Integrated transnational policies
and practical solutions for an environmentally-friendly
Inland Water Transport system in the Danube region

Interreg
EUROPEAN UNION
Danube Transnational Programme
GREEN DANUBE

Work Package 4: Greening Technologies

Selected Best Practices

February 2018

Green Danube Best Practices

GREEN DANUBE consortium addresses the major challenge of strengthening environmentally friendly, safe and balanced inland water transport systems in Danube area. The project aims, among other, to promote Innovative Greening Technologies toward low carbon IWT shipping. Within WP4 "Greening Technologies" the project partners conducted a study onGood Practices for IWT air emission reduction in the Danube region and other European rivers. Some 21 Good Practices have been identified and proposed for further discussion and nomination of "Best practices". All Good Practices identified are presented in the Technical Report D.4.2.1 (Annex 2) of the GREEN DANUBE project.

Selection of the "Best Practices" has been done after voting by all Green Danube Project Partners, including some of the Associated Strategic Partners. The list of selected Best practices has been approved after a final discussioncarried out at the 4thPPs Meeting in Duisburg, Germany, in May 2018. The nominated Green Danube Best Practices are listed here below, as well as shortly presented further in this document.

Green DanubeBest Practices

for

IWT air pollutant emission reduction

LNG technology reducing air pollutant emissions oftankers on the example of Greenstream and Green Rhine

Owner:
Interstream Barging (ISB)

Area of operation:
Netherlands, Belgium, Germany and Switzerland

Short technical description
LNG Greenstream is the first of two-liquefied natural gas (LNG)-powered barges being built by Peters Shipyards in Kampen, Netherlands. The two barges are chartered by Shell to transport liquid fuels along the Rhine River. The barges are the first of their kind for Shell and the inland marine industry.


Greenstream and Green Rhine

The LNG Greenstream is a fully electrically-powered LNG barge incorporating a double hull built of mild steel. She has an overall length of 110m and beam of 11.4m, while the length between perpendiculars is 109.5m and draught is 3.46m.
The 2,877dwt inland tanker has six cargo tanks with a capacity to carry 3,124m^3 of mineral oils and chemicals. The impact-resistant "IJsselhuid" shell plating allows for provision of larger cargo tanks. The U-shaped ballast tanks in the tanker shield the cargo tanks from impact on the sides or the bottom. The propulsion is provided by two electrically-powered VZ-550, Z-drives generating 500kW of power, and a 2-K-1000 Veth-Jet bow thruster. The azimuthing thrusters with a single propeller located in the nozzle form v-shaped frames. The placement provides optimum utilisation of the aft ship sections in shallow waters. The thrusters also assure great manoeuvrability eliminating the need for separate rudders.

- Type: Double hull barge
- Order Year: 2012
- Construction Completed: 2013
- Number of tanks: Six
- Builder: Peter Shipyards, Netherlands

Analysis / Comparison versus selection criteria

a) *Emission reduction*

25% and 80% - reduction of carbon dioxide and nitrogen oxide emissions
No sulphur oxide and particulate matters are discharged.

There are also general assumptions for the emission reductions using LNG, calculated in the LNG Masterplan in comparison to the usage of MDO. The details can be found in the table below.

Emissions MDO vs. LNG inland vessel

Emissions	Savings per kWh
NO_x	- 85%
SOx	- 100%
CO_2	- 25% - 30%
PM	- 100%

b) *Technical feasibility / transferability.*

LNG can be implemented on all newbuild inland vessels.

c) *Economical feasibility:*

The payback time significantly depends on the price gap between diesel and LNG, thus the range is 5 to 10 years. However, the additional acquisition costs are also depending on many factors like the available space for the tank, foreseen engine power, etc.

a) *Non-technological maturity. Barriers and facilitating factors for innovation uptake*

The technology – the usage of LNG - is proven, and demonstrated in operational conditions.
Shell also has received the first of fifteen new inland dual-fuel barges running 95- 98% on LNG and operating in the ARA and Rhinetrack regions.
(http://www.ngvglobal.com/blog/first-of-fifteen-lng-dual-fuel-barges-delivered-to-shell-0701)

General assessment for applicability/transferability of the Best Practice:

(1) Highly Recommended

Reference *(publication, citation):*

Ship technology: http://www.ship-technology.com/projects/lng-greenstream-tanker/

LNG Masterplan D2.4.4, 2015

The first 100% electric ferry
built in Romania on the Vard site in Braila

Owner:
Vard Shipyard, Braila, **http://www.vard.com/products/Pages/Shipbuilding.aspx**

Area of operation
Lower Danube, Galati, Constanta Romania

Short technical description

The new car and passenger ferry will be completely electric and is specially designed for operations in the Norwegian Fjords. The ferry, designed by Multi Maritime, will have a length of 74 meters and a total capacity of up to 60 cars and 199 passengers and crew, according to economica.net. “We look forward to building the electric ferry, where we can use our proven expertise in battery technology for efficient and environmentally friendly ships,” says Roy Reite, Vard CEO. The body of the ship will be built at the Vard site in Braila and ferry delivery is scheduled from the VardBrevik yard in Norway in the third quarter of 2019.raining programme

Analysis / Comparison versus selection criteria

a) Emission reduction

Zero emission of CO_2 and NOx emissions on board IWT vessels

b) Technical feasibility / transferability

No any essential implications are foreseen, that could hinder or obstruct the sharing and transferability of this practice from a technological point of view.

c) Economical feasibility

The investment cost compared to the diesel engine vessel can be estimated as 20-60% less. The payback time significantly depends on the service time and frequency of traffic, 3 to 10 years

d) Non-technological maturity. Barriers and facilitating factors for innovation uptake

Technology ready for use. The EU and national law does not provide explicit restrictions to this type of vessels. Moreover, it is expected that they will be promoted by the EU transport and environmental policies.

General assessment for applicability/transferability of the Best Practice:

(1) Highly Recommended

Father-son layout

Award-winning coupled formation El Niño/La Niña with various Energy-Saving Measures, Pushed convoy, Closed coupling point, Optimized bow section

(Allianz Esa Euro Ship Innovation Price 2015)

Owner:

Rolf Bach

Area of operation

Exchange traffic between Rhine, Main, Upper Danube and ARA ports

Short technical description

The coupled formation El Niño/La Niña won the Allianz Esa Euro Ship Innovation Price in 2015. It also holds the bronze Green Award.

It operates in exchange traffic between Rhine, Main, Upper Danube and the ARA ports. El Niño's main dimensions are 105m length, 10,5m width and a draught of 2,7m. The lighter La Niña has the dimensions 80m length, 10,5m width and a draught of 2,7m. The installed engines are 2 x Mitsubishi S12A2-MPTAW with 701kW at 1940 rpm and 2 x MAN D2886 LXE 47 with 221 kW at 1800 rpm. All engines comply with the CCR-II emission regulations.

The coupled formation El Niño/La Niña combines four of the most important energy saving measures for inland waterway vessels. As there is a significant difference between the power demand for up- and downstream routes the vessel has installed a father-son engine layout. With its lighter La Niña, El Niño is able to carry nearly the double amount of cargo at an only slightly increased fuel consumption per m^3 cargo. The vessels coupling point was integrated, this means the side gaps between the vessel's bow and lighter's aft were closed. This causes an energy saving of up to 15%. Moreover, the lighter's bow section was change from pontoon shape to a hydrodynamically optimized wedge shape bow. The optimization was done at the Development Centre for Ship Technology and Transport Systems in Duisburg, Germany.

Analysis / Comparison versus selection criteria

a) Emission reduction

The practices provide the following reductions of fuel consumption:

- Father-son engine layout: approx. 18% less fuel consumption
- Coupled formation: Nearly double amount of cargo, with slightly increased fuel consumption
- Integrated coupling point: approx. 15% less fuel consumption
- Optimized bow section: approx. 5% less fuel consumption

b) Technical feasibility / transferability.

The technologies used at the vessel are all available, proven and in use. Any essential implications are foreseen, that could hinder or obstruct the sharing and transferability of this practice from a technological point of view to any other inland navigation vessel.

c) Economical feasibility:

The extra cost of the measures taken compared to a conventional new system had a payback time of about 3 years due to the amount of fuel saved. The period of maintenance intervals could also be stretched.

d) Non-technological maturity. Barriers and facilitating factors for innovation uptake

The measures taken comply with strategies towards a greener IWT. As the engines installed fulfil the CCR-II regulations, financial funding is feasible. It should be mentioned that for the small MAN engines one might have an option to change them to other energy sources as a gas engine or an electric engine powered by a fuel cell.

General assessment for applicability/transferability of the Best Practice:

(1) Highly Recommended

Container vessel Eiger-Nordwand

Owner:
DCL Barge

Area of operation:
The operational area of the MV Eiger is mainly from Rotterdam to Basel and Antwerp and back.

Short technical description

Within the LNG Masterplan DCL Barge has refitted the tug-barge Eiger-Nordwandto accommodate a liquefied natural gas (LNG) drive system. It is the first inland waterway container vessel worldwide refitted for LNG. In July 2014 DCL Barge BV finished the conversion of her MV Eiger towards LNG driven propulsion after a period of three months. From that moment on the MV Eiger is the first dry cargo barge driven by dual fuel propulsion (LNG/Diesel). The dual fuel ratio should be 99 percent LNG to meet the best ecological results.

- **Type of vessel:**Doublescrewed motor vessel, arranged for the transport of bulk cargo and containers. The motor vessel was built in the year 2000.
- **Propulsion:**
    - Main Engines: 6-cylinder diesel
    - Manufacturer: Wärtsilä
    - Operation hours: 6400hrs

Container vessel Eiger-Nordwand

Analysis / Comparison versus selection criteria

a) *Emission reduction*

The main emission savings after the retrofitting are:

- CO2: 25% reduction
- SOx: Using only 1-5% diesel as pilot fuel indicates a reduction in SOx by 95-99% compared to low sulphur diesel fuelled reference vessels
- NOx: The results correspond to a NOx emission reduction by more than a factor 3 compared to the CCR II limits.

b) *Technical feasibility / transferability.*

One of the conclusions of the retrofitting of the MV Eiger in the Masterplan was, that a smooth and efficient retrofit was possible and they would recommend a similar approach as it was done in this example.
However, especially in the case of retrofitting it is important to mention, that each case / vessel has different requirements and condition, which influences the results and financial viability.

c) *Economical feasibility:*

Lower fuel costs with LNG, no detailed information on specific example are given. More information on the Economic feasibility of using LNG can be found in the document D.4.2.1 under "Greening technologies - Replacing/conversion of diesel engines to use LNG"

d) *Non-technological maturity. Barriers and facilitating factors for innovation uptake*

Selecting medium speed engines in combination with the low transmission losses of direct drive further enhances these benefits by creating an efficient propulsion system. All emission values proved to be better than the original design values.

General assessment for applicability/transferability of the Best Practice:

(1) Highly recommended

Reference *(publication, citation)*
LNG Masterplan: SuAc 5.3 LNG propelled vessels (LNG as fuel)

Zero-emission Solar Powered USV Boat for Hydrographic Survey

(technology applicable to small boats)

Owner:
CORES ltd. Varna, Bulgaria; www.coresbg.eu

Area of operation
Lower Danube, Bulgarian rivers, inland water bodies (dam lakes, canals) in Bulgaria

Short technical description

The boat can replace existing fossil fuel motor boats used for hydrographic surveying, and this way can provide significant impact on Danube water sector. The boat is driven by electrical engines (e.g. 2 engines by 4HP each), powered by Lithium-based deep-cycle batteries, charged by solar-photovoltaic modules. It can operate autonomously (24/24), powered by solar energy only. The onboard computer control unit and the large range radio-telemetry system (optional - a GSM, or a satellite modem) provides real-time data transfer to the land based desktop and/or web-applications.

The boat has relatively large payload capacity – enable to carry onboard various advanced measurement / monitoring equipment. The special hull shape provides excellent seakeeping stability and manoeuvrability. The boat incorporates a number of innovative solutions and provides the following advantages: small size and weight, easy transportation by road trailer, operated by one person from the land:

- autonomous power supply, intelligent charge controller, operates 24 of 24 hours(+ during night);
- bears up to 70 kg on-board equipment (measuring devices, see below);
- on-board computer ;
- 2.4 GHz radio-telemetry data transfer system, range 1200 m (up to 5000 m);
- electronic SELF-STEERING (AUTOPILOT) system, follows a predefined route.

Selected “*Best product of the month*” in February 2017 by “MarketPlace.WaterIn.EU”. This technology is considered at TRL8 - System complete and qualified, already used to provide contract measurements, ready for sharing/transferring.

Analysis / Comparison versus selection criteria

a) Emission reduction

This practice provides 100% reduction (zero emission) of all emissions regarded in this project:

- Greenhouse gas (GHG) emissions: carbon dioxide (CO_2), carbon monoxide (CO), methane slip CH_4;
- Air pollutant emissions: Particulate matter (PM), oxides of nitrogen (NO_x), nitrous oxide (N_2O), sulphur dioxide (SO_2).

b) Technical feasibility / transferability.

The technology of manufacturing of the boat is based on system integration approach, involving integration of various components of shipping, solar-photovoltaic, and water monitoring (hydrographic survey) technologies. The hull is made of fibreglass, engines are electrical, remote control is executed by radio from the land, there are multiple navigational and monitoring equipment devices mounted onboard, and operated also by the remote control. The technology is already proven, with 2 utility model certificates from the Bulgarian Patent Office, and through the performance of a series of hydrographic field surveys along Lower Danube – Nikopol, Ruse.
No any essential implications are foreseen, that could hinder or obstruct the sharing and transferability of this practice from a technological point of view.

c) Economical feasibility:

To give some indication on the economical aspect the presented Solar Powered USV is compared vs a 16 feet common boat driven by a Volvo Penta D1-20 Inboard diesel engine 18hp, equipped with the same hydrographic/monitoring equipment, and able to performing similar job.

- Cost of the services provided (for e.g. bottom sounding of 1000 m2 of a spot of a river) are estimated as being 20-50 % of the costs of the diesel engine boat, operated by 2 persons.
- The investment cost compared to the diesel engine boat (assuming comparable navigational equipment, and excluding any measurement/monitoring sensor equipment) can be estimated as 10-50% less.
- The payback time significantly depends on the price of the navigational equipment and survey/monitoring sensor equipment, and can be estimated as in the range of 3 to 10 years

d) Non-technological maturity. Barriers and facilitating factors for innovation uptake

Considering the size and power of the boat, no any registration or other implications can be expected. The EU and national law does not provide explicit restrictions to this type of vessels. Moreover, it is expected that they will be promoted by the EU transport and environmental policies.
It should be mentioned that the sharing/transferring of this practice shall comply with the international law on protection of copyright and industrial property rights of some individual components (e.g. a robotized water sampling device). In addition, the clients must follow in each separate case the procedure for standardisation of the monitoring activities, e.g. applying for ISO-9001; IS0-17125, or/and other standards.

General assessment for applicability/transferability of the Best Practice:

(1) Highly recommended

Reference *(publication, citation)*

- www.coresbg.eu
- Penchev V., Bojkov V., Banev B., Kirkegaard J. (2015) Full-Scale Laboratory Tests of an Unmanned Coastal Survey Vessel, Proc. 5th International Conference “CoastLab 2014", Varna, Bulgaria, IAHR, ISBN: 978-619-90271-1-0

Green Danube

Runners-Up Best Practices

forIWT air pollutant emission reduction

Integrated numerical (CFD) and physical model test technology for design of ship energy saving devices

Owner: Bulgarian Ship Hydrodynamics Centre (BSHC)

Area of operation / practicing: Bulgaria, Lower Danube, Black Sea

Short technical description

Most Energy Saving Devices (ESD) are used to enhance the flow into the propeller, aimed at increasing propulsion efficiency as well as reducing energy loss. The design of ESD requires knowledge of flow mechanism around ESD. At BSHC highly advanced Computational Fluid Dynamics(CFD) simulation, coupled to accurate model testing in large scale towing tanks, is used to design ESDs, and improve energy efficiency performance of both seagoing and inland water ships.

Analysis / Comparison versus selection criteria

a) *Emission reduction*

Proper design of ESD using the above technology may lead to:

- Fuel consumption reduction by 5-10 %;
- Relevant reduction of CO_2 and NOx emissions

b) *Technical feasibility / transferability.*

The technology is already proven, through the performance of a series of numerical and physical hydrodynamic tests of seagoing and inland water ships, done at the premises of BSHC, resulting in optimally designed ESDs. This technology has been already used also in other leading ship hydrodynamics centres in EU and beyond, and from a technological view point it is possible to be transferred to other similar R&D organisations.

It should be pointed however, that use of CFD usually requires purchase of commercial software, as well as highly competent and specifically trained engineers, that could hinder or obstruct the wide sharing and transferability of this practice.

c) Economical feasibility

There is no doubt that this technology is highly economically feasible. Despite it is difficult to draft a firm quantitative financial indicator, it can be concluded that for an already established research infrastructure, the total investment (in software purchase, and training of the staff) will be repaid from a few clients contracts, while for the ship-owners the money invested in design of ESDs will be repaid just in a couple of years.

d) Non-technological maturity. Barriers and facilitating factors for innovation uptake

No any legislative, administrative, financial or other non-technological barriers have been identified that could hinder or obstruct innovation uptake. It should be stressed that it is fully in line with EU policies on waterborne transport energy efficiency, and therefore it can seek for support from various EU funded programs and initiatives.

Conclusion of "Good practice" analysis:

(1) Highly recommended

Reference (publication, citation)

1. Kishev R., Georgiev S., Kirilova S., Milanov E., Kyulevcheliev S., Global View on Ship Trim Optimization, Proc. of the 2nd Int. Symposium on Naval Architecture and Maritime, (INT-NAM 2014), pp. 223-234, 23-24 Oct. 2014, YTU, Besiktas, Istanbul, Turkey, ISBN: 978-605-4123-31-5
2. Kisheva, D., „Investigation on Energy Saving in the Design and Operation of Push-Trains Carried out at BSHC", Proceedings of HADMAR International Symposium, Varna.
3. Marchal J., D. Kisheva, Investigations for Consolidation of Lower Danube Transport for ITS Full Integration into the Intermodal Chains along the Corridor Walloon Region – Black Sea, Proc. of the 12th Int. Conference on Marine Sciences and Technologies Black Sea'14, pp. 161-165, 25-27 Sept. 2014, Varna, ISSN 1314-0957
4. Milanov E., Chotukova V., Efremov D., Simulation Model of Danube Pusher Manoeuvrability in Deep and Shallow Waterways, "European Inland Waterway Navigation Conference", 10-12 September, 2014, Budapest, Hungary, ISBN 978-963-313-124-4
5. Kyulevcheliev St., Sv. Georgiev, Al. Vasileva, Hydrodynamic devices to increase ship energy effectiveness, Proc. of the Scientific Conference "Science in the service of society", Union of the Bulgarian Scientists, Varna branch, Section of Technical sciences, Oct. 25, 2013 (in Bulgarian)

ZEM/SHIPS – Zero Emission Ships

Owner:
FCS Alsterwasser operated by ATG AlsterTouristik

Area of Operation:
Hamburg, Germany

Description:

The first ever passenger vessel to sail propelled by fuel cells. The FCS Alsterwasser was the first inland passenger ship in the world to set off under fuel cell propulsion, and with hydrogen as its source of energy. The aim of this unique, EU-supported project was to test practical emission-free ship operation and to promote the use of this technology for maritime applications.

Until now, the maritime use of fuel cell technology has mostly been limited to military submarines and very small surface craft. Zemships is the first project in the world to integrate the process on board a passenger vessel. It combined two fuel cell systems with a 560-V lead gel battery pack. Both the systems were developed by Proton Motor and both had a peak output of 48 kW. The project is undeniably one of pioneering importance for inland shipping. One of the main tasks of the Zemships project is therefore to test the efficiency and practical performance of the fuel cell driven ship and the corresponding infrastructure required for filling up and storing hydrogen.

Analysis / Comparison versus selection criteria

b) *Emission Reduction:*

The Carbon footprint of the *Zemships project:***Local emissions** are zero – meaning that compared with a conventional diesel-electric ship, savings of around 47 000 kg of CO2 emissions per ship/ year can be made locally (3,000 operating hours). **Remote emissions:** (during generation of the necessary hydrogen), can vary considerably. The total carbon emissions for hydrogen generation by steam reforming of methane and use of liquid hydrogen for transport and storage, are higher than those of a comparable modern diesel-electric ship.

c) *Technical Feasibility:*

The Zero emissions ships–Zemships project aimed to develop and realise the first hydrogen-powered passenger ship (capacity > 100 persons), power-assisted by a 300-600 kW electric motor that gets its electricity from a fuel cell. Its main advantages over conventional ships would be zero local emissions, low noise, high energy efficiency and no risk of water pollution.

d) *Economic Feasibility:*

The available fuel cell technology for submarines is too costly and its use in small vessels not suitable to the targeted power requirements. The task for this project was to provide a technical solution that would be scalable to typical power requirements and which could be fully integrated into surface vessels of different sizes.

e) *Factor for innovation uptake:*

Future should include even better alternatives such as H2 generation with surplus wind energy. Both, H2 supply and pioneering H2 consumption projects such as Zemships need to be carried out concurrently to arrive at a viable large-scale H2 alternative in 10-20 years.

General assessment for applicability/transferability of the Best Practice:

(1) Highly Recommended

References:

1. Klimaschutz voraus: Das weltweit erste Fahrgastschiff mit Brennstoffzellenantrieb, 2007
2. ZEM/SHIPS - Zero.Emission.Ships, LIFE06 ENV/D/000465, 2010

The Cleanest Ship

Owner:
Owned by BP and managed by VerenigdeTankrederij (VT)

Area of Operation
Port of Rotterdam and Antwerp areas.

Description:

Within the EU project CREATING (www.creating.nu), carried out within the Sixth Framework Programme, the application of advising Tempomaat, low sulphur fuel equal to road standard EN 590, selective catalytic reduction and PM filter was found to be the most suitable solution to improve the environmental performance of inland navigation.
The project is carried out on the motor tank vessel "Victoria", owned by BP and managed by VerenigdeTankrederij (VT). The vessel, on long term charter to BP Marine Lubricants, was operated in the Port of Rotterdam and Antwerp areas. Lasting one year till the end of 2008, the demonstration was launched in November 2007. Fuel consumption, energy output of the main engine in kWh, distance sailed in km and NOX emissions were directly measured; CO2 and SOX emissions were calculated from fuel consumption and energy output in kWh, whereas particulate matter emissions were valuated using the emission reduction potential estimated on the test stand. The latter was done because accurate measurement of particulate matter emissions at service conditions was difficult. During the pilot phase the emission reduction results, the amount of trucks replaced by the vessel and the transport performance were monitored.

Analysis / Comparison versus selection criteria

a) *Emission Reduction:*

The emission reduction techniques utilized are the advising Tempomaat, low sulphur fuel equal to road standard EN 590, selective catalytic reduction and PM filters. As advising Tempomaat a system developed by Techno Fysicabv (NL) was used. The selective-catalytic-reduction catalyst and diesel particulate matter filters were implemented in the Nauticlean S system comprising a single reactor for NOX and PM removal, developed and built by Hug Engineering (D). Further, the auxiliary engines were equipped with particulate matter filters.

Based on the measurements performed, the average reduction of NOX emissions accounts for approximately 82 % and even more, depending on the engine loading and respective reference value. Compliance with EURO V and partly even with EURO VI standard is achieved. Based on reference measurements and an emission reduction potential of 97 %, compliance with EURO VI standard is achieved for particulate matter emissions.

By using low sulphur fuel according to EN 590, the SOX emissions are reduced by almost 100 % compared with the ones associated with diesel fuel with 2000 ppm sulphur content.

b) *Technical Feasibility:*

The m/v 'Victoria' uses low sulphur fuel equal to road standard diesel fuel (EN 590), supplied by energy company BP. Combustion of low sulphur fuel is a precondition for application of particulate matter filters (soot filters) and for efficient reduction of SOX emissions, which are directly related to the sulphur content of the fuel used. No problems related to engine operation were encountered when using low sulphur fuel EN 590. Selective catalytic reduction is a technique for efficient removal of NOX emissions by means of injecting a reducing agent into the exhaust gas. The Nauticlean S system uses ammonia to reduce nitrogen monoxide and nitrogen dioxide to nitrogen and water, which is injected as urea. For PM removal catalytically coated silicon carbide (SiC) particulate matter filters are used, consisting of several honeycombs made of micro fibres. The Advising Tempomaat (ATM), developed and supplied by Techno Fysica (NL), is a system enabling an economically optimised operation of a vessel. The core of the system is a computer programme advising the skipper on the most economical combination of route and speed, enabling the vessel to arrive on time with a most efficient use of fuel, leading to reduction of fuel consumption and emissions.

c) *Economic Feasibility:*

Reducing the fuel consumption of a vessel will result in decreased operational costs and emissions to the air.

References:

1. Schweighofer. J, Final Report the Cleanest Ship Project, 2009.
2. Gille J., Good practices Report for Inland Waterway Transport, pp. 169- 171, March 2011

Training – LNG as fuel for inland vessels

32 hrs Course on Ops level and Management level for Inland vessel crew

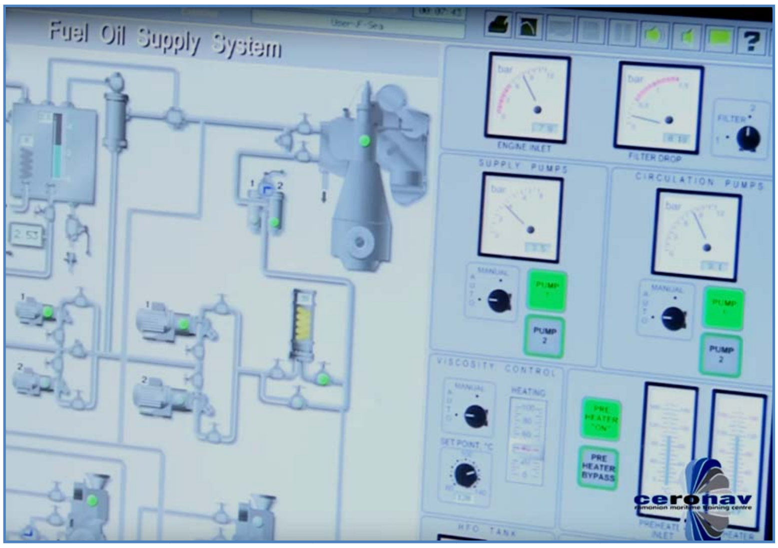
Owner:
CERONAV S.A. CONSTANTA, WWW.CERONAV.RO, **https://online.ceronav.ro:448/2018.html**

Area of operation: Lower Danube, Galati, Constanta Romania

Short technical description

Training programme: 32 hrs course, practical and theoretical.

Module 8, Operation level and Management level for Inland vessel crew.



Analysis / Comparison versus selection criteria

a) *Emission reduction*

Relevant reduction of CO_2 and NOx emissions by training of responsible crew on board IWT vessels

b) *Technical feasibility / transferability*

Full commercial application

c) *Economical feasibility*

Immediate effect on operation of the vessel

d) *Non-technological maturity. Barriers and facilitating factors for innovation uptake*

Fully applicable

General assessment for applicability/transferability of the Best Practice:

(1) Highly Recommended

Aquabus 850/1050

(Maximum transport capacity: 24 persons)

Owner:

ProjectCLEEA - CLEAN ACCESS IN CALARASI - SILISTRA CROSS-BORDER AREA
Project Leader - INCDIE ICPE CA, P2. Calarasi City Hall; P3.Silistra City Hall; P4. INCD COMOTI Bucuresti, P5. University „Angel Kanchev" Ruse

Area of operation

Calafat – Vidin, TurnuMăgurele – Nikopole, Zimnicea – Svistov, Giurgiu – Ruse, Oltenița – TutrakanșiCălărași –Silistra.

Short technical description

Aquabus 850/1050 (Capacitate transport: maxim 24 personae) - 2 constructive variants Length: 10.5m; Width: 2.5 m, cruse speed: 10 km / h; Propulsion power: 8kW; Autonomy: 8 hours.

Analysis / Comparison versus selection criteria

a) *Emission reduction*

Zero emission ofCO2 and NOx emissions on board IWT vessels

b) *Technical feasibility / transferability.*

Fully applicable on all IWT.

c) *Economical feasibility:*

With support of local authorities and EU projects

d) *Non-technological maturity. Barriers and facilitating factors for innovation uptake*

Still under R&D activities, but well documented technologies and ready to be implemented.

General assessment for applicability/transferability of the Best Practice:

(1) Highly Recommended