

Green and efficient Danube fleet

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

Output 3.3 – Consolidated Investment Needs & Training Requirements

Work Package 3 Fleet investment planning

Version 1.0

Date: 30/04/2020

FINAL

O 3-3_GRENDEL_Consolidated Investment and Training Requirements_v1.0_FINAL_2020-04-30

Document History

Version	Date	Authorised
1.0	30.04.2020	Pro Danube & CERONAV

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1 Scope of the document

Improving the environmental and economic performance of the Danube inland vessels is the overall goal of the GRENDEL project. It aims to achieve a higher acceptance and use of inland waterway transport (IWT) as an environmentally friendly transport mode contributing to economic growth and a more sustainable transport system in the Danube region.

In order to know how to encourage the modernisation of inland waterway vessels in the Danube region, investment priorities need to be identified, quantified, assessed and consolidated, which is the objective of the present report. Related new skills of personal and needs for education and training are explored too. The findings of the report form a basis for the elaboration of the GRENDEL model state aid scheme, and in particular for the choice of the five priorities of the model scheme:

- Priority 1 Improving environmental performance¹
- Priority 2 Better integration of IWT into logistic chains to increase multimodality of freight transport
- Priority 3 Modernisation of vessels leading to increased safety of inland water transport
- Priority 4 Renewal of actors in the sector
- Priority 5 Promote the emergence of innovative solutions.

These findings can also be used to identify financing measures which support the Danube IWT sector. The goal is to support the necessary investments helping to triggering overall modernisation processes.

The report is organised in two parts, a first one covering the consolidated fleet investment needs of the Danube region, a second one dealing with the human resources, education & training requirements as well as, where applicable, the relevant curricula.

The information used for the elaboration of the fleet investment needs comes in particular from previous works led in the framework of the GRENDEL project. With the help of the information collected in the know-how transfer event, funded fleet operators drafted detailed individual company investment plans. In addition to these detailed investment plans, assigned regional/national coordinating partners mapped national fleet investment needs. This approach shall ensure the coverage of investment needs of a vast majority of the Danube fleet².

¹ The promotion of education and training in inland navigation is a sub-measure of priority 1.

² The GRENDEL partners are not responsible for the accuracy, completeness or representativity of the information provided despite all their efforts to gather comprehensive information on the Danube fleet.

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1.0	30.04.2020	Pro Danube & DST

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3 Abbreviations

Abbreviation	Explanation
AT	Republic of Austria
BG	Republic of Bulgaria
CCNR	Central Commission for the Navigation of the Rhine
CESNI	Comité Européen pour l'Élaboration de Standards dans le Domaine de Navigation Intérieure
DE	Federal Republic of Germany
DPF	Diesel Particulate Filter
HR	Republic of Croatia
HU	Hungary
IWA	Inland Waterway vessels Auxiliaries
IWP	Inland Waterway vessels Propulsion
IWT	Inland Waterway Transport
MD	Republic of Moldova
NRMM	Non Road Mobile Machinery
PM	Particulate Matters
PN	Particle Number
RO	Romania
RS	Republic of Serbia
RU	Russian Federation
SCR	Selective Catalytic Reduction
SK	Slovak Republic
UA	Ukraine

4 Introduction

The GRENDEL project aims at a coordinated and sustainable modernization of the Danube fleet. The measures and the targeted national support programmes are intended to increase the competitiveness of inland navigation and promote the transfer of cargo to the waterway. While inland shipping is the most energy efficient mode of transport and correspondingly produces low emissions of greenhouse gases, the long lifecycles lead to disproportionate emissions of air pollutants. Therefore, the environmental performance of the inland fleet shall be improved, here referred to as “Greening”.

Greening always consists of three pillars: the reduction of climate-impacting emissions, the reduction of air pollutants and the increase in efficiency or reduction in fuel consumption. GRENDEL deals with short to medium term greening measures in a time horizon up to 2030. These measures include in particular the reduction of air pollutants and the preparation of ships for the use of zero-emission technologies from 2030 onwards. With the current framework conditions like age structure of the fleet and engines, low freight rates and, therefore, extremely limited investment capacities in combination with the legal conditions and cost structures, the fleet modernization can hardly be financed by the sector itself. Even with substantial state aid, the swift area-wide implementation of zero-emission technologies is not suitable for the Danube, as the technologies are often still in their development stage and are very cost-intensive both in acquisition and operation. Besides the greening measures, the realisation of additional activities to gain cargo is therefore also important for Danube navigation. This includes, for example, the adaptation of hatchways when new types of cargo are to be transported on a ship. Also the growing market for containerized cargo requires, besides infrastructural measures, adaptations of the cargo compartments.

Within GRENDEL fleet investment plans are prepared as an important input to the primary goal of the national state aid schemes. Therefore, very early in the project a questionnaire was circulated amongst the shipping companies and fleet operators to survey the ex-ante fleet investment strategies. Afterwards, a template for the fleet investment plans for motor vessels and barges was developed, circulated and filled by the early adopting fleet operating project partners. The national fleet investment plans were reported by the represented Danube countries. All these documents were analysed and they form the basis for the consolidated investment needs for the whole Danube regions documented in the following pages. For background information on the market situation, legal framework and technologies it is referred to the fact sheets published e.g. on the GRENDEL website.

4.1 Technological investment priorities

Putting the focus on the improvement of environmental performance, the technologies most suitable to be applied to the Danube fleet are the use of modern combustion engines complying with the latest Stage V regulations and alternatively the retrofitting of exhaust gas aftertreatment to existing systems. This choice is mainly based on the limited investment possibilities. For some applications and ships also Euro VI truck or NRE engines, which have even better emission profiles, are a cost effective option.

The implementation of new engines or retrofitted exhaust gas aftertreatment systems complying with the limits defined in directive (EU) 2016/1628 throughout the fleet would reduce the particulate matter emissions compared to the current situation by approximately 98 %. For the nitrogen oxides the reduction would still amount to about 85 %.

5 Necessary financial volumes and timelines

5.1 Key assumptions

In order to elaborate the public support measures for the Danube fleet, it is first necessary to identify needs. It is assumed that no significant part of the Danube fleet has yet been equipped with new, low-emission stage V engines. The following tables show the statistics of the Danube Commission for the Danube fleet. The investments are foreseen to serve for short to medium term greening measures in a time horizon up to 2030 equally distributed over the next ten years.

The composition of the fleet on the Danube by countries in 2017 is based on the Danube navigation statistics for 2016-2017 published by the Danube Commission. The fleet is distributed into three main types of vessels. The main types of vessels are:

- Dry bulk cargo vessels
- Liquid bulk cargo vessels
- Pusher vessels

The tables below are presenting the numbers of vessels and related overall power figures by countries for each of the main types.

Dry bulk cargo vessels		
Country	Number of vessels [-]	Power [kW]
UA	25	41,217
MD	8	0
RO	138	66,950
BG	47	35,344
RS	0	0
HR	16	9,760
HU	68	0
SK	8	3,124
AT	0	0
DE	45	34,372
Total	355	190,767

Table 1: Dry bulk cargo vessel composition of the Danube fleet by countries

Liquid bulk cargo vessels		
Country	Number of vessels [-]	Power [kW]
UA	1	883
MD	5	0
RO	26	18,408
BG	9	4,692
RS	42	3,598
HR	6	4,973
HU	2	0
SK	2	1,246
AT	0	0
DE	3	3,155
Total	96	36,955

Table 2: Liquid bulk cargo vessel composition of the Danube fleet by countries

Pusher vessels		
Country	Number of vessels [-]	Power [kW]
UA	53	88,669
MD	1	1,500
RO	155	169,830
BG	39	41,943
RS	86	14,986
HR	9	4,356

HU	14	0
SK	29	26,363
AT	0	0
DE	28	31,885
Total	414	379,532

Table 3: Pusher vessel composition of the Danube fleet by countries

For the calculation of the costs the following assumption were made:

Item	Costs
Stage V installation	50,000 €/Unit
Stage V engine	500 €/kW
SCR+DPF installation	25,000 €/Unit
SCR+DPF	100 €/kW

Table 4: Cost assumptions

6 Fleet investment needs per country

The findings of the deliverables 3.2.3 show that the problems of the sector are recognised and highlighted by the shipping industry in the Danube riparian countries. However, there is a big gap between the tasks at hand and the will of the public authorities to tackle these and to set up a support programme. This circumstance makes the presented approaches even more important.

The numbers presented below are calculated based on the assumptions and the fleet statistics data mentioned above.

Dry bulk cargo vessels		
Country	Costs for Stage V systems	Costs for retrofitting of DPF and SCR systems
	[€]	[€]
UA	18,767,225 €	4,128,445 €
MD	400,000 €	200,000 €
RO	35,353,750 €	9,140,750 €
BG	17,371,200 €	4,179,240 €
RS	- €	- €
HR	4,948,000 €	1,229,600 €
HU	3,400,000 €	1,700,000 €
SK	1,727,700 €	465,540 €
AT	- €	- €
DE	16,858,100 €	4,046,620 €
Total	98,825,975 €	25,090,195 €

Table 5: Investment needs for dry bulk cargo vessels per country

Liquid bulk cargo vessels		
Country	Costs for Stage V systems	Costs for retrofitting of DPF and SCR systems
	[€]	[€]
UA	425,275 €	100,055 €
MD	250,000 €	125,000 €

RO	9,123,400 €	2,214,680 €
BG	2,444,100 €	623,820 €
RS	3,629,150 €	1,355,830 €
HR	2,413,525 €	572,705 €
HU	100,000 €	50,000 €
SK	629,550 €	155,910 €
AT	- €	- €
DE	1,490,875 €	343,175 €
Total	20,505,875 €	5,541,175 €

Table 6: Investment needs for liquid bulk cargo vessels per country

Pusher vessels		
Country	Costs for Stage V systems	Costs for retrofitting of DPF and SCR systems
	[€]	[€]
UA	40,334,325 €	8,861,865 €
MD	687,500 €	152,500 €
RO	79,927,750 €	18,310,550 €
BG	19,775,775 €	4,540,155 €
RS	10,669,050 €	3,423,810 €
HR	2,301,300 €	595,260 €
HU	700,000 €	350,000 €
SK	12,654,275 €	2,965,855 €
AT	- €	- €
DE	14,951,125 €	3,410,225 €
Total	182,001,100 €	42,610,220 €

Table 7: Investment needs for pusher vessels per country

In average, a completely new Stage V engine is approximately four times more expensive than retrofitting an exhaust aftertreatment system to an existing engine. However, when an exhaust gas aftertreatment is retrofitted to an old engine there is a risk that the aftertreatment system becomes worthless in the event of major damage to the engine. This is due to the fact that any newly installed engine has to be Stage V and the certification of separate aftertreatment systems and engines is not possible with current legislation. All new engines already include an aftertreatment system with is part of the engine's type approval.

7 Proposed measures explained shortly

The program will first focus on minimizing air pollutants by means of engines with the latest exhaust gas standard and retrofitting of exhaust gas aftertreatment systems. This section gives a short explanation of both Stage V engines and exhaust after treatment. The categories for the evaluation of the systems can be found in Deliverable 3.1.1

There are some engine solutions available that help to improve the emission standards either by exhaust aftertreatment or by an improvement of the engine itself. Measures for exhaust after-treatment can be the application of an SCR (Selective Catalytic Reduction) to reduce NO_x or the application of a DPF (Diesel Particulate Filter) to reduce PM or a combination of both. If it is foreseeable that this measure will not have the desired effect or they are not compatible with the existing system, one should consider, whether the exchange with an engine of the latest emission standard Stage V is feasible.

Selective Catalytic Reduction (SCR)

The term selective catalytic reduction (SCR) refers to a technique for reducing nitrogen oxides in exhaust gases from internal combustion engines. The chemical reaction at the SCR catalyst is selective, i.e. the nitrogen oxides (NO, NO₂) are preferably reduced, while undesired side reactions such as the oxidation of Sulphur dioxide to Sulphur trioxide are largely suppressed. The reaction requires ammonia (NH₃), which is added to the exhaust gas. The products of the reaction are water (H₂O) and nitrogen (N₂). Because the need of ammonia additional tanks have to be installed on board. The operational costs will increase due to the amount of ammonia consumption. Mostly the ammonia is not stored as a mono-constituted substance. A common trade name is AdBlue® which is a solution of urea (CH₄N₂O) and purified water. It disintegrates (thermal decomposition and hydrolysis) into enough ammonia for the redox reaction, but is not toxic like pure ammonia.

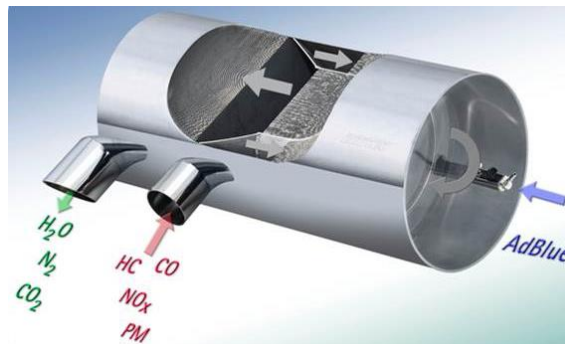
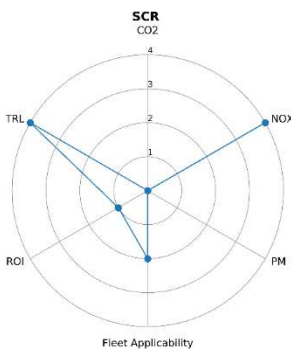


Figure 1: Working principle of an SCR. Source: www.exomission.de

Diesel Particulate Filter (DPF)

Diesel particulate filters reduce the emissions of toxic fine dust (PM) from the exhaust gas. The separation of soot is up to 85 %. This measure is suitable for many ships, while restrictions might be the space in the engine room and a sufficient exhaust gas pressure.

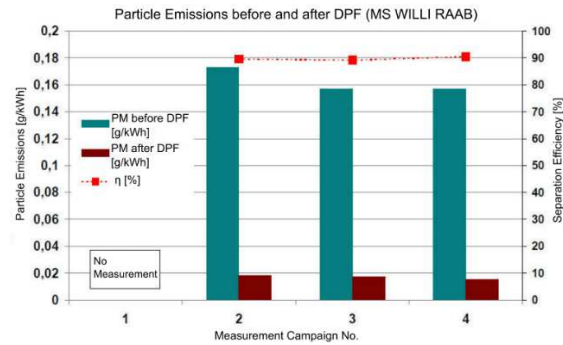
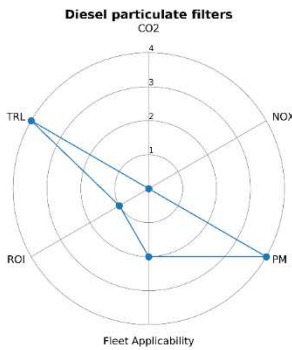


Figure 2: Measurements of particle emissions on board of the MS WILLI RAAB. Source: www.bmvi.de

Combination of SCR and DPF

The combination of SCR and DPF can reduce both NO_x and PM emissions. One prerequisite for the use of this measure is a sufficient exhaust gas pressure (back pressure tolerance of the engine) as well as enough space in the engine room.

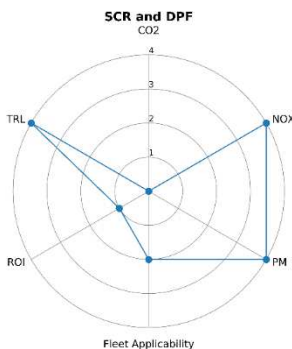
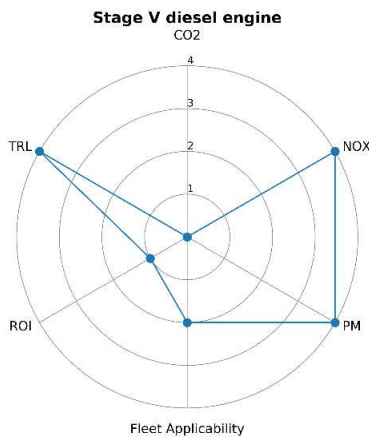


Figure 3: SCR and DPF on board of the MAX PRÜSS Source: www.wochender-umwelt.de

Exchange of main diesel engine with a Stage V engine

Stage V engines comply with the Regulation (EU) 2016/1628. This regulation gives new limits for the emissions of carbon monoxide (CO), hydrocarbons (HC), nitrogen oxides (NO_x), particulate matter (PM) and particulate number (PN) for non-road mobile machinery (NRMM). The old emission regulations for IWT were CCNR I and CCNR II. The engine manufacturers are just starting to launch the first Stage V engines for IWT.



	US EPA Tier 1 P > 560 kW	CCNR 1 from 2003 P ≥ 130 kW	CCNR 2 from 2007 P > 560 kW	NRMM St. V from 2020 P ≥ 300 kW
CO (g/kWh)	11.4	5.0	3.5	3.5
HC (g/kWh)	1.3	1.3	1.0	0.19
PM (g/kWh)	0.54	0.54	0.2	0.015
PN				1 × 10 ¹²
NO _x (g/kWh)	9.2	500 ≤ n < 2,800 min ⁻¹ : 45n ^{-0.2} 1,600 min ⁻¹ : 10.3	343 ≤ n < 3,150 min ⁻¹ : 45n ^{-0.2-3} 1,600 min ⁻¹ : 7.3	1.8

Table 8: Comparison of the emission regulations Tier1, CCNR 1, CCNR 2, and NRMM Stage V, each for the largest engine category

Maintenance plans, accumulation of reserves, overhaul of existing engines

In addition to the installation of new systems, the preparation of maintenance plans for existing systems is an important measure. This ensures that the systems are always in good condition, also reducing emissions, and prevents sudden total failure due to poor or no maintenance. If a sufficient budget is set for maintenance and, if it has not been fully spent, savings are made. The reserves created can be used to finance a new system.

An overhaul of the existing main engine(s) can raise the efficiency of an older engine by about 10 %. The overhaul can include crankcase, crankshaft, cylinder liners, pistons, connecting rods, camshaft and injection nozzles, as well as the components injection pump, turbocharger, intercooler and exhaust tract.

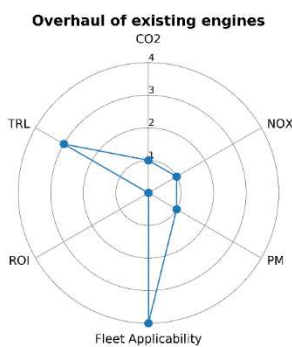


Figure 4: Small engine service on board. Source: www.a-storm.com

8 Fleet investment plan consolidation

The feedback collected based on the Fleet Investment Questionnaire confirmed the low investment capacity among most fleet operators in the Danube region. Accordingly, commissioning activity for new ships is very low in the cargo segment of the fleet. It also revealed that the sector has significant reservations against alternative energy carriers for inland shipping. Advanced greening options like fuel cells, hydrogen combustions or alike are not on the agenda for the coming years. Here the outcome of pilot applications and in other sectors should be watched until technological readiness and profitability are improved.

Besides the energy efficiency and the emissions of noise, air pollutants and greenhouse gases there are further approaches for greening. For example, the project partner DANUBIA serves as a forerunner with the development of advanced sewage plants for their cabin vessels.

9 Determination of the funding needs

The project MoVe It! funded by the EC within the 7th framework program yielded that the most extensive greening of the fleet for given budget is achieved with inexpensive measures for as many vessels as possible. Few flagship projects with advanced measures maximize the effect per ship but have only a small influence on the (environmental) performance of the sector. Also, it is proposed to focus at least part of the invested budget on vessels with high energy throughput. The improved emission profiles of these vessels saves the most with few installations.

Funding rates can be set according to various criteria. A criterion often used is the size of the company. For example, an owner who runs his ship as his own business (micro-entrepreneur) would then receive a larger funding rate than a large company. The funding should be granted as non-repayable support. As state aid is not allowed to just fulfil the effective legislation, the companies are required to exceed the latest emissions standards in order to apply for funding. Support requirements should always be technologically neutral in order not to discourage the development of new technical solutions for inland navigation.

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Version 1.0

Date: 30/04/2020

FINAL

Document History

Version	Date	Authorised
0.1	29.01.2019	CERONAV
0.2	09.09.2019	CERONAV
0.3	17.02.2020	CERONAV
0.4	05.03.2020	CERONAV
1.0	30.04.2020	CERONAV

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2 Abbreviations

Abbreviation	Explanation
CESNI	Comité Européen pour l'Élaboration de Standards dans le Domaine de Navigation Intérieure
CESNI/QP	Comité Européen pour l'Élaboration de Standards dans le Domaine de Navigation Intérieure/Qualification Professionnelle
CESNI/TI	Comité Européen pour l'Élaboration de Standards dans le Domaine de Navigation Intérieure/ Technologie de l'information
Danube SKILLS	Increased institutional capacity in Danube navigation by boosting joint transnational competences and skills in education and public development services
ES-QIN	European Standards- Qualification in Inland Navigation
ES-TRIN	European Standards- Technical Requirement for Inland Navigation vessels
EU	European Union
EUSDR	European Union Strategy for the Danube Region
INNOVATIVE SKILLS	Efficient and sustainable Danube navigation based on forward looking competences
IWT	Inland Water Transport
ML	Management level
OL	Operational level
PROMINENT	Sustainable, safe and economically feasible energy concepts and technologies for European Inland Shipping
RIS	River Information Services
TASCS	Towards a sustainable crewing system
TEN-T	Trans -European Transport Network

3 Executive summary

Modernising the Danube fleet and thus efficiently adapting it to the needs and requirements of emerging markets, is one of the core objectives of the GRENDEL project. In order to achieve this endeavour, several aspects must be taken into consideration. Securing a smooth integration of technological innovation in IWT, providing access to proper financial instruments, proper fairway maintenance and finally, adequate competencies of the workforce, are essential preconditions to adapt the IWT sector to a future-oriented and competitive European transport system. The aim of this document is to provide a comprehensive overview on the human resources aspect of the IWT sector, its education and training requirements.

In light of the policies promoted at the European level, training centres must provide their students with an adequate competency-based education that facilitates the adaptation to technological innovation. Moreover, a widely harmonized education system through common quality standards, would make transnational transport on inland waterways more competitive.

The existing EU legal framework provides the ground for the transnational recognition of professional qualifications in inland navigation. A decisive step in this regard was the Directive **(EU) 2017/2397** on the recognition of professional qualifications in inland navigation. Furthermore, the **Delegated Directive (EU) 2020/12** on supplementing the aforementioned Directive plays a major role in the actual implementation of the legal framework governing the harmonisation of educational issues in inland waterborne transport. It covers the most important educational aspects: standards of competence and corresponding knowledge and skills as well as for practical examinations and the approval of simulators and medical fitness.

This output will moreover touch the main results of former and currently running European projects that deal with the competencies that are required to be in line with the adopted legal framework at EU level.

The ongoing educational harmonisation processes at the EU level is highly welcomed at the national level and was developed in response to the new kind of jobs required for a changing sector. This development undoubtedly represents a huge challenge – both for the sector and the education system. New training programmes that consider the innovative technological aspects are of outmost importance. This means that training institutes must strengthen their capacity to adapt more efficiently and enduringly to the new legal framework.

4 Introduction

Investing in education is essential to boost growth and competitiveness. In the long-term, adequate competences can trigger innovation and shape the future of a truly European transnational labour market. Education is an indispensable pillar of the Internal Market and has to be adapted to its increasing mobility needs.

The upcoming 10 years will see the emergence of new educational and training programs that can adapt to the new requirements of emerging markets that will play a decisive role in fully integrating IWT to the intermodal transport and logistic chains. Flexibility will perhaps be the main characteristic of this development.

As a general approach, **emphasis has to be put on delivering key competences (knowledge and abilities) for employees, increasing the efficiency and inclusiveness of education and training institutions while working collaboratively with all relevant stakeholders.**

The development capacity of the inland waterway sector is hampered by difficulties in terms of labour mobility, persistent vacancies and skill mismatches. The concrete benefits of inland navigation can only be fully exploited **if a skilled workforce is available in order to secure a safe integration in the transnational logistics chain.**

The situation on the IWT labour market is shaped by two market forces: the demand of workers, determined by high transport volumes of both the passenger and the freight market, and the supply of workers, which is driven by career perspectives. As regions are interconnected, workers tend to be mobile.

5 EU legal framework

5.1 Adoption of the new EU Directive

On 27 December 2017, the **Directive 2017/2397** of the European Parliament and of the Council on the recognition of professional qualifications in inland navigation was published in the Official Journal of European Union.

By providing the common standards across the Union necessary to achieve the internal market for workers in IWT, the new Directive streamlines the legal framework related to professional qualifications in the European IWT sector, which is currently fragmented. The Directive replaces a complex set of regional requirements with multilateral and bilateral agreements by a simpler and, more importantly, EU-wide framework for certification and mutual recognition. The Directive provisions minimize the administrative burden for those applicants who completed an approved training programme by avoiding that they would have to take unnecessary additional administrative exams.

5.2 Essential competences requirements for deck crew members

Essential competence requirements for obtaining Union certificate of qualification for deck crew members are grouped in three main categories, such as:

I. Essential competence requirements at operational level

These essential competence requirements are included in the Standards of Competence for Operational level which refers to the following specialized subjects:

- Navigation;
- Operation of the craft;
- Cargo handling, stowage and passenger transport;
- Marine engineering and electrical, electronic and control engineering;
- Maintenance and repair;
- Communication;
- Health and safety and environmental protection.

II. Essential competence requirements at management level

These essential competence requirements are included in the Standards of competence for Management level which refers to the following specialized subjects:

- Navigation;
- Operation of the craft;
- Cargo handling, stowage and passenger transport;
- Marine engineering and electrical, electronic and control engineering;
- Maintenance and repair;

- Communication;
- Health and safety and environmental protection

III. Essential competence requirements for specific authorizations and specific operations

These essential competence requirements for specific authorizations and specific operations are included in the:

- Standards of competence for sailing on inland waterways with a maritime character;
- Standards of competence for sailing with the aid of radar;
- Standards of competence for passenger navigation experts;
- Standards of competence for liquefied natural gas (LNG) experts, which refers to the following specialized subjects:
 - Sailing on inland waterways with a maritime character;
 - Radar navigation;
 - Passenger navigation; and
 - Liquefied natural gas used as fuel.

5.3 CESNI work on standards

In order to provide minimum harmonised standards for the certification of qualifications, to facilitate the exchange of information between Member States and the implementation, monitoring and evaluation of the Directive (EU) 2017/2397 by the Commission, **the power to adopt acts in accordance with Article 290 of the Treaty on the functioning of the European Union should be delegated to the Commission in respect of the setting of standards of competence**, standards for medical fitness, standards for practical examinations, standards for the approval of simulators and standards defining the characteristics and conditions of use for the database, to be maintained by the Commission, that is to host a copy of key data related to Union certificate of qualification, service record book, logbook and recognised documents.

CESNI, which is open to experts from all Member States, draws up standards in the field of inland navigation, including standards for professional qualifications.

6 Capitalisation of the results of former EU projects

The results of former **EU projects focusing on education and training of human resources involved in the IWT sector** will be useful to elaborate a minimum set of requirements for future competences of personal involved in the IWT sector and for the development of new competency-based curricula.

The table below summarizes the main results of various European projects, whose results are relevant for the core objective of this output.

Project document	Model course/ curriculum	Modules	Competences identified	Compliance with ES-QIN	New/innovative competences
PROMINENT project					
D 4.3- Digital tools to support the further integration of IWT knowledge to general logistics education and training	Basic Module and Case studies <i>Web-based training course and curriculum</i>	M1-Use and comparison of transport modes	Describe the characteristics of transport modes, advantages and disadvantages.	OL1- Navigation	-
		M2-Economic geography and infrastructure waterways	Describe the characteristics of the main important national and international inland waterways, the main ports and terminals and the influence of inland waterways infrastructures on the economics of transport	OL 1- Navigation	-
		M3-Multimodal transport	Describe what multimodal transport is, the main characteristics of multimodal transport and name the factors that are part of cost calculation of multimodal processes	ML 3- Cargo handling, stowage and passenger transport	-
			Name the main legal aspects regarding transport of dangerous goods in inland waterway transport	OL 3- Cargo handling, stowage and passenger transport	-
		M4-Innovative transport concepts and green logistics	State the importance of sustainable freight transport for the future development of inland navigation	-	State the importance of sustainable freight transport for the future development of inland navigation
			Name the characteristics of green ports and differences to a common port as well as the actions needed for establishing a green port	-	Name the characteristics of green ports and differences to a common port as well as the actions needed for establishing a green port
			State the main facts about LNG Name the advantages and challenges when switching to LNG in connection with inland navigation	Standards of competence for LNG experts	
D 4.4- Prototype of	<i>E-learning modules</i>	1. Energy efficient navigation	Name the advantage of energy efficient navigation State the different possibilities/potentials to save	-	Name the advantage of energy efficient navigation

digital education and training tools			fuels, fuel saving regarding different sailing policies State the ship depending, waterway depending factors and other factors which influence the fuel consumption		State the different possibilities/potentials to save fuels, fuel saving regarding different sailing policies State the ship depending, waterway depending factors and other factors which influence the fuel consumption
		2. ADN/Dangerous goods	Relate what ADN is and what is regulated in this agreement State the classification of dangerous goods, labels, risk properties, precautions, measures in case of emergency Name the main properties and the transportation requirements of LNG Describe the construction and configuration of LNG tanks Explain the holding time calculation	OL 3- Cargo handling, stowage and passenger transport	-
		3. Vessel stability	Explain the basic stability of the vessel Calculating the centre of gravity Being able to calculate stability State the special factors for the stability of container cargo vessels State the special requirements needs to be considered during loading and unloading Being able to use the storage plan	OL 2- Operation of the craft ML 2- Operation of the craft	-
Danube SKILLS project- Danube Transnational Programme					
Output 3.2.b- Transnational model course	Safety practices in emergency situations during ship operation- Operational level <i>Learning and</i>	1.Safety of work	Work according to instructions and rules for the safety of work and prevention of accidents Follow instructions and communicate with others in term of shipboard duties Contribute to good social relation and cooperate with others on board Dangers of alcohol and drug abuse on board vessel Use personal protective equipment to prevent accidents	OL 7-Health and safety and environmental protection	-

	<i>e-learning modules</i>	2. Medical first aid	Act in case of emergencies according to applicable instructions and procedures Perform medical first aid Required first aid measures in case of emergency	OL 7-Health and safety and environmental protection	-
		3. Personal survival techniques	Use and maintain personal life-saving appliances and shipboard life-saving equipment Provide assistance in the case of rescue operations Use emergency escape routes Use internal emergency communication and alarm system	OL 7-Health and safety and environmental protection	-
		4. Fire fighting	Distinguish the elements of fire and types and sources of ignition Act according to shipboard fire-fighting procedures and organization Use different types of extinguishers and fire-fighting systems Follow instructions concerning: personal equipment, methods, extinguishing agents and procedures during fire-fighting and rescue operations	OL 7-Health and safety and environmental protection	-
		5. Environment protection	Protect the environment in accordance with relevant regulations Take precaution to prevent pollution of the environment Use resources efficiently	OL 7-Health and safety and environmental protection	-
Output 3.2.c- Transnational model course	Human resource management and social responsibility on board-Management	1. Principles and good practices in shipboard human resource management	Organize and stimulate teambuilding and coach the crewmembers regarding shipboard duties and, if necessary, take disciplinary measures	ML 6-Communication	-

	<i>Learning and e-learning modules</i>	2.Information & Communication system, and data management	Instruct crew on information and communication system Collect, save and manage data with regards to data protection laws Describe circumstances by using relevant technical and nautical terminology Retrieve, evaluate and use information with relevance to safety on board as well as nautical and technical issues	ML 7- Communication	-
		3.Leading and managing teams	Ensure a good social working environment	ML 7- Communication	-
		4.International policy to control the operation of the vessel and care for the person on board	Apply national, European and international social legislation Follow strict alcohol and drug prohibition and react appropriately in cases of infringement, take responsibility and explain consequences of misbehaviour Organize provisioning and preparation of meals on board.	ML 7- Communication	-
INNOVATIVE SKILLS project- Danube Transnational Programme					
Output T1- Report on the state of play of supply and demand forward-looking innovative competences in the IWT	<i>Identification of new competences</i>	1.Trans - European transport network	Ensure compliance with the new development and operation guidelines of the trans- European transport networks Apply knowledge of the Good Navigation Status-GNS concept on main inland waterways Comply with the new technologies development and innovations	-	Ensure compliance with the new development and operation guidelines of the trans- European transport networks requirements: Apply knowledge of the Good Navigation Status- GNS concept on main inland waterways Comply with the new technologies development and innovations
		2.RIS- River Information Services	Use of Inland ECDIS and associated navigation systems to assist command decision making Communicate in foreign languages in written and oral in compliance with the RIS directive 44/20015 provisions	OL1-Navigation ML1-Navigation ML6- Communication Standard of competence for	Use of Inland ECDIS and associated navigation systems to assist command decision making

				passenger navigation experts	
		3.Digitalization in IWT	Use digital platforms to improve navigation, traffic management and to reduce the administrative burden Integrate information from IWT in the multimodal logistic chain		Use digital platforms to improve navigation, traffic management and to reduce the administrative burden Integrate information from IWT in the multimodal logistic chain
		4.Electronic technology for IWT	Ensure compliance with the new development of electronic technology to ensure a safe navigation planning, safe stowage planning and safe crewing planning		Ensure compliance with the new development of electronic technology to ensure a safe navigation planning, safe stowage planning and safe crewing planning
		5.Environmental protection	Evaluate the compliance with the legislative requirements regarding alternative fuels Monitor and control compliance with legislative requirements related to gaseous and particulate pollutant emissions limits Ensure compliance with the new developed technologies and technical standards		Ensure compliance with the legislative requirements regarding alternative fuels Monitor and control compliance with legislative requirements related to gaseous and particulate pollutant emissions limits Ensure compliance with the new developed technologies and technical standards
		6. Carrier of goods by inland waterway	Compliance with civil and commercial law, social and tax legislation Compliance with legal requirements for the commercial and financial management of an undertaking Apply knowledge of the access to the market of the inland transport activity Ensure compliance with technical standards and technical aspects of operation Monitor the applicable legal requirements and take measures to ensure the safety of operations and to prevent accidents use the legal provisions applicable to inland waterway transport		Compliance with civil and commercial law, social and tax legislation Compliance with legal requirements for the commercial and financial management of an undertaking Apply knowledge of the access to the market of the inland transport activity Ensure compliance with technical standards and technical aspects of operation Monitor the applicable legal requirements and take measures to ensure the safety of operations and to prevent accidents use the legal provisions applicable to inland waterway transport

		Apply the customs practices and formalities in the inland waterway transport Apply knowledge of the applicable traffic regulation on main inland waterways		Apply the customs practices and formalities in the inland waterway transport Apply knowledge of the applicable traffic regulation on main inland waterways
TASCS – TOWARDS A SUSTAINABLE CREWING SYSTEM				
Development of a crewing instrument	11 tasks considering the agreed new profiles for crew competences	These 11 tasks were considered for the identification of new profiles for crew competences (Boatmaster and Boatman)		
		1.Navigation	Voyage planning, org.crew change Sailing & manoeuvring Mooring & unmooring Organize and control work	ML 1- Navigation OL 1- Navigation
		2. Operation of the craft	Bunkering Ballast water & waste management	ML 2- Operation of the craft OL 2- Operation of the craft
		3.Cargo handling, stowage and passenger transport	Handling hoses, tank clean Freight document & control Checking strength & stability passengers	ML 3- Cargo handling, stowage and passenger transport OL 3- Cargo handling, stowage and passenger transport
	4. Periodic inspection of marine engineering equipment	Periodic inspection (ship hardware/software etc.)	ML 4- Marine engineering and electrical, electronic and control engineering OL 4- Marine engineering and electrical, electronic and control	

				engineering	
		5.Maintenance& repair	Maintenance (preparation and coordination) Planning	ML 5- Maintenance and repair OL 5- Maintenance and repair	
		6.Communication	Crew management & shift handover Organization	ML 6- Communication OL 6- Communication	
		7. HSE/emergencies	HSE, Emergency drills Control work & rest time (shifts) Developing safety plans Instruct the crew in safety drill	ML7- Health and safety and environmental protection OL 7- Health and safety and environmental protection	
		8.Entrepreneuring	Acquisition (follow-up cargo) Commercial accounting Personnel administration Ship account (port duties etc.)		Acquisition (follow-up cargo) Commercial accounting Personnel administration Ship account (port duties etc.)
		9.Other tasks	Studying, waiting Housekeeping (cooking, cleaning accommodation) Teaching apprentices		Studying, waiting Housekeeping (cooking, cleaning accommodation) Teaching apprentices
		10.Recovery/pause	Pause, leisure, sleep, standby		
		11.Travel	Commuting to/from vessels		
COMPETING project- ERASMUS+					
WP3- Developemnt of curricula and course manuals	Curricula and course manuals with learning and e-learning	Educational programme for Boatman- OL with 7 modules according to the ES-QIN	Navigation Operation of the craft Cargo handling, stowage and passenger transport Marine engineering and electrical, electronic and control engineering Maintenance and repair	OL1, OL2, OL3, OL4, OL5, OL6 and OL7	-

	modules	<i>Learning modules</i>	Communication Health and safety and environmental protection		
		Educational programme for Boatmaster -ML with 7 modules according to the ES-QIN <i>Learning modules</i>	Navigation Operation of the craft Cargo handling, stowage and passenger transport Marine engineering and electrical, electronic and control engineering Maintenance and repair Communication Health and safety and environmental protection	ML1, ML2, ML3, ML4, ML5, ML5 and ML7	-
	Creation of a blended learning environment	Starting from the ES-QIN - Standards of competence for OL and ML and the Knowledge and Skills (column 2 of these Standards), will be prepared a document with the knowledge and abilities which are relevant to be introduced in the blended learning environment concept. The final concept will be presented as a feasibility study for development of blended learning environment with all the details for design, install, functionalities, hardware and software, user manual, subsequent maintenance etc., included.		OL1, OL2, OL3, OL4, OL5, OL6 and OL7 ML1, ML2, ML3, ML4, ML5, ML5 and ML7	-

Table 1: Results of former EU projects - Model courses/curricula/competences

7 Required competences for human resources involved in the IWT sector

7.1 General considerations

To align the competences of human resources involved in the inland navigation sector with current and future labour market requirements and with the future vision, actions, recommendations and challenges included in the main initiatives at EU level the CESNI/QP Work Programme for 2019-2021 is taken into consideration, as well as the main relevant results of various European projects presented earlier in this document.

New and innovative competences for people involved in the IWT sector are defined and grouped into main relevant domains, such as:

- **Standardised communication phrases in four languages;**
- **Smart shipping, including environment-friendly and efficient navigation (eco navigation);**
- **Entrepreneurs carrying goods or passengers by IWT,**
and to be completed with other relevant domains, such as:
- **Trans-European transport networks multimodal transport;**
- **Green ports;**
- **Digitalization and electronic technology for IWT sector.**

The future development of the IWT sector should take into account that implementing the use of all of these new technologies requires the need of highly skilled staff.

7.2 New competency-based curricula

In addition of the mandatory education and training programmes the newly developed programmes should take into account the innovative competences identified in various European projects, required by the technological development of the sector.

Two examples of course curricula for the new training programmes are presented in the **Annex 1** of this deliverable document:

- **Energy efficient operations of vessels** and
- **Ports as multimodal hubs.**

An inventory of **future required additional and innovative competences** for the human resources involved in the IWT sector is presented in the table below.

I.	Domain : Standardised communication phrases in four languages		
	Competences	Job position	Remarks
	Describe circumstances by using relevant technical and nautical terminology	Crew member at ML (Boatmaster) on board of inland navigation vessels with following additional knowledge and skills: <ul style="list-style-type: none"> • Knowledge of the correct use of relevant technical and nautical terms; • Ability to master communication. 	Digital abilities are needed to use the digital application LE SINCP developed in the Ler(n)ende Euregio project, application available that can be installed free of charge.
	Retrieve, evaluate and use information with relevance to safety on board as well as nautical-technical issues	Crew member at ML (Boatmaster) on board of inland navigation vessels with following new additional knowledge and skills requirements: <ul style="list-style-type: none"> • Knowledge of procedures to follow in all distress, emergency and safety communication; • Ability to use the standard communication phrases. 	Digital abilities are needed to use the digital application LE SINCP developed in the project Ler(n)ende Euregio, application available that can be installed free of charge.
	Present facts using technical terms	Crew member at OL (Boatman, Able Boatman, Helmsman) on board of inland navigation vessels with the following additional knowledge and skills requirements: <ul style="list-style-type: none"> • Knowledge of the required technical and nautical terms as well as terms related to social aspects in standardised communication phrases; • Ability to use required technical and nautical terms as well as terms related to social aspects in standardised communication phrases. 	Digital abilities are needed to use the digital application LE SINCP developed in the project Ler(n)ende Euregio project, application available to be installed free of charge.
II.	Domain: Smart shipping, including environment-friendly and efficient navigation (eco navigation)		
	Energy efficient navigation		
	Name the advantage of energy efficient navigation	Crew members on board of inland navigation vessels (Chief Mechanical Engineer, Boatmaster) with following additional knowledge and skills: <ul style="list-style-type: none"> • Knowledge on fuel management aspects for energy efficiency; • Ability to apply the main energy efficient measures on board of the vessel 	Owner company staff responsible for energy efficient management and technical activities
	State the different possibilities/potentials to save fuels, fuel saving regarding different sailing policies	Crew members on board of inland navigation vessels (Chief Mechanical Engineer, Boatmaster) with following additional knowledge and skills: <ul style="list-style-type: none"> • Knowledge on the fuel oil consumption calculation and record keeping on board • Ability to explain what trim, trim optimisation is, its energy saving impacts and best practices; 	Owner company staff responsible for energy efficient management and technical activities

		<ul style="list-style-type: none"> Ability to monitor and control fuel management aspects including storage, treatment and purification. 	
	State the ship depending, waterway factors and other factors which influence the fuel consumption	<p>Chief Mechanical Engineer on board of inland navigation vessel and Boatmaster on board of inland navigation vessel, with additional knowledge and skills:</p> <ul style="list-style-type: none"> Knowledge on engines and machinery performance and use management; Ability to explain issues of hull and propeller toughness, fouling, level of impact on energy efficiency and options for monitoring Ability to apply and observe vessel maintenance aspects and their impact on energy efficiency 	Owner company staff responsible for energy efficient management and technical activities
	Ensure compliance with the legislative requirements regarding alternative fuels, new developed technologies and technical standards	<p>Compliance manager with the following main responsibilities:</p> <ul style="list-style-type: none"> keeps the legal and ethical integrity of a company intact through policy enforcement and program planning; makes sure all departments of a business are complying with the rules and regulations the company upholds; prepares reports for to their management detailing these laws and how the employees of the company are obeying them. 	Crew members at the Management level
		Environmental protection	
	Monitor and control compliance with legislative requirements related to gaseous and particulate pollutant emissions limits	<p>Compliance manager with the following main responsibilities:</p> <ul style="list-style-type: none"> keeps the legal and ethical integrity of a company intact through policy enforcement and program planning; makes sure all departments of a business are complying with the rules and regulations the company upholds; preparing reports to present the management detailing these laws and how the employees of the company are obeying them. 	
	Use of LNG as a fuel for IWT vessels	<p>Crew members on board of inland navigation vessels (Chief Mechanical Engineer, Boatmaster) with following additional knowledge and skills:</p> <ul style="list-style-type: none"> Knowledge on the LNG physical properties and on its contribution to significantly reduce the air emissions from engines Ability to apply operational procedures to use LNG as a fuel on board of the vessel 	Owner company staff responsible for energy efficient management and technical activities
	Apply knowledge with the means to reduce greenhouse gases and comply with the legislative framework requirements	<p>Crew members on board of inland navigation vessels (Chief Mechanical Engineer, Boatmaster) with following additional knowledge and skills:</p> <ul style="list-style-type: none"> Knowledge on the alternative fuels used for propulsion and energy generating equipment; Knowledge on the measures to be taken in order to mitigate greenhouse gas emissions, noise and, as appropriate other negative environmental impacts; Ability to identify the new working and handling procedures, and safety measures for 	Owner company staff responsible for environmental protection activities

		using alternative fuels;	
III.	Domain: Entrepreneurs carrying goods or passengers by IWT		
	Entrepreneurs carrying goods or passengers by IWT, <i>with following knowledge and skills</i>		
	Compliance with civil and commercial law, social and tax legislation	<ul style="list-style-type: none"> • Knowledge on the objectives and the development of the European transport network; • Ability to apply the concept of integrated and multimodal traffic; • Ability to comply with means to simplify the administrative procedures; • Knowledge on legal procedures to increased security and safety of the transport system. 	
	Compliance with legal requirements for the commercial and financial management of an undertaking	<ul style="list-style-type: none"> • Ability to use and apply the legal provisions for commercial and financial management; 	
	Apply knowledge of the access to the market of the inland transport activity	<ul style="list-style-type: none"> • Ability to apply the legal provisions and procedures concerning the chartering system; 	
	Ensure compliance with technical standards and technical aspects of operation	<ul style="list-style-type: none"> • Knowledge on the European standards ES-TRIN in order to comply with for their own vessels; 	
	Monitor the applicable legal requirements and take measures to ensure the safety of operations and to prevent accidents	<ul style="list-style-type: none"> • Ability to use and respect the traffic regulations applicable to navigation on inland waterways to avoid damage; • Ability to implement within the company and on board of the vessels the European standards and take appropriate measures for safety of work, health protection and the prevention of accidents; 	
	Use the legal provisions applicable to inland waterway transport	<ul style="list-style-type: none"> • Knowledge on the characteristics of the main European inland waterway networks; 	
	Apply the customs practices and formalities in inland waterway transport	<ul style="list-style-type: none"> • Ability to use and respect the legal provisions and procedures regarding the customs practices and formalities in the inland waterway transport sector; 	
IV.	Trans-European transport networks multimodal transport		
	Ensure compliance with the new development and operation guidelines of the trans- European transport networks	Crew member at ML (<i>Boatmaster</i>), owner company staff, entrepreneur carrying goods or passengers by IWT <i>with following knowledge and skills:</i> <ul style="list-style-type: none"> • Knowledge on the objectives and the development of the European transport network; • Knowledge on the concept of integrated and multimodal transport. 	
	Apply knowledge of the Good Navigation Status- GNS concept on main inland waterways	Waterway administration staff and owner company staff <i>with following knowledge and skills:</i> <ul style="list-style-type: none"> • Knowledge on the GNS scope, meaning and core components; 	

		<ul style="list-style-type: none"> • Ability to apply good practices in compliance with GNS; 	
	Comply with the new technologies' development and innovations	<p>Crew member at ML (<i>Boatmaster</i>), owner company staff, entrepreneur carrying goods or passengers by IWT <i>with following knowledge and skills:</i></p> <ul style="list-style-type: none"> • Knowledge on the ways to improve the safety and sustainability of the transport of passengers and goods through new innovative development in the field; • Ability to support and promote the decarbonisation of transport by the transition to innovative and sustainable transport technologies; • Ability to apply measures that improve the safe operation and efficiency of transport; • Ability to promote the sustainable use of transport infrastructure, including an efficient management. 	
V.	Green ports		
	Comply with new technologies and developments of port infrastructure and facilities	<p>Crew member at ML (<i>Boatmaster</i>) and OL (<i>Boatmen, able Boatmen, Helmsman</i>) owner company staff, port workers, port administrations staff, logistics staff, entrepreneur carrying goods or passengers by IWT <i>with following knowledge and skills:</i></p> <ul style="list-style-type: none"> • Knowledge of the innovative port facilities for the environment protection and the green supply for ship, vessels, port activities and society; • Knowledge of the secure communication and IT architecture needed for the benefit of strategic traffic and port management and vessel-assist infrastructure; • Knowledge of the innovative development of new, more flexible solutions for bunkering and energy storage of alternative fuels; 	
	Apply knowledge of sea and inland ports as multimodal hubs for fully integrated mobility and logistics system	<p>Crew member at ML (<i>Boatmaster</i>) and OL (<i>Boatmen, able Boatmen, Helmsman</i>) owner company staff, port workers, port administrations staff, logistics staff, entrepreneur carrying goods or passengers by IWT <i>with following knowledge and skills:</i></p> <ul style="list-style-type: none"> • Knowledge of the multimodal hubs for integrating IWT into synchro-modal logistics operations; • Knowledge of inland ports fulfilling the role of city logistics hubs 	
VI.	Digitalization		
	Use digital platforms to improve navigation, traffic management and to reduce the administrative burden	<p>Crew member at ML (<i>Boatmaster</i>) and OL (<i>Boatmen, able Boatmen, Helmsman</i>) owner company staff, port workers, port administrations staff, logistics staff, entrepreneur carrying goods or passengers by IWT <i>with following knowledge and skills:</i></p> <ul style="list-style-type: none"> • Knowledge on the required digital platforms to interconnect information from IWT with other modes of transport; 	

		<ul style="list-style-type: none"> • Knowledge on the core components of digital platforms; • Knowledge on the relevant IWT legislation on digital platforms; • Ability to explain the content and the operation procedures of main relevant European digital platforms; • Knowledge on the digital services for e-navigation/autonomous navigation; • Ability to explain how to use a Single window access for the exchange of vessel and cargo position information 	
	Integrate information from IWT in the multimodal logistic chain	<p>Crew member at ML (Boatmaster) and OL (Boatmen, able Boatmen, Helmsman) owner company staff, port workers, port administrations staff, logistics staff <i>with following knowledge and skills:</i></p> <ul style="list-style-type: none"> • Knowledge of Trans- European Transport network; • Ability to use telematics applications; • Knowledge on the content of electronic freight transport documents; • Ability to use Cloud based controlled data sharing; • Knowledge of the procedures to make available the data related to the inland waterways network infrastructure using the European Reference Data Management System; • Ability to use booking and transport management platforms of shippers and logistics service providers to integrate IWT into multimodal logistics chain; • Knowledge of the digital platforms to simplify and reduce administrative burden; • Ability to support and promote the use of electronic data exchange between business and government; • Knowledge of the Digital Single Market; • Ability to explain how to use electronic trust services (i.e. electronic signatures, electronic seals or time stamps, electronic delivery services and website authentication) • Knowledge on the cyber-risks for IT application in inland navigation 	

Table 2: List of new and innovative competences, knowledge and abilities required for existing and new jobs in the IWT sector

8 Jobs in the IWT sector

8.1 Existing jobs in IWT sector

On board of inland vessels

Existing jobs on board of inland navigation vessels according to the EU Directive 2017/2397 on the recognition of professional qualifications in inland navigation, such as:

Entry level

- Deckhand
- Apprentice boatman

Operational level

- Boatman
- Able Boatman
- Helmsman

Management level

- Boatmaster

All these jobs are for deck crew members on board of inland vessels, jobs that belong to the category of safe manning personnel.

In addition to these jobs defined by the EU Directive 2017/2397 on board of inland vessels, the following **auxiliary jobs** are needed:

Management level

- Mechanical engineer;
- Chief mechanical engineer.

Operational level

- Electrician.

Other jobs on board of passenger vessels such as:

- Personnel serving passengers on board passenger vessels;
- Safety officer.

Other jobs on board of technical vessels such as:

- Dredger;
- Craner for floating crane.

Main categories of jobs in inland ports:

- Port workers (dock labourer, craner, forklift worker, winch worker, driver, machinist mobile machines, warehouse manager, storekeeper etc.)
- Berth operators;
- Port terminal operator;

- Port facility security officer;
- Dispatching operator;
- Logistics providers;
- Port managers;
- Freighter;
- Freight railway agent;

8.2 Future jobs

In order to respond to the needs and requirements of potential employees, it is of utmost importance to take several aspects into consideration. First of all, efficiently integrating IWT to the intermodal transport system assumes that highly qualified personnel are attracted to this field. Operating in an environment that requires the operation of innovative technologies presupposes that adequately educated personnel is available. Another possible solution would be to encourage the existing workforce to continuously develop themselves professionally. The keyword in this regard is lifelong learning. Ways of achieving this ambitious goal are presented and discussed in the framework of this output.

As an example, in the port sector, there is currently a demand for significant change in skills development. These changes have transformed the skills required of a port worker, which in turn demand a new professional training system.

The changes expected to result from the development of various driving forces of the transportation sector, and in particular those intended to influence the employability of the sector, are among the main objectives of the **SKILLFUL project** (<http://skillfulproject.eu/>) financed by the Horizon 2020 programme. It provides 28 priority schemes and future scenarios on prioritized skills and competences concerning the professions that are expected to be mostly affected by the present and future changes of the European transportation system. Even though IWT is not considered per se in this project, examples of good practices can still be effectively incorporated to inland navigation.

9 Conclusions

IWT is an energy efficient, safe and sustainable alternative to other modes of transport and contributes to decongesting overloaded road and rail networks for goods and people. A better integration of inland navigation into transport chains improves the efficiency of the entire European transport network.

Successfully implementing the solutions proposed in the framework of this document will require continuous cooperation efforts between all involved actors. Coordination should end at the boundaries of IWT: land use planning, environment, new market segments and more needs to be integrated when developing further actions.

By 2030, road freight shall be significantly shifted to sustainable transport modes to which IWT belongs. A further shift shall be reached by 2050. This goes hand in hand with **largely eliminated greenhouse gases and other pollutants by 2050.** All these changes require a shift towards future-oriented thinking and planning in the education system. In light of the expected incorporation of technological innovation in IWT, the sector will more and more depend on people specialized in a multitude of domains – like engineering, marketing and economics – just to name a few.

10 Annex 1: Training courses curricula

This annex contains examples of two training course curricula:

- **The Energy Efficient Operation of Vessels** and
- **Ports as Multimodal Hubs.**

MODULE 1- THE CLIMATE CHANGE AND THE INTERNATIONAL RESPONSE

Competence	Knowledge and skills
1.1 Monitor and control compliance with legislative requirements and various initiatives established to deal with the issues related to air pollution;	<ol style="list-style-type: none"> 1. Knowledge of the origin of the issues related to air pollution. 2. Knowledge of energy source and energy efficient strategy. <p>2. Ability to explain the international response to the air emission issues;</p>
1.2 Describe the issue of Greenhouse Gas (GHG) and the international response to the problem;	<ol style="list-style-type: none"> 1. Knowledge of the Greenhouse Gas (GHG) issue and climate change. 2. Knowledge of the shipping impact on climate change and GHG emissions. 3. Ability to explain the international organizations commitment to protect the environment and the atmosphere
1.3 Apply knowledge on the main international organizations instruments to address the GHG issue.	<ol style="list-style-type: none"> 1. Knowledge of the international response to the GHG problem, and on the various initiatives established to deal with the problem.

MODULE 2- FROM MANAGEMENT TO OPERATION

Competence	Knowledge and skills
2.1 Understand the advantages of energy efficient navigation and the role of vessel management to support GHG saving;	<ol style="list-style-type: none"> 1. Knowledge of the links between fuel saving and GHG emission reduction. 2. Knowledge of the impact of shipping contracts of carriage and possible conflicts of interest. 3. Ability to apply the companies' energy efficient policy
2.2 State the different possibilities/potentials to save fuels;	<ol style="list-style-type: none"> 1. Knowledge of the fuel consumption calculation and record keeping on board. 2. Knowledge of the use of specific resources on board of the vessel to optimise the fuel consumption. 2. Knowledge of the need to anticipate vessel loading. 3. Ability to explain what is trim, trim optimisation, its energy saving impacts and best practices 4. Ability to monitor and control fuel management aspects including storage, treatment and purification
2.3 Understand the role of vessel technical management to support GHG savings in terms of safety, cost and regulatory conflict for energy management.	<ol style="list-style-type: none"> 1. Knowledge of the international response to the GHG problem, and on the various initiatives established to deal with the problem. 2. Knowledge on engines and machinery performance and technical management 3. Ability to apply and observe vessel maintenance aspects and their impact on energy efficiency. 4. Ability to explain issues of hull and propeller toughness, fouling, level of impact on energy efficiency and options for monitoring.

MODULE 3- PORT STAY AND ITS IMPACTS

Competence	Knowledge and skills
3.1 Apply knowledge on how time in port affects the efficient vessel operation in terms of fuel consumption, operating costs, and in particular GHG emissions;	<ol style="list-style-type: none"> 1. Knowledge of the port operation. 2. Knowledge of the importance of port time in the efficient ship operation context. 3. Ability to calculate how much fuel can be saved by reducing port time 4. Knowledge on the link between port operations and GHG emissions.
3.2 Understand the concept of onshore power supply as the main way of reducing air emissions in ports;	<ol style="list-style-type: none"> 1. Knowledge of the onshore power supply in ports. 2. Ability to explain why onshore power combined with just-in-time operations can significantly reduce port –related pollutions. 2. Knowledge of the requirements at port-side and vessel-side to enable an effective onshore power supply system. 3. Ability to analyse the impact of onshore power supply on vessel-at-berth air emissions and energy efficiency. 4. Knowledge with port related green initiatives.

MODULE 4- EN ROUTE

Competence	Knowledge and skills
4.1 Raise awareness of management jobs positions for efficient vessel operation with the main aim of reducing GHG emissions;	<ol style="list-style-type: none"> 1. Knowledge on the vessel operations Manager attributions and responsibilities. 2. Ability to explain the day to day operations of the vessel including navigational safety, cargo, and inspections. 3. Knowledge of the safety standards and procedures as well as environmental management. 4. Ability to act as a member of an Emergency Response Team.
4.2 Use the suitable practices of en route vessel operation with particular to voyage and itinerary management;	<ol style="list-style-type: none"> 1. Knowledge of the current practices of en route vessel operation with regard to voyage and itinerary management. 2. Knowledge of the importance of just in time operations and the barriers facing its implementation. 3. Ability to name and explain various elements of system planning to ensure en route energy efficient operations. 4. Ability to demonstrate of how systems can be managed efficiently during manoeuvring to increase fuel efficiency.

MODULE 4- ENERGY EFFICIENCY MANAGEMENT SYSTEMS

Competence	Knowledge and skills
5.1 Establish the Vessel Energy Efficient Management Plan;	<ol style="list-style-type: none"> 1. Knowledge to establish a management plan for improving efficient operations of vessels. 2. Ability to implement effectively the management plan for improving efficient operations of vessels. 2. Ability to use Energy Efficient Operational Indicator (EEOI) for a vessel operated under your control .

<p>5.2 Apply knowledge of the energy efficient operation of vessel as well as of the mechanism to be established for the company and/or vessel to improve the energy efficiency of a vessel's operation;</p>	<ol style="list-style-type: none"> 1. Knowledge of the energy efficient operation of vessel. 2. Knowledge of the mechanism to be established to improve energy efficiency. 3. Ability to use and review a management system for energy efficient operation of vessel. 4. Ability to explain the mechanism to be established for the company and the vessel to improve the energy efficiency of a vessel's operation.
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MODULE 1- GLOBAL AND GENERAL CHALLENGES FOR EUROPEAN PORTS

Competence	Knowledge and skills
<p>1.1 Understand the competitiveness of European ports and their effective integration into global supply chains demands;</p>	<ol style="list-style-type: none"> 1. Knowledge of the needs of a clear European legislative environment, to guarantee equal conditions for competition and legal certainty. 2. Knowledge of TEN-T Guidelines as an important legal instrument to connect port to the rail, inland waterways and road network and to enhance their role as an integral logistics element within the corridors. 3. Ability to explain the main causes of the challenges faced by the sector ;
<p>1.2 Apply knowledge of the Trans European Transport Network;</p>	<ol style="list-style-type: none"> 1. Knowledge of the Regulation (EU) no. 1315/2013 of the European Parliament and of the Council/2013 on Union guidelines for the development of the trans-European transport network. 2. Ability to explain the scope, objectives, resource – efficient for the development of Trans European Transport Network. 3. Ability to name the necessary measures for the development of core and comprehensive networks.
<p>1.3 Apply knowledge on the main international organizations instruments to address the integration of European ports into Trans European Transport networks.</p>	<ol style="list-style-type: none"> 1. Knowledge of the international response and on the various initiatives established for the integration of European ports into Trans European Transport networks. 2. Knowledge of the EU strategies for EU ports, and especially the ports of the Trans European Transport networks.

MODULE 2- PORT CONNECTIVITY TO LAND, MARITIME AND INLAND WATERWAY TRANSPORT

Competence	Knowledge and skills
<p>2.1 Understand the advantages of good hinterland connections;</p>	<ol style="list-style-type: none"> 1. Knowledge of the concepts of hinterland transport and port performance in a broader sense. 2. Ability to explain and identify how efficient hinterland transport influences ports in general. 3. Ability to describe and identify the relationship between hinterland transport and port performance.
<p>2.2 State the TEN-T planning instruments to support modal shift</p>	<ol style="list-style-type: none"> 1. Knowledge of the Action Plan enabling the uptake of the TEN-T project pipeline

to land, maritime and IWT;	<p>by the financial market- 2019</p> <p>2.Knowledge of the General and specific context of the transport investment framework</p> <p>3.Ability to name the necessary measures for the development of core and comprehensive networks.</p>
2.3 Understand the role of hub-and-spoke model and its benefits.	<p>1. Knowledge of the hub-and-spoke transportation system.</p> <p>2. Ability to describe the hub-and-spoke architecture.</p> <p>3. Ability to explain how the hub-and-spoke model transform the transportation system</p>

MODULE 3- INNOVATION IN PORT LOGISTICS

Competence	Knowledge and skills
3.1 Apply knowledge on innovation in intelligent transport systems and cluster models of logistics systems to optimise capacities and develop multimodality;	<p>1. Knowledge of the innovation in intelligent transport system.</p> <p>2. Ability to explain the necessity of standardisation in the European transport market.</p> <p>3. Ability to identify the main areas of innovation that will affect virtually all of the logistical and economic aspects of ports.</p> <p>4. Knowledge of the benefits of smart ports</p>
3.2 Raise awareness on the changing nature of port jobs as a result of innovation and automation;	<p>1. Knowledge of the specificity of port jobs</p> <p>2. Knowledge of the policy and legal issues of port labour market issues</p> <p>3. Ability to explain how the automation can change the nature of port jobs.</p> <p>4. Ability to identify new and innovative competences for jobs in the port sector</p>

MODULE 4- PORT, ENERGY SECURITY AND CLIMATE POLICY

Competence	Knowledge and skills
4.1 Apply knowledge on new forms of energy, including renewable energies and alternative fuels, which would enable the transport system to become a low carbon industry;	<p>1. Knowledge of the innovation in intelligent transport system.</p> <p>2. Ability to explain the necessity of standardisation in the European transport market.</p> <p>3. Ability to identify the main areas of innovation that will affect virtually all the logistical and economic aspects of ports.</p> <p>4. Knowledge of the benefits of smart ports</p>
4.2 Understand the further contribution of ports to European energy security and climate goals;	<p>1. Knowledge of the specificity of port jobs</p> <p>2. Knowledge of the policy and legal issues of port labour market issues</p> <p>3. Ability to explain how the automation can change the nature of port jobs.</p> <p>4. Ability to identify new and innovative competences for jobs in the port sector</p>
4.3 Apply knowledge on the European policies for emissions reduction	<p>1. Knowledge of the legal aspects of the emission reduction in IWT sector and in ports</p> <p>2. Ability to explain the main principles of European Green Deal</p>

MODULE 5- PORT CITIES

Competence	Knowledge and skills
5.1 State the main factors for the development of port cities and an integrated port-city ecosystem;	<ol style="list-style-type: none"> 1. Knowledge of the characteristics of port cities 2. Ability to explain the main factors for the development of port-cities. 3. Ability to explain the role of inland ports in urban logistics.
5.2 Establish the main principles for the development of guideline of port cities;	<ol style="list-style-type: none"> 1. Knowledge of the future development of port cities 2. Knowledge of the policy and legal issues for the development of port cities 3. Ability to identify the necessity, opportunity and legality of the development the harmonised guideline for port cities.