Reducing emissions from high-speed vessels: technology developed and future challenges

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Acknowledgements

Co-financed by the European Union
Connecting Europe Facility

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REGULATIONS FOR SHIP EMISSIONS

As of 2020, shipping companies will have to use low-sulphur fuels to comply with current international regulations set out in Annex VI of the MARPOL Agreement (Regulations for the prevention of air pollution from ships), which will limit the maximum sulphur content in marine fuels to 0.5%.

What are the options for ship owners to comply with this regulation?

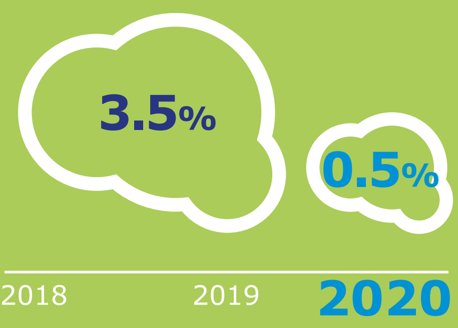
The upcoming implementation of the international environmental regulation, MARPOL Annex VI, will force ship owners to assess different fuel options and technologies that enable them to comply with the regulation whilst helping them to improve their position in an increasingly competitive market. The forthcoming global 0.5% limit on sulphur in 2020 is driving ship owners to evaluate alternative fuels as a means for compliance.

Given the uncertainty on the future of the European economy and the evolution of key factors such as fuel prices, which affect the outcome of ship owners' decisions, making the right choice among the multiple feasible technologies available becomes a considerable challenge.

This report presents the analysis of alternative solutions in order to decide which technology would best enable compliance with this regulatory framework. The following sections will be shown:

- Analysis of options for the case of large high-speed vessels (HSC).
- How to retrofit HSC vessels to run on LNG. Case study: HSC ropax Bencomo Express operated by Fred. Olsen S.A.
- Dual-fuel technology developed: world's first LNG dual-fuel engine adapted for HSC.
- Adaptation of the four main engines and the vessel.
- Financial feasibility of the business case under study.

Sulphur content in marine fuels



OPTIONS FOR HIGH-SPEED VESSELS

• Using alternative fuel oil with a maximum sulphur content of 0.5%

Marine fuels are classified by ISO:8217 depending on their origin (residual or distillate), viscosity and carbon residue. The most common denominations to different qualities of the fuel are Heavy Fuel Oil (HFO) for pure residuals; Intermediate Fuel Oil (IFO) for mixtures of residuals and distillates and Marine Diesel Oil (MDO) and Marine Gas Oil (MGO) for pure distillates. Fuels with residual content (HFO and IFO) are sold with different sulphur content levels, however, all of them have over 0.5% sulphur.

Heavily desulphurised IFO fuels could also be used, but in practice the desulphurisation of HFO is too expensive to make economic sense. A cheaper Ultra-Low-Sulphur Fuel Oil (ULSFO) is commercially available, composed exclusively of distillates with a sulphur content of under 0.5%.

The use of ULSFO could be assessed in order to reduce operating costs. However, this type of fuel is not compatible with high-speed engines above 1000 rpm used on high-speed vessels. Therefore, there is currently no alternative fuel oil for HSC to be used to comply with international regulation coming into force in 2020.

• Installing scrubbers on board the vessel

The use of HFO in combination with scrubber systems to remove the sulphur content from the vessel's exhaust gases seems to be an ideal solution. However, not all vessels are suitable for scrubbers.

This solution could not be used for HSC vessels as 1) HFO is not a fuel compatible with high-speed engines; 2) the extra weight resulting from having this system on board would reduce the speed and payload and 3) the lack of space for their installation.

• Using LNG as a marine fuel

Currently, LNG is the most environmentally-friendly and sustainable fuel: it emits practically zero sulphur, up to 85% less NOX and at least 20% less CO_2. From an economic point of view, LNG costs on average approximately 35% less than MGO. In addition, LNG-powered vessels benefit from a reduction in port taxes.

The main obstacles for using LNG as a marine fuel are the major investments required for replacing or adapting engines on the vessel and the lack of LNG bunkering facilities to supply LNG to shipping and port consumers.

LNG AS A MARINE FUEL

The results of the analysis show that, from a technical, environmental and economic point of view, for the case of high-speed vessels, it is preferable to invest in LNG technological solutions.

The current European framework provides a window of opportunity for the research of the use of LNG as a marine fuel, which requires overcoming several challenges for its implementation on a larger scale.

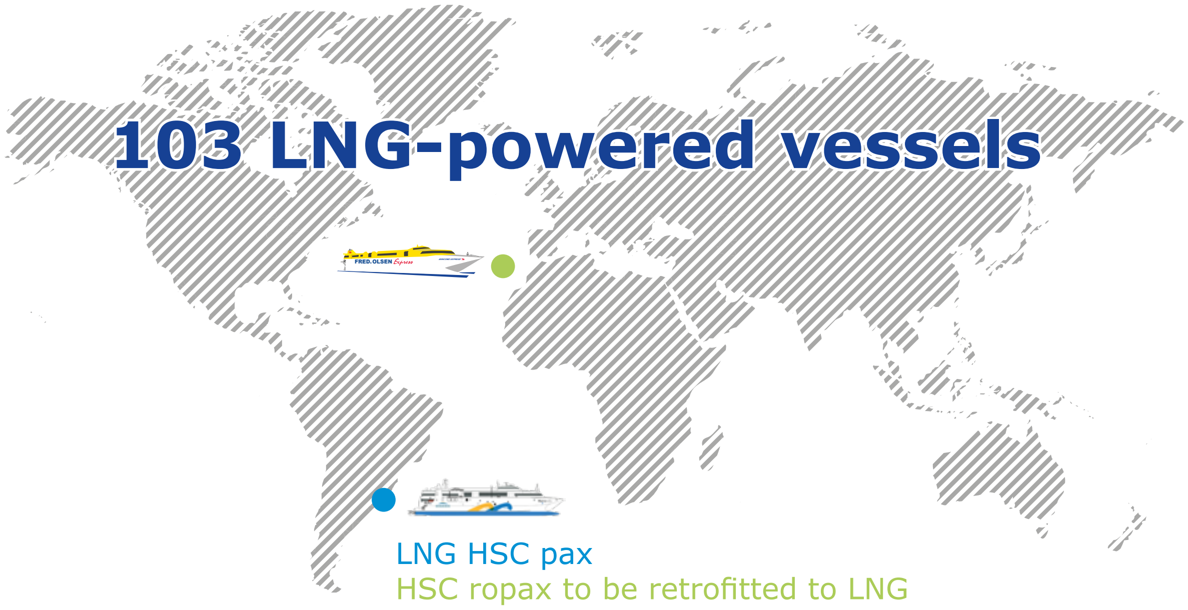
Currently, there are 103 LNG-fuelled vessels in operation around the world and 97 on order. Car and passenger vessels make up the largest segment, accounting for 40 of the 103. None of these is a HSC ropax vessel with capacity for both passengers and trucks in open seas.

Although, the first and only LNG-powered HSC in the world is the newbuild HSC Francisco operating between Argentina and Uruguay, its capacity is only for cars and passengers in river operations and it is powered by gas turbines.

In this context, the GAINN4SHIP INNOVATION project, coordinated by Fundación Valenciaport and co-financed by the European Union via the "Connecting Europe Facility" programme, was selected to support the retrofitting of the HSC ropax Bencomo Express, the world's first high-speed ropax vessel with capacity for both passengers and trucks in open seas to undergo conversion to LNG dual fuel.

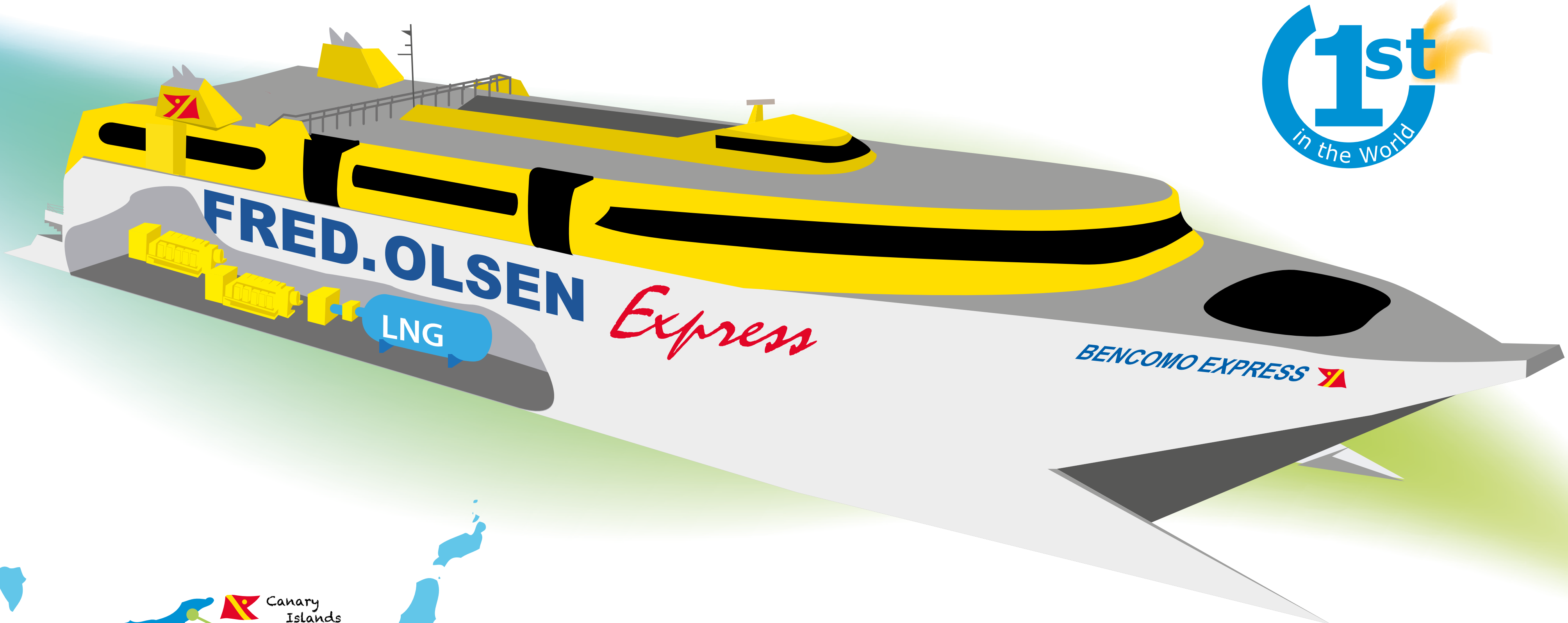
The HSC ropax Bencomo Express is one of the five high-speed ships catamarans of the Fred. Olsen Express fleet. It was first put into service in October 1999 on the route between Santa Cruz de Tenerife (Tenerife) and Agaete (Gran Canaria). It operates the route between both ports three times a day in each direction at a service speed of 36 knots and the voyage takes one hour and 15 minutes.

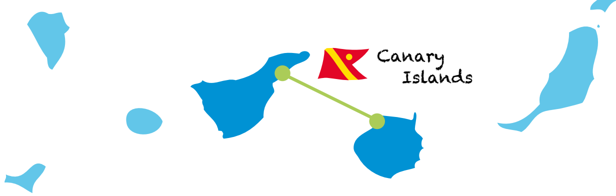
The Bencomo Express is 95.47 meter long, able to carry a maximum of 859 passengers. The cargo capacity of the Bencomo Express is 250 line metres for trucks and 80 cars, or 230 cars.



LNG dual-fuel

retrofitted ropax high-speed craft





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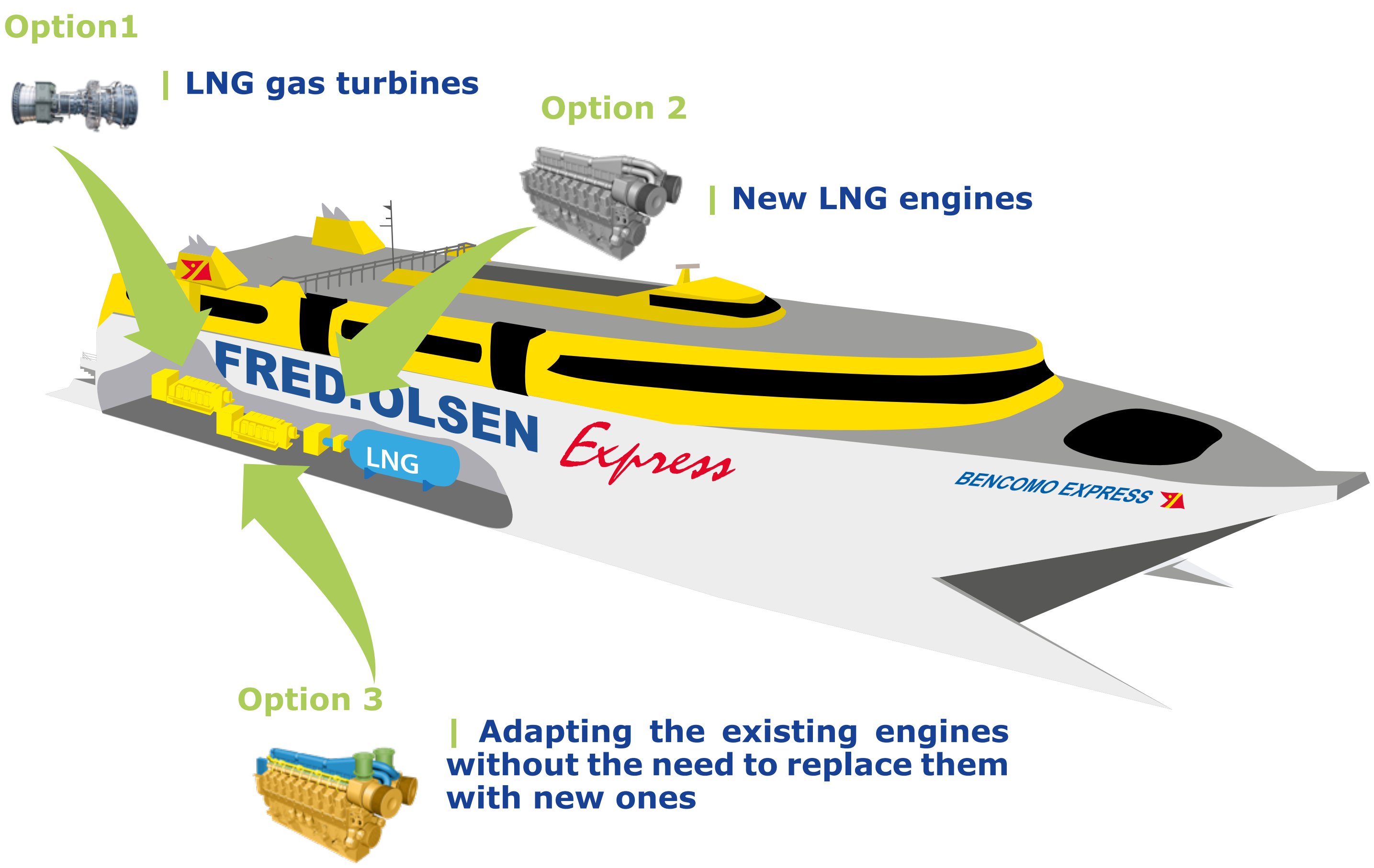
HOW TO RETROFIT HSC VESSELS TO RUN ON LNG: BENCOMO EXPRESS

Pioneering technology would be used for the HSC Bencomo Express retrofit as there is currently no technology available that could be implemented with HSC vessels. This is the first case in the world of an adaptation of an HSC ropax vessel to be powered by both diesel and LNG.

All the different options that could be used to retrofit the HSC Bencomo Express to run on LNG have been thoroughly analysed: 1) powering the HSC Bencomo Express with LNG gas turbines; 2) installing new LNG engines on the HSC Bencomo Express and 3) adapting the existing engines.



• Option 1| Powering the HSC Bencomo Express with LNG gas turbines

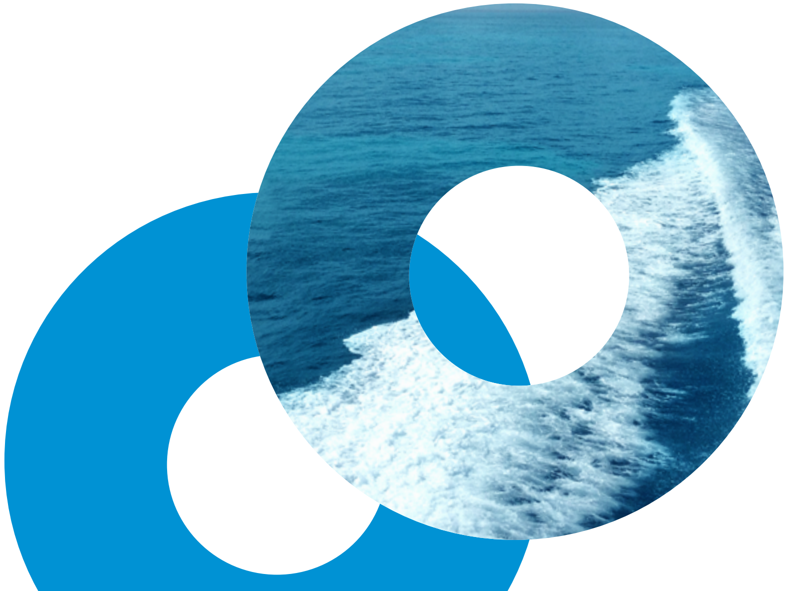
Although the first and only LNG-powered HSC in the world is the newbuild HSC Francisco operating between Argentina and Uruguay, the technology used to power it with LNG is entirely different from the technology to be used for the HSC Bencomo Express. The HSC Francisco is the first HSC powered by gas turbines using LNG as a primary fuel source and marine distillate for standby and ancillary use. In particular, the HSC Francisco is equipped with two 22MW GE LM2500 gas turbines driving two Wärtsila LJX 1720 SR waterjets. The vessel is designed to transport passengers and cars at 50 knots in a river with maximum Significant Wave Height (SWH) of 2.5m. The HSC Bencomo Express will be the first LNG-fuelled HSC in the world transporting passengers, cars and cargo vehicles in open seas with up to 5m Significant Wave Height (SWH).

The high consumption of gas turbines (3 to 4 times the average diesel engine fuel consumption at the same nominal power), means that this solution is only profitable for the shipping companies operating in countries where they can buy LNG at low prices, which is the case for the Argentinean market. This kind of solution would not be possible in Europe where LNG prices are considerably higher than in Argentina, and would be even less attractive in the Japanese market. The capital cost of just one 22 MW dual fuel turbine is above €10m, while for a similar amount one could get four 9 MW diesel engines (36MW) designed for HSC. Thus the investment becomes prohibitive.

On the one hand, maintenance tasks (mainly time between overhauls -TBO-) on turbines are driven by the thermal cycles, directly related to the number of start-stop cycles of each turbine. With diesel engines, on the other hand, TBO depends on the engine running hours. Thus, when an HSC makes several port calls per day (several start-stop cycles), the maintenance cost is much higher using turbines.

Considering the actual route of the HSC Bencomo Express, using dual-fuel turbines would mean adding an intermediate overhaul every year and having a major overhaul every two years. In comparison, with the present vessel engines an intermediate overhaul is needed every three years and a major overhaul every six years.

Apart from requiring a higher initial investment, gas turbines are not a suitable technological or economic solution for most HSC ropax services in Europe as the operational costs for this technology increase substantially in direct relation to the number of port calls in the vessel itinerary. Given that the average port-to-port transit time of the 67 high-speed shipping lines operating in the European Union is 4.5 hours, the vessels' average number of stops is very high and using gas turbines would make maintenance costs prohibitive.



• Option 2| Installing new LNG engines on the HSC Bencomo Express

HSC vessels are deployed in niche markets requiring high-speed engines (in the 1000 rpm range) for these maritime transport connections. Many high-speed short-sea services are currently offered to connect ultra-peripheral regions with the EU mainland or with outer islands, or between islands in remote archipelagos. Given the peripheral nature and lack of connectivity of many of the ports where these services operate, maintaining service speed is crucial to foster territorial cohesion and contribute to reducing peripherality. Losing speed is unacceptable to the sea carriers as speed is the most important feature of this kind of maritime transport service.

A lightweight craft is crucial in order to reach high-value commercial speeds. LNG has 50% of the energy density of diesel oil and therefore, roughly speaking, about four times the space is required for the LNG tanks, piping and other fuel-handling equipment. Together with the heavier LNG medium-speed engines (in the range of 500-700 rpm), this results in a propulsion package (for the same power range) that is significantly heavier than a conventional high-speed diesel engine installation.

Indeed, one set of conventional medium-speed LNG engines available in the market weighs approximately 200 tonnes more than one set of high-speed diesel engines installed on HSC vessels. In the case of the Bencomo Express it would mean losing a third of the carrying capacity of the vessel, this being unacceptable for a sea carrier. Thus, a solution to the LNG engines' extra weight must be found if HSC vessels are to be fuelled by LNG.

As shown in the table, dual-fuel engines that are currently on the market are too large and heavy to be used in HSC vessels. In the specific case of the HSC Bencomo Express, with two engines per engine room, the maximum height available in the engine room is 4.6 m, so only two out of six available new engines would fit in the engine room.

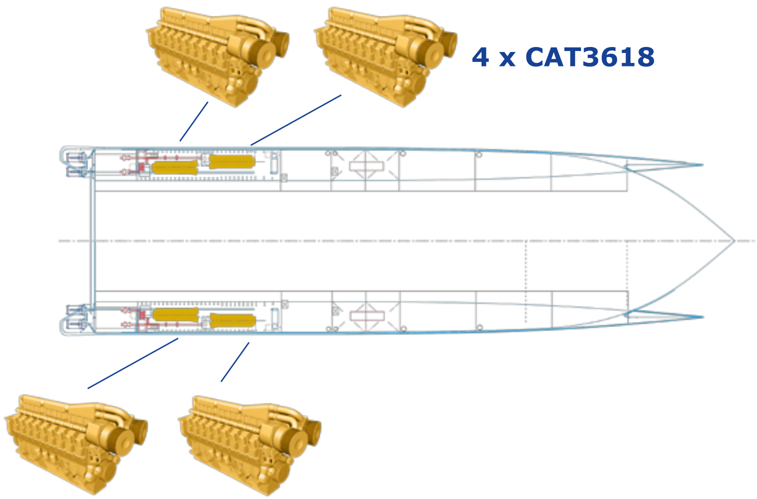
As the two new engines that would fit into the Bencomo Express engine room are heavier than the original engines, the extra weight of installing these new engines would be 168 tonnes [(77-35)*4]. Additionally, the extra-weight of LNG tanks and fitting would be about 35 tonnes to be added once the retrofitting is completed. In total, this means adding 203 tonnes of weight to the vessel. Given than the maximum vessel displacement (maximum deadweight + lightweight) is fixed, if the original maximum deadweight tonnage of the vessel is 717, adding 203 tonnes to vessel lightweight would mean reducing the maximum deadweight on that amount, that is losing 28.3% of her loading capacity; this being a very high percentage of loading capacity that would not be acceptable for any sea carrier.

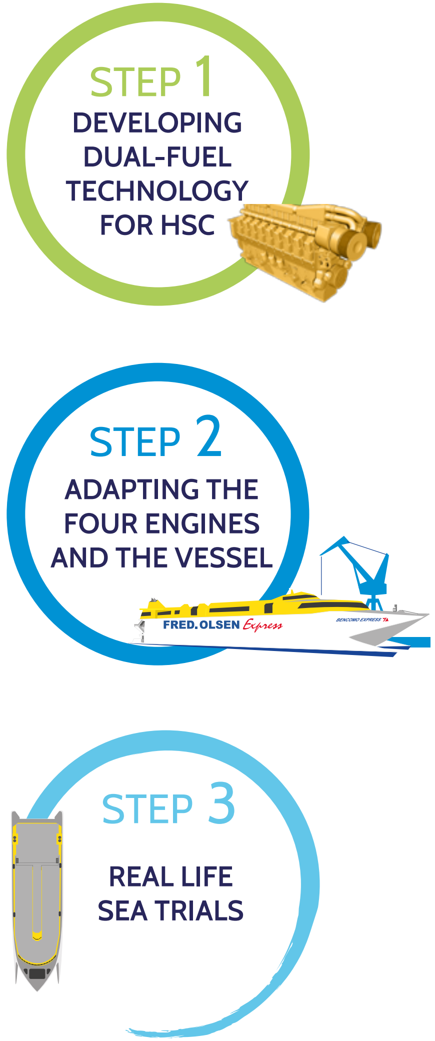
ENGINE	WEIGHT (tonnes)	HEIGHT (m)	DWT	% LOSS OF CARRYING CAPACITY
MAK 8M46DF	114	4.9		
ROLLS-ROYCE B:32:40V16P	73	4.8		
WARTSILA 14V31DF	77	4.1	717	28.3%
WARTSILA 16V34DF	77	3.8	717	28.3 %
WARTSILA 7L46DF	118	4.7		
MAN 8L51/60DF	135	5.3		

The installation of new commercially-available LNG or dual-fuel engines is not possible, as four out of the six existing new dual-fuel engines do not fit into the engine room. In the case of the two new dual-fuel engines that do fit into the engine room, the loss of carrying capacity would be 28.3%, which is unacceptably high. Losing such a high percentage of carrying capacity would make the retrofitting investment financially unfeasible.

• Option 3| Adapting the existing engines of the HSC Bencomo Express to LNG dual fuel

The only solution found to the challenge of applying existing technologies to HSC vessels is to adapt the engines currently on board to burn a blend of diesel and LNG, rather than replacing them with new ones. This solution will provide the best results in terms of environmental performance, regulatory compliance and technological and financial feasibility.

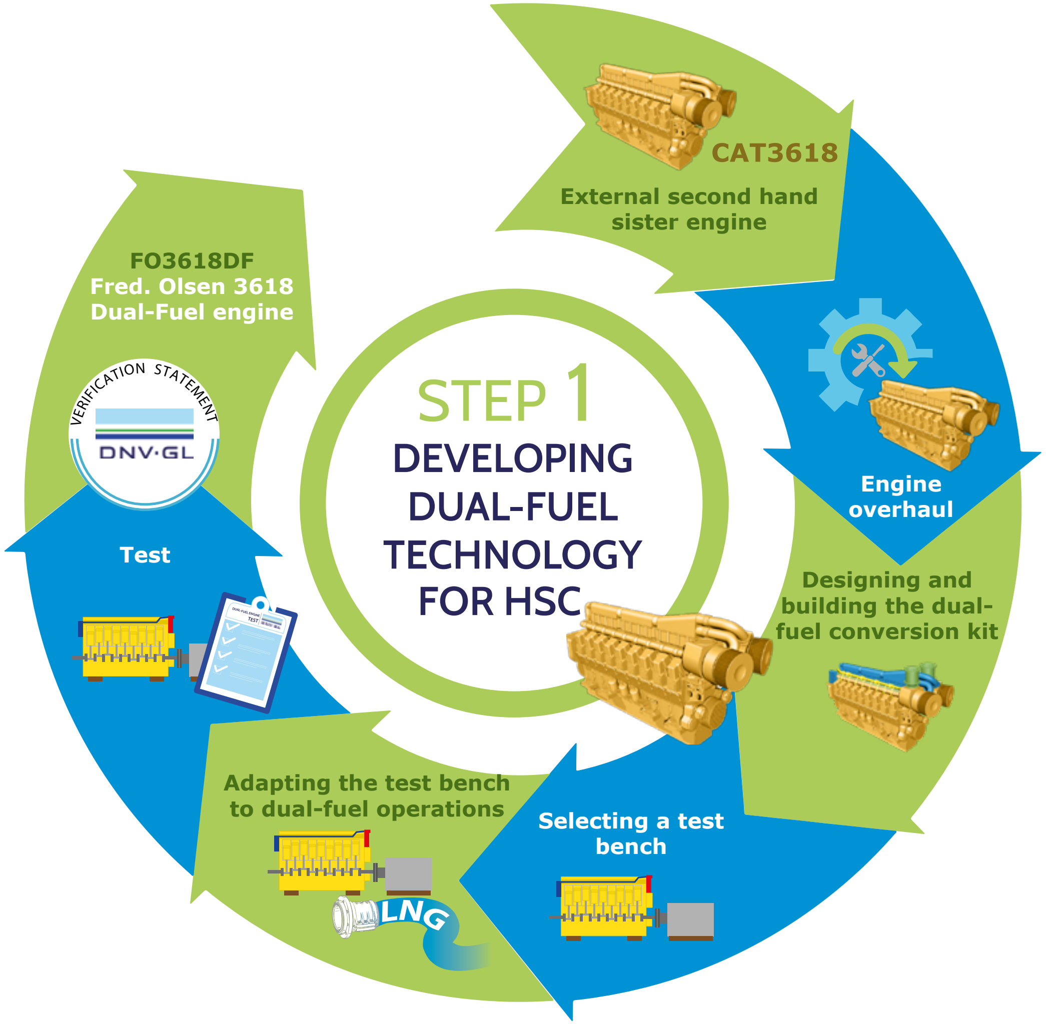




How to adapt the four existing engines?

As there is no commercially-available technology to adapt the Caterpillar 3618 (CAT3618) engines, Fred. Olsen first developed the dual-fuel technology required.

In order to avoid the vessel spending a long time in dry dock, and all the operational costs that this would entail, the technology was developed in an external second-hand sister engine with the same characteristics as the four engines on board the vessel. In addition, this option allows the test to be conducted in a controlled environment, improving the safety and increasing the number of parameters and scenarios tested.



In order to develop the dual-fuel technology required for HSC, a second-hand sister engine with the same characteristics as the four main engines on board the vessel was bought by Fred. Olsen, as the CAT3618 engines were discontinued and there are no engines in the market with similar power, weight and volume.

Firstly, the second-hand sister engine was dismantled and revised by the Spanish engine dealer, Finanzauto, in order to ensure the test bench did not produce incorrect results due to low engine performance.

Secondly, the conversion kit used to adapt the engine to dual-fuel was designed and built. The adaptation of the engine mainly consists of the injection of natural gas into the admission air, maintaining the initial diesel injection system. Consequently, this adaptation does not limit the unrestricted diesel operation, if required.

Through a public tendering process, Navantia facilities in Cartagena (Spain) were selected for conducting the test bench.

The next step was to define the test bench layout required for the adapted engine to be tested in dual-fuel operation with LNG according to the DNV-GL rules for Gas-Fuelled Ship Installations that entered into force in January 2016.

The test bench was adapted to dual-fuel operations in accordance with the applicable legislation, in order to ensure its safe operation with natural gas. A portable LNG station by Endesa was installed at Navantia in order to supply LNG to the test bench at the pressure and flow required.

Finally, the tests to validate technical characteristics and emissions from the adapted engine (FO3618DF) were successfully completed by the end of November 2016.

More details in the following video:

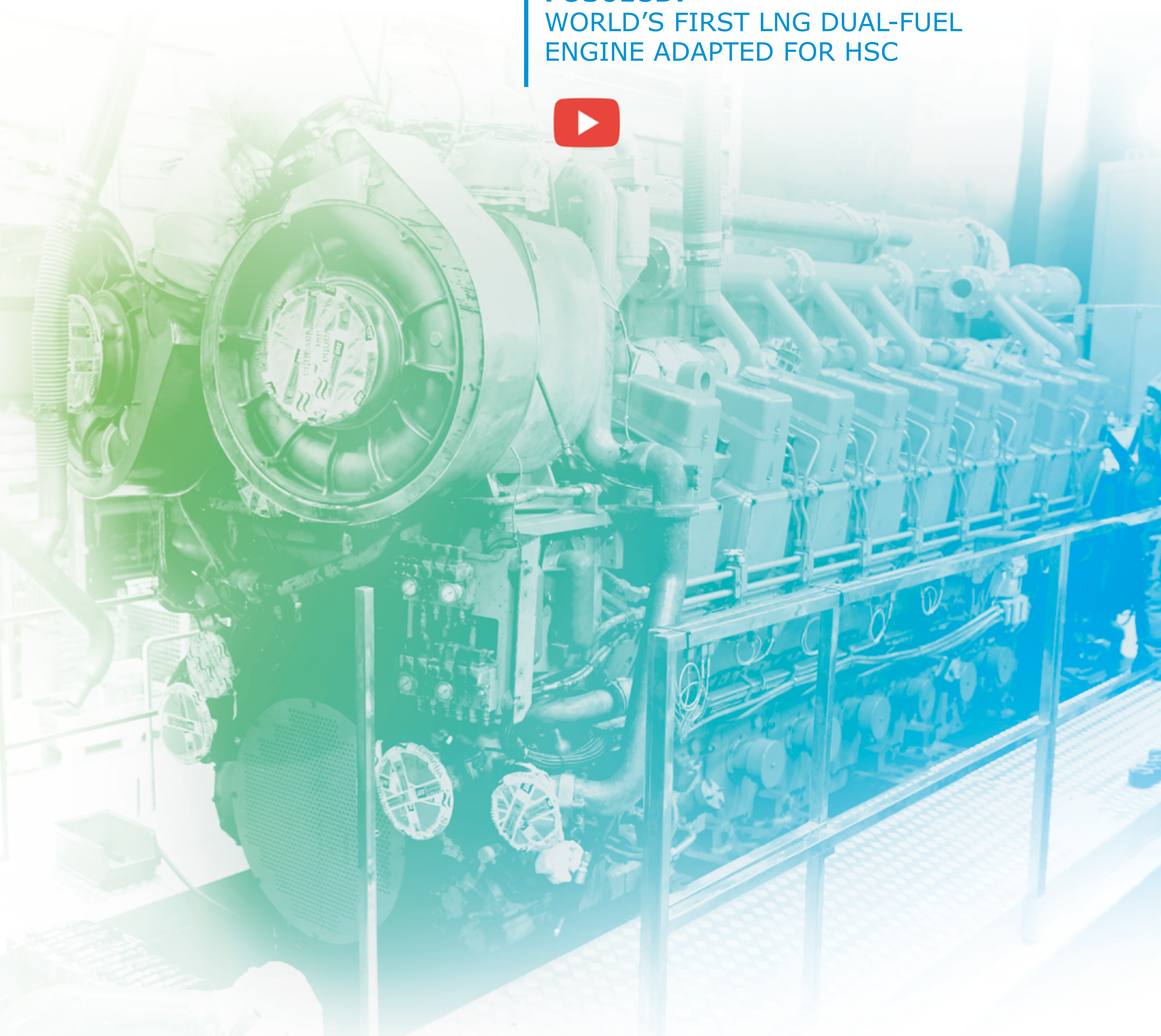
http://bit.ly/2BHcPX1

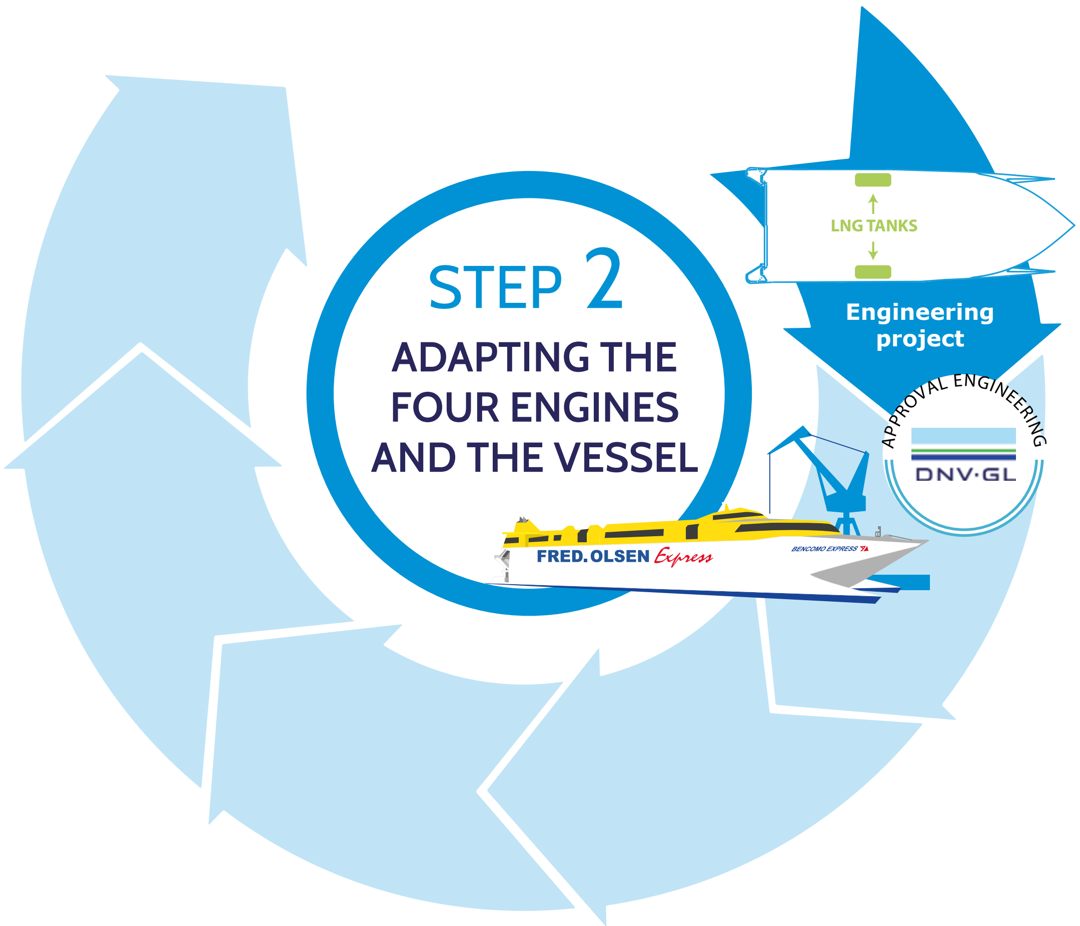
In terms of emissions, the results of the test were better than expected. The emissions from the retrofitted engine show a 90% reduction in sulphur oxides as well as a 32% reduction in carbon dioxide and 45% in nitrogen oxides, when the engine is operating in dual-fuel mode with a ratio of 90% natural gas to 10% diesel.

In terms of engine performance, the normal operating conditions were simulated, demonstrating a noticeable reduction of fuel consumption due to the increase in engine efficiency. The situations tested included sailing in adverse weather conditions, demonstrating high reliability in dual-fuel mode.

This internationally pioneering technology could be applicable to most high-speed vessels operating around the world.

FO3618DF
WORLD'S FIRST LNG DUAL-FUEL ENGINE ADAPTED FOR HSC





The pioneer technology developed for the adaptation of the propulsion engine to dual fuel will be used to convert the four CAT3618 engines currently on the Bencomo Express, without any need to replace them with new ones.

A basic engineering project of the HSC ropax Bencomo Express has been developed compiling the necessary regulatory studies, guidelines and assessment tools, as it was necessary to properly apply IGF Code (International Code of Safety for Ships using Gases or other Low-flashpoint Fuels) in order to obtain the approval by the classification society and the Spanish statutory flag if the project is feasible.

This design description and accompanying drawings are a feasibility study to determine what systems are required for an actual gas conversion project on the existing HSC Bencomo Express. The main challenges that need to be faced and solved in the Bencomo Express to be powered by LNG are: location of the LNG storage tanks, engine room arrangement and adaptation to run on LNG dual fuel, adaptation and modification of the vessel systems, installation bunkering system, safety, stability.

Although the approval from the classification society DNV-GL and the Spanish Directorate-General for Merchant Shipping, was successfully obtained at the end of 2017, the Board of Directors of Fred. Olsen has decided not to continue with the retrofitting of the Bencomo Express (adaptation of four engines and the vessel systems) given the lack of LNG supply infrastructure in the Canary Islands and the high logistic costs of transporting LNG from the Iberian peninsula. Fred. Olsen has expressed in several occasions that the vessel retrofitting only makes sense if the LNG regasification plant that is planned in Tenerife is finally built.

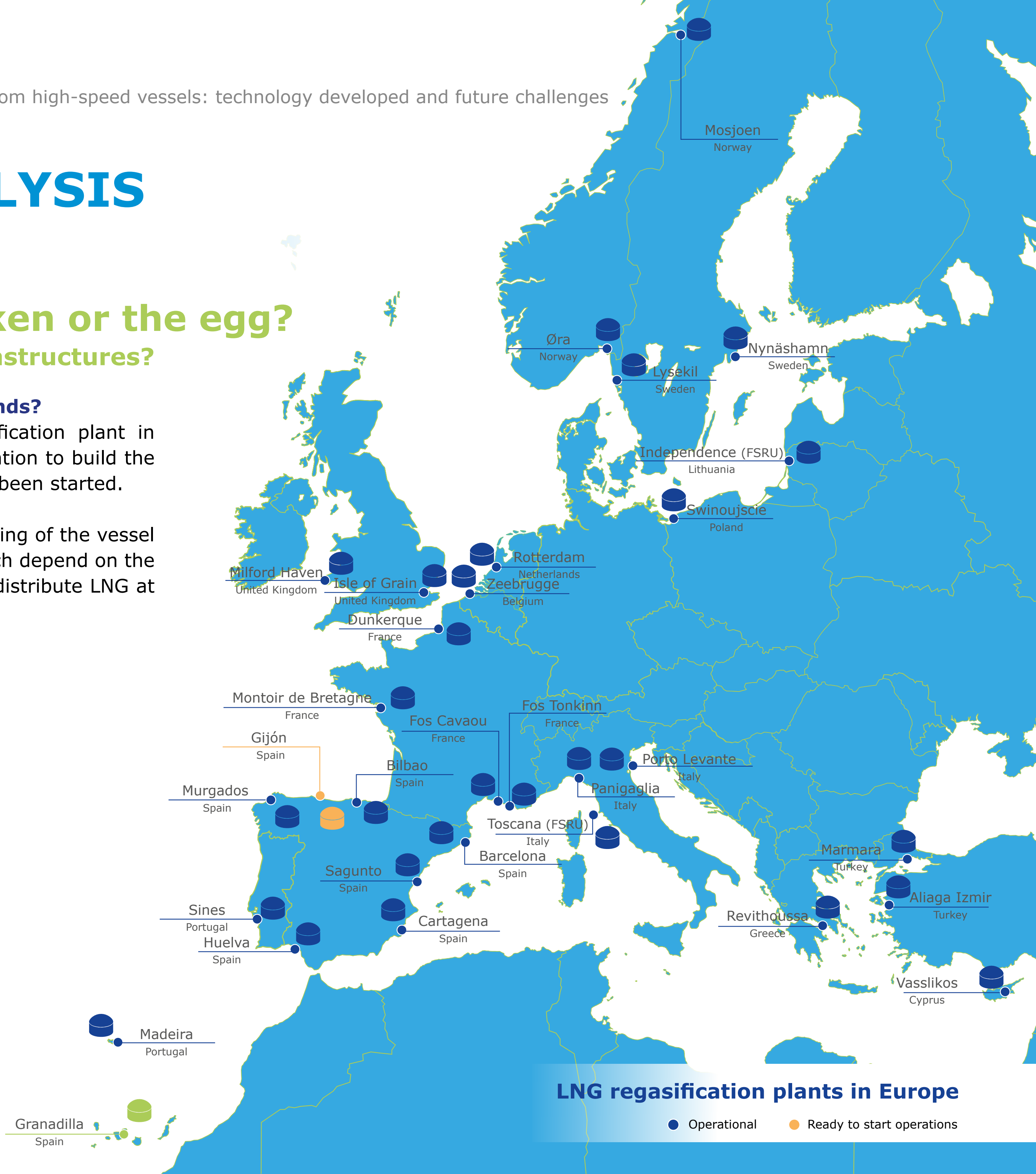
COST-BENEFIT ANALYSIS

Which came first: the chicken or the egg?

LNG-powered vessels or LNG supply infrastructures?

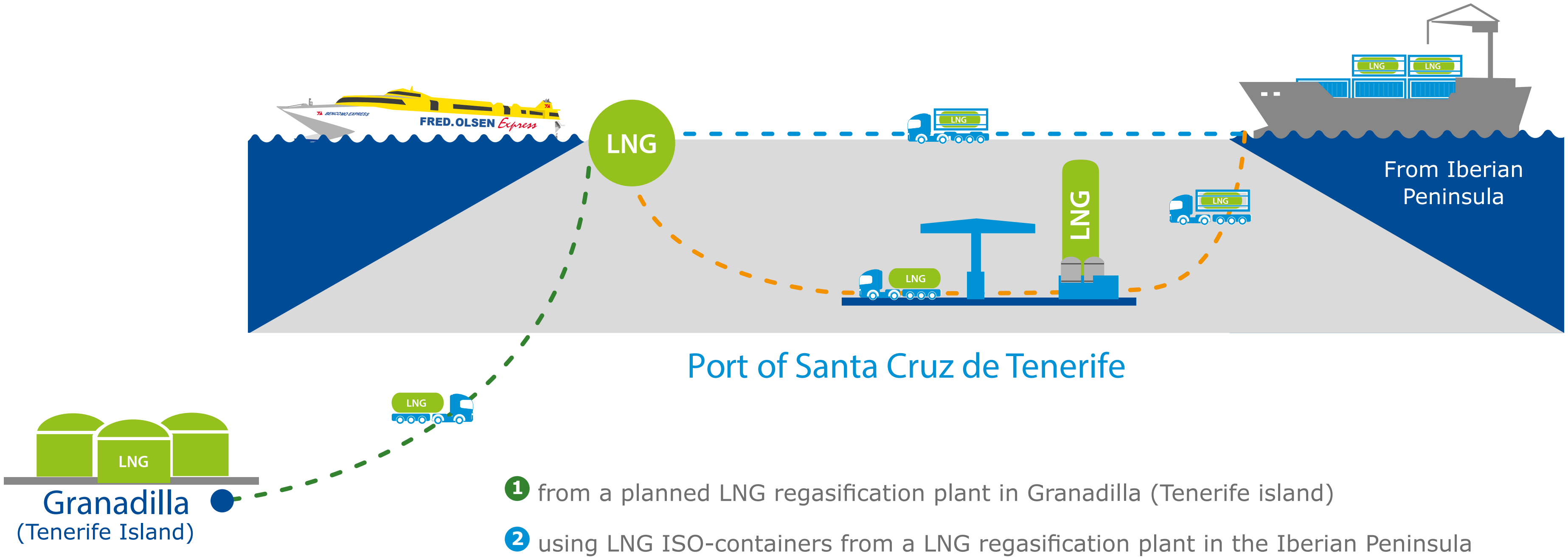
Is a regasification plant needed in the Canary Islands?
Although the investor (Enagás) behind of the regasification plant in Granadilla (Tenerife island) has clearly stated their intention to build the plant from the beginning of the project, works have not been started.

Fred. Olsen has decided not to proceed with the retrofitting of the vessel due to the negative results of the financial analysis, which depend on the availability of LNG bunkering facilities to introduce and distribute LNG at Canary Islands ports.



A cost-benefit analysis (CBA) of the project has been carried out following the methodology included in the "Guide to Cost Benefit Analysis of Investments Projects"[1] elaborated in December 2014 by the Evaluation Unit of the European Commission Directorate General of Regional Policy.

The CBA compares a scenario with-the-project with a counterfactual baseline scenario without-the-project (business as usual scenario – BAU), using an incremental approach. Three scenarios have been analysed according to the identified options to supply LNG at the port of Santa Cruz de Tenerife:



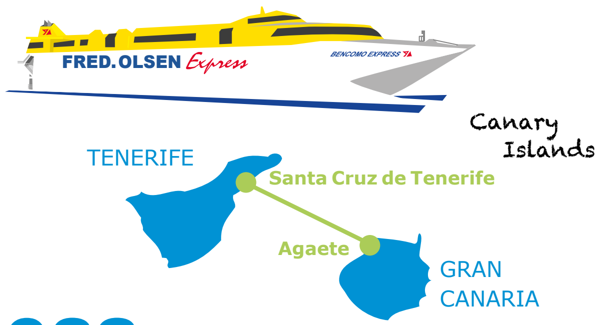
1 from a planned LNG regasification plant in Granadilla (Tenerife island)

2 using LNG ISO-containers from a LNG regasification plant in the Iberian Peninsula

3 from a LNG satellite plant in the Santa Cruz de Tenerife port fed by LNG ISO-containers from the Iberian Peninsula

[1]Henceforth, the Guide.

The Bencomo Express operates the route between ports of Santa Cruz de Tenerife (Tenerife island) and Agaete (Gran Canaria island) three times a day in each direction and the voyage takes one hour and 15 minutes.



988 round trips/year

The fuel consumption per year for the Bencomo Express running on LNG dual-fuel mode would be:

1,815 tonnes

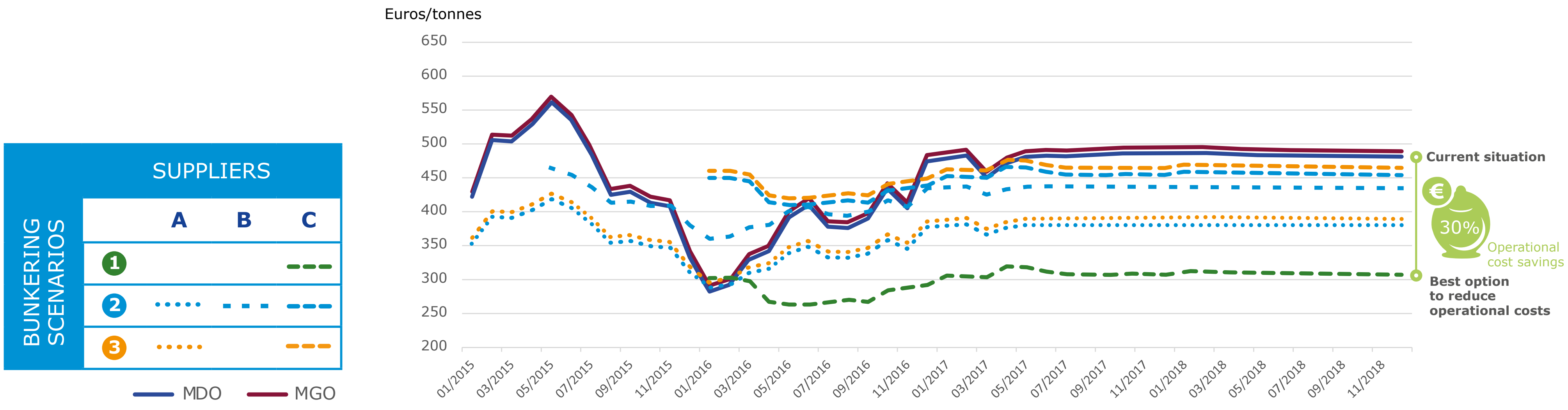
7,129 tonnes

Bunkering operations would be done by truck-to-ship system at the port of Santa Cruz de Tenerife twice per day.

Three different suppliers (A, B and C) have submitted their offers to supply LNG at the port of Santa Cruz de Tenerife including logistics costs.

The following graphic summarises the evolution of the costs for supply LNG at the port in recent years by combining the three different scenarios for LNG bunkering and the three suppliers interested.

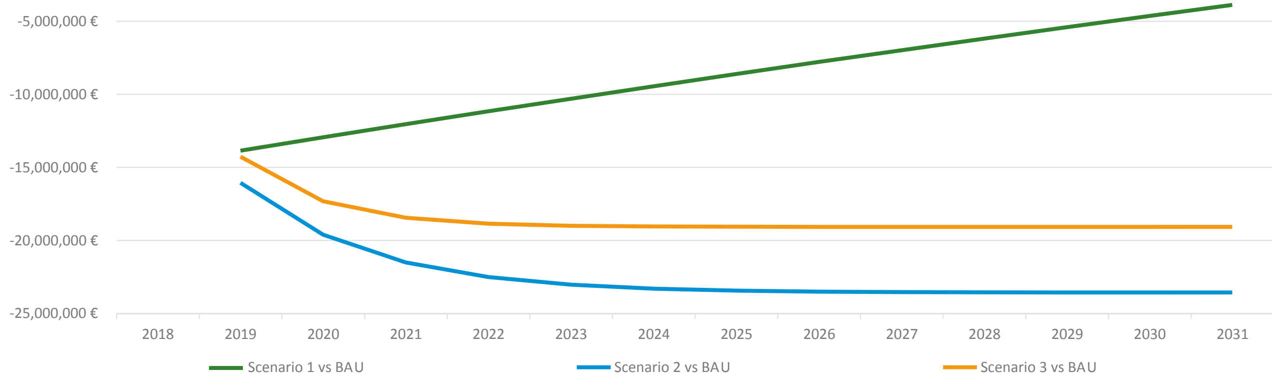
In accordance with the objectives of the GAINN4SHIP INNOVATION project of fostering greener, safer and sustainable maritime transport by reducing operational costs associated to fuel consumption on average by 30% with the retrofitting of the Bencomo Express, the only option that would reduce **operational costs by 30%** is scenario 1 LNG bunkering from a planned LNG regasification plant in Granadilla (Tenerife island).



Firstly, a **financial analysis** has been carried out to assess the retrofitting project viability by calculating the project's financial performance indicators.

The internal rate of return (IRR) is positive, 1.16%, although lower than the discount rate, only in the scenario where the Granadilla LNG regasification plant would be built and ready to supply LNG to the Tenerife Island users. For the two project scenarios that are immediately available (as it is unknown if and when the LNG plant in Granadilla is going to be built) the IRR would be negative (-9.40% IRR for scenario 2 and -11.19% for scenario 3).

The following graph shows the evolution of the cumulative net cash flows that would be generated in each of the three project scenarios analysed in comparison to the BAU scenario.



Secondly, a **socio-economic analysis** has proven that the project would create positive welfare change in the three assessed project scenarios. The results show that the retrofitting of the HSC Bencomo Express is desirable from a socio-economic perspective meaning that the society would benefit if the project were to be implemented.

With an estimated 13.10% Economic Internal Rate of Return and a positive economic net present value of 11.2 million Euros, the completion of the Action would have increased social welfare if the Granadilla LNG plant would have been built and would have been the supply origin of LNG for Fred. Olsen. Even though the ERR falls to 9.69% and 9.14% in the scenarios where LNG is supplied from the Iberian Peninsula, either directly with ISO containers (scenario 2) or via a small LNG station in Tenerife (scenario 3), it is still positive, so socio-economic welfare would have increased in all scenarios.

The most sensitive input variable for the adaptation of the HSC Bencomo Express is fuel price, so a full set of scenarios varying fuel prices (both MGO and LNG) has been analysed.

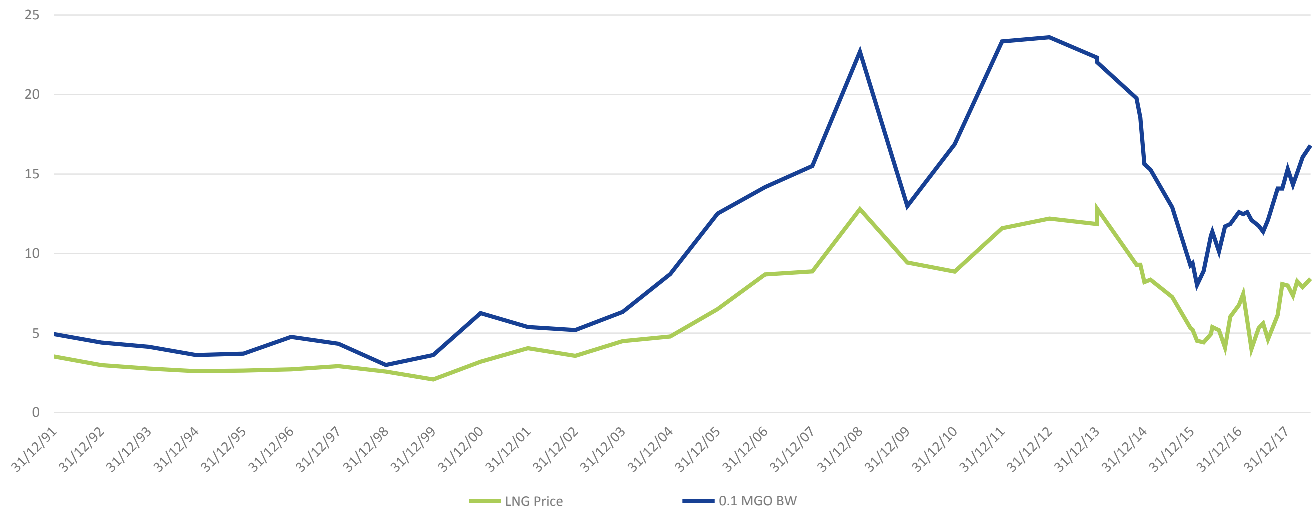
The following table shows the sensitivy analysis of the Financial Net Present Value (FNPV) to changes in fuel prices, in Euros.

LNG Price	MGO Price						
	492.16	550	600	700	800	900	1000
310.67	-3,879,105 €	360,055 €	4,024,612 €	11,353,726 €	18,682,840 €	26,011,954 €	33,341,068 €
325	-5,061,337 €	-822,178 €	2,842,379 €	10,171,494 €	17,500,608 €	24,829,722 €	32,158,836 €
350	-7,123,536 €	-2,884,376 €	780,181 €	8,109,295 €	15,438,409 €	22,767,523 €	30,096,637 €
375	-9,185,735 €	-4,946,575 €	-1,282,018 €	6,047,096 €	13,376,210 €	20,705,324 €	28,034,439 €
400	-11,247,933 €	-7,008,774 €	-3,344,217 €	3,984,897 €	11,314,012 €	18,643,126 €	25,972,240 €
425	-13,310,132 €	-9,070,973 €	-5,406,415 €	1,922,699 €	9,251,813 €	16,580,927 €	23,910,041 €
450	-15,372,331 €	-11,133,171 €	-7,468,614 €	-139,500 €	7,189,614 €	14,518,728 €	21,847,842 €
475	-17,434,530 €	-13,195,370 €	-9,530,813 €	-2,201,699 €	5,127,415 €	12,456,530 €	19,785,644 €
500	-19,496,728 €	-15,257,569 €	-11,593,012 €	-4,263,897 €	3,065,217 €	10,394,331 €	17,723,445 €

Finally, in order to complete the **sensitivity analysis**, the past evolution of fuel prices has been taken as an input and the results of the FNPV and Economic Net Present Value (ENPV) in Euros in the scenario 1 (LNG would be supplied from the granadilla LNG plant to HSC Bencomo) have been calculated.

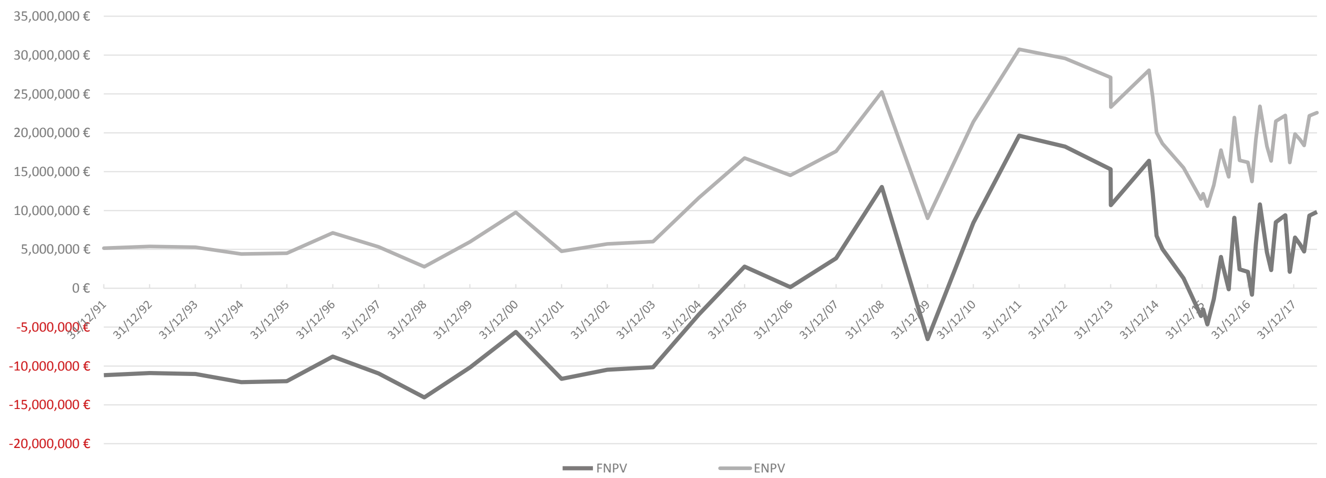
Price evolution of EU gas prices and 0.1 MGO BW in US$/mmBTU

Source: Own elaboration based on data by DNV-GL 2018



As it can be seen in the following graph, introducing as input values the individual LNG and MGO prices of each quarter since 2005, FNPV would have been positive for most of the time period until the present date. If the Granadilla LNG plant were to be built in the island of Tenerife and LNG suppliers were to take into consideration the average price gap between LNG and MGO over the last 10 years, a long-term quotation for 10 years could be given by LNG suppliers at a rate that would make it financially feasible to retrofit and operate on LNG the HSC Bencomo Express.

The ENPV would have remained positive whichever the price gap between MGO and LNG since 1991. The socio-economic results are less sensitive to variations in marine fuel prices than the financial indicators of the project.



CONCLUSIONS

Dr.-Ing. Hinrich Mohr
Key Account Manager and Product Manager
Systems Integration Large Engines
-AVL List GmbH-

The key to the adaptation of the dual-fuel engine has been the technological expertise leading to the development of a cost-effective conversion kit that is easy to install on the CAT3618. The kit consists of several type-approved components in a double-walled configuration, meeting the requirements of "ESD (Emergency Shut Down) protected machinery spaces" according to the IGF Code (International Code of Safety for Ships using Gases or other Low-flashpoint Fuels). In particular, the dual-fuel system is operated by a control system that activates double-walled gas admission valves designed for marine applications. Additional systems such as an intelligent air path management and a Knock Control System are installed, making it possible for the engine to run with a replacement ratio of up to 90% natural gas/10 %MGO.

A thermodynamic simulation running on dual fuel was carried out, as well as a transition simulation when switching from dual fuel to MGO and vice versa. This was done in order to optimise the conversion kit for these particular engines, determining consumption amounts and establishing the final test bench protocol required. After the thermodynamic simulation running on dual fuel, the conversion kit was built and installed following the design defined for future implementation on the four engines on board.

AVL List GmbH, the world's largest independent company specialising in the development, simulation and testing technology of powertrains systems, was initially responsible for optimising the conversion kit design, the thermodynamic and real time dual-fuel operation engine modelling. Heinzmann, a competent and innovative supplier of dual-fuel systems supplied the conversion kit for the adapted marine engine.

The test bench at Navantia in Cartagena was adapted to dual-fuel operations in accordance with the applicable legislation, to ensure its safe operation with natural gas by AVL Ibérica.

AVL supervised and evaluated the performance development as well as the emission and reliability test at the Navantia test bench in order to receive the certification issued by the classification society DNV-GL, which certifies the safe and reliable operation of the engine in dual-fuel mode. Measurements of exhaust gas emissions from the retrofitted engine were carried out with the collaboration of the Polytechnic University of Cartagena (UPCT).

The technical concept of AVL, which was applied to stationary diesel engines since quite some time already, can be transferred to other marine applications as well. These can be high-speed vessel as in the current project but also other vessel types. There are more ideas existing to improve the concept further leading to more reduced emissions and enhanced efficiency. In all cases the developed dual-duel-conversion concept enable ship owners to prolong the lifetime of existing diesel engines gaining the before mentioned advantages.

First interest is shown already by several ropax HSC owners operating in the Mediterranean Sea, but also from power plant operators in Central America. In all cases the potential to reduce fuel consumption and operational costs in combination with emissions are important. It can be expected that there will be applications soon in compliance with stricter emission standards after establishing LNG bunkering infrastructures in the relevant areas as the Canary Islands.

Iván Fernández
Technical Manager
Fred. Olsen

Sometimes markets do not provide the product that is needed at a certain time, but thanks to the support of the European Union CEF projects, Fred. Olsen has been able to develop an innovative solution to retrofit a Large High Speed Ferry to run on LNG, when the actual engine manufacturers used on these type of vessels have not developed a suitable dual fuel engine yet and it is not even expected for the coming 5-8 years.

Thus, the world´s first conversion project of a 7,2 MW fast engine (only 35 tonnes and above 1.000 rpm) to dual fuel has been a great success from the technical results point of view, as the same operating profile on dual fuel was kept and new technologies have been developed under the project.

Thus, all evaluations, analyses and simulations prove that being fuelled by LNG is a real solution. This has been based on the development, certification and approval of new hardware and software for marine propulsion engines (under a very strict regulation) with a very significant reduction of emissions.

This successful engine conversion is now the solution to be adopted for future dual-fuel conversions of special applications engines (like high speed ferries) or even developments of new dual fuel engines.

The design of the modifications on our high speed ferry (applicable to many other similar vessels) has also been developed so that the four main engines of this ferry can be converted to dual fuel and all required LNG systems fulfilling the new IGF code and minimizing the extra weight requirements, always under revision and approved by the Classification Society DNVGL, be implemented.

Our large high-speed ferries link only the Canary Islands, this means that the conversion of the HSC “Bencomo Express”, and progressively our other sister vessels, depends on the regular supply of LNG in this ultra-peripheral region. All major LNG suppliers have shown a deep interest on supplying LNG to our fleet with different solutions proposed and evaluated, but unfortunately the regasification plant scheduled to be built in Tenerife for years has not got the building permit yet. Without a regasification plant in service in the Canaries, the logistic costs from all solutions quoted forces Fred. Olsen put the project on stand-by. Fred. Olsen hopes that this innovative project may be continued as soon as the logistic costs become reasonable.

Thus Fred. Olsen S.A. is happy and proud to demonstrate that the technology to run a large high speed ferry with LNG is ready and available. And although we feel sad for not being able to complete the project at this moment, we hope to end the project as soon as the LNG logistic supply chain provides a competitive solution for the Canary Islands.

We thank the teams from all our partners, contractors and collaborators on this key project for our company, for their support and enthusiasm at all times.

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Co-financed by the European Union

Connecting Europe Facility