CLINSH

SUSTAINABLE WATERWAY TRANSPORT, CLEAN AIR

Deliverable A and B1

Report on Fleet demonstration activities

CLEAN INLAND SHIPPING

WWW.CLINSH.EU

Project:	CLINSH – Clean Inland Shipping
Goal:	The objective of LIFE CLINSH is to improve air quality in urban areas situated close to ports and inland waterways, by accelerating IWT emission reductions.
Project reference:	LIFE15 ENV/NL/000217
Duration:	2016 – 2020
Project website:	www.clinsh.eu

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This deliverable is part of B1 Preparatory and implementation actions.

Contributors: Province of Zuid-Holland

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1 Introduction

CLINSH is an European consortium promoting clean waterway transport. Within CLINSH Dutch, Belgian, German and English public and private organizations work together. The main objective of CLINSH is to improve air quality in urban areas by accelerating emission reductions in Inland Waterway Transport. Therefore, CLINSH fits in the European Life Program. This program is a European financial instrument. It supports environmental, nature conservation and climate action projects throughout the EU. The province Zuid-Holland is the lead partner of the CLINSH project.

Within CLINSH 43 ships are selected, on which the performance of various emission reduction techniques and alternative fuels will be tested. Before and after these adjustments the ships emissions (NOx and PM) will be monitored in real life conditions. Also, the chances for further introduction of onshore power supply will be investigated. The measurement results are collected in a database. The results provide a tool for local, regional, national and European governments for (new) policies on the greening of waterways. The results also provide skippers more information about the most cost-effective environmental measures for their ship

2 Partners and external organizations involved and their responsibilities

Project partners

Partner	Responsibility
Provincie Zuid-Holland (PZH)	Action leader Overall coordination of demonstration and monitoring
Expertise en innovatiecentrum binnenvaart (EICB)	Advice and support procurement and monitoring of all demonstrations
Provincie Zuid-Holland (PZH)	Action leader for the procurement Selection and progress monitoring of all demonstrations
Gemeentelijk Havenbedrijf Antwerpen (ANTWERP)	Selection and progress monitoring of all demonstrations
Stichting Energy Valley (EV)	Selection and progress monitoring of LNG demonstration
Shell Global Solutions International B.V. (SHELL)	Selection and progress monitoring of GTL demonstrations
DCMR Environmental Protection Agency (DCMR)	Methodology of monitoring campaign, supervision data validation
NRW LANUV (LANUV)	Coordination of monitoring campaign Max Prüss
University of Newcastle Upon Tyne (UNEW)	Process emission data in CLINSH database
CE-Onderzoek, Advies en Consultancy voor Duurzaamheid B.V. (CE)	Coordination of socio-economic questionnaires

External organizations:

Organization	Responsibility
Ship-owning companies	Execution of the demonstration project
Multronic	Execution of the on-board (continuous) monitoring
Tauw	Execution of the on-board (discontinuous) measurements

3 Recruitment

Project plan

In accordance with the project plan two European tenders were intended to be organised in order to recruit the external parties. The purpose of the first European Public Tender Procedure was to select 30 vessels to test sustainability techniques in order to accelerate the emission reduction of inland shipping.

- For 15 of the selected vessels the shipowners have to equip their vessels with predefined emission reduction technologies by contracting a supplier of the emission reduction technologies on their own initiative. The supplier contracted by the shipowner will have to supply and install the technologies in accordance with the CLINSH project.
- The remaining 15 already remodelled ships will be provided with monitoring equipment to measure the performance of the existing emission reduction technology.

The purpose of the second European public tender procedure was to

- Select a supplier of onboard monitoring technology to monitor the emission. The 30 selected shipowners are obliged to accept the monitoring equipment and provide their cooperation. The monitoring will take place before and after the emission reduction technology is installed on the 15 involved ships. The other 15 ships are monitored all the time.
- Select a supplier for discontinuous measurements at the contracted vessels. These measurements will be carried out three times and will serve as reference measurements to the continuous monitoring and for the measurement of PM.

The vessel owners are hired as consultants for the project. A service fee (include idle time, data collection and max 50 % of the actual costs) will be paid to the vessel owners for:

- investing in a specific technology;
- down time during installation of the technology;
- allowing their ship to be equipped with measurement technology;
- allowing their ship to be traced and measured during the trial;
- keeping logbooks and being available for interviews.

The major costs are related to the demonstration of the five selected technologies. In total, the intention was that the emissions performance of 30 unique vessels will be measured during the demonstration phase. 15 of these vessels are already

equipped with greening technology or use a green fuel. The remaining 15 vessels (13 vessels + 2 GTL) will be equipped with one of the innovative technologies. The total estimated costs (outcome of tender procedure is subject to market forces) for the service fees are €2.000.000,- (PZH, ANTWERP, EV and Shell).
The fees for GTL and are covered by SHELL, GTL fuel consumption is provided for free by shell.

Recruitment in practice

During the tender of the fleet it became clear that organising a successful European tender to attract enough shipowners is quite a challenge. The administrative demands that are connected to a European tender has led to reluctance amongst shipowners to participate in the project. The following actions were taken to attract enough shipowners for a successful tender: the most important tender documents were translated in Dutch and German, including Easy to Read documents, a helpdesk was set up, the branch organisations were approached and two big maritime fairs were visited. Next to the existing tender platform a procedure was set up to enable shipowners to use email instead of the tender platform and the tender period was prolonged. Apart form the administrative demands, a lot of shipowners have reservations to invest in their ship, mainly because the margin of profit in the sector is in a lot of cases very low and there is no level playing field in the market to invest in greening technology. I turned out much easier to attract shipowners to be only monitored.

From September 2016 the necessary steps were taken to organize the European tenders for the fleet selection.

- The first fleet tender was launched in February 2017. This has led to 26 contracted ships, including test ship Max Prüss. It turned out not to be successful to contract an LNG ship to refit. Also, of the four wanted diesel electric ships only one was contracted. The effect of this was that of the allocated project budget of € 2 million, € 950.000 was not contracted after the first tender.
- In order to achieve the goals and ambitions of the project in December 2017 preparations started to organize an additional fleet tender to attract extra ships. This tender was launched in April 2018. This has led to an additional of 8 contracted ships, all being monitor ships. One of the goals of the second tender was to find a creative way to attract LNG-ships and diesel electric ships. Working from the experience that it turned out to be more easy to attract ships that are already fitted with greening technology we formulated lots with refitted ships in combination with a comparable ship on diesel. In this way an additional LNG ship and an additional diesel electric ship, both with sisterships were contracted. Also an LNG monitor ship and an diesel electric monitor ship were contracted.
- Because of delays that arose from problems with the tender for the continuous monitoring and the prolonging of the project there was room and there was

budget to launch a third tender in April 2019. The main goal was to attract some extra refit ships and contribute to the direct CLINSH greening effect. This has led to 11 additional contracted ships, including 5 refit ships.

- Due to the corona virus, most ships were for some period not accessible for reference measurements or for repairs to the monitoring equipment. There was also less sailing and there are skippers who are completely stationary. This will be dealt with a strict project management in the follow up activities to avoid having to extend the project any longer.

The CLINSH-fleet consists of 43 ships:

Ship category	Project plan	Actual outcome
Refit	13**	14***
Green fuel (GTL, HVO)	2	3
Diesel for comparison	0	5
Monitoring	16*	21****
Total	31	43

* Including the test ship the Max Prüss

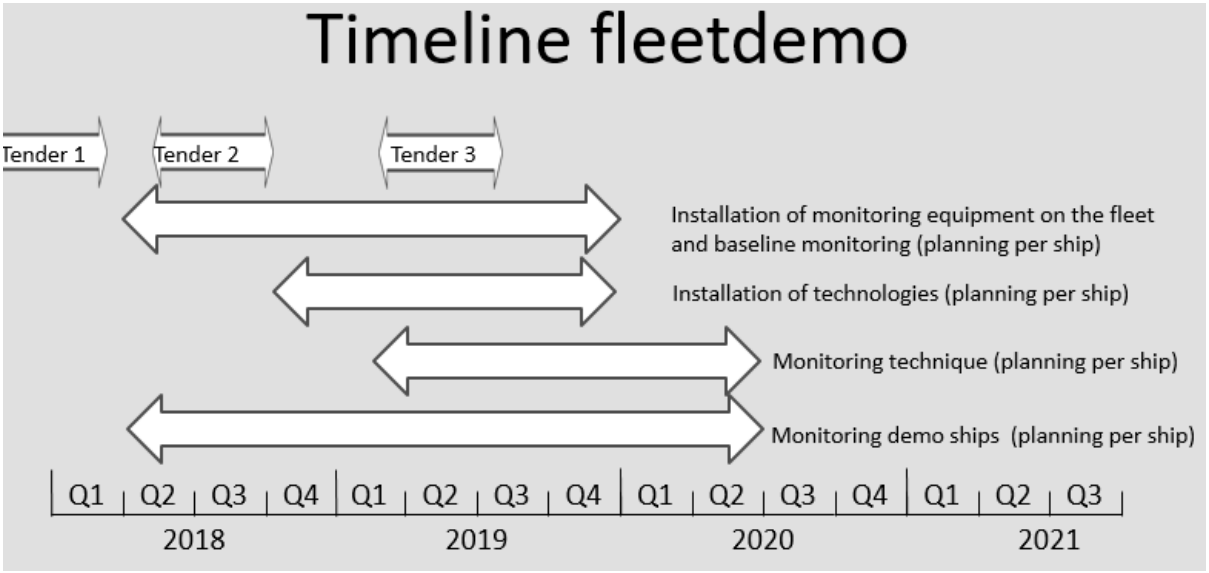
** 6 SCR/ DPF, 2 FWE, 4 diesel electric, 1 LNG

*** 6 SCR/ DPF, 2 FWE, 2 diesel electric, 1 Euro VI, 2 FWE + GTL, 1 full electric

**** 7 SCR/ DPF, 5 diesel electric, 4 GTL, 3 LNG, 1 Euro VI, 1 hydro injection

4 Installation monitoring equipment on the ships

After the ships were contracted, they were approached by Multronic, the company that was recruited to install the monitoring equipment. This process took a longer period than was planned for because of the three tenders that were done to recruit the 43 ships. The underneath figure shows the timeline. The installation process took from April 2018 until December 2019.

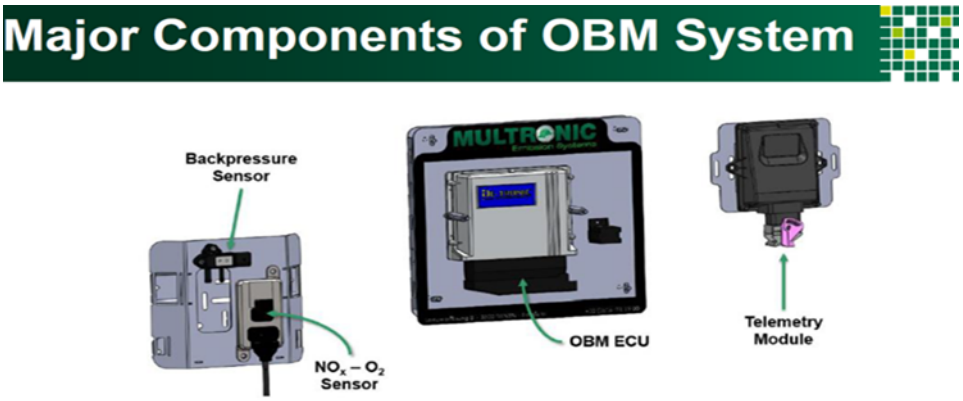


Multronic approached all shipowners with a questionnaire in order to asses the situation on the ships. This is important because all ships are different in terms of the dimensions of the engine rooms and the installations that are onboard. This is more efficient then to visit all ships first, because of the often unpredictable sailing patterns or changes in these patterns. After this inventarisation Multronic planned a visit to the ships. This turned out to be quite a challenge because a lot of ships wanted to combine the visit with a logical moment of (un)loading or maintenance. This sometimes leaded to discussions about the lead time that was involved. On some ships 2 or 3 engines were equipped with monitoring equipment. That was done when these engines were used in different patterns. Another point of attention turned out to be the fuel meters.The shipowners were responsible for a properly functioning fue lmeter, that was precise enough and could provide the right output signal. In practice a lot of ships were not equipped with the fuel meters that complied with these demands. In a lot of cases it turned out that there was even no standard technical solution available, so it had to be developed. This process took some extra time and it also meant that Multronic had to return to these ships to

connect the fuel meter to the monitoring unit. In order to faciltate this process the province made available a contribution of max € 2.000, ex VAT per ship for the installation of the right fuel meters. The cost for this on some ships could run up to € 6.000,- ex VAT.

On the ships that were refitted with financial aids of CLINSH the monitoring installation had to be installed again after the refit. Another issue could be that the monitoring installation on some ships stopped generating information. A number of reasons could be the cause of this, like maintenance activities on the ships, unplugging of vital elements or shipowners that wanted to change things in the engine room. Especially in the COVID period in the spring of 2020 it was impossible to fix this kind of issues on the ships. Also, a lot of flexibility was asked of Multronic; appointments could change at any time and return visits were necessary a number of times for various reasons.

In summary the installation that was installed on each ship:

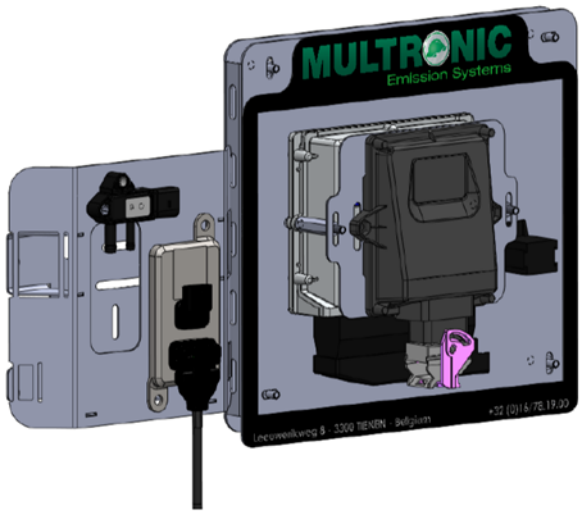


The sensors (1) measure the physical parameters such as NO_x, O_2, Pressure and Temperature...etc. All information received from sensors, fuel meter and engine ECU are centralized in the OBM ECU (2). Simultaneously, the OBM ECU processes all the relevant data and broadcasts them to the Telemetry Module (3). This device sends that gathered data to the database of Multronic.

5 Monitoring and measuring

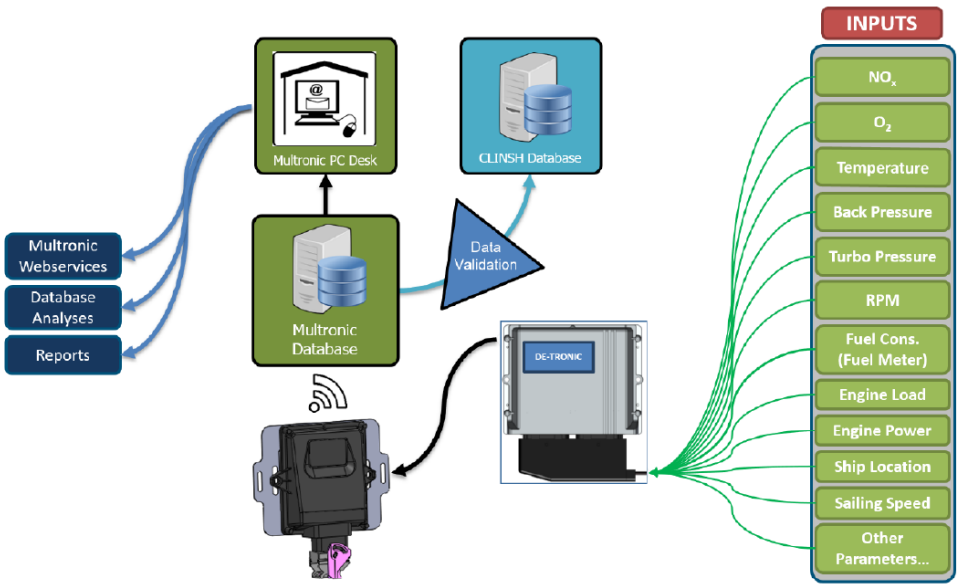
The continuous monitoring process is quite straightforward. Once the monitoring installation is functional the processing unit that is installed on the ships collects the data and sent it with the telemetry module to the Multronic database. Multronic filters out spikes and mistakes in the data readings. This data is stored in the Multronic database as 'checked' data and delivered to the CLINSH database at the project share point. The shipowners can access their own data with a personal inlog to a data dashboard.

Data Collection & Transmission



- All the collected data are transferred to the Telemetry Module and stored internally at on-board data buffer.
- This transmitted data can be downloaded manually and/or automatically on a regular basis within a settable time interval as .csv file to the local Multronic server.
- The raw data is stored in a cloud database (Multronic server) where it will be post processed, validated and broadcasted to the CLINSH server.

Layout of the OBM System



6 Reference measurements and validation

The reference measurements are carried out by Tauw. One goal of the reference measurements is to check whether the continuous monitoring on the ships provides comparable NOx emission data and to do a validation. The second goal is to measure PM (Particulate Matter) of the ships.

The equipment that was used consists of a portable measuring unit (Testo 350) that was used conform the standardized E3 measuring cycle (with different engine loads), as was prescribed by the monitoring- and measurement protocol of CLINSH.

testo 350 MARITIME

- Analyzer box testo 350-MARITIME fitted with: O_2, CO, CO_2-(IR), NO, NO_2 and SO_2,incl. gas preparation , differential pressure sensor, 2 temperature probe inputs, connection Testo data-bus, fresh air valve for long-term measurement, integrated battery, integrated combustion air probe (NTC), trigger input, measurement data store, USB interface
- Control-Unit testo 350-MARITIME V2
- Robust protection case with trolley function (without protective cap in the bottom)
- Exhaust gas probe for industrial engines with probe pre-filter, 335 mm immersion depth incl. cone and heat shield, Tmax 1000 °C, special hose for NO_2-/SO_2 measurements, length 5.2 m, incl. thermocouple for exhaust gas temperature measurement (NiCr-Ni, length 400 mm, Tmax. +1000 °C) with 5.4 m connection line and additional temperature protection
- Connection cable between Control Unit and analyzer box, length 5 m
- testo fast printer with wireless infrared interface, 1 roll of thermal paper and 4 mignon batteries for printing readings out on site
- Humidity/temperature instrument testo 610
- Silicon connection hose (Ø 4mm, length 5 m) incl. hose connector to exhaust gas probe to measure back pressure in the measurement
- Germanischer Lloyd (GL)-certificate no. 37 811 - 12 HH

Order No. 0563 3503

A practical issue that Tauw came across was the lack of availability of measuring openings in the exhaust of several ships, or in some cases they were too small. In

those cases, new or bigger openings had to be made. This was sometimes complicated by all the isolation that is used on the exhaust systems and not all shipowners were very enthusiastic to remove this.

Number of measurements:

How many times measured	Number of ships
0	3
1	11
2	12
3	17
4	2
94	43

The goal was to do 2 or 3 measurements on each ship. For the refit ships this is done in the period before the refit and after the refit. On two ships 4 measurement were done because of changes in the installation on board. In three cases there were no measurements performed at all because of technical problems or because of COVID. This last factor was a complication in this process, because during the spring of 2020 it was not possible to do any measurements on the ships at all. Tauw had to be very flexible to achieve these results. Ships gave notice on very last moment sometimes or cancelled on the day of the appointment.

Validation

In case the deviation between the continuous monitoring data and the reference data of more then 20% a correction is applied to the monitoring data. This was only needed with the data of two ships. For most of the ships there was only a small difference between the continuous monitoring data and the discontinuous measurements.

7 Refitting the ships

The process of refitting the ships did not cause too many complications. Only in the COVID period in the spring of 2020 there were some delays in the process. The time that is involved in the refitting process is very depended on the technique that is used. Applying a SCR/ DPF installation takes only one or two weeks, a complete repowering to diesel electric or to build in a Euro VI engine can take one to two months to realize. In general, there were no big complications connected to the refit process in the CLINSH fleet.

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