Hydrogen in the Maritime Industry

Greening Potential, Technical and Regulatory Obstacles

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International Hydrogen Symposium

Handelskammer Hamburg, 24 October 2019

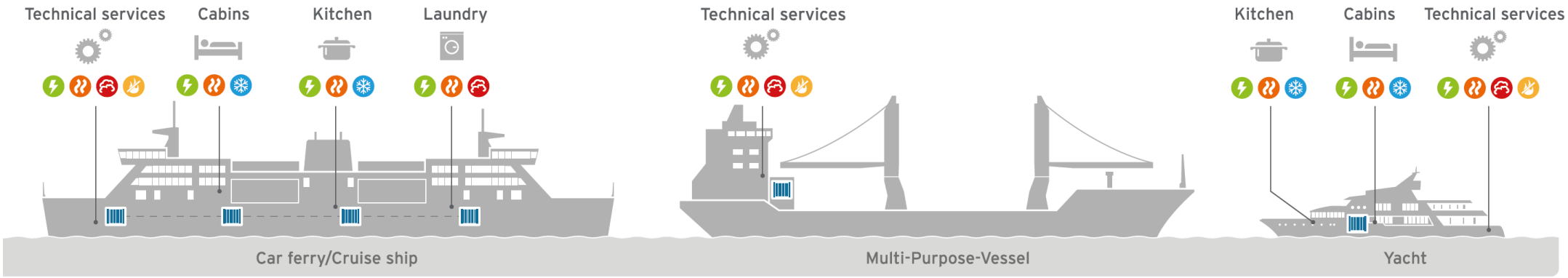
Fuel Cells – Maritime Application Case #1 for Hydrogen

- e4ships R&D projects and full scale demonstrators utilize different…

…Primary fuels

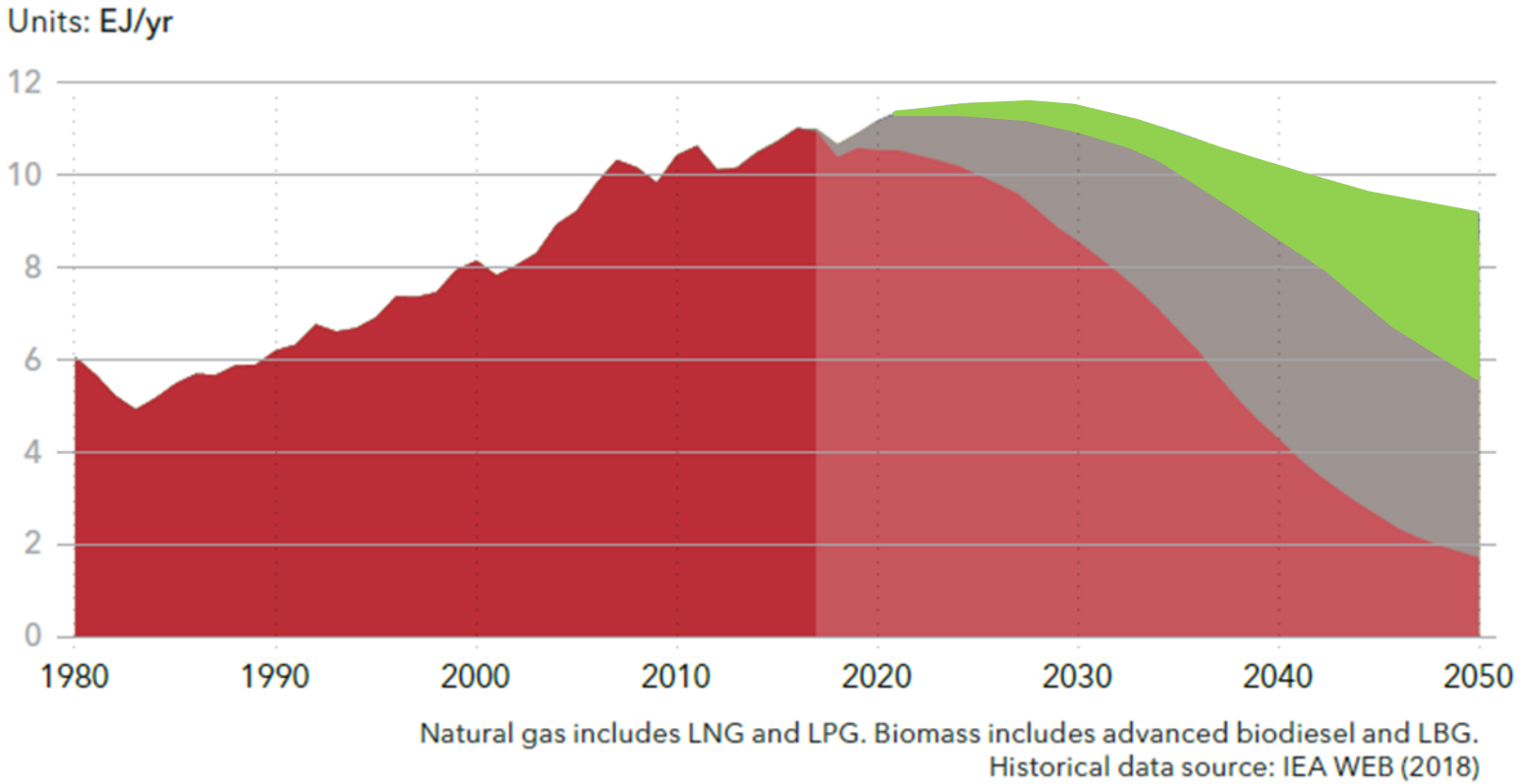
…Outputs

- and will be applied on different seagoing (and inland waterway) ship types:



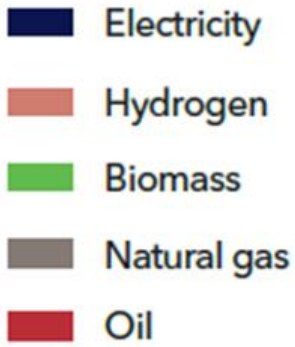
DNV GL Prognosis of the World Maritime Energy Demand

- This prognosis projects the development of different energy carriers
- The alternative energy carriers can be stored differently onboard:



Primary fuels:

- ⇨ Batteries
- ⇨ Hydrogen
- ⇨ Methanol (PtL)
- ⇨ Ammonia



Influencing Factors for Maritime Hydrogen Application

Following aspects have to be assessed in order to ensure that hydrogen (or any PtX fuel) can contribute to GHG emission reduction:

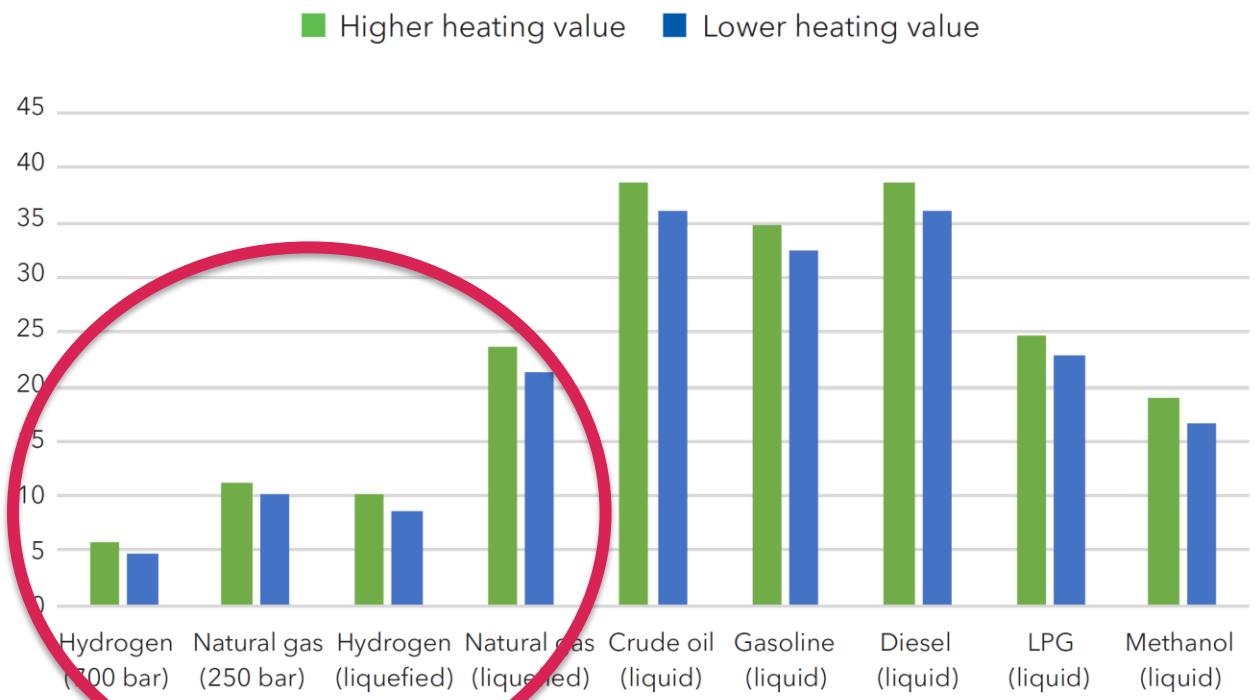
- Emission reduction potential – is the fuel green, grey or black?
- Cost-effectiveness – is it cheap enough to be competitive?
- Technical feasibility and availability – can it be used onboard everywhere?
- Regulatory aspects – will hydrogen be a permissible fuel and will the greening effect be correctly be accounted in national / maritime inventories?
- Sufficient political support – efficient CO_2 pricing, continued R&D support, in particular for large scale demonstrators and commercially used prototypes.

These questions occur in all sectors, but the answers might be different.

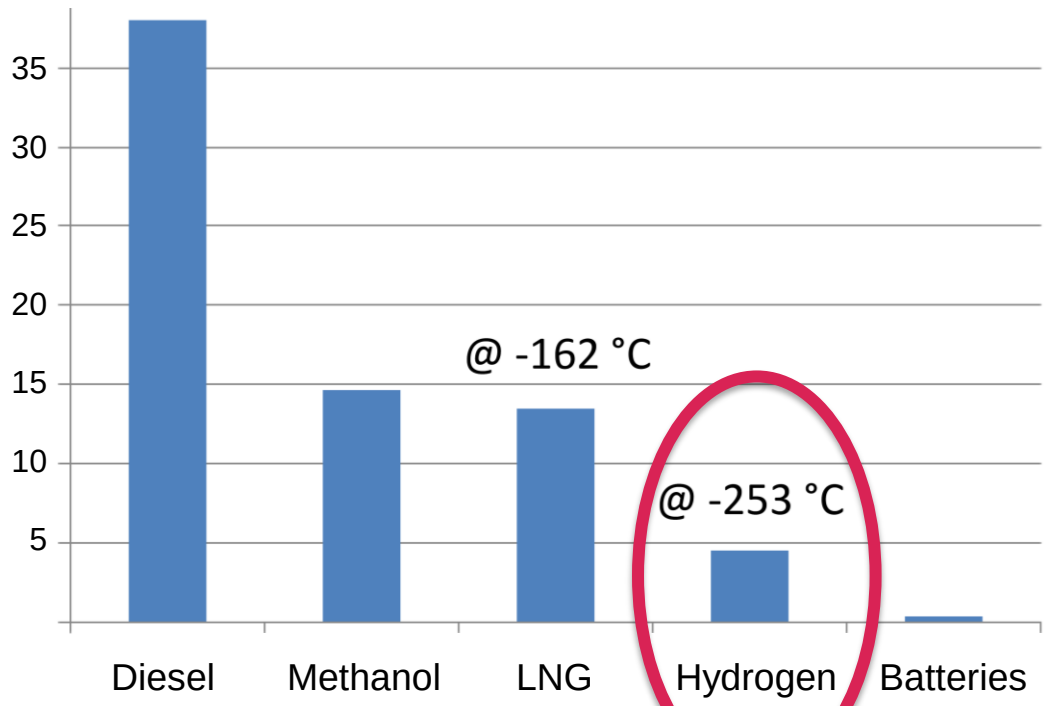
Technical aspects – how to store energy onboard?

- The technical feasibility of gas fuels is hampered by extremely low energy densities;
- which further deteriorate, if storage technology is considered for the tank room size:

Energy densities of fuels [MJ/l]



Energy density of tank room [GJ/m³]



Energy Demand of Different Shiptypes

- Large cruise ship or container ship for international service
- Medium Size Baltic ferry for short crossing, such as „Vogelfluglinie“

Regulatory Driving Force – Initial IMO GHG Strategy

The International Maritime Organization (IMO) has adopted a green vision and ambitious goals for the decarbonization of international shipping:

- Carbon intensity to be reduced by up to 70% by 2050;
- Reduce total emissions by 50% by 2050;
- Phase out GHG emissions by the end of the century.

implemented by new and existing mandatory instruments:

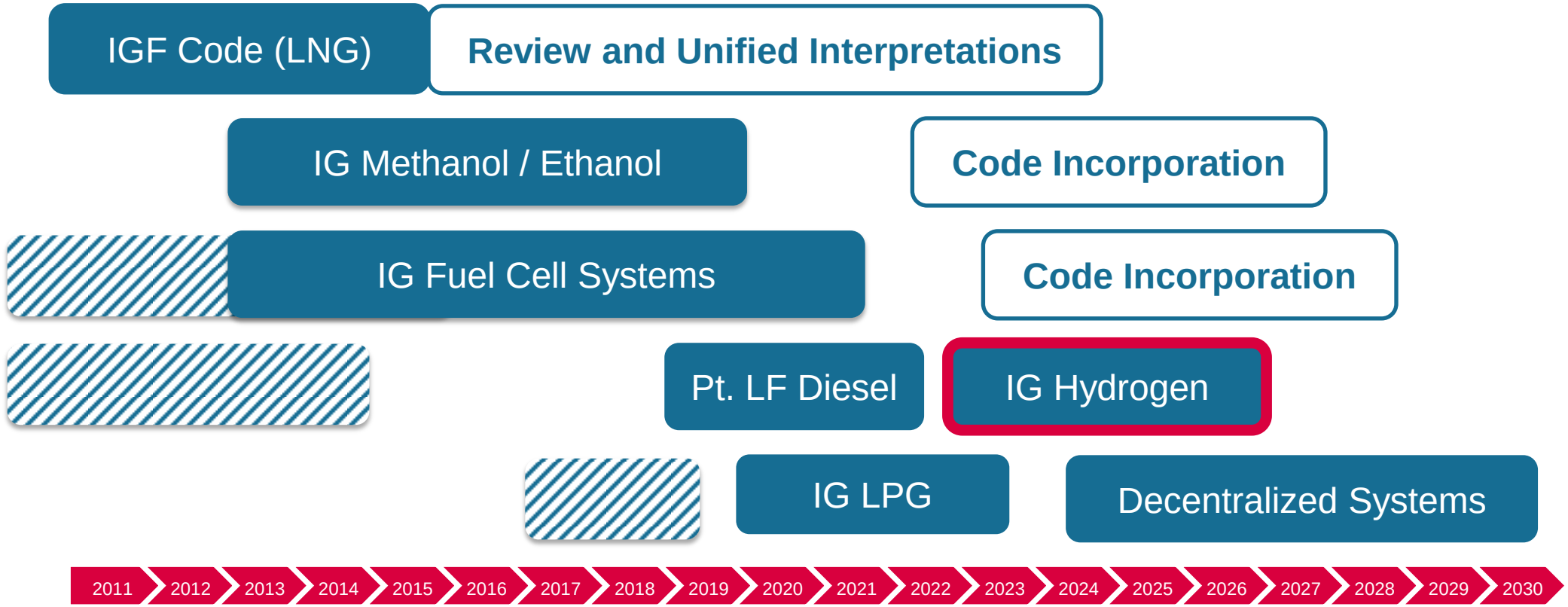
- Energy Efficiency Design Index (EEDI);
- Market-based Measures (MBM), e.g. GHG pricing.

INTERNATIONAL MARITIME ORGANIZATION

Shipping is the only transport mode with internationally binding energy efficiency and CO_2 emission requirements addressing individual ships.

Roadmap for Development of IMO Safety Requirements

- German Maritime Industry has a Roadmap to regulate all alternative fuels at IMO (and CESNI)
- Hydrogen might enter the IMO Work programme already in 2022



Hydrogen in Shipping – Summary

Hydrogen is a promising energy option for shipping, because or provided that:

- Potential to reduce both emission of GHG and harmful substances to zero;
- Used in fuel cells, which will be the high efficiency energy converter of the future;
- Technically and commercially feasible for Short Sea Shipping and Inland Waterways;
- IMO / CESNI safety regulations are developed as soon as possible;
- Energy Efficiency Instruments are capable of addressing all alternative fuels (including PtX) correctly (avoiding perverse incentives);
- Competitive when GHG pricing is successfully implemented internationally.

The Maritime Industry is therefore part of the hydrogen community, but subject to specific boundary conditions that have to be observed.

VSM CESA COMMUNITY OF EUROPEAN SHIPYARDS' ASSOCIATIONS

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Thank you for your kind attention!

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funded by: Federal Ministry of Transport and Digital Infrastructure

coordinated by: NOW National Organisation Hydrogen a Fuel Cell Technology