Work Package 2: Innovation & Fleet

Innovation Platform and draft Research and Innovation Roadmap for Inland Waterway Transport

Draft innovation agenda outlining future research needs, proposed research activities as well as implementation roadmaps of eco-efficient innovations

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1. INTRODUCTION

Three big priorities of the European Commission in the current term have a strong link with innovation and rely on it to be achieved: “Jobs, growth and investment”, “Digital Single Market” and “Energy Union and Climate”. In a rapidly digitalising world with a closing window to act on energy and climate, strong growth opportunities are present in digitalisation and greening. The worldwide greentech market alone is worth 2,536 billion EUR and expected to double by 2025. With an average growth rate of 9.6% per year, the sustainable mobility market is the fastest grower of all the global lead markets for greentech. The worldwide volume for sustainable mobility was EUR 315 billion in 2013 and is expected to triple by 2025[1].

Next to an increase of the EU innovation budget through Horizon2020 and other programmes, the European Commission aims to set conditions for growth by focusing on regulation that supports innovation through the removal of regulatory and administrative barriers to innovation and speeding up harmonisation and interoperability in other fields in order to encourage disruptive ideas and foster their commercial up-take. Transport is an important aspect in the innovation agenda as indispensable carriers of goods and people in the internal market, as an important consumer of fossil energy and with disruptive changes in e-transport ahead. The interdependency between the three priorities competitiveness, digitalisation and greening is particularly high in transport. A company like Uber acquired quick market share as a digital market platform for vehicles offering real-time delivery of people and parcels, which will be sooner than later clean and self-driving and providing solutions for car ownership, last mile deliveries and fragmentation in transport markets in urban areas. It has become the school example of transport innovation. Similar innovations are expected in different transport markets and the challenge is to create the right framework to foster innovative ideas which spur green growth.

This innovation agenda addresses the challenge of outlining an adequate framework for supporting innovation in inland waterway transport and aims to consolidate, coordinate and prioritise research & development. Continuous research and development in shipbuilding, ship machinery (e.g. engines, fuels, alternative propulsion, ship equipment), innovations in logistics (loading units, transhipment equipment), river information services but also infrastructure maintenance is needed to maintain inland navigation as a competitive component to move goods. Technological, legal and environmental challenges influence the content of jobs, where education and qualification should be key areas of innovation priorities as well. The atomised structure and the size of the inland waterway market are today barriers to the establishment of a critical mass for dedicated research & innovation development triggered by the market. In order to facilitate innovation, PLATINA II proposes the establishment of an inclusive platform on research and innovation and the formulation of a research and innovation roadmap for inland waterway transport.

Building on the vision of the Strategic Research and Innovation Agenda for Inland Waterway Transport (Navigator 2020)[2] PLATINA II aims at enhancing the innovation deployment dimension of the agenda

[1] Source: http://www.greentech-made-in-germany.de/en/lead-markets/sustainable-mobility/global-market-breakdown/

[2] Navigator 2020 - Towards a Strategic Research and Innovation Agenda for Inland Waterway Transport, PLATINA I, 2013

and preparing a deployment strategy coupled to the emerging innovation trends changing the market and the new policy priorities of the Union. That has to detail in particular funding needs for the innovation, the expected inputs, outcomes, impacts and priorities. Additional focus is necessary, as well as the involvement aiming at a commitment of the industry, supported by appropriate industry-driven structures.

Involvement of the industry is one thing, but having the industry to commit is the real challenge given the fragmentation of the supply side of the sector and diversity among stakeholders and their investment capacity. That is where the Innovation Platform is to help out. It shall organize and prepare for a dialogue between the European Commission and industry on preconditions for, and the actual implementation of research and innovation: What are the chances and possibilities of innovation implementation on the one hand and what are the barriers, hindrances and risks on the other? On the basis of this dialogue and of the identified preconditions and 'enabling conditions' a deployment strategy for research and innovation will be developed.

In light of the limited resources available PLATINA II will focus on preparing the ground for the deployment of a small number of priority R&I issues that have been chosen as the result of a combination between desk research and the input from stakeholders.

2. APPROACH

The financial and subsequently economic crisis which hit most of industrial and service activities has also affected the innovation capacity of the inland waterway transport industry. Decreasing demand resulted in overcapacity in the fleet of large vessels leading to low freight tariffs reducing company margins available for reinvestment in innovation in greening and logistics. The fleet of small vessels has, apart from some exceptions, reached a considerable age and annually vessels leave the market at a rate which results in undercapacity. Innovation investments in very old vessels are less evident, while market demand is up given its flexibility.

From a multimodal perspective, inland waterway transport is mainly in competition with land transport. Traffic congestion and its associated external effects mainly stem from passenger transport where multiple innovative green and digital initiatives combined with regulation and public funding emerge in city regions to bring congestion and emission levels down creating more space for freight vehicles. In road freight transport, internal competition is fierce and margins are low, but costs per vehicles are lower and the overhaul of vehicle is shorter. This results in higher innovation penetration, especially in larger companies active in collaborative partnerships and multimodal logistics.

The necessary energy transition compatible with climate goals and the accelerating digitalization brings challenges and opportunities. Partnerships in different forms between barge companies and between barge companies, logistics service providers and shippers can help to avoid a race-to-the-bottom and enable cooperation with regard to assets and/or more long-term and solid freight traffic perspectives essential for durable innovation strategies and investments. Governments which have been equally affected by the crisis have in certain cases cut down on infrastructure investments, service level and subsidies. A prioritization of what policy measures foster innovation and productivity to the benefit of business and society help to reorient budgets towards durable growth.

Inland waterway transport has strong cards in the congested hinterland of major seaports where call size is predicted to increase following the logic of scale efficiency and greening. It has a strong potential for continental market in equally congested city regions and densely populated areas with navigable waterways for containers, pallets, industrial flows and niche markets. Different instruments can strengthen and support the potential in these markets, Next to alternative fuels and technological breakthroughs, digitalization can introduce organizational optimization in the 4 areas fleet, infrastructure, education & qualification as well as logistics. It is a basic tool to improve fairway information and can assist authorities with well-informed policy decisions on infrastructure and service level. Digitalization can support logistics optimization such as bundling and load factor improvement, it can support greening and energy efficiency initiatives, education and training as well as increasing automation and allowing autonomous navigation without lowering safety standards. In addition, digitalization supports the harmonization and modernization process of professional qualifications in inland navigation and the integration of IWT into the logistics chain.

Authorities play an important enhancing role. Targeted funding is important but investment risks also come down thanks to a stable and positive policy framework. Innovation-oriented regulation, reduction of administrative barriers and public innovation procurement in line with business and policy innovation priorities are essential ingredients to successful innovation clusters where industry, authorities and knowledge institutes cooperate together.

This innovation roadmap identifies and evaluates relevant research and innovation priorities and corresponding deployment approaches in which the elements above are combined. Content wise the 4 areas fleet, infrastructure, education & qualification as well as logistics are addressed.

Starting with desk research, research demand, priorities and deployment challenges have been discussed and reflected with stakeholders in various countries. In detail, the following steps have been carried out:

- Desk research considering a screening of existing studies and an evaluation and filtering of measures (chapter 3)
- Discussion and reflection of research demand, priorities and deployment challenges with stakeholders e.g. through innovation meetings (chapter 4)
- Conclusions and recommendations (chapter 5)

3. DESK RESEARCH

3.1 Screening

The need for research and innovation in Inland Waterway Transport already has been highlighted in various investigations from different perspectives. PLATINA II makes use of them analyzing them with reference to relevant contributions for the Research and Innovation agenda. Above all this concerns the following studies and reports, respectively, which have been screened in order to identify the most relevant approaches:

- The PLATINA II report on Information architecture for European infrastructure-related information
- Evaluation of RIS Implementation for the period 2006-2011, Panteia (2014)
- Draft Good Practices Manual on Inland Waterway Maintenance (PLATINA II, 2015)
- The PLATINA I report 'Technical support for an impact assessment on greening the inland fleet' (via donau et al, 2013) which focuses on greening approaches,
- The Move It project, which focuses on approaches to retrofit existing vessels. As regards Move It,
  - deliverable 1.1 (TNO, 2012) as well as
  - the Move It Guidelines, deliverable 9.1 (DST, SPB et al, 2014) are addressed,
- The report 'Contribution to impact assessment of measures for reducing emissions of inland navigation' (Panteia et al, 2013)
- The Commission staff working document 'Greening the fleet: reducing pollutant emissions in inland waterway transport' (European Commission, 2013)
- The Dutch program 'Impuls Dynamisch Verkeersmanagement Vaarwegen'[3] (impulse dynamic traffic management waterways, IDVV)' in order to improve the role of waterways in logistics (2011-2014). Addressed research clusters comprised: system innovation within the inland navigation sector, utilization of infrastructure, coordination within the supply chain, clean vessels and innovations in inland navigation.
- The EC funded European Logistics Advisory Network (ELAN) pilot project (2012-2015), where possibilities were investigated for shifting continental transport flows towards IWT.
- Living and working conditions in inland navigation in Europe, ILO (2013)
- Evaluation of the relevant directives related to the initiative on recognition and modernisation of professional qualifications in inland navigation (Directives 91/672/EEC and 96/50/EC), Panteia et al. (2013)
- Contribution to the problem definition in the context of the preparation of the Impact Assessment regarding the recognition of professional qualifications and training standards in inland navigation, Panteia et al. (2014)
- The PLATINA II report on Recognition and Modernisation of Professional Qualifications in Inland Navigation, Technical Support for an Impact Assessment (2014/2015)
- The PLATINA II Deliverable 1.5: Analysis of Possibilities to Enhance Market Transparency and Synergistic Actions (2014/2015)

The result is a comprehensive overview (see table 1 / annex 1 below, column 'Measure').

3 http://www.rijkswaterstaat.nl/zakelijk/verkeersmanagement/idvv/onderzoeksprogramma_idvv

3.2 Evaluation and filtering

3.2.1 Evaluation of measures

For the evaluation of the identified measures in general different approaches and criteria are possible. Examples are again the above mentioned studies.

The evaluation approach applied for this task combines elements and criteria of these studies. Further, it addresses the two main challenges 'greening the fleet' and 'strengthening the competitiveness' as addressed in 'Navigator 2020'[4] and NAIADES II and considers the corresponding criteria 'Emission reduction potential' and 'Economic potential'. In addition, the criteria 'Applicability on share of the fleet' as well as the 'Technological maturity' and 'Non-technical maturity' are addressed.

Criterion 1a: Emission reduction potential

This criterion analyses the 'greening' potential. It is based on the 'Greening the fleet' study and considers the expected maximum degree of emission reduction (in %). In some cases the reduction of certain emissions e.g. NOx or PM is addressed; in most cases however, a reduction of the fuel consumption and hence, a reduction of all emissions is expected. Please note that the indicated figures refer to certain individual cases and hence depend on the corresponding particular circumstances. Since they describe the maximum emission reduction, lower figures are to be expected under less favorable conditions. Further it has to be considered, that a simple summing up of the reduction figures in case of a combination of different measures is not possible; also overlaps between the various measures exist.

Criterion 1b: Economic potential

Other measures are primarily addressed to increase the competitiveness. In line with the results of the research project 'Move It' this criterion is measured in terms of the payback period (in years). Payback periods between 1 and 5 years are considered as highly feasible (green bullet), periods from 6 till 10 years as still favourable (yellow bullet) and those above 10 years as a non-viable option (red bullet). For measures analyzed in the Move It guidelines, this evaluation is available, for others not.

Criterion 2: Applicability on share of the fleet

As mentioned above, ecological and economic potential address the main challenges 'greening the fleet' and 'strengthening the competitiveness'. However, these criteria do not consider if a measure can be applied on large scale or if it is rather considered as specific solution for a particular case. Accordingly, criterion 2 evaluates the 'applicability on the share of the fleet' as follows:

1: >50% (indicated with green bullet)

[4] Navigator 2020 - Towards a Strategic Research and Innovation Agenda for Inland Waterway Transport; PLATINA I, Deliverable D 2.6, 2013

2: 10-50% (indicated with yellow bullet)

3: <10% (indicated with red bullet)

Criterion 3a: Technological Maturity

With reference to the deployment of promising measures and innovations the technological maturity has to be ensured as well. For this classification the 'Technology Readiness Levels' used in the EU Research and Innovation program Horizon 2020 are applied as follows (leading to 9 technology readiness levels):

1. Basic research
2. Technology formulation
3. Experimental proof of concept
4. Validation: Small scale prototype / in lab
5. Validation: large scale prototype / in relevant environment
6. Demo in relevant environment
7. Demo / system prototype in operational environment
8. System complete and qualified
9. Full commercial application

In this last step 9 it is important to note that for greening tools full commercial application strongly relates to prices resulting from serial production and further standardisation (e.g. LNG, SCR, DPF systems). Current tailor-made installed LNG, SCR, DPF systems in vessels do not comply with this condition.

Criterion 3b: Aggregated technological maturity

In order to improve the understandability of the classification, these 9 levels are further condensed to 3 levels of technological readiness leading to the following aggregated technological maturity:

- Those technologies, which are more or less ready for commercial application and which can be implemented into the market without additional support due to their economic benefits (type 3, indicated with a complete bullet)
- Those technologies, which still need some additional R&D in order to achieve technological maturity (and market readiness). (type 2, indicated with a half bullet)
- Those technologies, which are in a rather initial stage and need basic R&D (type 1, indicated with an empty bullet)

Criterion 4: Non-technical maturity and other hindrances

Besides pure technical and research related criteria also the non-technological maturity has been considered as some measures are facing significant further barriers for general market implementation. This e.g. refers to measures related to after treatment systems or new fuels which (under present conditions) do not or hardly ensure economic benefit (lacking business case) or too

high costs e.g. due to lack of standardisation and low demand from the market. Complementary to corresponding research e.g. addressing modular and/or standardized systems for those cases additional support (e.g. in terms of dedicated subsidies and/or fiscal incentives) is needed. Furthermore, e.g. as regards the implementation of LNG as fuel and corresponding high investments IWT entrepreneurs need legal certainty in terms of corresponding regulation and legal frame conditions.

Other measures which are considered as favourable in terms of emission reduction potential like e.g. larger vessel units would however contribute to the already existing overcapacity in the market. Even though this issue is rather considered as a barrier it is covered in this section. In the filtering process later on it will be considered as criterion for exclusion, c.f. chapter 3.2.2 underneath.

Accordingly, corresponding additional evaluation criteria are needed. These questions are addressed in criterion 4 ‘Non-technical maturity’, which gives attention to the following cases:

- Financial support needed (indicated with blue background)
- Regulation & financial support needed (indicated with blue background as well)
- Overcapacity (indicated with red background)

The result of this evaluation is an overview of promising measures and their particular assessment. It is presented in table1 below. Please note, that for some measures and certain criteria an assessment is not available or not applicable. Also, it has to be kept in mind, that certain overlapping between various measures exist, e.g. as regards smart steaming and waterway depth information.

Table III-1: Overview and evaluation of promising measures

Source: PLATINA I report 'Technical support for an impact assessment on greening the inland fleet' (via donau et al, 2013) with modifications based on Move It, deliverable 1.1 (TNO, 2012), Move It Guidelines, deliverable 9.1 (DST, SPB et al, 2014) and internal expert knowledge. (c.f. also Annex I with table in landscape format)

Reference: Infrastructure	Reference: Fleet	Reference: Education & Qualification	Reference: Logistics	Type of measure	Area	Measure	Criterion 1a: Emission reduction potential (max. %) (not cumulative)	Criterion 1b: Economic potential payback period (years) (selected meas. only)	Criterion 2: Applicability on share of the fleet 1: > 50% 2: 10-50% 3: <10%	Criterion 3a: Technological Maturity 1: basic R&D needed till 9: full comm. applic.	Criterion 3b: Technological Maturity 1: basic R&D needed 2: add. R&D needed 3: ready	Criterion 4: Non-technical Maturity & other hindrances red: overcapacity blue: (reg &) fin. supp. needed
x			x	Infrastructure	Ports & mooring places	Shore side power	5%	n.a.	1	5	2	reg. & fin.support
x		x	x			Optimisation of locking procedure/ traffic mgt.	5%	n.a.	1	6	2	
x		x	x		Waterway information	Better pred. of av. water depth (c.f. load factor)	10%	n.a.	1	4	2	
x		x	x			Electronic ECDIS charts with actual depth information	5%	n.a.	1	7	3	
x			x			Real time info on fairw. data (link to energy.eff.nav.)	10%	n.a.	1	5	2	
x			x		Waterway Infrastructure	Improve fairway conditions (upgrading)	68%	n.a.	1	9	3	budget constr.
x			x			Technologies for waterway maintenance	t.b.d.	n.a.	1	5	2	
	x			Ship-related technical	Fleet structure	Use larger vessel units	75%	n.a.	2	9	3	overcapacity
	x					Use more coupled convoys	20%	7	2	9	3	overcapacity
	x					Lengthening (+25%; Europe type vessel) + nozzle	15%	2	2	9	3	overcapacity
	x					Lengthening (+10%; smaller than Europe type vessel)	5%	26	2	9	3	overcapacity
x	x	x	x		Fuels, standardised solutions	Use LNG (Liquefied Natural Gas) (PM reduction)	95%	n.a.	1	5	2	reg. & fin.support
x	x	x	x			Apply dual fuel (LNG and diesel) (PM reduction)	80%	n.a.	1	5	2	reg. & fin.support
	x					Use hydrogen / fuel cells	100%	n.a.	1	2	1	reg. & fin.support
	x				Propulsion system, standardised solutions	Exchange of main diesel engine (red. of NOx & PM)	20%	n.a.	1	9	3	
	x					Overhaul of existing engines	10%	n.a.	1	9	3	
	x					Diesel-electric prop. (truck engines; no buffer batt.)	10%	n.a.	2	7	2	fin.support
	x					Hybrid prop. (diesel [or gas]-electric + buffer batt.)	10%	n.a.	1	7	2	fin.support
	x					Improved propeller systems	30%	5	3	9	3	
	x					Improved wake field	5%	n.a.	1	7	2	
	x					Pre Swirl stator	5%	n.a.	3	5	2	
	x					Applying nozzle	25%	n.a.	2	8	3	
	x					Propelling bow thruster	0%	n.a.	3	8	3	
	x					Multiple propeller propulsion	10%	n.a.	2	4	2	
	x				Hydro-dynamics	Apply air lubrication	10%	n.a.	2	6	2	
	x					Apply wake field separation plate	25%	n.a.	3	8	3	
	x					Apply adjustable tunnel apron	10%	4	2	6	2	
	x					Apply coupling point optimisation	20%	5	2	7	2	
	x					Optimise hull dimension and form	15%	n.a.	3	8	3	
	x					Nozzle strut removal	5%	11	2	8	3	
	x					Remove flanking rudders	7%	4	3	8	3	
	x					Alternative rudder concepts	4%	25	2	7	2	
	x					Improved aft-ship gondolas	3%	25	3	7	2	
	x					Coatings	0%	n.a.	1	9	3	
	x					Bow thruster valve	5%	n.a.	3	7	2	
	x					Adjustable bulbous bow	0%	n.a.	3	3	2	
	x				Aux. systems	Use waste heat energy recovery	5%	25	2	4	2	
	x				Emission reduction; standardised solutions	Apply SCR (selective catalytic reduction) (NOx red.)	95%	n.a.	1	7	2	reg. & fin.support
	x					Use emulsified fuels (PM reduction)	80%	n.a.	1	7	2	reg. & fin.support
	x					Apply diesel particulate filters (DPF) (PM reduction)	96%	n.a.	1	7	2	reg. & fin.support
	x					Combine SCR and DPF (PM reduction)	96%	n.a.	1	7	2	reg. & fin.support
	x				Ship structures & weight	ADN double steel hull	0%	7	3	9	3	
	x					λ-shaped steel double hull	0%	8	3	8	3	
	x					Steel-Foam-Steel double hull	0%	10	3	4	2	
	x					Lengthening with composite mat. (instead of steel)	1%	5	2	3	2	overcapacity
	x					Reduce vessel weight	5%	n.a.	3	4	2	
x	x	x	x	Ship-operational	Sailing behaviour Maintenance	Smart and energy-eff.nav.	10%	n.a.	1	5	2	
	x	x				Optimise trim and heel	5%	n.a.	1	8	3	
	x					Clean underwater bodies/ hull/ ballast/ bilges	5%	n.a.	3	8	3	
	x					Clean and undamaged propellers	10%	n.a.	3	9	3	
		x		Education & Qualification		Mobile Learning		n.a.	1	5	2	
		x				Simulator training (related to energy eff. nav.)	10%	n.a.	1	5	2	
		x	x			Integration of IWT into logistics education	t.b.d.	n.a.	1	5	2	
	x	x	x	Logistics		Organise downstream navigation in formations	10%	n.a.	3		2	
			x			Best practices in collaboration (e.g. hub & spoke)	16%	n.a.	2	9	3	
			x			Gain sharing models (increased payload)	15%	n.a.	2	8	3	
			x			Collaborative planning (red. of empty km)	15%	n.a.	2	9	3	
		x	x			Info exch.syst. betw. operators (red. of empty km)	5%	n.a.	3	8	2	
		x	x			Innov. transhipm. & transp. systems & load units	10%	n.a.	3	2	1	
x	x	x	x			New log. concepts incl. vessels & ports (Q-barge)	10%	n.a.	2	4	2	

3.2.2 Filtering of measures

In order to focus on the most relevant measures a proper filter using the above criteria is applied. Only those measures, which receive a favourable ranking in all criteria, i.e. which fulfil the following combination of criteria shall be further investigated:

Criterion 1a: min.10% **or** criterion1b: max 10 years (green or yellow bullet)

and

Criterion 2: larger 50% (green bullet) or between 10 and 50% (yellow bullet)

and

Criterion 4: No remark 'overcapacity' (measures with remark 'overcapacity' are excluded)

The result of step 2 is a consolidated overview of most promising measures and innovations which are considered as relevant for further investigation.

Table III-2: Consolidated overview and evaluation of promising measures based on table 1 and on above filter criteria (c.f. also Annex I with table in landscape format)

Reference				Type of measure	Area	Measure	Criterion 1a: Emission reduction potential (max. %) (not cumulative)	Criterion 1b: Economic potential payback period (years) (selected meas. only)	Criterion 2: Applicability on share of the fleet 1: > 50% 2: 10-50% 3: <10%	Criterion 3a: Technological Maturity 1: basic R&D needed till 9: full comm. applic.	Criterion 3b: Technological Maturity 1: basic R&D needed 2: add. R&D needed 3: ready	Criterion 4: Non-technical Maturity & other hindrances red: overcapacity blue: (reg &) fin. supp. needed
Infrastructure	Fleet	Education & Qualificaiton	Logistics									
x		x	x	Infrastructure	W.way info	Better pred. of av. water depth (c.f. load factor)	10%	n.a.	1	4	2	
x			x			Real time info on fairw. data (link to energy.eff.nav.)	10%	n.a.	1	5	2	
x			x		Waterway	Improve fairway conditions (upgrading)	68%	n.a.	1	9	3	budget constr.
x			x		Infrastructure	Technologies for waterway maintenance	t.b.d.	n.a.	1	5	2	
x	x	x	x	Ship-related	Fuels,	Use LNG (Liquefied Natural Gas) (PM reduction)	95%	n.a.	1	5	2	reg. & fin.support
x	x	x	x	technical	standardised	Apply dual fuel (LNG and diesel) (PM reduction)	80%	n.a.	1	5	2	reg. & fin.support
	x				solutions	Use hydrogen / fuel cells	100%	n.a.	1	2	1	reg. & fin.support
	x				Propulsion	Exchange of main diesel engine (red. of NOx & PM)	20%	n.a.	1	9	3	
	x				system,	Overhaul of existing engines	10%	n.a.	1	9	3	
	x				standardised	Diesel-electric prop. (truck engines; no buffer batt.)	10%	n.a.	2	7	2	fin.support
	x				solutions	Hybrid prop. (diesel (or gas) - electric + buffer batt.)	10%	n.a.	1	7	2	fin.support
	x					Applying nozzle	25%	n.a.	2	8	3	
	x					Multiple propeller propulsion	10%	n.a.	2	4	2	
	x				Hydro-	Apply air lubrication	10%	n.a.	2	6	2	
	x				dynamics	Apply adjustable tunnel apron	10%	4	2	6	2	
	x					Apply coupling point optimisation	20%	5	2	7	2	
	x				Emission	Apply SCR (selective catalytic reduction) (NOx red.)	95%	n.a.	1	7	2	reg. & fin.support
	x				reduction;	Use emulsified fuels (PM reduction)	80%	n.a.	1	7	2	reg. & fin.support
	x				standardised	Apply diesel particulate filters (DPF) (PM reduction)	96%	n.a.	1	7	2	reg. & fin.support
	x				solutions	Combine SCR and DPF (PM reduction)	96%	n.a.	1	7	2	reg. & fin.support
x	x	x	x	Ship operation	Sailing behav.	Smart and energy-eff.nav. (incl. track choice)	10%	n.a.	1	5	2	
		x		Education &		Mobile Learning	t.b.d.	n.a.	1	5	2	
		x		Qualification		Simulator training (related to energy eff. nav.)	10%	n.a.	1	5	2	
		x	x			Integration of IWT into logistics education	t.b.d.	n.a.	1	5	2	
			x	Logistics		Best practices in collaboration (e.g. hub & spoke)	16%	n.a.	2	9	3	
			x			Gain sharing models (increased payload)	15%	n.a.	2	8	3	
			x			Collaborative planning (red. of empty km)	15%	n.a.	2	9	3	
x	x	x	x			New log. concepts incl. vessels & ports (Q-barge)	10%	n.a.	2	4	2	

As a further step this table is divided into the 3 steps:

- Type 3: ready for market application (c.f. table III-3),
- Type 2: additional R&D needed (c.f. table III-4) and
- Type 1: basic R&D needed (c.f. table III-5).

Table III-3: Consolidated overview and evaluation of promising measures focusing on type 3: ready for market application (c.f. also Annex I with table in landscape format)

Reference: Infrastructure	Reference: Fleet	Reference: Education & Qualificaiton	Reference: Logistics	Type of measure	Area	Measure	Criterion 1a: Emission reduction potential (max. %) (not cumulative)	Criterion 1b: Economic potential payback period (years) (selected meas. only)	Criterion 2: Applicability on share of the fleet 1: > 50% 2: 10-50% 3: <10%	Criterion 3a: Technological Maturity 1: basic R&D needed till 9: full comm. applic.	Criterion 3b: Technological Maturity 1: basic R&D needed 2: add. R&D needed 3: ready	Criterion 4: Non-technical Maturity & other hindrances red: overcapacity blue: (reg &) fin. supp. needed
x			x	Infrastructure	Waterway	Improve fairway conditions (upgrading)	68%	n.a.	1	9	3	budget constr.
	x			Ship related	Prop. system,	Exchange of main diesel engine (red. of NOx & PM)	20%	n.a.	1	9	3	
	x			technical	stand. sol.	Overhaul of existing engines	10%	n.a.	1	9	3	
	x					Applying nozzle	25%	n.a.	2	8	3	
			x	Logistics		Best practices in collaboration (e.g. hub & spoke)	16%	n.a.	2	9	3	
			x			Gain sharing models (increased payload)	15%	n.a.	2	8	3	
			x			Collaborative planning (red. of empty km)	15%	n.a.	2	9	3	

Table III-4: Consolidated overview and evaluation of promising measures focusing on type 2: add. R&D needed (c.f. also Annex I with table in landscape format)

Reference: Infrastructure	Reference: Fleet	Reference: Education & Qualificaiton	Reference: Logistics	Type of measure	Area	Measure	Criterion 1a: Emission reduction potential (max. %) (not cumulative)	Criterion 1b: Economic potential payback period (years) (selected meas. only)	Criterion 2: Applicability on share of the fleet 1: > 50% 2: 10-50% 3: <10%	Criterion 3a: Technological Maturity 1: basic R&D needed till 9: full comm. applic.	Criterion 3b: Technological Maturity 1: basic R&D needed 2: add. R&D needed 3: ready	Criterion 4: Non-technical Maturity & other hindrances red: overcapacity blue: (reg &) fin. supp. needed
x		x	x	Infrastructure	W.way info	Better pred. of av. water depth (c.f. load factor)	10%	n.a.	1	4	2	
x			x			Real time info on fairw. data (link to energy.eff.nav.)	10%	n.a.	1	5	2	
x			x			Technologies for waterway maintenance	t.b.d.	n.a.	1	5	2	
x	x	x	x	Ship-related	Fuels,	Use LNG (Liquefied Natural Gas) (PM reduction)	95%	n.a.	1	5	2	reg. & fin.support
x	x	x	x	technical	stand. solut.	Apply dual fuel (LNG and diesel) (PM reduction)	80%	n.a.	1	5	2	reg. & fin.support
	x				Prop. System	Diesel-electric prop. (truck engines; no buffer batt.)	10%	n.a.	2	7	2	fin.support
	x				stand. solut.	Hybrid prop. (diesel (or gas) - electric + buffer batt.)	10%	n.a.	1	7	2	fin.support
	x					Multiple propeller propulsion	10%	n.a.	2	4	2	
	x					Apply air lubrication	10%	n.a.	2	6	2	
	x				Hydro-dynamics	Apply adjustable tunnel apron	10%	4	2	6	2	
	x					Apply coupling point optimisation	20%	5	2	7	2	
	x				Emission	Apply SCR (selective catalytic reduction) (NOx red.)	95%	n.a.	1	7	2	reg. & fin.support
	x				reduction;	Use emulsified fuels (PM reduction)	80%	n.a.	1	7	2	reg. & fin.support
	x				standardised	Apply diesel particulate filters (DPF) (PM reduction)	96%	n.a.	1	7	2	reg. & fin.support
	x				solutions	Combine SCR and DPF (PM reduction)	96%	n.a.	1	7	2	reg. & fin.support
x	x	x	x	Ship operation	Sailing behav.	Smart and energy-eff.nav. (incl. track choice)	10%	n.a.	1	5	2	
		x		Education &		Mobile Learning	t.b.d.	n.a.	1	5	2	
		x		Qualification		Simulator training (related to energy eff. nav.)	10%	n.a.	1	5	2	
		x	x			Integration of IWT into logistics education	t.b.d.	n.a.	1	5	2	
x	x	x	x	Logistics		New log. concepts incl. vessels & ports (Q-barge)	10%	n.a.	2	4	2	

Certain measures are already addressed in current research programs. This among others refers to the following measures which are addressed to the H2020 call for proposals “MOBILITY for GROWTH

2014-2015 / Promoting innovation in the Inland Waterways Transport (IWT) sector (MG-4.4-2014)" and the corresponding project PROMINENT:

- LNG
- Dual fuel (LNG and diesel)
- Diesel-electric propulsion
- Hybrid propulsion
- Selective Catalytic Reduction (SCR)
- Emulsified fuels
- Diesel Particulate Filters (DPF)
- Combination of SCR and DPF
- Smart and eco efficient steaming
- Mobile Learning and
- Simulator training (related to eco efficient steaming)

This will be taken into consideration in chapter 5 (underneath) when subsequent research priorities will be determined.

Table III-5: Consolidated overview and evaluation of promising measures focusing on type 1: basic R&D needed (c.f. also Annex I with table in landscape format)

Reference				Type of measure	Area	Measure	Criterion 1a: Emission reduction potential (max. %) (not cumulative)	Criterion 1b: Economic potential payback period (years) (selected meas. only)	Criterion 2: Applicability on share of the fleet 1: > 50% 2: 10-50% 3: <10%	Criterion 3a: Technological Maturity 1: basic R&D needed till 9: full comm. applic.	Criterion 3b: Technological Maturity 1: basic R&D needed 2: add. R&D needed 3: ready	Criterion 4: Non-technical Maturity & other hindrances red: overcapacity blue: (reg &) fin. supp. needed
Infrastructure	Fleet	Education & Qualification	Logistics									
	x			Ship techn.	Fuels	Use hydrogen / fuel cells	100%	n.a.	1	2	1	reg. & fin.support

3.3 Summary and conclusions of desk research

Various studies and research topics correspondingly have been analyzed and evaluated focusing on the need for research and innovation in Inland Waterway Transport. The outcome are clustered overviews of 3 types of measures:

- Measures ready for market application (Type 3),
- Measures which require additional R&D (Type 2) and
- Measures which require basic R&D (Type 1)

Several measures are considered ready for market application as regards technological maturity (type 3). There is however no or limited market uptake for instance due to limited business case (various

greening measures) or due to budget constraints of the public sector as well as limited public acceptance in case of infrastructure upgrades.

For quite a lot of measures additional research has been considered necessary (type 2). This for instance refers to infrastructure related measures like improved maintenance solutions or real time information on fairway data. In most cases market readiness is missing but in many cases besides research for instance in terms of standardization also regulation and financial support is missing. In particular this is the case for measures related to fuel and propulsion systems as well as for systems for emission reduction and after treatment, correspondingly. Subsequently to the work of PLATINA II, especially the fleet related (greening) measures will be further worked out in the PROMINENT project. Further, also for mobile learning and simulator training of energy efficient navigation additional research is considered necessary and addressed in PROMINENT as well. The same refers to the integration of IWT into the logistics education.

Besides, hydrogen and fuel cell drive trains still require rather basic research (type 1). This topic shall be addressed to future research projects.

4 DISCUSSION AND REFLECTION WITH STAKEHOLDERS

4.1 Approach

Complementary to the desk research stakeholders have been approached both bilaterally and in 3 innovation meetings. Core intention was to discuss and reflect research items and priorities from the sectors point of view. Besides identification and priority setting of research topics also expected barriers and required steps and instruments for deployment have been addressed. Based on this, the research and innovation topics were updated where needed.

This chapter provides the results of the feedback from stakeholders and the related background information. Insights gained through these meetings are outlined in section 4.2 and summarised in chapter 4.3. The detailed outcome of the 3 innovation meetings is presented in the minutes (Annex II).

4.2 Challenges and research & innovation topics

Typically for the Inland Waterway Transport sector is the difficult economic situation that the market currently finds itself in. Due to this, most entrepreneurs consider a short- to mid-term time horizon to be more relevant than a long-term time horizon. This can also be derived from in the input that the market has provided during the innovation platform meetings.

The situation in the different member states is not fully comparable, for instance as a result of different fleet structures. The Netherlands is probably best characterized by a rather modern and professional fleet and high public awareness of the IWT sector. While on the other hand the situation in France is characterized by a rather aged fleet of mainly smaller vessels and a disproportional need for

modernization. In other countries like Germany fleet structures and the need to modernize are considered somewhere in between of the Dutch and French situation.

Therefore, country specific approaches and solutions may be needed to some extent and considered beneficial to overcome the challenges that arise. Nevertheless, various similarities and similar challenges exist. This is for example reflected in the need for greening of the vessel fleet. Here, a common approach is of a high importance to counteract challenges such as energy efficient navigation.

To obtain a structured overview, the various innovation angles are arranged in four thematic groups addressing the same thematic fields as in chapter 3:

- Infrastructure,
- Fleet,
- Education & Qualification and
- Logistics & organisation.

Infrastructure

As recently confirmed by a report of the European Court of Auditors[5], Quality infrastructure is paramount to ship more freight in an efficient way by inland waterways. This not only relates to the waterway and port infrastructure, but also to River Information Services and bunkering stations of (alternative) fuels. The infrastructure in terms of available fairway dimensions and water levels sets the frame for inland waterway transport capacity and performance potentials. The weakest stretch of the waterways determines the vessel's maximum size and loading draught for the complete considered transport relation. In addition, the depth of the waterway and its variations clearly affects the relevant fuel consumption and the emissions. Furthermore, the aging infrastructure[6] and the climate change will possibly lead to increased uncertainties. This has to be analysed against the on-going trend to larger vessels, which are more and more approaching the limits of the waterway infrastructure. In addition, extreme low water conditions affect traffic density, manoeuvrability and safety of vessel operations. Besides inland navigation, waterways serve further important functions such as water supply, provision of eco-services, flood protection, energy generation, agriculture or leisure. Future research concepts have to consider this multiple usage of the infrastructure, in order to improve investment leverage and public acceptance.

As regards to the physical infrastructure, the following two measures are of outstanding importance:

[5] http://www.inlandnavigation.eu/news/infrastructure/more-effort-required-to-improve-eu-waterways/ on 22.05.2015

[6] In Germany 30% of the most important locks have reached their technical life expectancy (Bundesanstalt für Wasserbau Geschäftsbericht 2013, www.baw.de)

- Improve fairway conditions (draught characteristics) in particular by optimization of waterway and infrastructure maintenance procedures by applying the principle of Monitoring, Planning, Executing and Informing[7].
- Further development of technologies for waterway and infrastructure maintenance and development. This will for instance relate to the following topics, improvement of the monitoring of the waterway infrastructure (e.g. harmonization of the status assessment of aging locks; optimal data quality, frequency and timing of measurements, usage of photogrammetry for status monitoring), optimizing planning (e.g. trade-off between regular maintenance and structural measures, modelling possible interventions, IT-based decision support tools, optimal win-win situation for all concerned user-groups), implementing measures (e.g. automating post-processing of surveying results, optimized dredging technologies, trade-off between fairway relocation and dredging).

As regards to 'greening of the fleet' (see also chapter 'Vessels' below) as well as implementation of alternative or transition-fuels such as LNG, also the corresponding infrastructure for the refuelling network needs to be installed by at latest 2030, thus avoiding a "chicken and egg" problem. The European Commission has developed a strategy that focuses on the fuels where failures of market coordination are particularly relevant, that is electricity, hydrogen and natural gas (LNG and CNG). Without such an action all other efforts to promote alternative fuels risk to remain ineffective. By means of the Clean Fuel Directive[8], the necessary infrastructure shall be available by 2025 in seaports and 2030 for inland ports. As regards to River Information Services, challenges here regard the availability of real-time fairway information on fairway depths, bridge clearances, availability of key infrastructure (moveable bridges, locks), water levels and currents. See also the PLATINA II report on Information Architecture (2015)[9]. Also information regarding traffic situations is important for two reasons:

- Through this, skippers will be allowed to make navigational arrangements with other vessels. This way, accidents can be prevented. This has been demonstrated in the RIS Evaluation (Panteia, 2014)[10].
- Strategic Traffic Image can provide the user with information about intended voyages of vessels, (dangerous) cargo and requested times of arrival (RTA) at defined points such as locks and terminals. During high-traffic demands, barge operators can change their behaviour and adapt their fuel consumption if queues at locks, bridges or terminal are inevitable. In the RIS Evaluation, it has been assessed that such Strategic Traffic Images have led to benefits for the sector of 2.9 to 7.1 million Euros. Further corridor management by infrastructure managers might increase these benefits.

[7] Link to Good Navigation Status discussion, TEN-T-Guidelines as regards Core Network Corridors

[8] Directive 2014/94/EU on the deployment of alternative fuels infrastructure: http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32014L0094&from=EN

[9] PLATINA II (2015), Information architecture for European infrastructure-related information

[10] Panteia (2014), Evaluation of RIS Implementation for the period 2006-2011

Suggested research and innovation efforts concern improved information systems with regards to fairway conditions allowing for optimized trips planning and energy efficient navigation. Therefore, an information system that provides information about fairway conditions in a timely and a reliable manner is of great importance, especially on the critical stretches of the main rivers in Europe (Rhine and Danube). These rivers and especially the river Rhine, account for a large share in the European IWT transport performance.

Reducing the underperformance of IWT by means of real time information systems on key infrastructure is also a basis for energy efficient navigation. The topic of energy efficiency is further dealt with below.

Regarding RIS infrastructure, the following requirements need to be fulfilled:

- Full data coverage: information is not necessarily reported at the same level in each country; Vessel tracking and tracing systems are mostly available for ship and shore based systems, but to ensure full coverage amendments of the RIS Directive are necessary.
- Standardised formats: This is not yet the case for Notices to Skippers.
- Data protection: Data may be aggregated to a central level without any problems, if it (a) relates to publicly available data such as Notices to Skippers or (b) the data is anonymised.

Fleet & greening

During the innovation platform meetings challenges were mentioned in different fields of “fleet & greening”. In that respect, the following issues were highlighted:

- New small vessels
- Greening
- Financing
- Legal certainty

Hereafter, these issues will be dealt with in more detail.

New small vessels[11]

Apart from environmental benefits from scale increase, also small vessels adjusted to limited waterway dimensions and bridge clearances are required. These ships either operate direct services from the seaport or are used as feeders from inland terminals. Direct services of small and medium-sized ships avoid additional transhipment in the hinterland. This saves time and transhipment costs, which may compensate higher shipping cost along the waterway. It can however be observed, that the number of small vessels has been steadily declining in the past years[12], mainly as a result of

- the economic crisis,
- a declining demand for smaller vessels from new entrants to the sector and

[11] Addressing vessels of e-g- 600 t - 1500 t payload

[12] Market observations are available on the CCNR website from 2005 and on: http://www.ccr-zkr.org/13020800-en.html

- unwillingness from banks to give financial supports to starters.

Preventing an unused fleet of overaged small vessels, a phased general modernization of this fleet segment is required. Suggested research and innovation can be found in the field of cost-efficient fleet renewal. i.e. large scale serial production of standardized (modular) new small vessels. Standardization and large scale serial production may lead to lower total production costs of small vessels, making it more interesting to invest. Calculations by Panteia/NEA for CBRB indicate that the operational costs of newly build small vessels are comparable to the operational costs of the current fleet as far as the new vessels have more operational hours per year compared to old/existing vessels.

Additionally, innovative business models will have to be developed. As there is still a market for small vessels, investing in these vessels should be stimulated. Developed business models will provide insight in the benefits and possibilities of these new vessels and will show a range of business opportunities to the current operators.

Greening

As regarding the external costs of air pollutants emissions, IWT benefits from economies of scale. However, advantages compared road haulage are quickly diminishing, due to more innovations in the road sector, also driven by bans on older trucks to enter cities and incentives in toll charges (such as the German MAUT system). The following underlying drivers were obtained via the innovation platform meetings:

- First, the IWT sector is lagging in terms of emission standards; hence there is no reference aim or goal. Especially compared to the road sector, where standards were established long time ago.

- Secondly, the investment costs of after treatment systems (e.g. Diesel Particulate Filter, Selective Catalytic Reduction) or Emulsified Fuels are high, but provide hardly any economic advantage yet in IWT. On the contrary, the systems mentioned lead to a slight increase of the fuel consumption. This means that there are no financial incentives for barge operators to invest in such technologies. Another hindering factor is a lack of standardization for after-treatment systems. This leads to high production costs that require high investments for barge operators. Besides, high running costs are considered as additional barrier. Further, there are technical challenges with regards to the use after treatment systems, e.g. limited space in engine-rooms for additional aggregates.

- There is a limited market for engine manufacturers. This means that research and development in particular for these engines is limited. The use of truck engines in vessels might be a possible solution to overcome this problem. However, this implies other challenges. Engine characteristics and the utilization profile of vessels and trucks are different. Truck engines might not be able to provide the required characteristics & profile and hence only maintain a rather short “life time”. Also high costs are involved to ‘marinise’ truck engines. The high costs might lead to the conclusion that using SCR or DPF after treatment for existing or

new CCNR 1 or CCNR 2 engines or hybrid propulsion are considered more cost effective ways to reduce emissions.

- Finally challenges were addressed for using LNG as fuel. Due to the lack of emission standards, standardization and experience, at this stage it is only possible to buy costly tailor-made systems for LNG. Indications of payback periods for LNG solutions are uncertain and much dependent on the development of both conventional fuel prices and prices of LNG. Additionally, safety risks are mentioned as a challenge for using LNG as a fuel. This can be addressed to the fact that a minor part of the sector related employees is qualified to work with LNG. This requires high costs in recruiting adequately qualified staff, or investment in own staff. Also, a lack of available infrastructure hampers the current uptake of LNG. The topic of LNG is addressed in detail in the LNG Masterplan for Rhine Main Danube[13].

Together with the stakeholders, suggestions for research and innovations were addressed to overcome these challenges. Additional research is therefore suggested considering the use of truck engines in vessels, thereby also considering corresponding drivetrain developments and after treatment systems. Further research and innovation should be done on electric / hybrid propulsion solutions (e.g. diesel-electric or gas-electric). Both options are considered short- to mid-term.

Financing

In general, the past and current economic situation makes it much harder for the IWT sector to invest in newer fleet technologies. Financial means are required from banks, in order to finance innovations and modernisations of the vessels. However, due to the past economic crisis, banks are more careful providing loans. Also, banks hardly finance ships that are labelled as “old”: Even modernised vessels that meet all or most technical and environmental standards, hardly qualify for financing by banks. Further, the past and current overcapacity limits the profitability of IWT-undertakings; for many operators the own equity capital has been reduced to a large extent and for several larger vessel operators even became negative.

Accordingly, proper and innovative financial instruments are needed. These could consist of co-funding mechanisms, bank guarantees, revolving funds or loans at lower interest rates. Also the use of the Reserve Funds as guarantee to develop leverage for loans is suggested. Further, approaches have to be developed to label older but modernised vessels as a precondition for financing, preventing that they become unattractive for financing.

Legal Certainty

A stable and predictable legal framework is a necessary condition for the market of IWT to take up innovative measures that reduce emissions and pollutants. This also concerns continuation permission for greening investments into existing engines and vessels in case of adapted future

[13] For more information about the LNG Masterplan for Rhine Main Danube, see: http://www.lngmasterplan.eu/

regulation. Also for engine manufacturers, a stable legal framework with emission standards is important, so engines and equipment can be designed to meet up future legislation.

It is also important to have legislation in place that does not only set clear limits for new build vessels and/or engines, but also for the existing fleet. Based on the long serviceable lifetime of inland vessels, these regulations currently leave the existing engines of the majority of older vessels, or legacy fleet, unaffected. As a result, there is a gap in the emission performance of average engines in IWT in comparison to road haulage. Transition rules to meet up future emission limits or 'hard' legislation such as in place in the Port of Rotterdam by 2025 could help to green the current fleet.

Regulation and financial support are two sides of the same coin: both are needed to trigger the desired greening. Regulation in the form of increasingly stringent standards of ship emissions is a necessary condition to move inland enterprises to invest; at the same time, financial support of investments needed to achieve greening.

Greening a vessel causes significant additional investment costs without clear returns on investment for the vessel owner/operator. Lacking a system of internalisation of external costs, operators of greener and cleaner vessels are generally not rewarded in business economic terms. Whereas CO_2 reduction strategies usually go hand in hand with the interests of IWT operators (accompanying fuel reduction), operators have little or no own financial interest to invest in after-treatment or end-of-pipe devices to reduce NO_x or PM. On the contrary however, operational costs usually rise through the use of these technologies. There are also little or no incentives from shippers to operate more environmentally friendly vessels.

Education and Qualification

In the field of education and qualification several challenges were mentioned. Shortages of qualified nautical staff already exist[14,15,16] and the sector is therefore in need of legislation that enables intersectoral labour mobility and reduces existing barriers to attract workforce from other sectors. On the other hand, shortages may be compensated by a reduction of required crew sizes without reducing safety standards, for example by more automation. In addition, automation and technological developments require adapted competencies. A joint European approach is needed to overcome these challenges.

Besides this, stakeholders also addressed challenges in the skippers' entrepreneurial skills such as for instance basic knowledge on business management as well as commercial, insurance and liability

[14] Panteia et al. (2013), Evaluation of the relevant directives related to the initiative on recognition and modernisation of professional qualifications in inland navigation (Directives 91/672/EEC and 96/50/EC).

[15] Panteia et al. (2014), Contribution to the problem definition in the context of the preparation of the Impact Assessment regarding the recognition of professional qualifications and training standards in inland navigation.

[16] The Platina II report on Recognition and Modernisation of Professional Qualifications in Inland Navigation, Technical Support for an Impact Assessment. (2014)

questions. Due to the fragmented nature of IWT[17], many SME's can be found in the sector and each entrepreneur requires knowhow on these topics.

Further, challenges are addressed in the field of energy efficient navigation. This was already addressed under the greening topic as well as under infrastructure. Due to both expected future increases in energy costs but also tightening emission standards, there will be more pressure on reducing the fuel consumption. The nautical staff needs to be prepared for these challenges, that can be overcome by proper approaches and corresponding education as addressed in the PROMINENT project.

Also, mobile learning approaches are mentioned. Due to the 'mobile profile' of the IWT sector[18], mobile learning approaches are considered a proper approach to improve educational standards in an innovative and cost-efficient manner. Such approaches are already addressed in the PROMINENT project.

Further, simulators are considered an innovative approach for the nautical education both for vocational education but also to educate experienced staff members in challenging or dangerous nautical situations. Mutual recognition of professional qualifications acquired by simulator usage or exams is therefore needed; impact assessments on the needed legislation are currently taking place[19]. Simulator-supported education is also addressed in the PROMINENT project.

Last not least, it is considered important that technological, legal or other developments in the market need to be addressed in the corresponding education; a proper adaptation of the respective learning units has to be ensured, accordingly. Here, a European approach is needed.

Logistics and organisation

Challenges in the field of logistics and organisation are often related to each other. In this light some of the suggested R&I can be applied to face multiple challenges. Furthermore, in some cases the different suggested R&I reinforce each other. During the Innovation platform meetings challenges in the field of logistics where often mentioned.

One of the challenges mentioned is that often the utilization of a vessel is suboptimal, for example due to empty trips. The current market of supply and demand does not aim for maximum payloads or utilisation rates, requiring operators to return (half) empty or to make detours. However, where IWT is competing with road and railway transport, a high utilisation rate of vessels is a necessary pre-condition, especially for being competitive in the container market segment.

[17] This has been addressed in Platina II Deliverable 1.5: Analysis of Possibilities to Enhance Market Transparency and Synergistic Actions

[18] See also ILO (2013), Living and working conditions in inland navigation in Europe

[19] Panteia et al. (2014), Recognition and Modernisation of Prefessional Qualifications in Inland Navigation, Technical Support for an Impact Assessment.

Another challenge addressed is that, especially for container transport, the majority of the operators focus on maritime containerised flows. As regarding the continental cargo flows large potentials for transport by IWT exist that are currently not developed.

Accordingly, the following suggestions for research and innovations were proposed. First, further research in the field of advanced cooperation in maritime and continental containerised goods was suggested with respect to aspects such as planning, organisation, bundling. Better utilisation of the fleet would enable IWT to meet the competition with other transport modes, particularly in containerised transport. As examples of successful research projects the hub & spoke concept and the hop concept developed within the context of the Dutch IDVV project have been mentioned. These concepts enable larger call sizes per sea terminal, decreasing the number of sea terminals per barge and reducing turnaround times.

Further research and innovation efforts can be dedicated to approaches for advanced cooperation in (maritime) container transport. Ways to increase the average payload of the vessels are of importance here, reducing the number of empty trips and enabling higher utilisation of vessels. This refers to planning and organisational part of the barge operators and shippers.

Finally, research and innovation can be dedicated to the development of the continental cargo market. This type of research requires a new mind set for both the IWT sector as well as for the developers. To date, the continental cargo market is considered an unusual market for inland waterway transport, although the potential is available to a large extent. PLATINA II (2015)[20] concluded that in the most likely scenario, as much as 87 million tonnes of continental cargo flows can be shifted towards IWT. This would bring benefits to the sector of 899 million per year, equalling 10% of the total estimated transport costs. Reaching this market might require research in the field of combining maritime container flows with continental flows, or in some cases new vessels or loading systems to handle other commodities, i.e. palletised cargo.

In addition, raising awareness of the possibilities of IWT is key to further integrate IWT as one of the modalities in the logistics chain. Dedicated efforts are taking place in PLATINA II and will be taken up in PROMINENT, where the emphasis is being put on the integration of IWT knowledge in general logistics education and training.

4.3 Summary of stakeholder's views

The stakeholder's views as reflected in chapter 4.2 on research and innovation challenges and demand can be summarized as follows:

General

As already outlined earlier, despite of different, country specific situations, various similarities and similar challenges exist. This e.g. refers to the need for modernization and greening and corresponding approaches resulting in rather consistent approaches of general importance, e.g. as

[20] PLATINA II (2015), Deliverable 1.6 Macro analysis of the market potential in the continental cargo market

regards energy efficient navigation. On the other hand, certain rather country specific items have been addressed, e.g. the German 'Meister' qualification.

As regards the four thematic areas (infrastructure, fleet, education & qualification as well as logistics), fleet related measures are of relative high importance due to the demand for modernization and greening; this also addresses existing engines. However, these measures are rather cost intensive and hence require proper financing approaches. Besides financing, legal certainty in terms of regulation (and continuation permission in case of adapted future regulation) is considered as crucial.

Infrastructure

Suggested research and innovation efforts concern improved information systems with regard to fairway conditions allowing for optimized trips planning and energy efficient navigation. Therefore, an information system that provides information about fairway conditions in a timely and a reliable manner is of great importance, especially on the critical stretches free flowing sections of the main rivers in Europe (Rhine and Danube). These rivers and especially the river Rhine account for a large share in the European IWT transport performance.

Fleet & Greening

Suggested research and innovation can be found in the field of cost-efficient fleet renewal, i.e. large scale serial production of standardized (modular) new small vessels. Standardization and large scale serial production may lead to lower total production costs of small vessels, making it more interesting to invest. Business models shall provide insight in the benefits and possibilities of these new vessels and shall show a range of business opportunities to the current operators. A condition for stable and viable business cases is that future engine emission standards should be clear.

Various greening topics are already touched in projects like PROMINENT; this for instance refers to LNG and hybrid solutions as well as standardized approaches for emission reduction such as after treatment applications etc. Besides, also the issue of energy efficient navigation is addressed.

Other prime energy sources, e.g. electro mobility (in terms of 100% electric), hydrogen and fuel cells hardly have been addressed from stakeholders so far; obviously such technologies are considered too far in the future while at the same time the economic situation and daily business of many IWT-entrepreneurs is considered existentially difficult. As regards the long term view these questions are however considered crucial from PLATINA II. Accordingly, corresponding research needs to be addressed. Thereby, particular attention shall be paid towards developments in other sectors and chances for targeted adaptation towards feasible IWT-applications looked at.

Greening a vessel causes significant additional investment costs without clear returns on investment for the vessel owner/operator. Lacking a system of internalisation of external costs, operators of greener and cleaner vessels are generally not rewarded in business economic terms. Whereas CO_2 reduction strategies usually go hand in hand with the interests of IWT operators (accompanying fuel reduction), operators have little or no own financial interest to invest in after-treatment or end-of-pipe devices to reduce NO_x or PM. On the contrary however, operational costs usually rise through the use

of these technologies. There are also little or no incentives from shippers to operate more environmentally friendly vessels.

A stable and predictable legal framework is a necessary condition for the market of IWT to take up innovative measures that reduce emissions and pollutants. Also for engine manufacturers, a stable legal framework with emission limits is important, so engines and equipment can be designed to meet up future legislation.

Finally innovative financial instruments have to be developed that will lower the threshold for operators to invest in “green” innovations or new vessels. A good example is a discount on port dues, although additional incentives are needed.

Education and Qualification

Shortages of qualified nautical staff already exist and the sector is in need of legislation that enables intersectoral labour mobility and reduces existing barriers to attract workforce from other sectors.

Further, education & qualification are also considered of relative high importance for innovation implementation. Due to moderate costs compared to fleet related measures a high leverage effect is expected. Innovative approaches exist e.g. in terms of simulator supported or mobile learning approaches or as regards energy efficient navigation; they are already covered in the project PROMINENT.

As regards relevant technological, legal or other developments in the market a proper adaptation of the respective learning units has to be ensured on a European scale.

Logistics and organisation

Further research in the field of advanced cooperation in maritime and continental containerised goods was suggested with respect to aspects such as planning, organisation and bundling. Better utilisation of the fleet would enable IWT to meet the competition with other transport modes, particularly in containerised transport. As examples of successful research projects the hub & spoke concept and the hop concept developed within the context of the Dutch IDVV project have been mentioned. These concepts enable larger call sizes per sea terminal, decreasing the number of sea terminals per barge and reducing turnaround times.

Further research and innovation efforts can be dedicated to approaches for advanced cooperation in (maritime) container transport. Ways to increase the average payload of the vessels are of importance here, reducing the number of empty trips and enabling higher utilisation of vessels. This refers to planning and organisational part of the barge operators and shippers.

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 General approach to innovation and deployment

The innovation agenda shall meet the need for consolidation, coordination and prioritisation of research & development in the field of inland waterway transport. Continuous research and development is needed to boost inland navigation's competitive position. IWT needs the innovation deployment dimension of the research priorities to be enhanced and a deployment strategy to be prepared. Additional focus is necessary as well in light of the limited means available. Moreover, the involvement and commitment of the industry (supported by appropriate industry-driven structures) is a precondition to successfully stimulate R&I and deployment of innovation.

An approach is needed to enable "Ownership of the sector". This is however a big challenge given the high level of fragmentation of the supply side of the market. Direct involvement of the sector / industry should therefore be considered by means of focus on individual innovation leaders (pioneers) from the sector/industry as well as by setting up structures that bring small companies together in order to develop the necessary critical mass of demand and financing that demand. The latter shall be done in close cooperation with branch organisations such as EBU and ESO that can also play an important role in the financing discussion. The available financial resources of the Reserve Fund may be considered to generate leverage on capital investments from other sources

In this respect there is a strong link recommended to the work of the foreseen European Working Group on Financial Instruments (WG FI) to discuss co-funding, bank guarantees, revolving funds, loans at low interest rates to foster in particular the deployment of innovations.

Furthermore, the topics addressed shall be included in programmes such as Horizon 2020, Connecting Europe Facility, LIFE, ERDF.

In order to develop the critical mass and to bring actors systematically together it is recommend to cluster innovation topics and to address various dimensions that play a role (e.g. technical issues, legal issues, financial issues, market issues, human factors/education). Examples of such an approach are the LNG Masterplan, EICB Innovation Lab, and PROMINENT where a 'neutral partner' gathers together operators, suppliers, authorities and knowledge institutes for innovative solutions and scale deployment. The added value of such a comprehensive system approach is that it offers a coherent look at innovation, including solutions at vessel level, infrastructure, regulation etc. and allows for the development of a total ("carrot and stick") package of financial incentives, legal instruments, cost effective technical solutions, equipment and infrastructure, educated staff for fostering gains on efficiency and sustainability of transport. In particular the financing dimension and legal framework is highlighted in this respect whereas the potential for external cost savings is very high, the business case for the private operator however may not be convincing (especially regarding greening the fleet).

Moreover, Green Deals and covenants could be established with the sector representatives and key stakeholders in the process to set the agenda and common objectives. This might be the outcome of the planned Platform.

The question however shall be answered what are the key topics to be addressed in the Platform and to be taken up in such a holistic way?

In order to answer this question, the next chapter concludes on the identified topics on the basis of the desk research carried out (see chapter 3), the exchanges with the stakeholders and the related background information (see chapter 4). In addition it has been checked to what extent the identified topics are already covered in ongoing projects and how they could link to policy and funding programs.

Therefore, in order to select and prioritize the main topics to be highlighted a number of aspects have been reviewed:

- Which are the topics identified in desk research also brought forward by the stakeholders?
- Are the topics already covered in projects and initiatives, notably: Horizon 2020 project PROMINENT and LNG Masterplan?
- To what extent do the topics match the European instruments such as Horizon 2020, CEF and financing instruments?
- What topics could be addressed under the header of Digital Agenda / Digital Inland Navigation Arena?

5.2 Analyses of priorities

The first two questions are answered by means of the next table.

Table V-1: Overview on priorities (desk research and stakeholders):

Priorities chapter 3 (desk research)	Priorities chapter 4 (stakeholders)
Infrastructure	
- Better prediction of available water depth - Real time info on fairway data[21] - Technologies for waterway maintenance	- Real time fairway information
Fleet and greening	
- Emission reduction / after treatment - New fuels (standardized solutions) - Propulsion systems (standard. solutions) - Hydrodynamics - Fuel cells / hydrogen	- Affordable greening approaches in combination with financing and legal certainty for greening investments - Smaller (self-propelled) vessels
Education & qualification	
- Mobile learning	- Mobile learning

[21] Green indicated topics: addressed in running research projects, e.g. PROMINENT or in envisaged research programs

- Simulator training (energy eff. navigation) - Energy efficient navigation - Integration of IWT into logistics education	- Simulator training (energy eff. navigation) - Energy efficient navigation - Entrepreneurial skills - Automation / (semi-)autonomous navigation - European approach on the effects of changes on the content of Education
Logistics	
- Best practices in collaboration - Gain sharing models (increased payload) - Collaborative planning (red. of empty trips) - New logistics concepts (Q-Barge)	- Collaboration / maritime containers - Collaboration / increase payload - Continental cargo

The following list can be derived from the table, as regards priority topics.

- **Infrastructure**:
  - information on the fairway conditions and predictions, allowing for targeted infrastructure investment, optimized trips planning and energy efficient navigation
- **Fleet and Greening**:
  - Cost-effective emission monitoring and control systems (e.g. after treatment SCR/DPF)
  - Cost effective LNG systems, including solutions for methane slip issue
  - Hybrid propulsion systems (e.g. diesel – electric)
  - Hydrodynamic optimization
  - Fuel cells / hydrogen
  - Financing solutions, emission standards and legal certainty for greening investments
  - Small vessels: large scale development and replacement program for smaller vessels, combining new logistic concepts, business and financing models and technical innovation
- **Education and qualification**:
  - Mobile learning
  - Simulator training
  - Energy efficient navigation
  - Entrepreneurial skills
  - Automation
  - European approach on the effects of changes on the content of Education
- **Logistics**:
  - Enhanced collaboration between market players (consolidation of flows)

After an analysis of topics covered already in PLATINA II, ELAN, IDVV, Move-IT, PROMINENT and LNG Masterplan, it can be concluded that a lot of topics are already addressed in these projects. The following table presents the assessment on what is left to do, taking into account the projects.

Table V-2: Overview on topics and coverage in (running or foreseen) research:

Field and topic	Comments on coverage in projects carried out
Infrastructure:	
• Information on the fairway conditions and predictions, allowing for optimized trips planning and energy efficient navigation	Covered in projects such as COVADEM (IDVV) and PROMINENT. Further support from EC for the deployment will however be needed (through RIS, H2020, CEF).
Fleet and Greening:	
• Cost effective emission monitoring and control systems (e.g. after treatment SCR/DPF)	Addressed in PROMINENT. However, there will remain a need for financing instruments to support the IWT industry. Links to work of the foreseen Working Group Financial Instruments (WG FI)
• Cost effective LNG systems, including solutions for methane slip issue	Addressed in PROMINENT and LNG Masterplan. However methane slip will remain an issue and further research needed on BioLNG application (H2020) and need for funding instruments as well as for deployment of LNG infrastructure (CEF).
• Hybrid propulsion systems (e.g. diesel – electric)	Addressed in PROMINENT, however no real life demonstrator. Depending on the results of PROMINENT on the potential of this technology, support for further development (e.g. real life pilots) could be considered by 2016/2017.
• Hydrodynamic optimization	Covered in Move-It and will also be addressed in PROMINENT. It seems not to be a main R&I topic anymore since the technology is mature and available for the market. There is a need for financing instruments (WG FI)
• Fuel cells / hydrogen	Not covered in PROMINENT. Will be a research item for the longer future. Consider to be taken up in H2020 calls.
• Financing solutions	Financing is of key importance and

	highlighted as a major bottleneck. R&I work is planned in PROMINENT and furthermore this topic shall be addressed in the WG FI
• Emission standards existing vessels	A key issue is to settle clear standards for the industry. This work needs to take place, regardless if it will be mandatory standards or voluntary standards. Links to possible work by CESNI. PROMINENT will also pay some attention to this issue (WP3 certification, monitoring and enforcement), but will not develop the standards as such.
• Small vessels: large scale development and replacement program for smaller vessels, combining new logistic concepts, business and financing models and technical innovation	The need for renewal of small vessels is clear and needs to be addressed. A large scale project is recommended (e.g. H2020, CEF) to accommodate the various dimensions and to develop a solution. This will not be done by PROMINENT and LNG Masterplan as PROMINENT will target mostly the larger vessels and LNG is no real option for small vessels.
Education and qualification:	
• Mobile learning	Covered in PROMINENT
• Simulator training	Covered in PROMINENT
• Energy efficient navigation	Covered in PROMINENT
• Entrepreneurial skills	Not covered.
• Integration of IWT into logistics education	Covered in PROMINENT
• Automation	Not covered. Possibly a new H2020 project.
• European approach on the effects of changes on the content of Education.	Possibly addressed in CESNI
Logistics:	
• Enhanced collaboration between market players (consolidation of flows and increased payload)	To large extent covered in Dutch program IDVV and to some extent in ELAN. Consider to roll it out in Europe by means of CEF and H2020 projects, linking also closely to ICT support (ICT platforms) and the Digital Agenda

• Continental cargo	Covered in PLATINA II
• New logistics concepts (Q-Barge)	Q-barge project is currently in a start-up phase.

5.3 Conclusions

From the table presented on the previous pages, it can be concluded that:

- The majority of topics are already addressed in projects, in particular the PROMINENT project. The analyses made in this report (PLATINA 2 SWP 2.3) therefore confirm that the right topics are done in PROMINENT. In particular this refers to:
  - Cost reduction and applicability of after treatment SCR/DPF systems
  - Cost reduction and applicability of LNG
  - Energy efficient navigation
  - Mobile learning, simulator training

- In general, much attention shall be paid to three barriers:
  - Financing support for implementation (funding) of innovative technologies, in particular as regards greening the fleet
  - Legislative support: voluntary or mandatory sense of urgency is needed for instance through emission standards for existing vessels (and their engines); attention has to be paid to ICT and privacy issues
  - Lack of critical mass: pooling of innovation and investment plans among vessel owners will allow for standardization and cost reductions.

- Some topics seem not to be covered yet and these could qualify for development of new projects in future. This concerns in particular:
  - The challenge to find solutions for the replacement of the fleet of old small vessels, while addressing the opportunities for modal shift, innovative business and financing models, staff management and greening (e.g. electric vessels, hybrids, possibly the usage of CNG).
  - Fuel cells and hydrogen as main fuel for the future

For the two latter topics, further explanation is provided in separate fact sheets in Annex III.

5.4 Opportunities for innovation deployment and next steps

As indicated a further discussion shall take place in the Platforms with stakeholders, to further select topics and to link them to the programs such as H2020, CEF and to embed them in the broader discussion about Financial Instruments linking it also to EFSI and EIB.

However, as there is a policy momentum troughs the publication of the Digital Agenda, some final specific views are provided in the next section on the links of priority topics under this header.

5.4.1 Digital Agenda / Digital Inland Navigation Arena

The **Digital Agenda** provides a policy momentum to ask support for ICT subjects or ICT related topics in IWT. A number of topics can be brought under the header "**Digital Inland Navigation Arena (DINA)**". This concerns in particular the topics in the fields "Infrastructure, Education & Qualification and Logistics". However, it is also relevant for Greening the Fleet, in relation to developments such as on board monitoring of transport efficiency, fuel consumption and emissions.

Regarding Education and Qualifications, the PROMINENT project will already address most of these issues, such as the development of the electronic service record book, mobile learning and simulator supported approaches to increase safety, efficiency and labor mobility in IWT. However, it can be considered to further expand these activities. Further attention can be paid to research and innovation as regards automation / (semi) autonomous navigation in order to prepare for the medium/ long term.

As regards infrastructure, the RIS framework shall be used to further boost the information on fairway data and the traffic situation as well as improved service level and planning on public/semi-public infrastructure such as dredging, locks and ports/terminals. More information and collaborative planning and traffic / corridor management will allow for more efficient navigation and will reduce waiting times. This is a major topic that is for some extent addressed in IDVV and will be addressed in PROMINENT as well, but will need broader support. In particular also the issue is to provide the legal support, e.g. as regards safeguarding privacy information of skippers related to international data exchange.

As regards logistics attention shall be paid to exchange of information (electronic documents, paperless communication) and fostering cooperation between parties in the logistics chains by means of setting standards for data exchange and by offering (neutral) platforms where information can be brought together and retrieved. For example this shall provide opportunities to do matchmaking on cargo flows to develop the critical mass needed for multimodal services and to also reduce costs by means of fostering return loads in order to increase efficiency of transport and reduce the environmental footprint.

Finally attention shall be paid as well to the statistics and benchmarking opportunities. By means of ICT systems, more information can be collected and processed for the sake of better decision making in the sector. This may help as well to prevent a future situation of overcapacity and also to signal opportunities for new markets and to serve as a key reference for policy analyses focusing on gains for efficiency and sustainability.

ANNEX I: OVERVIEW AND EVALUATION OF PROMISING MEASURES

Annex I provides the tables of chapter 3 in landscape format with larger font size for better readability.

Annex I.1a: Overview and evaluation of promising measures (part a)

Reference				Type of measure	Area	Measure	Criterion 1a: Emission reduction potential (max. %) (not cumulative)	Criterion 1b: Economic potential payback period (years) (selected meas. only)	Criterion 2: Applicability on share of the fleet 1: > 50% 2: 10-50% 3: <10%	Criterion 3a: Technological Maturity 1: basic R&D needed till 9: full comm. applic.	Criterion 3b: Technological Maturity 1: basic R&D needed 2: add. R&D needed 3: ready	Criterion 4: Non-technical Maturity & other hindrances red: overcapacity blue: (reg &) fin. supp. needed
Infrastructure	Fleet	Education & Qualificaiton	Logistics									
x			x	Infrastructure	Ports & mooring places	Shore side power	5%	n.a.	1	5	2	reg. & fin.support
x		x	x			Optimisation of locking procedure/ traffic mgt.	5%	n.a.	1	6	2	
x		x	x		Waterway information	Better pred. of av. water depth (c.f. load factor)	10%	n.a.	1	4	2	
x		x	x			Electronic ECDIS charts with actual depth information	5%	n.a.	1	7	3	
x			x			Real time info on fairw. data (link to energy.eff.nav.)	10%	n.a.	1	5	2	
x			x		Waterway Infrastructure	Improve fairway conditions (upgrading)	68%	n.a.	1	9	3	budget constr.
x			x			Technologies for waterway maintenance	t.b.d.	n.a.	1	5	2	
	x			Ship-related technical	Fleet structure	Use larger vessel units	75%	n.a.	2	9	3	overcapacity
	x					Use more coupled convoys	20%	7	2	9	3	overcapacity
	x					Lengthening (+25%; Europe type vessel) + nozzle	15%	2	2	9	3	overcapacity
	x					Lengthening (+10%; smaller than Europe type vessel)	5%	26	2	9	3	overcapacity
x	x	x	x		Fuels, standardised solutions	Use LNG (Liquefied Natural Gas) (PM reduction)	95%	n.a.	1	5	2	reg. & fin.support
x	x	x	x			Apply dual fuel (LNG and diesel) (PM reduction)	80%	n.a.	1	5	2	reg. & fin.support
	x					Use hydrogen / fuel cells	100%	n.a.	1	2	1	reg. & fin.support
	x				Propulsion system, standardised solutions	Exchange of main diesel engine (red. of NOx & PM)	20%	n.a.	1	9	3	
	x					Overhaul of existing engines	10%	n.a.	1	9	3	
	x					Diesel-electric prop. (truck engines; no buffer batt.)	10%	n.a.	2	7	2	fin.support
	x					Hybrid prop. (diesel [or gas]-electric + buffer batt.)	10%	n.a.	1	7	2	fin.support
	x					Improved propeller systems	30%	5	3	9	3	
	x					Improved wake field	5%	n.a.	1	7	2	
	x					Pre Swirl stator	5%	n.a.	3	5	2	
	x					Applying nozzle	25%	n.a.	2	8	3	
	x					Propelling bow thruster	0%	n.a.	3	8	3	
	x					Multiple propeller propulsion	10%	n.a.	2	4	2	

Annex I.1b: Overview and evaluation of promising measures (part b)

Reference: Infrastructure	Reference: Fleet	Reference: Education & Qualificaiton	Reference: Logistics	Type of measure	Area	Measure	Criterion 1a: Emission reduction potential (max. %) (not cumulative)	Criterion 1b: Economic potential payback period (years) (selected meas. only)	Criterion 2: Applicability on share of the fleet 1: > 50% 2: 10-50% 3: <10%	Criterion 3a: Technological Maturity 1: basic R&D needed till 9: full comm. applic.	Criterion 3b: Technological Maturity 1: basic R&D needed 2: add. R&D needed 3: ready	Criterion 4: Non-technical Maturity & other hindrances red: overcapacity blue: (reg &) fin. supp. needed
	x			Ship-related technical	Hydro-dynamics	Apply air lubrication	10%	n.a.	2	6	2	
	x					Apply wake field separation plate	25%	n.a.	3	8	3	
	x					Apply adjustable tunnel apron	10%	4	2	6	2	
	x					Apply coupling point optimisation	20%	5	2	7	2	
	x					Optimise hull dimension and form	15%	n.a.	3	8	3	
	x					Nozzle strut removal	5%	11	2	8	3	
	x					Remove flanking rudders	7%	4	3	8	3	
	x					Alternative rudder concepts	4%	25	2	7	2	
	x					Improved aft-ship gondolas	3%	25	3	7	2	
	x					Coatings	0%	n.a.	1	9	3	
	x					Bow thruster valve	5%	n.a.	3	7	2	
	x					Adjustable bulbous bow	0%	n.a.	3	3	2	
	x				Aux. systems	Use waste heat energy recovery	5%	25	2	4	2	
	x				Emission reduction; standardised solutions	Apply SCR (selective catalytic reduction) (NOx red.)	95%	n.a.	1	7	2	reg. & fin.support
	x					Use emulsified fuels (PM reduction)	80%	n.a.	1	7	2	reg. & fin.support
	x					Apply diesel particulate filters (DPF) (PM reduction)	96%	n.a.	1	7	2	reg. & fin.support
	x					Combine SCR and DPF (PM reduction)	96%	n.a.	1	7	2	reg. & fin.support
	x				Ship structures & weight	ADN double steel hull	0%	7	3	9	3	
	x					λ-shaped steel double hull	0%	8	3	8	3	
	x					Steel-Foam-Steel double hull	0%	10	3	4	2	
	x					Lengthening with composite mat. (instead of steel)	1%	5	2	3	2	overcapacity
	x					Reduce vessel weight	5%	n.a.	3	4	2	

Annex I.1c: Overview and evaluation of promising measures (part c)

Reference				Type of measure	Area	Measure	Criterion 1a: Emission reduction potential (max. %) (not cumulative)	Criterion 1b: Economic potential payback period (years) (selected meas. only)	Criterion 2: Applicability on share of the fleet 1: > 50% 2: 10-50% 3: <10%	Criterion 3a: Technological Maturity 1: basic R&D needed till 9: full comm. applic.	Criterion 3b: Technological Maturity 1: basic R&D needed 2: add. R&D needed 3: ready	Criterion 4: Non-technical Maturity & other hindrances red: overcapacity blue: (reg &) fin. supp. needed
Infrastructure	Fleet	Education & Qualificaiton	Logistics									
x	x	x	x	Ship-operational	Sailing behaviour	Smart and energy-eff.nav.	10%	n.a.	1	5	2	
	x	x				Optimise trim and heel	5%	n.a.	1	8	3	
	x				Maintenance	Clean underwater bodies/ hull/ ballast/ bilges	5%	n.a.	3	8	3	
	x					Clean and undamaged propellers	10%	n.a.	3	9	3	
		x		Education & Qualification		Mobile Learning		n.a.	1	5	2	
		x				Simulator training (related to energy eff. nav.)	10%	n.a.	1	5	2	
		x	x			Integration of IWT into logistics education	t.b.d.	n.a.	1	5	2	
	x	x	x	Logistics		Organise downstream navigation in formations	10%	n.a.	3		2	
			x			Best practices in collaboration (e.g. hub & spoke)	16%	n.a.	2	9	3	
			x			Gain sharing models (increased payload)	15%	n.a.	2	8	3	
			x			Collaborative planning (red. of empty km)	15%	n.a.	2	9	3	
		x	x			Info exch.syst. betw. operators (red. of empty km)	5%	n.a.	3	8	2	
		x	x			Innov. transhipm. & transp. systems & load units	10%	n.a.	3	2	1	
x	x	x	x			New log. concepts incl. vessels & ports (Q-barge)	10%	n.a.	2	4	2	

Annex I.2: Consolidated overview and evaluation of promising measures based on table 1 and on corresponding filter criteria

Reference				Type of measure	Area	Measure	Criterion 1a: Emission reduction potential (max. %) (not cumulative)	Criterion 1b: Economic potential payback period (years) (selected meas. only)	Criterion 2: Applicability on share of the fleet 1: > 50% 2: 10-50% 3: <10%	Criterion 3a: Technological Maturity 1: basic R&D needed till 9: full comm. applic.	Criterion 3b: Technological Maturity 1: basic R&D needed 2: add. R&D needed 3: ready	Criterion 4: Non-technical Maturity & other hindrances red: overcapacity blue: (reg &) fin. supp. needed
Infrastructure	Fleet	Education & Qualificaiton	Logistics									
x		x	x	Infrastructure	W.way info	Better pred. of av. water depth (c.f. load factor)	10%	n.a.	1	4	2	
x			x			Real time info on fairw. data (link to energy.eff.nav.)	10%	n.a.	1	5	2	
x			x		Waterway	Improve fairway conditions (upgrading)	68%	n.a.	1	9	3	budget constr.
x			x		Infrastructure	Technologies for waterway maintenance	t.b.d.	n.a.	1	5	2	
x	x	x	x	Ship-related	Fuels,	Use LNG (Liquefied Natural Gas) (PM reduction)	95%	n.a.	1	5	2	reg. & fin.support
x	x	x	x	technical	standardised	Apply dual fuel (LNG and diesel) (PM reduction)	80%	n.a.	1	5	2	reg. & fin.support
	x				solutions	Use hydrogen / fuel cells	100%	n.a.	1	2	1	reg. & fin.support
	x				Propulsion	Exchange of main diesel engine (red. of NOx & PM)	20%	n.a.	1	9	3	
	x				system,	Overhaul of existing engines	10%	n.a.	1	9	3	
	x				standardised	Diesel-electric prop. (truck engines; no buffer batt.)	10%	n.a.	2	7	2	fin.support
	x				solutions	Hybrid prop. (diesel (or gas) - electric + buffer batt.)	10%	n.a.	1	7	2	fin.support
	x					Applying nozzle	25%	n.a.	2	8	3	
	x					Multiple propeller propulsion	10%	n.a.	2	4	2	
	x				Hydro-	Apply air lubrication	10%	n.a.	2	6	2	
	x				dynamics	Apply adjustable tunnel apron	10%	4	2	6	2	
	x					Apply coupling point optimisation	20%	5	2	7	2	
	x				Emission	Apply SCR (selective catalytic reduction) (NOx red.)	95%	n.a.	1	7	2	reg. & fin.support
	x				reduction;	Use emulsified fuels (PM reduction)	80%	n.a.	1	7	2	reg. & fin.support
	x				standardised	Apply diesel particulate filters (DPF) (PM reduction)	96%	n.a.	1	7	2	reg. & fin.support
	x				solutions	Combine SCR and DPF (PM reduction)	96%	n.a.	1	7	2	reg. & fin.support
x	x	x	x	Ship operation	Sailing behav.	Smart and energy-eff.nav. (incl. track choice)	10%	n.a.	1	5	2	
		x		Education &		Mobile Learning	t.b.d.	n.a.	1	5	2	
		x		Qualification		Simulator training (related to energy eff. nav.)	10%	n.a.	1	5	2	
		x	x			Integration of IWT into logistics education	t.b.d.	n.a.	1	5	2	
			x	Logistics		Best practices in collaboration (e.g. hub & spoke)	16%	n.a.	2	9	3	
			x			Gain sharing models (increased payload)	15%	n.a.	2	8	3	
			x			Collaborative planning (red. of empty km)	15%	n.a.	2	9	3	
x	x	x	x			New log. concepts incl. vessels & ports (Q-barge)	10%	n.a.	2	4	2	

Annex I.3: Consolidated overview and evaluation of promising measures focusing on type 3: ready for market application

Reference				Type of measure	Area	Measure	Criterion 1a: Emission reduction potential (max. %) (not cumulative)	Criterion 1b: Economic potential payback period (years) (selected meas. only)	Criterion 2: Applicability on share of the fleet 1: > 50% 2: 10-50% 3: <10%	Criterion 3a: Technological Maturity 1: basic R&D needed till 9: full comm. applic.	Criterion 3b: Technological Maturity 1: basic R&D needed 2: add. R&D needed 3: ready	Criterion 4: Non-technical Maturity & other hindrances red: overcapacity blue: (reg &) fin. supp. needed
Infrastructure	Fleet	Education & Qualificaiton	Logistics									
x			x	Infrastructure	Waterway	Improve fairway conditions (upgrading)	68%	n.a.	1	9	3	budget constr.
	x			Ship related technical	Prop. system, stand. sol.	Exchange of main diesel engine (red. of NOx & PM)	20%	n.a.	1	9	3	
	x					Overhaul of existing engines	10%	n.a.	1	9	3	
	x					Applying nozzle	25%	n.a.	2	8	3	
			x	Logistics		Best practices in collaboration (e.g. hub & spoke)	16%	n.a.	2	9	3	
			x			Gain sharing models (increased payload)	15%	n.a.	2	8	3	
			x			Collaborative planning (red. of empty km)	15%	n.a.	2	9	3	

Annex I.4: Consolidated overview and evaluation of promising measures focusing on type 2: add. R&D needed

Reference				Type of measure	Area	Measure	Criterion 1a: Emission reduction potential (max. %) (not cumulative)	Criterion 1b: Economic potential payback period (years) (selected meas. only)	Criterion 2: Applicability on share of the fleet 1: > 50% 2: 10-50% 3: <10%	Criterion 3a: Technological Maturity 1: basic R&D needed till 9: full comm. applic.	Criterion 3b: Technological Maturity 1: basic R&D needed 2: add. R&D needed 3: ready	Criterion 4: Non-technical Maturity & other hindrances red: overcapacity blue: (reg &) fin. supp. needed
Infrastructure	Fleet	Education & Qualificaiton	Logistics									
x		x	x	Infrastructure	W.way info	Better pred. of av. water depth (c.f. load factor)	10%	n.a.	1	4	2	
x			x			Real time info on fairw. data (link to energy.eff.nav.)	10%	n.a.	1	5	2	
x			x			Technologies for waterway maintenance	t.b.d.	n.a.	1	5	2	
x	x	x	x	Ship-related	Fuels,	Use LNG (Liquefied Natural Gas) (PM reduction)	95%	n.a.	1	5	2	reg. & fin.support
x	x	x	x	technical	stand. solut.	Apply dual fuel (LNG and diesel) (PM reduction)	80%	n.a.	1	5	2	reg. & fin.support
	x				Prop. System	Diesel-electric prop. (truck engines; no buffer batt.)	10%	n.a.	2	7	2	fin.support
	x				stand. solut.	Hybrid prop. (diesel (or gas) - electric + buffer batt.)	10%	n.a.	1	7	2	fin.support
	x					Multiple propeller propulsion	10%	n.a.	2	4	2	
	x					Apply air lubrication	10%	n.a.	2	6	2	
	x				Hydro-dynamics	Apply adjustable tunnel apron	10%	4	2	6	2	
	x					Apply coupling point optimisation	20%	5	2	7	2	
	x				Emission	Apply SCR (selective catalytic reduction) (NOx red.)	95%	n.a.	1	7	2	reg. & fin.support
	x				reduction;	Use emulsified fuels (PM reduction)	80%	n.a.	1	7	2	reg. & fin.support
	x				standardised	Apply diesel particulate filters (DPF) (PM reduction)	96%	n.a.	1	7	2	reg. & fin.support
	x				solutions	Combine SCR and DPF (PM reduction)	96%	n.a.	1	7	2	reg. & fin.support
x	x	x	x	Ship operation	Sailing behav.	Smart and energy-eff.nav. (incl. track choice)	10%	n.a.	1	5	2	
		x		Education &		Mobile Learning	t.b.d.	n.a.	1	5	2	
		x		Qualification		Simulator training (related to energy eff. nav.)	10%	n.a.	1	5	2	
		x	x			Integration of IWT into logistics education	t.b.d.	n.a.	1	5	2	
x	x	x	x	Logistics		New log. concepts incl. vessels & ports (Q-barge)	10%	n.a.	2	4	2	

Annex I.5: Consolidated overview and evaluation of promising measures focusing on type 1: basic R&D needed

Reference: Infrastructure	Reference: Fleet	Reference: Education & Qualificaiton	Reference: Logistics	Type of measure	Area	Measure	Criterion 1a: Emission reduction potential (max. %) (not cumulative)	Criterion 1b: Economic potential payback period (years) (selected meas. only)	Criterion 2: Applicability on share of the fleet 1: > 50% 2: 10-50% 3: <10%	Criterion 3a: Technological Maturity 1: basic R&D needed till 9: full comm. applic.	Criterion 3b: Technological Maturity 1: basic R&D needed 2: add. R&D needed 3: ready	Criterion 4: Non-technical Maturity & other hindrances red: overcapacity blue: (reg &) fin. supp. needed
	x			Ship techn.	Fuels	Use hydrogen / fuel cells	100%	n.a.	1	2	1	reg. & fin.support

ANNEX II: MINUTES OF INNOVATION PLATFORM MEETINGS[22]

Annex II.1: Minutes of French meeting[23]

Conférence fluviale
Groupe de travail n°3 – compétitivité des entreprises de transport fluvial
Paris, le 29 janvier 2015

Rappel de l'ordre du jour

I. Ajustement du Compte rendu de la précédente réunion
II. Présentation état des lieux / perspective de la flotte fluviale française (par VNF)
III. Financement (par EPF)
IV. Règlements sur les moteurs non routiers « EMNR » (par DGTIM)
V. Point PLATINA II (par Commission Européenne)

Pièce jointe : supports de présentation

Participants :

Nom	Prénom	Organisme
François	PHILIZOT	DIDVS
Joffrey	GUYOT	VNF
Steve	LABEYLIE	CFT
François	BOURIOT	CAF
Didier	LEANDRI	CAF
Yves	BODILIS	Logiseine /Logirhône
Francis	DOREAU	CFANI
Marilyn	VERBEKE	CNBA
Henri	LACOUR	CNBA
Jacques	DELHAY	La glissoire
Marc	VANDERHAEGEN	Commission Européenne
Didier	BEAURAIN	DGITM
Raymond	VAN DOORN SMEULERS	DGITM
Nicolas	WAGNER	CGEDD
Christian	ROSE	AUTF
Danielle	ROUGANNE	EPF
Patrick	GRANGE	EPF
Philip	MAUGE	SCAT
Chantal	CATOIR	SNCRBF

[22] Please note that suggestions from stakeholders are not always consistent and not in all cases shared by others.

[23] Only available in French

I. Ajustement du Compte rendu de la précédente réunion

Le syndicat la Glissoire demande des ajustements/précisions au compte rendu de la réunion du 10 décembre.

Concernant le point relatif aux horaires de navigation, le préfet indique qu'il ne s'agit pas de la durée du travail des mariniers mais de la durée d'ouverture des ouvrages.

Suite à des interrogations sur la formation et la professionnalisation des intermédiaires, il est indiqué qu'un point spécifique sera prévu à la prochaine réunion le 11 février.

De la même façon, les surcoûts au port du Havre relèvent a priori du GT2.

Concernant les relations commerciales et plus particulièrement sur le Rhône, la Glissoire indique avoir saisi la commission d'examen des pratiques commerciales il y a plus de deux ans sans retour.

- ➔ L'AUTF demande qu'un de ses représentants puisse éventuellement venir à la prochaine réunion afin de présenter son organisation et son fonctionnement. Cette demande est approuvée par les participants.

II. Présentation état des lieux / perspective de la flotte fluviale française (par VNF)

En introduction, VNF rappelle son périmètre d'intervention sur les sujets flotte : production de statistiques, gestion d'une base de données de bateaux, accompagnement ponctuel de projets innovants, soutien financier à la modernisation de la flotte, gestion du réseau en fonction de l'évolution de la flotte fluviale active.

Les trafics fluviaux 2014 ont reculé de 2.8 % en tonnes et 2% en tonnes-kilomètres. On note la forte chute des combustibles solides avec une baisse de 30%, liée aux réductions d'activité des centrales à charbon.

A la demande de M. DELHAY, la répartition entre petit et grand gabarit sera précisée postérieurement à la réunion.

Le CAF complète l'analyse de la NST 9 avec l'évolution du nombre d'EVP sur le Rhône et sur la Seine, enregistrant des hausses respectives de +22% et + 5%. Il indique également le besoin d'avoir des statistiques consolidées et fiables sur les conteneurs.

Concernant l'évolution de la flotte depuis 2006, on note les tendances suivantes :

- ➔ baisse du nombre total d'unités,
- ➔ dont, baisse du nombre de bateaux dont le port en lourd (PEL) est inférieur à 650 t ;
- ➔ mais hausse du nombre d'unités dont le PEL est supérieur à 1000 t ;
- ➔ **hausse du tonnage de port en lourd moyen ;**
- ➔ **hausse continue de la part du pavillon français dans les trafics,** passée de 73 % en 2006 à 80 % en 2012 ;
- ➔ **hausse continue des flux réalisés en automoteurs** (passés de 68 % en 2006 à 76 % en 2012);

➔ hausse du nombre de bateaux captifs des bassins Rhône Saône et Seine (137 bateaux captifs sur le bassin du Rhône en 2013, 220 bateaux de plus de 1000 tonnes sur la Seine);

Concernant les coûts de revient présentés, VNF indique qu'ils ont surtout une valeur comparative, ce prix dépendant de plusieurs paramètres (distance, nombre de rotations).

En tenant compte de la demande supplémentaire à l'horizon 2025 (estimée à 6 milliards de tks), VNF estime la flotte fluviale active en 2025 à 1555 unités EPF estime ce besoin à 2030 unités –source étude BEARING POINT.

Les gros bateaux doivent être exploités de façon industrielle.

L'AUTF indique que les bateaux de 3000 tonnes ne sont pas adaptés à de nombreux ports qui ne sont pas dotés des capacités d'accueil adéquates. Les participants s'accordent pour conclure que des bateaux de 2000 tonnes sont suffisants en tonnage.

Mr DELHAY insiste sur la nécessaire adaptation des bateaux aux ports : les petits bateaux sont plus difficiles et plus longs à décharger notamment car la grue tape sur la muraille. A Fos les petits bateaux ne sont plus admis. VNF indique que ces sujets peuvent être traités en sous-commission Hygiène, sécurité et qualité de vie des navigants.

La CNBA confirme le besoin en bateaux Freycinet pour desservir par exemple les silos le long du réseau Freycinet.

Concernant la propulsion au diesel électrique, la CFT indique un retour d'expérience mitigé alors que la Glissoire prétend que c'est une très bonne solution.

Enfin, au sujet des sur-motorisations, les opérateurs confirment que c'est un sujet d'étude mais qu'il faut être attentif aux types de voies sur lesquelles le bateau va naviguer. Pour cela, les équations de comportement d'un bateau en milieu confiné, doivent être partagées et assimilées par tous.

Conclusions et pistes de travail :

- la perspective de la mise en service de Seine-Nord-Europe implique une anticipation par les opérateurs pour capter la demande supplémentaire dans un contexte intermodal concurrentiel. Les enjeux de renouvellement de la flotte sont forts, y compris pour le petit gabarit, et impliquent un changement de rythme
- L'adaptation des bateaux aux exigences des chargeurs et à la demande de transport est une nécessité
- La synthèse et l'analyse des bonnes pratiques (logistique / innovation) fournissent des guides pour une démarche pluriannuelle

Les débats sur ces sujets font apparaitre le besoin de poursuivre cette réflexion dans le cadre d'une réunion ou d'une instance spécifique plus technique, apte à descendre dans les détails par segment de flotte ou de bassin

III. Financement (par EPF)

EPF souligne le sous-investissement chronique dans la filière fluviale et le fait que les chantiers sont sous capitalisés.

EPF présente le projet de holding visant à réunir des fonds d'investisseurs pour financer le renouvellement de la flotte à petit gabarit. Le besoin est estimé à 200 bateaux d'ici 10 ans.

Les outils de financement (avec l'appui de modèles financiers) concilient une performance de long terme acceptable par des investisseurs privés et compatible avec le modèle économique spécifique des exploitants bateliers (activité capitalistique à faible marge).

Conclusions et fiches de travaux

- La nécessité du changement de mode de travail, pour porter un programme pluriannuel d'investissement est une évidence
- L'approche collective est de nature à faciliter la mobilisation des financements privés, bancaires notamment
- Les systèmes coopératifs méritent d'être privilégiés
- La diversification des schémas de financement est souhaitable

IV. Règlements sur les moteurs non routiers « EMNR » (par DGTIM)

Les objectifs politiques sont dérivés du programme de travail « Naïades II » qui vise à renforcer l'attractivité du transport fluvial et notamment rattraper le retard vis-à-vis du transport routier d'ici 2030 pour certaines émissions polluantes.

Pour les différents types d'EMNR, le règlement indique le niveau maximal autorisé en termes d'émissions de gaz d'échappement en fonction de la puissance du moteur.
Beaucoup d'autres types de moteurs sont également concernés : les moteurs ferroviaires et agricoles (sauf les tracteurs), les motos-neige, les véhicules tous-terrains et les pelleteuses.
Les fabricants doivent garantir que les nouveaux moteurs respectent ces seuils afin de pouvoir les commercialiser.

La partie déterminante du règlement est constituée des annexes qui indiquent les valeurs limites.
Concernant le secteur fluvial, le règlement distingue deux catégories: les moteurs à propulsion (en cinq catégories de plage de puissance) et les moteurs auxiliaires (en deux catégories de plage de puissance).S'agissant des moteurs à propulsion : les deux premières catégories sont alignées sur les normes américaines, tandis que les trois suivantes sont plus strictes.

En Europe, le NP (nombre de particules) est ajouté aux normes, vu leur caractère nuisible pour la santé publique (la Commission Européenne justifie ce choix par la plus grande proximité des riverains des fleuves par rapport aux États-Unis).

Le président du groupe de travail indique que l'Etat devra être vigilant lors de la rédaction du texte français d'application.

La DGTIM précise que les moteurs routiers Euro VI utilisés dans des bateaux fluviaux respectent le règlement EMNR.

L'application de ces orientations constituera un surcoût important selon les transporteurs : + 20 % dans le cas des petits bateaux.

La puissance installée peut correspondre à certains usages mais pas pour les bateaux de plus de 1000 tonnes. En effet, un moteur routier ne dépasse pas 500 cv et est donc inadaptée pour de tels tonnages

Cela pourrait induire l'ajout de composants complémentaires souvent peu fiables tels que filtres à particules ou vannes EGR. CFT indique qu'il existe un vrai risque de report modal négatif car ces adaptations sont susceptibles de réduire la fiabilité du transport fluvial.

La DGTIM indique qu'une étude technique du CEREMA relative à l'adaptation à la flotte fluviale actuelle aux moteurs de type Euro VI est en cours. Les conclusions devraient être disponibles fin février 2015.

Le CAF indique que la profession partage l'ambition environnementale du règlement mais s'interroge sur la capacité du marché à supporter ce saut technologique. En effet, on vend environ 150 moteurs fluviaux par an (dont une vingtaine en France) alors que pour les camions, le marché est de 200 000 moteurs /an. Il y a donc un besoin d'accompagnement financier car les opérateurs ne peuvent assumer ce saut en si peu de temps.

Il serait intéressant de connaître la situation dans les autres pays de l'union à ce sujet ?

Le CAF insiste pour que nos représentants au Parlement européen portent des messages forts sur cette question.

La direction des services de transport confirme la convergence des points de vue des autorités néerlandaises, allemandes et autrichiennes quant à la trop grande rigueur des valeurs limites envisagées.

Le CNBA demande un alignement du règlement sur les normes américaines.

Conclusions et pistes de travail :

- Etablir une position commune avec d'autres pays de l'Union européenne, en particulier de l'Europe du Nord-Ouest
- Diffuser les conclusions du CEREMA, en vue de partager une même analyse technique
- Créer un groupe de travail spécifique avec l'ensemble des opérateurs européens pour dégager quelques pistes d'amendements au projet de la Commission, notamment lors de la discussion au Parlement

V. Financement européen (par Commission Européenne)

Marc Van Der Haegen chef équipe politique transport par voie navigable au sein de la direction générale de la mobilité et des transports (DG – MOVE) de la Commission européenne

Il confirme le soutien total de la Commission européenne au transport fluvial de marchandises.

Il a bien noté les problèmes de financement que les mises aux normes et études/recherches/travaux d'innovation vont engendrer.

Il existe un programme de l'EU pour la recherche et l'innovation doté de 80 milliards d'euros (2014 - 2020) dont 6,339 Milliards dédiés aux transports intégrés, verts et intelligents. Si les outils existants ne sont pas suffisants, la Commission Européenne est prête à étudier la création de nouveaux fonds.

Il indique que la Commission Européenne a besoin de données financières pour objectiver les besoins de financement et les obstacles auxquels est confronté le secteur.

La présentation est malheureusement écourtée faute de temps. Le préfet indique qu'une prochaine présentation sera programmée, garantissant le déroulement d'une intervention adaptée

Annex II.2: Feedback from the Dutch speaking stakeholders/experts in IWT

February13th 2015, Rotterdam

Suggestions on needed innovations in IWT:

Infrastructure:

- Underperformance of inland waterways infrastructure is an issue, e.g. costs for the IWT industry due to disruptions in availability of locks, bridges (time windows) and lack of maintenance (e.g. lack of dredging). A study of the costs for IWT and the performance of inland waterway managers would be appreciated to give arguments and data for policy making. This can also be linked to the infrastructure requirements and the term “Good Navigation Status” mentioned in the TEN-T Regulation 1315/2013 EC Article 15b (http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32013R1315)
- Multifunctional use of mooring places and more utilisation of existing quays by means of information systems (although contrary to wish of sector to shut off AIS when moored)
- Sharing of information on the fairway for optimisation of the load rate and speeds

Ship related technical:

- Attention needed for a larger scale serial production of standardised new small vessels (that would only be used for 20 years and then scrapped) in the range of 1000-1500 tons, e.g. modular concept. Old small vessels need to be phased out due to high investment costs to comply to the upcoming technical requirements and the need for greening of the drive train.
- The IWT sector needs to work on greening the fleet and needs clarity as regards the upcoming emission regulations (reference to NRMM revision discussion and EC proposal) and the need to address also the existing vessels and existing engines to prevent infinite overhauling of existing engines to avoid investing in expensive new engines.
- LNG retrofit by means of group, statements on the return on investment to be differentiated to the different sailing profiles and vessel types
- Standardised vessel drawings and modular concepts (see also the first point)
- Bio fuels and blending
- Additives to fuel to reduce emissions
- Hydrogen injection (intake of the engine)

Education and training and qualifications:

- More attention to be paid in the formal training for skipper to awareness as regards opportunities and best practices in collaboration
- Study and revision needed on the crew requirements: the real requirements of staff on board (both in knowledge and number of crew): the vessel is more and more a floating office, more managerial skills are needed and possibly also more higher educated staff (Bachelor/Master level)

- Intersectoral labour mobility, more attention needed on reducing the barriers to attract workers for IWT from other sectors (e.. truck drivers), but also more exchange between people working on shore and the people working on board of the inland vessels
- Image building to attract young people to IWT sector
- Basic safety training needs to be developed for IWT, similar to training existing in deep sea transport
- Zero accident platform

Ship operational:

- Attention needed for opportunities of autonomous sailing of vessels, e.g. platooning using modern ICT systems
- Attention needed for the optimised coupled convoys

Organisational / logistics:

- Advanced collaboration in container transport, e.g. hub& spoke and hop concepts (examples from IDVV project)
- Opportunities to develop the continental cargo market and reaching also smaller shippers with smaller volumes
- Collaboration models to increase the average payload of vessels and to reduce the share of empty trips (better planning, matchmaking)
- Serious gaming with market parties to explore opportunities of enhanced collaboration (refer to presentation at Barge-to-Business by Henk-Erik Sierink)
- Need for standardisation of equipment, procedures and information systems to reduce practical barriers for collaboration

Other:

- Need for better statistics about inland waterway transport to feed better decision making on investments, e.g. by means using modern ICT technologies
- Further discussion needed on the greening strategy for inland waterway transport focussing on existing vessels from a broad perspective of possible measures to reduce the emissions (not only strict emission limits for new engines)
- The EICB organisation in The Netherlands provides a good example and great added value for the IWT industry in bringing together stakeholders and consolidation of interests and small projects to close the gap with the financing instruments from the EC (reference to the Horizon 2020 proposal “Greening IWT” and CEF proposal for LNG breakthrough)

Annex II.3: Minutes of German meeting

Duisburg, March, 17th, 2015

Participants:
Representatives of German "BDS/Abteilung Binnenschifffahrt" ("Partikuliers" association, focus) as well as representatives of BDB, DST, DVS (NL) and University Duisburg-Essen

In the meeting, both innovation and qualification aspects addressing the projects PLATINA II and Smart Qu@lification have been discussed.

The general focus of the meeting was on fleet & greening as well as on education & qualification activities. Infrastructure and logistics topics have been considered less relevant. The main feedback from the participants is summarised as follows:

Infrastructure

Water level predictions

- Considered rather good for most river basins. Compared to Fleet and Education & Qualification rather limited need for innovation.
- Furthermore the participants were of the view that the practical situation from a skippers perspective can be complex. From experience they know that predictions only go so far, while the skipper has to make sure he'll be able to arrive.

Fleet & greening

Fleet general

- Need and demand for smaller vessels still exist.
- Innovation and modernisation of the fleet: In general considered relevant. However, only under the condition of financing possibilities.
- The balance between a very energy efficient engine and a robust, long-lasting engine considered important but not easy to find.
- Modern technology can have its own drawbacks. For instance with hybrid technology you might suddenly need the extra power from the engine, which has had no time to warm up. How does this influence the longevity of the engines?
- What technology best suits specific situations? Better information concerning the available technologies, how they work in practice, etc is needed (Greening Tool!).

Greening general

- The logistical chain has to be sensitive for greening. For instance skippers have agreed to arrive at 6pm, only to find out they will be handled the next morning at 9,
- Skippers need clarity on the regulatory framework, because they invest for the long term. Continuation permission needed for Greening investments in case of adapted future regulation.

Greening, e.g. after treatment systems

- “High costs and hardly any economic advantage.” There are no incentives for investment in these technologies.
- Besides investment itself, also and especially follow-up-costs (e.g. maintenance) are considered significant and high barrier for the implementation of greening measures.
- In many cases also technical challenges exist, e.g. limited space in engine-rooms for such additional aggregates.
- Implementation of truck engines into vessels in general considered a proper approach in order to overcome the problem of limited market size for engine manufacturers and suppliers. However, engine characteristics and utilization profile of vessels and trucks are different. Truck engines might not be able to provide the required characteristics & profile and hence only maintain a rather short “life time”
- Hint from PLATINA 2 towards the IWT Greening tool available under http://greeningtool.naiades.info/web/

LNG as fuel

- Some of the participants considered LNG difficult due to expected safety risks (they seem to compare LNG with Propane and Butane).
- Acquisition (and payment) of adequately qualified /skilled staff is considered a challenge, esp. for family operated entrepreneurs
- High investments are barriers. Especially when the future price of LNG is uncertain. What happens if demand for LNG rises considerably?

Financing

- Banks usually only finance (large) vessel newbuildings but hardly any modernisation of (elder, smaller) vessels (which are prevailing among Partikuliers). Difficult to get loans for ships that are labeled old, even when they have been regularly modernised.
- "Cooperative" financing approaches (common application of loans) are considered difficult due to unclear liability questions.
- Vehicles for innovation implementation and financing: As a positive example the funding of silent brakes in the rail sector has been mentioned (around 50% public funding). Such or similar approaches are considered necessary especially for greening measures since they hardly provide economic advantages.

Education and Qualification

Clear focus on the following items which are considered as quite important:

Energy efficient navigation

- Behavior-related approach is considered to be very important, also because hardly any investments are needed (e.g. for engines, after treatment equipment etc.), approach is applicable to most vessels and personnel.
- Also, physical basics (background) are relevant for skippers.
- Trend towards over-motorisation of vessels in some cases however limits the possibilities for energy-efficient navigation.
- Skippers that pay for the fuel themselves are sensitive to efficiency, but frequently third parties pay for the fuel.

Additional qualification "Meister IWT"

- At present, besides the basic qualification as skipper, river patents and certificates like ADN etc., a further dedicated qualification in analogy to the German "Meister"-qualification in other industrial or craftsmen sectors is missing.
- Relevant skills which should be acquired in such qualification are on the one hand general, not sector-specific skills like e.g. instructor and supervisor skills for the training of apprentices or commercial and entrepreneurial skills which have become much more important for a modern skipper. On the other hand sector specific skills should be addressed.
- Besides, such qualification is also considered as important incentive to attract young people to the sector (sector suffers from a lack of qualified personnel)

Legal, insurance and liability questions and skills

- Basic knowledge to be able to answer such questions is considered relevant for professional treatment of transport and contracts.

ANNEX III: FACT SHEETS

MEASURE: HYDROGEN / FUEL CELLS

Objective and approach

This technology has been successful with smaller entities and special ships such as submarines but has not been used in conventional inland waterway transport so far. The reason for this is seen in high technical and safety requirements and in particular in high investment costs. Furthermore, the energy-consuming production of hydrogen and its missing availability in ports are limiting factors.

However, hydrogen is considered a promising chemical energy storage for overshoot of renewable energies, which is giving this technology a long term perspective and which is relativizing the disadvantage of the energy-consuming production of hydrogen. The objective is to develop a market for affordable hydrogen fuel cell technologies for the IWT-sector, possibly driven by future improvements of the technology in other sectors (lower costs, progress in renewable energy production).

Impacts

- Environmental effects
  Complete elimination of greenhouse gas emissions when hydrogen is produced by renewable energies.
- Economic impacts
  Due to the significant development work still to be done, at present reliable conclusions on cost savings are hardly possible. However, significant cost reductions for production are expected due to scale effects in case of envisage future mass application.
- Applicability to share of the fleet
  In general, this measure is applicable to large parts of the fleets. However, due to the long way of development to go, at present hardly applicable on commercial level.

Barriers and challenges

- Technology at present is considered being far from market readiness
- Costs involved in hydrogen production, storage techniques and handling

Preconditions / frame conditions for deployment

- R&D: Further basic research is needed as regards solutions compatible for IWT
- Incentive & Regulation:
  - Short term horizon: Not applicable, since at present proper technical solutions are hardly available
  - Long term horizon (once proper technological solutions exist): Shall be cost-effective once mass production is realized; carrot and stick approach considering positive incentives, e.g. accompanying support program as well as regulation for the transition period.

MEASURE: SMALL VESSELS: LARGE SCALE DEVELOPMENT AND REPLACEMENT PROGRAM FOR SMALLER VESSELS

Objective and approach

For the fleet segment of small vessels of e.g. 600 t - 1500 t payload adjusted to limited waterway dimensions a general modernization is required. Suggested research and innovation can be found in the field of cost-efficient fleet renewal, i.e. large scale serial production of standardized (modular) new small vessels including the drive train and corresponding green technology. Standardization and large scale serial production shall lead to lower total production costs of small vessels, making it more interesting to invest.

R&I shall address a combination of technical innovation considering hydrodynamics and drive train developments with new logistics concepts, innovative business and financing models as well as staff management.

Impacts

- Environmental effects
  reduction of emissions due to implementation of greening technologies, e.g. electric vessels, hybrids, possibly the usage of CNG
- Economic impacts
  Cost savings due to economies of scale (serial production)
- Applicability to share of the fleet
  addressed to a significant share of the fleet (varying in the various river basins)

Barriers and challenges

- Economic situation and limited investment capacity of mainly family operated sme's.

Preconditions / frame conditions for deployment

- R&D: as addressed above
- Incentive & Regulation:
  - Proper financing approaches in combination with
  - a stable and predictable legal framework are necessary conditions for the market of IWT to invest in innovative greening technology.