Legal-administrative procedures and barriers to hydrogen applications in the maritime sector

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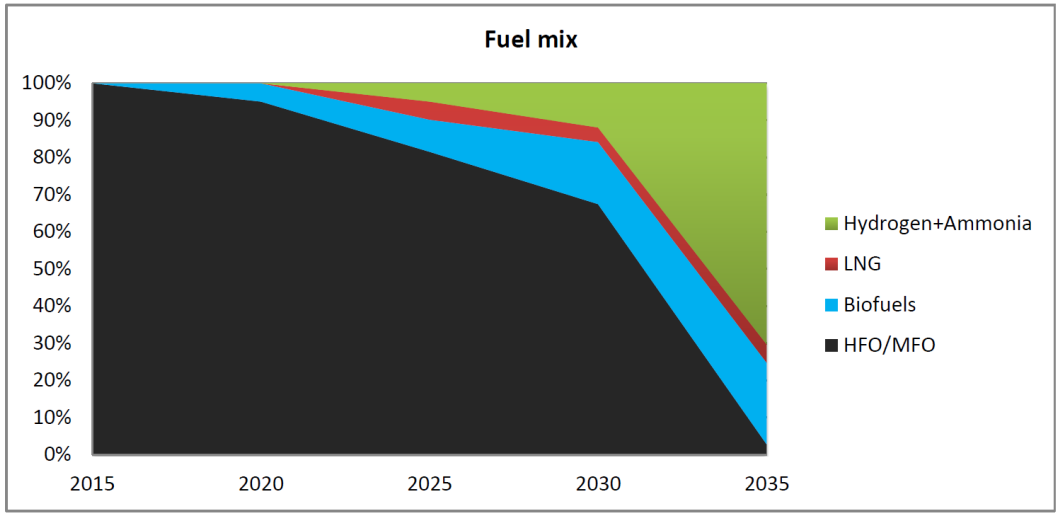
Background

- Maritime transport emits around 1000 mill tons of CO2 annually - about 2.5% of global GHG emissions (3rd IMO GHG study)
- Shipping emissions predicted to increase between 50% and 250% by 2050
- IMO to reduce CO2-emissions 50% by 2050
- 0.50% Sulphur Cap on marine fuel from 2020
- Opportunity and need for new alternatives!

Eidesvik Viking Lady - one of the first H2/fuel cell ships in commercial operation (2009)

Energy Observer, round the world-demonstration from 2017 (www.engie.com)



OECD International Transport Forum (2018): fuel mix evolution between 2015-2035 for 80% carbon factor reduction, ships

Promising projects, but lack of H2 specific regulations

Water-Go-Round, first fuel cell / H2 gas vessel in the US (Golden Gate Zero Emission Marine, 2019)

GKP7H2 (Brødrene Aa, new construction, H2 (compressed gas) and fuel cells, 2021)

Viking Cruises, 230 m /900 passenger cruiseship, fuel cells and liquid hydrogen

- Or ammonia, or LOHC?

Design, type approval – overarching IMO Regulation

- SOLAS, MARPOL
- IGF Code
  - Main part (A-1): Specific requirements for use of LNG
  - First part (A): Opens up for use of other gases or low-flashpoint liquids, through "Alternative design"
    - Safety, reliability and dependability shall be equivalent to that of new and comparable conventional systems (how to demonstrate this?)
    - 18 additional functional requirements
    - Risk and explosion studies required
  - Requirements for fuel cell installations will be added as a new part E to the Code (2024)
  - Hydrogen specific requirements are not yet on the agenda in IMO/CCC

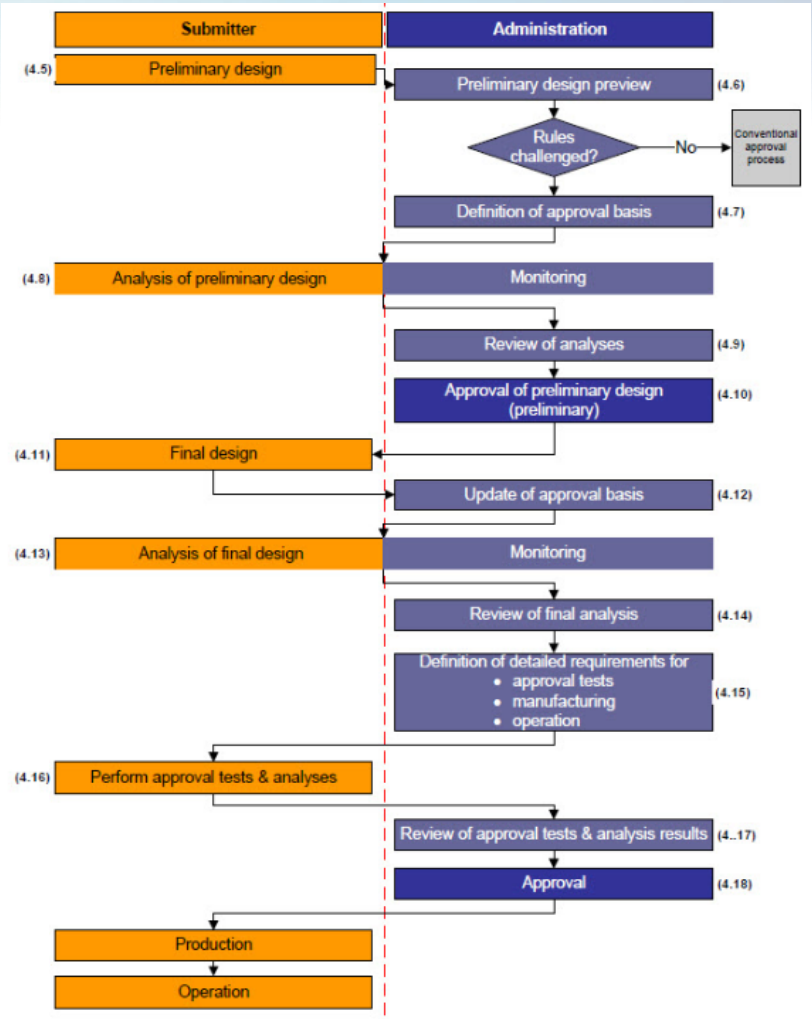
From IMO and EU to the national level

- IGF Code, SOLAS, MARPOL implemented through EU Directives
    - Directive 2014/90/EU, on marine equipment
    - Directive 2009/45/EC, on safety rules and standards for passenger ships
    - Directive 2009/16/EC and Directive 2013/38/EU, on port State control
    - Directive 2012/18/EU – "SEVESO Directive"
    - Directive 2014/34/EU – "ATEX Directive"

- National Maritime Authorities responsible, in most cases
    - Relating to international rules and standards
    - Transposed through EU- and national legislation

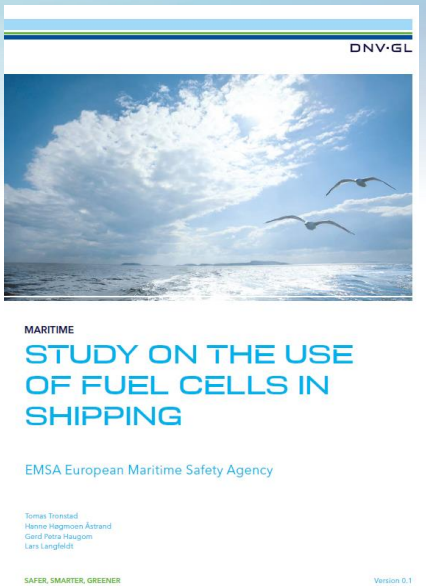
SOLAS Ch. II-1 Regulation 55 and MSC.1/Circ.1455

- Reg. 55: methodology for alternative design and arrangements for machinery, electrical installations and low-flashpoint fuel storage and distribution systems
- Refers to “Guidelines for the approval of alternatives and equivalents as provided for in various IMO instruments” (MSC.1/Circ.1455)
- Linear, but comprehensive process
- Close collaboration and dialogue required
- Guidelines include
    - Detailed description of the roles of the involved parties
    - Description of the project phases and the parties’ responsibilities in the respective phases
    - Guide for establishing evaluation-and acceptance criteria
    - Suggested documentation requirements
    - Operational requirements



Applicable class rules

- For fuel cell installations
  - Requirements, design principles
  - Spaces, fire safety, control and monitoring systems
  - No fuel specific requirements
- And gas fuelled ship installations
- But not specifically for HFC vessels



	ABS	BV	DNV GL	LR	KR
Own prescriptive rules	Directive under development. Since 2009	Directive published in 2009	Directive published in 2016	-	Directive published in 2014
Alternative authorization procedure	-	-	-	Risk-based process	-
Based on MSC.285(86) (LNG interim guidelines)	-	Yes	Yes	No	Yes
Regulated fuels	-	Natural gas, hydrogen	All fuels with flashpoint ≤60 °C	No; Risk-based process	All fuels with flashpoint ≤60 °C
Class approval mark	-	No	FC(Power) FC(Safety)	No	"FC-PWR" "FC"
Risk analysis required	Yes; No specific method	Yes; No specific method	Yes; FMEA	Yes; No specific method	Yes; FMEA
Complementary material requirements	-	Yes; Hydrogen (gaseous, liquefied)	Reference to general guidelines of DNV GL.	No	Reference to IEC 62282-3 and Rules for the Classification of Steel Ships (KR)

Remaining concerns

- Common concerns for LH2 and CH2
  - Relevant hazardous (EX) zones for hydrogen
  - Embrittlement
  - Risk of autoignition when burst discs are used
  - Capacity of safety relief valves
  - Inerted spaces?
  - Ignition mechanisms
- Compressed hydrogen
  - The high pressure is a hazard on its own
- Liquefied hydrogen
  - Loss of vacuum
  - Sloshing in tank
  - Inerting issues
  - Condensation and solidification of oxygen
  - Impact of extremely low temperature
- Ammonia
  - Impact of possible leakages on marine life?
  - Lack of safety procedures, standards as marine fuel
  - On-board reforming is challenging and energy intensive
  - Technology to utilize ammonia directly is still in very early stage

Vessels on inland waterways

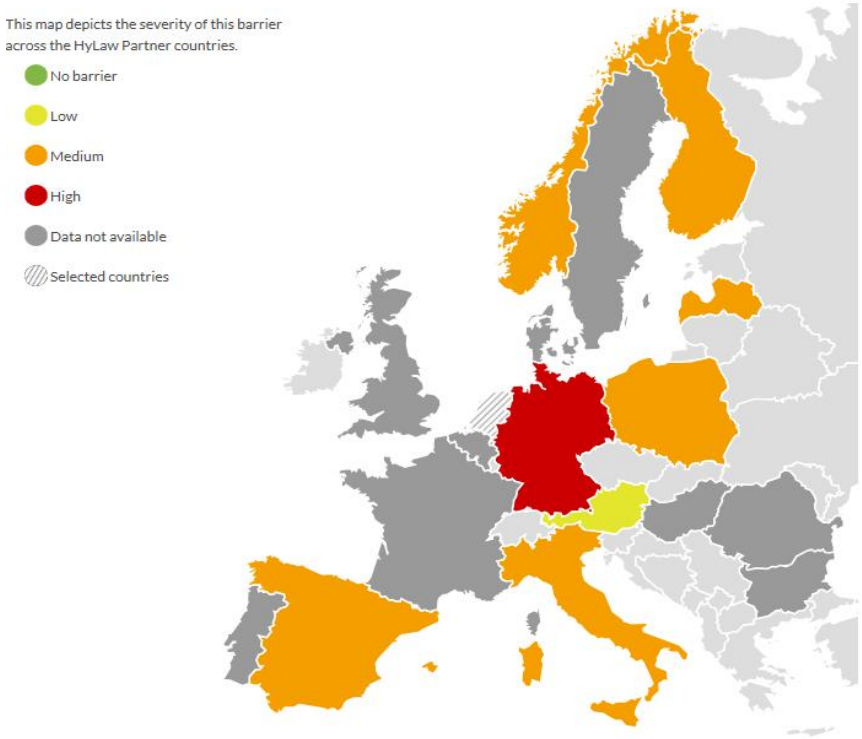
- CESNI - European committee for drawings up standards for inland navigation
- ES-TRIN (European Standard for Transport on inland navigation vessels) provides general provision for low-flashpoint fuels (Ch. 30; Appendix 8)
- EU Directive 2016/1629/EU provides the possibility for CESNI to issue special permits for new technologies
- Equivalence of safety, risk assessment

'Hydroville' (CMB)

Landing and bunkering installations

- Regulated under the ATEX directives
- Directive 2012/18/EU (aka Seveso-III): Control of Major-Accident Hazards Involving Dangerous Substances
- Norway: Installations harbouring more than 5 t, and **all bunkering installations for HFC passenger vessels, require special consent**
- Time-consuming - normal processing time is 3 months, may take longer
- Comprehensive, quantitative risk assessment
- Function-based rather than specific requirements
- Costs depend on case, difficult to specify
- ISO 20519 – LNG standard
- Need internationally aligned norms and guidelines

Approval for landing/bunkering installations



https://www.hylaw.eu/database#/database/vehicles/boats-ships/approval-for-landing-bunkering-installations

Barriers and opportunities: View from Hybridship

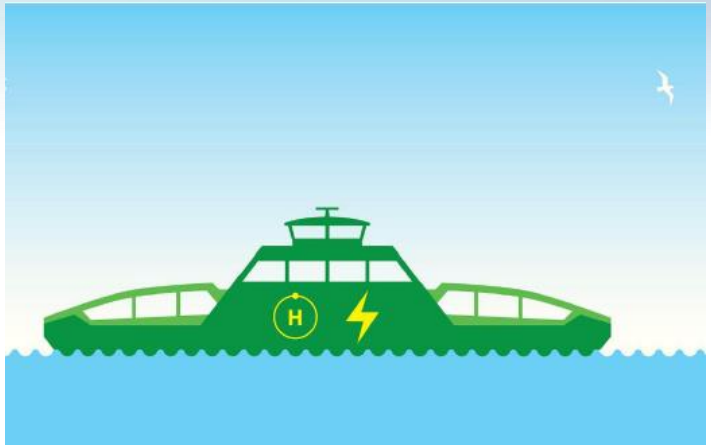
- Car and passenger ferry, flexible hybrid, HFC and battery, rebuild, 2020
- R&D support through Pilot-E
- Develop technology AND accelerate approval process
- Industry and relevant authorities, including NMA and Directorate for Civil Protection, SINTEF, DNV GL, Standard Norway
- Ship propulsion, bunkering and storage options
- **Challenge no.1: Develop regulations!***

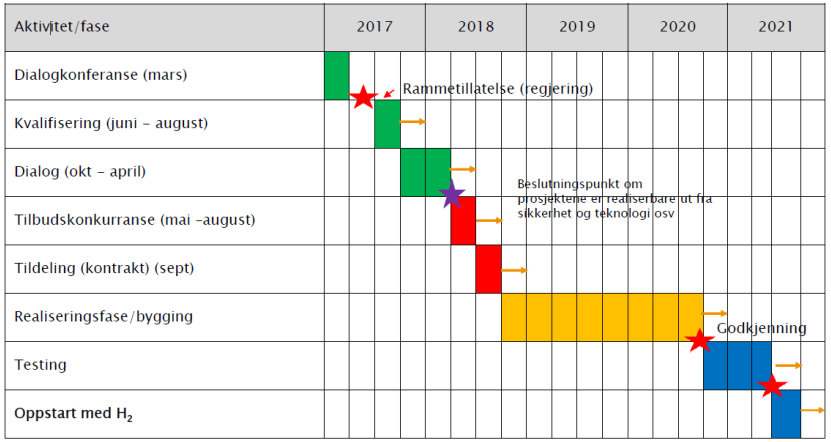
Picture: Fiskarstrand shipyard / Multi Maritime

*Presentation by K. Nerem, Fiskerstrand, Oslo 4th May 2017

Barriers and opportunities: View from NPRA

- Resolution no. 873, 13. June 2016: Parliament request, development contract for HFC ferries
- Car and passenger ferry, new construction
- Competitive innovation contract /competitive dialogue
- Public tendered service, into operation 2021
- Close dialogue with NMA and Directorate for Civil Protection
- Crucial that IMO make specific regulations for hydrogen (shipping and classification societies must push!))*
- Need internationally aligned norms and guidelines for landing and bunkering installations





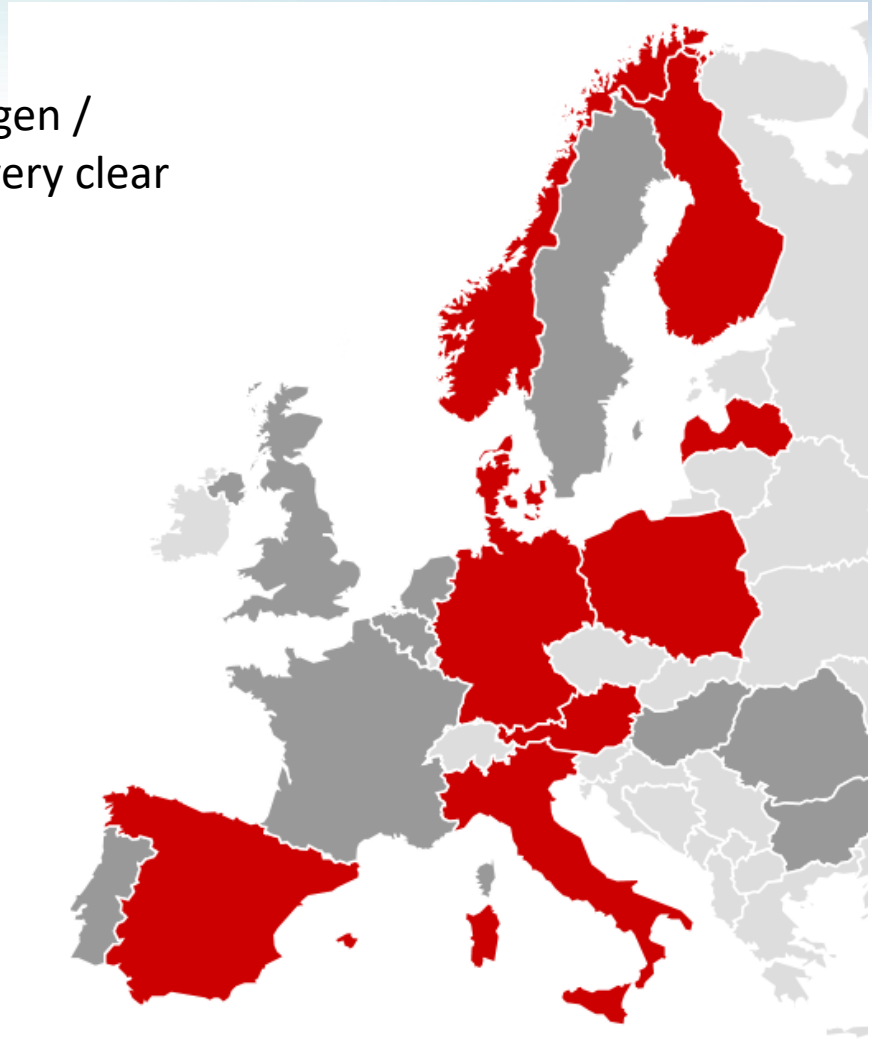
*Camilla Røhme, NPRA, 10.10.2018

HyLAW partners sending a clear message

As to design / type approval of hydrogen / hydrogen fuel cell vessels, there is a very clear and highly damaging regulatory gap

This map depicts the severity of this barrier across the HyLaw Partner countries.

- No barrier
- Low
- Medium
- High
- Data not available
- Selected countries



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Recommendations

- Develop specific rules for the type approval of Hydrogen and Hydrogen Fuel Cells vessels
  - Who: The IMO, National Maritime Authorities, EMSA, the European Commission, Class societies, CESNI (for inland navigation)
- Clarify and streamline applicable rules for the landing and bunkering of hydrogen
  - Who: The European Commission, National / Regional and Local authorities, business assurance companies, standardization bodies
- Develop and share minimum requirements for the operation and maintenance of HFC vessels
  - Who: National Maritime Authorities, EMSA, the European Commission, Class societies, the IMO, CESNI