the ferry to travel longer distances of up to 21.4 nautical miles (nearly 38 km) before it needs to be recharged.

The use of electricity and batteries for the propulsion of short-sea shipping ferries is expected to introduce a paradigm shift for the

operational setup in ferry transport within the EU's coastal regions. The main aim is to replacing fossil fuels and conventional diesel generators with pure electrical drive trains. The operation of electric ferries is seen as one measure to reach the goal of decarbonising maritime transport. However, the proper environmental benefits of certain propulsion systems is difficult to evaluate since the environmental-friendliness of electricity and batteries is dependent on the environmental-friendliness of the source that is used for generating the electricity. In case of electric vessels, it needs to be considered their environmental impacts and the lifetime CO2 emissions of batteries in production, operation and recycling as well as other pollutants that exist during energy production and storage.

Also the e-ferry Ellen will have to demonstrate that it has a positive ecologic effect. As in case of all electric vehicles, its environmental friendliness will highly depend on the utilization of renewable energy sources for the generation of the electricity it uses. Electric vessels can only minimise the carbon footprint of maritime transport if the power production is based on renewable sources.

## 【記事 : Article】

### 1. Background of CO2 emission reduction for vessels

Regarding the reduction of GHG emissions, and to reduce the negative impact of the transport sector to the climate, also maritime transport has to improve its sustainability. Compared to other transport modes, ships are relatively fuel-efficient, but the air pollution originating from shipping is of concern as most ships still use heavy fuel oils with high levels of emissions, including sulphur dioxide (SOx), particulate matter (PM), and nitrogen oxides (NOx). The upcoming introduction of the new global sulphur limit of 0.5% by 2020 and the increasing pressure to introduce regulations to mitigate the CO2

emissions from maritime transport leads to considerations regarding the application of alternative fuels and propulsion systems in maritime transport. On 13 April 2018, the IMO's Marine Environment Protection Committee (MEPC) 72 adopted the initial strategy on GHG emission reduction for international shipping and related guiding principles, which is the first step in a three-step approach of reducing the GHG emissions in maritime transport. However, the IMO's envisaged target of a 50% reduction of CO2 emissions by 2050 based on 2008 levels will require the introduction of additional emission reduction measures including alternative fuels and propulsion systems and the development of low- and zero- emission vessels.

In Europe, the Baltic Sea and the North Sea and English Channel are sulphur oxides (SOx) emission control areas (SECAs). With the perspective of tightening the new sulphur limit to 0.5% as of 1 January 2020 and the possible introduction of a regulation of GHG emission limits for the maritime transport, the shipping industry is intensifying its search for technologies and alternative fuels. Islands and remote coastal regions are often dependent on the waterborne transport means for connecting with the mainland. The further tightening of emission reduction rules in maritime transport is the background of an on-going trend in Europe to equip coastal ferries with low to zero emission propulsion. Therefore, the introduction of alternative fuel solutions has also reached the ferry industry. The use of electricity and batteries for the propulsion of short sea ferries could lead to a paradigm shift for the operational setup in ferry transport on shorter distances. The main aim is to replacing fossil fuels and conventional diesel generators with pure electrical drive trains. In particular in Norway, the concept of ferries powered by electricity has been tested. Currently, Norway has two fully operational electric-powered ferries but more will follow in the years to come. Since early 2015, a

mid-sized car ferry, the MS Ampere, has been traversing the Sognefjord in western Norway, seven days a week, without emitting tailpipe pollution or CO<sub>2</sub>. The MS Ampere, which carries 120 cars and 360 passengers, is the one of world's first modern, electric-powered commercial ships. Also Finland launched its first electric car ferry and dozens of hybrid ferries and electric-powered ferries are scheduled to go into service in the coming years. Denmark and Sweden are cooperating on a plan to introduce electric passenger ferries and have already launched two battery ferries, the Tycho Brahe and Aurora. Both ferries originally had diesel engines and can carry a higher number of passengers and operate between Denmark and Sweden. The latest project is the E-ferry project, promoting energy efficient, zero GHG emission and air pollution-free waterborne transportation for island communities has also been launched in Denmark.

## 2. The E-ferry concept

The E-ferry ferry is a project supported by the EU's Horizon 2020 research and innovation programme under grant agreement No 636027, involving the design, building and demonstration of a fully electric powered "green" ferry. The project has received EUR 15 million in funding to develop an electric drive train ferry service, which would connect the island of Aero to the Danish mainland. The European initiative Horizon 2020 is supporting the e-ferry project since 2015. The E-ferry concept is directly addressing the urgent need of reducing the increasing European CO<sub>2</sub> emissions from maritime transport and short-sea shipping in particular in order to make this transport mode even more sustainable. E-ferries can sail without direct pollution and CO<sub>2</sub> emissions in operation. It promotes energy efficient, zero GHG emission and air pollution-free waterborne transportation for island communities, coastal zones and inland waterways. The overall objective of E-ferry is to apply an extremely energy efficient concept in

order to demonstrate that a 100% electric, emission free, medium sized ferry for passengers and cars, trucks and cargo has the ability to operate record-breaking 22 nautical miles between charging. E-ferry has an increased battery capacity (charging only at one end of the route) and improved operational characteristics (speed, largest sailing range, operation on ice conditions). The E-ferry project reached its final stages with the baptising of the new fully electric ferry, Ellen, which took place on Soby Harbor on the island of Aero, Denmark, on 1 June 2019.

## 3. The fully electrified E-ferry Ellen starts operation

With its charging station in Soby Harbor on the island of Aero, the 60 m long and 13 m wide E-ferry Ellen can sail up to 22 nautical miles between charges, which is 7-times farther than previously possible for an electric ferry. The E-ferry Ellen has been designed with the capacity to carry 31 cars or 5 trucks on open deck and an amount of passengers accounting to 147 during winter and 196 during the summer. The E-ferry has officially started operating on 15 August 2019, between the ports of Soby and Fynshav, which are located on the islands of Aero and Als in the south of Denmark.

The E-ferry is said to be the world's largest, 100% electric powered Ro-Pax ferry by battery capacity. This fully electric ferry is powered by a battery system with an unprecedented capacity of 4.3MWh, provided by Leclanché SA. The company claims that the ferry alone will "prevent the release of 2000 tonnes of CO<sub>2</sub>, 42 tonnes of NO<sub>x</sub>, 2.5 tonnes of particulates and 1.4 tonnes of SO<sub>2</sub> into the atmosphere" on an annual basis.

The battery system developed for the E-ferry by Leclanché incorporates many new design features that are used to increase the safety and lifetime of the energy storage system. The development has required a number of tests and validation, which have resulted in delays of the start of the ferry operations, in particular due to the final

production step of the battery modules.



The fully electric ferry Ellen

<https://ec.europa.eu/inea/en/news-events/newsroom/horizon-2020-transport-meet-ellen-%E2%80%93-first-all-electric-ferry>

Type approval and product delivery sign-off of the battery system have been completed by classification society DNV-GL. Charging will only be carried out on the island of Aero, and in the high season the vessel has three 22 minutes breaks and three 32 minutes per day, as well as a 40-minute lunch break. In addition, a slow charging of 7.5 hours is carried out during the night.

On the day of inauguration, EF Ellen sailed 3 return-trips between Soby, on the island of Aero and Fynshav, on the island of Als.

From September the number of trips increase and the ferry will have to demonstrate that it is possible to complete up to 7 return-trips per day between Soby and Fynshav.

According to the Mayor of Aero, Ole Wej Petersen, the EF Ellen demonstrates that even longer regional routes can be covered by pure electric means. Also Mayor of Sonderborg on Als, Erik Lauritzen, was pleased with the green connection between the two municipalities.

The fully electric ferry is suitable for journeys between small island groups, and along coasts and inland waterways. At the moment, the electricity comes from Denmark's national power grid, but Aero plans to use electricity from solar power and wind to recharge the E-ferry Ellen in the future. The

electric propulsion also allows considerable noise and wave reductions bringing important environmental benefits to the wildlife and people along routes. Considering the plan to make the power generation carbon neutral in future by using wind and solar sources for power generation, Aero is an ideal spot for the first deployment of E-ferries. The island set a goal of running solely on renewable energy nearly 20 years ago and has sizable solar and wind turbine installations.

The development and start of operation of the e-ferry Ellen comes on time for the coming into force of the new sulphur limits on 1 January 2020 and the IMO's start of introducing measures to reducing the GHG emissions of vessels.

References:

A Game Changing approach to medium range ferry connections. In:

<http://e-ferryproject.eu/>, retrieved 16 Sept. 2019

Baptism of the e-ferry Ellen. In:

[http://e-ferryproject.eu/Portals/0/News/Press\\_release\\_ENG\\_Baptism\\_Ellen.pdf](http://e-ferryproject.eu/Portals/0/News/Press_release_ENG_Baptism_Ellen.pdf), Press release E-ferry 20 Maj 2019, retrieved 16 Sept. 2019

Come and join Ellen on her inaugural voyage E-ferry Ellen ready for her first trip with passengers on the 15th of August, 2019. In:

[http://e-ferryproject.eu/Portals/0/News/Press\\_Release\\_Eferry\\_Ellen\\_begins\\_normal\\_operations.pdf](http://e-ferryproject.eu/Portals/0/News/Press_Release_Eferry_Ellen_begins_normal_operations.pdf), E-ferry

press release-14th of August 2019, retrieved 16 Sept 2019

Frangoul, Anmar: An electric ferry with a

'record-breaking' battery has completed its maiden voyage. In:

<https://www.cnn.com/2019/08/19/the-worlds-largest-all-electric-ferry-completes-maiden-voyage.html>, 19 Aug 2019, retrieved 19 Sept. 2019

Klotz, Frieda: Electric ferries and joined-up shipping to turn sea travel green. In:

[https://horizon-magazine.eu/article/electric-ferries-and-joined-shipping-turn-sea-travel-green\\_en.html](https://horizon-magazine.eu/article/electric-ferries-and-joined-shipping-turn-sea-travel-green_en.html), 18

April 2018, retrieved 12 Sept 2019

Horizon 2020 Transport: Meet Ellen - the first all-electric ferry. In: <https://ec.europa.eu/inea/en/news-events/newsroom/horizon-2020-transport-meet-ellen-%E2%80%93-first-all-electric-ferry>, retrieved 16 Sept 2019

Lambert, Fred: World' s largest all-electric ferry completes its maiden trip. In: <https://electrek.co/2019/08/21/worlds-largest-electric-ferry/>, Aug. 21st 2019, retrieved 2 Sept. 2019

Launching of the E - Ferry delayed. In: <http://e-ferryproject.eu/Portals/0/News/launchingoftheE-Ferrydelayed.pdf>, 23rd of July, 2018, retrieved 16 Sept 2019