



Green and efficient Danube fleet

“Towards modernisation & greening of Danube inland waterborne sector and strengthening its competitiveness”

Output 3.2 – IWT Innovative Technologies Database

Work Package 3 Fleet investment planning

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1 Introduction

The core objective of the GRENDEL project is to give a lasting impulse to the modernisation process of the Danube fleet. With the Danube being considered as the economic backbone of a region that comprises 10 different European countries, adapting its severely outdated inland fleet to the needs and requirements of a future oriented transport system is an endeavour that must go beyond borders. Efficiently integrating IWT to the transnational transport and logistic chains will have a positive impact on the overall socioeconomic development of this region.

Even though IWT is considered as one of the most environmental-friendly modes of transport, it is by far not exploited at its full potential. The reasons for this are manifold. Since the Danube Region is primarily characterized by less developed regions, vessel operators usually lack the necessary financial capacities to properly invest in their fleet. Moreover, the findings of GRENDEL have shown that there are currently no financial incentives available at the national level that would encourage the greening of the Danube fleet. The IWT sector is furthermore characterized by the relatively slow incorporation of innovative technologies as compared to other modes of transport.

The aim of this **IWT Innovative Technological Database** therefore is to centrally collect valuable information on greening technologies. It provides both a general overview as well as - based on the provided documentation - an in-depth analysis of the existing innovation rate and its potential to be efficiently implemented in IWT.

This database is in particular built on the know-how gathered in the framework of the GRENDEL project, taking into account the developed technological factsheets and the organised know-how transfer events¹, thus focussing on topics relevant for the Danube fleet. Some presentations were also collected from the workshop on the modernisation of the Danube vessels fleet² organised by INDanube together with the PROMINENT (H2020) and the GREEN DANUBE (DTP) projects in Vienna (Austria) on 18 April 2018, from the 1st LEC Sustainable Shipping Forum³ organised in Graz (Austria) on 26-27 September 2019 where the GRENDEL project was presented and from the green inland shipping event⁴ organised in Brussels (Belgium) on 16 October 2019.

The database will be regularly updated until the end of the GRENDEL project, in particular in regard of the next Know-how transfer event organised in September 2020 and of the vessel concepts developed by GRENDEL fleet operators until November 2020.

¹ The first GRENDEL Know-how transfer event took place on 7-8 March 2019 in Vienna (Austria).

² Further information is available on <https://indanube.eu/2018/04/19/workshop-modernisation-danube-vessels/>.

³ Further information is available on <https://www.lec.at/network/sustainable-shipping-technologies-forum/>.

⁴ Further information is available on <https://eibip.eu/events/3215/>.

2 IWT Innovative Technologies Database

The IWT Innovative Technologies Database is accessible from [the EIBIP Innovation Radar](#) and is available under [a dedicated section of the GRENDEL website](#).

The interface of the EIBIP Innovation Radar is as illustrated below.



The following images are screenshots of the database.

Innovative Technologies	Brief description/advantages	Presentation/detailed information
OVERVIEW DOCUMENTS		
Greening technologies for IWT sector		Assessment of greening technologies for IWT sector <i>(Workshop on modernisation of Danube vessels, Vienna, 18.04.2018)</i>
VESSEL-RELATED TECHNICAL MEASURES		
Energy sources		
Hydrogen in Combustion Engines	<ul style="list-style-type: none"> ○ increase of efficiency and considerable reduction of harmful emissions 	HyMethShip <i>(Know-How Transfer Event on the Modernisation of the Danube Fleet, Vienna, 7-8.03.2019)</i>
Innovative Energy Storage Solutions	<ul style="list-style-type: none"> ○ extremely useful for long distances ○ technologies based on methanol require less storage space ○ low maintenance costs ○ renewable energy, no environmental footprint 	Options and trends in the Propulsion of Future River Cruise Vessels <i>(Know-How Transfer Event on the Modernisation of the Danube Fleet, Vienna, 7-8.03.2019)</i> Innovative Energy Storage Solutions <i>(First Sustainable Shipping Technologies Forum, Graz, 26-27.09.2019)</i>
New Diesel Fuels	<ul style="list-style-type: none"> ○ renewable fuels solution ○ cost effective ○ efficient alternative for conventional diesel ○ low emissions 	Cleaner Future by New Diesel Fuels <i>(Know-How Transfer Event on the Modernisation of the Danube Fleet, Vienna, 7-8.03.2019)</i>
Dual Fuel Hydrogen Diesel Combustion Engines	<ul style="list-style-type: none"> ○ low emission rates 	Dual Fuel Hydrogen Diesel Combustion Engines <i>(First Sustainable Shipping Technologies Forum, Graz, 26-27.09.2019)</i>
Fuel Cells	<ul style="list-style-type: none"> ○ various energy sources can be used as fuel for fuel cells 	Fuel Cell Propulsion <i>(GRENDEL Factsheet n°4)</i>
Hydrogen Fuel Cell Technology	<ul style="list-style-type: none"> ○ efficient, zero emission 	Let's Navigate towards Zero Emission Shipping <i>(First Sustainable Shipping Technologies Forum, Graz, 26-27.09.2019)</i>
Drop-in Fuels	<ul style="list-style-type: none"> ○ it does not require the adaptation of the engine or the fuel system 	Drop-in Fuels <i>(GRENDEL Factsheet n°6)</i>

Propulsion systems		
Electric propulsion	<ul style="list-style-type: none"> ○ suitable for short distances ○ sustainable and reliable technology ○ renewable energy, low to no environmental footprint 	<p>Battery Powered Ferry</p> <p><i>(Know-How Transfer Event on the Modernisation of the Danube Fleet, Vienna, 7-8.03.2019)</i></p> <p>Battery Electric Propulsion</p> <p><i>(GRENDEL Factsheet n°5)</i></p>
Ambient Water Transmission	<ul style="list-style-type: none"> ○ new technology to lubricate gears with water instead of oil ○ considerable reduction of noxious elements 	<p>Ambient Water Transmissions</p> <p><i>(Know-How Transfer Event on the Modernisation of the Danube Fleet, Vienna, 7-8.03.2019)</i></p>
Side-by-Side Propeller	<ul style="list-style-type: none"> ○ ability to operate at lower water levels (draught) ○ shorter building times as in the case of "traditional" propellers 	<p>Side-by-Side Propeller</p> <p><i>(Know-How Transfer Event on the Modernisation of the Danube Fleet, Vienna, 7-8.03.2019)</i></p>
After-Treatment	<ul style="list-style-type: none"> ○ innovative approach to reduce harmful effects on the environment 	<p>Projects and experience on the Rhine</p> <p><i>(Workshop on modernisation of Danube vessels, Vienna, 18.04.2018)</i></p> <p>Exhaustaftertreatment for IWT vessels</p> <p><i>(Know-How Transfer Event on the Modernisation of the Danube Fleet, Vienna, 7-8.03.2019)</i></p> <p>After-Treatment</p> <p><i>(GRENDEL Factsheet n°3)</i></p>
Gas and Gas-Electric Propulsion	<ul style="list-style-type: none"> ○ it has a lower environmental impact than conventional fuels 	<p>Mono-fuel gas engines</p> <p><i>(Workshop on modernisation of Danube vessels, Vienna, 18.04.2018)</i></p> <p>Dual-fuel gas engine</p> <p><i>(Workshop on modernisation of Danube vessels, Vienna, 18.04.2018)</i></p> <p>Gas and Gas-Electric Propulsion</p> <p><i>(GRENDEL Factsheet n°7)</i></p>
Diesel-Electric Propulsion	<ul style="list-style-type: none"> ○ low noise level ○ lower impact on environment as compared to conventional propulsion systems 	<p>Diesel-Electric Propulsion</p> <p><i>(GRENDEL Factsheet n°2)</i></p>
EURO VI truck and NRE engines	<ul style="list-style-type: none"> ○ High emission standards ○ Proven quality and reliability ○ High production numbers 	<p>EURO VI as Marine engines</p> <p><i>(Workshop on modernisation of Danube vessels, Vienna, 18.04.2018)</i></p> <p>EURO VI truck and NRE engines</p> <p><i>(GRENDEL Factsheet n°7)</i></p>

VESSEL-OPERATIONAL MEASURES		
Autonomous Shipping	<ul style="list-style-type: none"> ○ adapted technological solutions that meet new market requirements 	<p>Journey towards Autonomous Vessels</p> <p><i>(Know-How Transfer Event on the Modernisation of the Danube Fleet, Vienna, 7-8.03.2019)</i></p>
Energy efficient navigation	<ul style="list-style-type: none"> ○ Combination of different measures offers a high potential for increased energy efficiency ○ Smart Steaming is not only energy efficient but also cost-efficient 	<p>Energy efficient navigation</p> <p><i>(GRENDEL Factsheet n°8)</i></p>
INFRASTRUCTURE		
Shore Power for IWT	<ul style="list-style-type: none"> ○ no noise pollution ○ no vibrations ○ low emissions 	<p>Shore Power System for IWT</p> <p><i>(Know-How Transfer Event on the Modernisation of the Danube Fleet, Vienna, 7-8.03.2019)</i></p>
Fuelling infrastructure		<p>Availability of LNG & LNG fuelling infrastructure in the Danube countries</p> <p>fuelCNG: L-CNG infrastructure in Slovakia</p> <p>LNG Hub Austria: L-CNG infrastructure in Austria</p> <p><i>(Workshop on modernisation of Danube vessels, Vienna, 18.04.2018)</i></p>
EXAMPLES OF INNOVATIVE VESSELS		
<p>LNG as fuel for inland vessels: "MS Ecoliner"</p> <p><i>(Workshop on modernisation of Danube vessels, Vienna, 18.04.2018)</i></p>		
<p>Gas-Electric Ecotanker</p> <p><i>(Green inland shipping event, Brussels, 16.10.2019)</i></p>		
<p>Fuel Cell Hydrogen and Hybrid Electric Emeli</p> <p><i>(Green inland shipping event, Brussels, 16.10.2019)</i></p>		
<p>Hydrogen Dual Fuel Hydroville</p> <p><i>(Green inland shipping event, Brussels, 16.10.2019)</i></p>		
<p>Hybrid Electric Sento Liner</p> <p><i>(Green inland shipping event, Brussels, 16.10.2019)</i></p>		
<p>Marinised Euro VI Truck Engine on Wantij</p> <p><i>(Green inland shipping event, Brussels, 16.10.2019)</i></p>		

The presentations from the First Sustainable Shipping Technologies Forum (Graz, 26-27.09.2019) are available on the respective website after filling out a form to gain access. The respective links of the database are redirecting to this website.