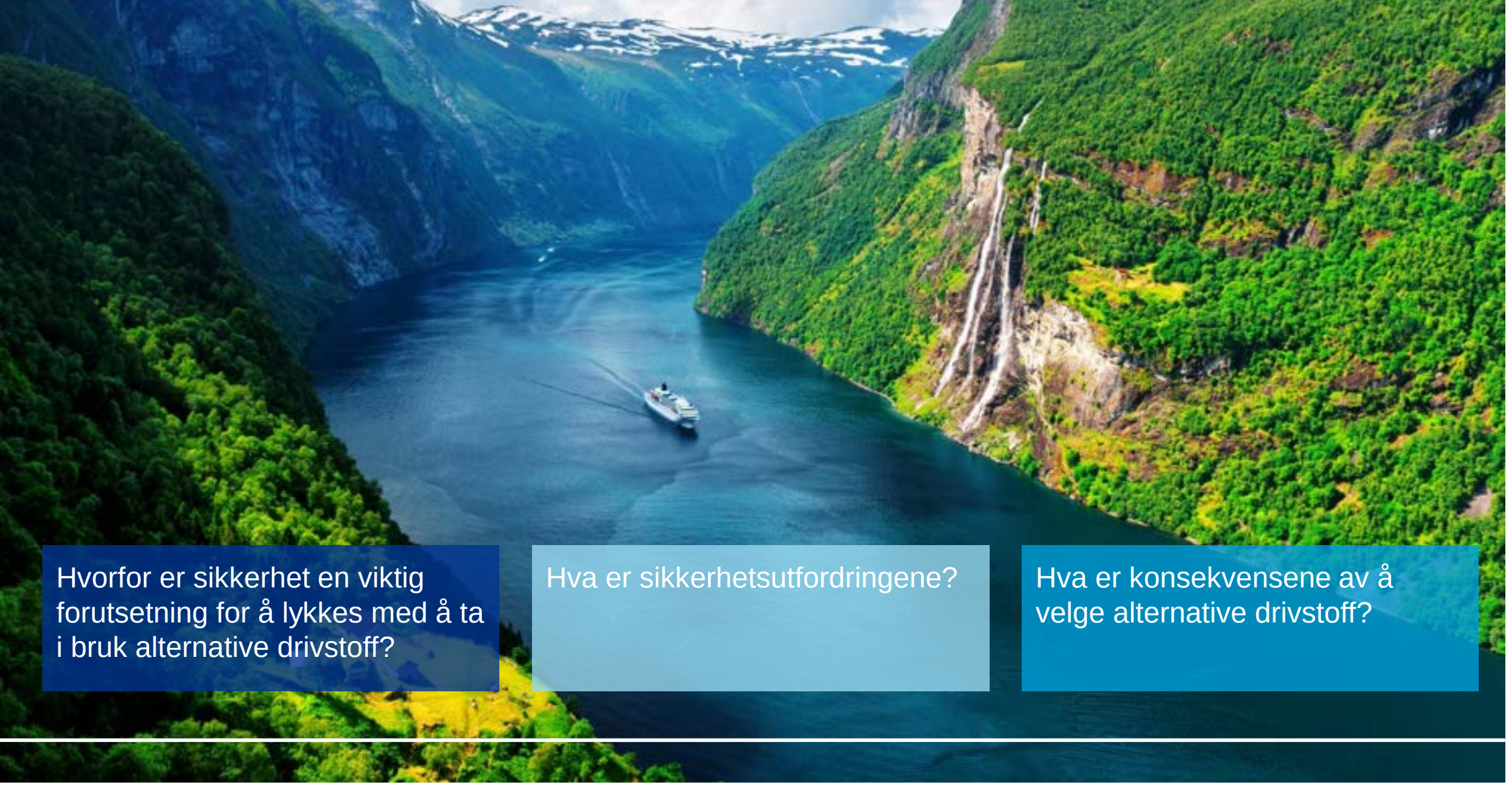
WHEN TRUST MATTERS

Sikkerhetsutfordringer for alternative drivstoff

GSP Mini-Seminar 3.juni 2021

Linda S. Hammer, Principal Consultant DNV Environment Advisory



Hvorfor er sikkerhet en viktig forutsetning for å lykkes med å ta i bruk alternative drivstoff?

Hva er sikkerhetsutfordringene?

Hva er konsekvensene av å velge alternative drivstoff?



CROWLEY


VIKING LINE

U A S C






Alternative fuels – what are the safety challenges?

Most non-conventional fuels have properties posing different safety challenges from those of conventional fuel oils.

Additional safety barriers required to maintain the safety level when compared with conventional fuels.

The properties are specific for each fuel.

Some important facts about natural gas (LNG)

The main component in natural gas is methane CH_4

Methane is a colorless and odorless gas at room temperature

Methane has a boiling point of −161 °C at atmospheric pressure

It is non-toxic and non-corrosive

Some important facts about natural gas (LNG)

Volume of natural gas is reduced by 600 times when it is liquefied at atmospheric pressure

Hazards include

- flammability after vaporization into a gaseous state
- freezing
- asphyxia

Some important facts about natural gas (LNG)

As a gas it is flammable over a range of concentrations **4.4–17% in air** at standard pressure

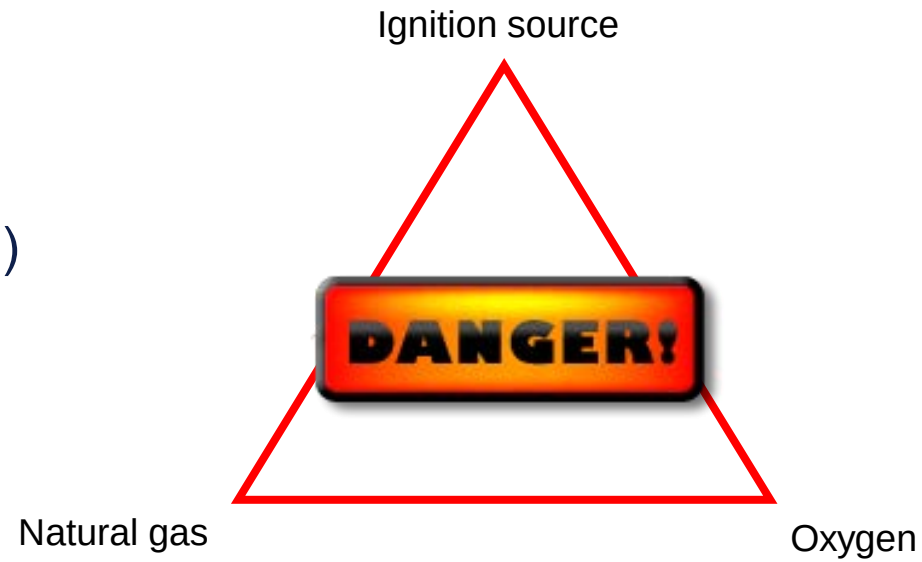
Some important facts about natural gas (LNG)

1 part LNG X 600 expansion ratio / 0.044 LEL = **13600 parts flammable gas**

3 safety challenges to remember

- **Fire/ explosion risk**
  - Flammability after vaporization into gaseous state
- **Low temperature** of liquid gas
  - Cryogenic spill
  - LNG at -161°C
  - Normal ship steel will be very brittle
- **High energy content** in gas tank (for LNG: liquid → gas)

- Other: asphyxia



Safety principles
DNV rules for LNG fuel

DNV Rules for LNG fuelled ships – Main principles

Segregation

Protect gas fuel installation from external events

Double barriers

Protect the ship against leakages

Leakage detection

Give warning and enable automatic safety actions

Automatic isolation of leakages

Reduce consequences of a leakage

Hydrogen

What are the safety concerns

High leak potential

Wide flammability range

Low ignition energy

Cryogenic temperature (LH_2)

Explosion risk

H_2: 4-75%

(NG: 4.4-17%)

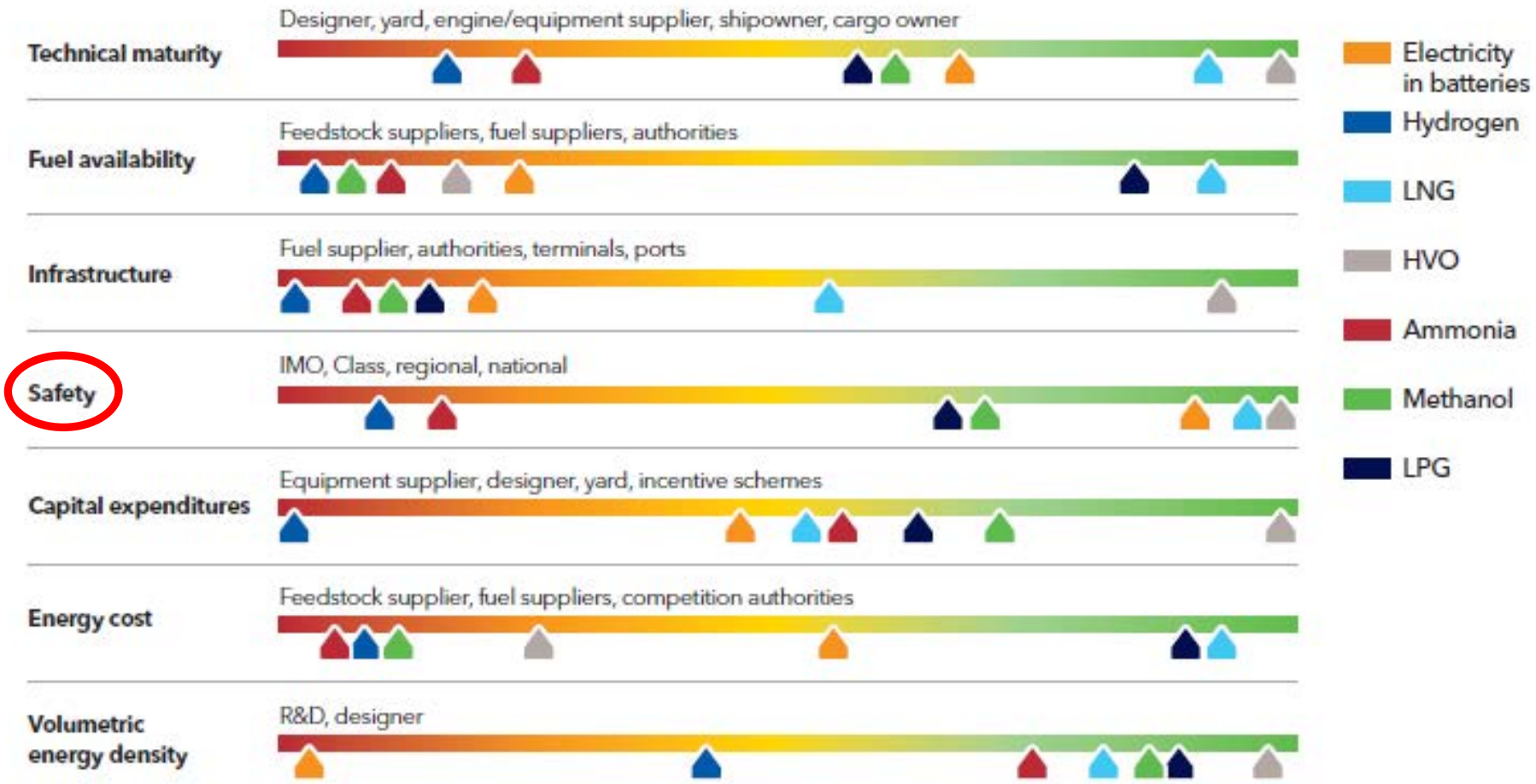
H_2: 0.017 mJ

(NG: 0.3 mJ)

LH_2: -253°C

(LNG: -161 °C)

The Alternative Fuel Barrier Dashboard – indicative status of key barriers for selected alternative fuels in 2020



HVO – hydrotreated vegetable oil;

LNG – liquefied natural gas;

LPG – liquefied petroleum gas;

Hydrogen – carbon-neutral liquefied hydrogen consumed in fuel cells;

Ammonia – carbon-neutral ammonia burned in internal combustion engines;

Electricity in batteries – full-electric with batteries;

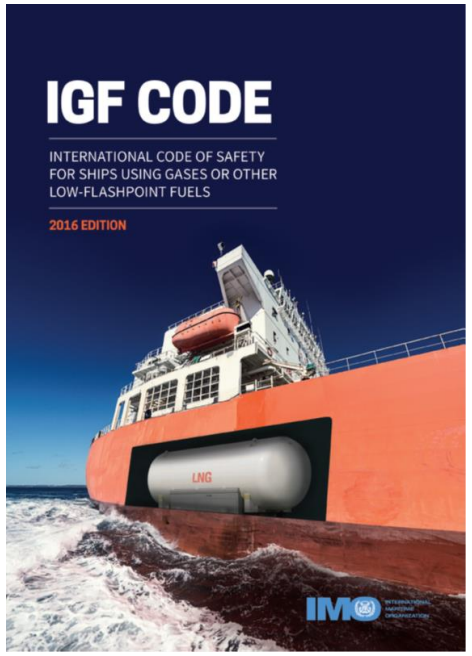
Methanol – carbon-neutral methanol burned in internal combustion engines.

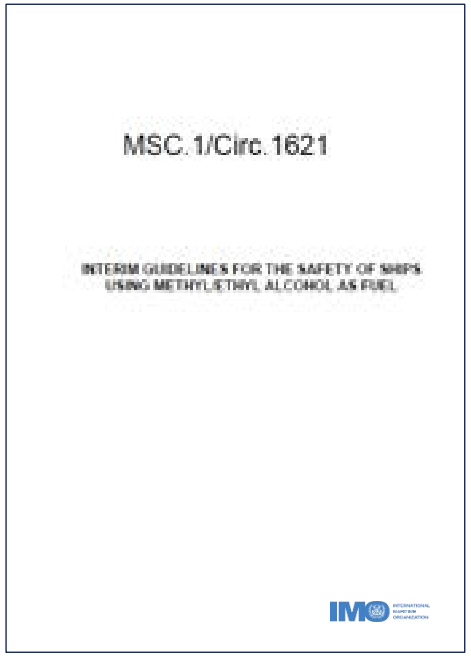
Source: DNV's Maritime Forecast to 2050

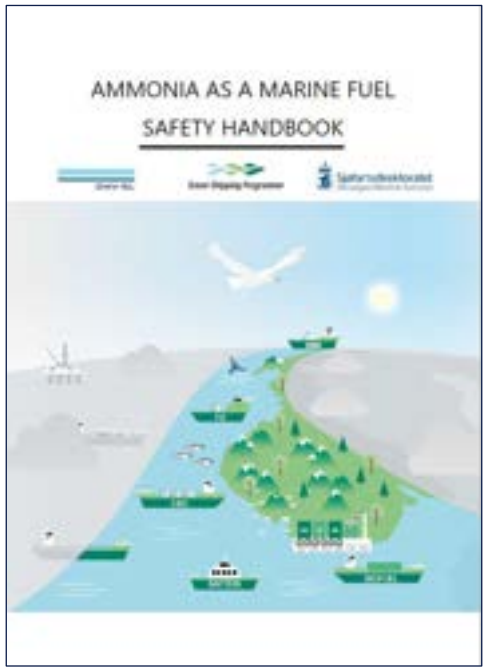
Development of safety rules and regulations in Norway

The continued development of IMO regulations for new fuels is key to enable uptake of alternative fuels in global deep-sea shipping

Different level of regulatory maturity for ships using alternative fuels







LNG - detail requirements

Other low flashpoint fuels - risk based approval process (alternative design approach)

Methanol - IMO interim guidelines

LNG
Methanol
LPG
Ammonia (July 2021)
Fuel Ready (July 2021)

Fuel cells

DNV Class Notation **Fuel Ready**

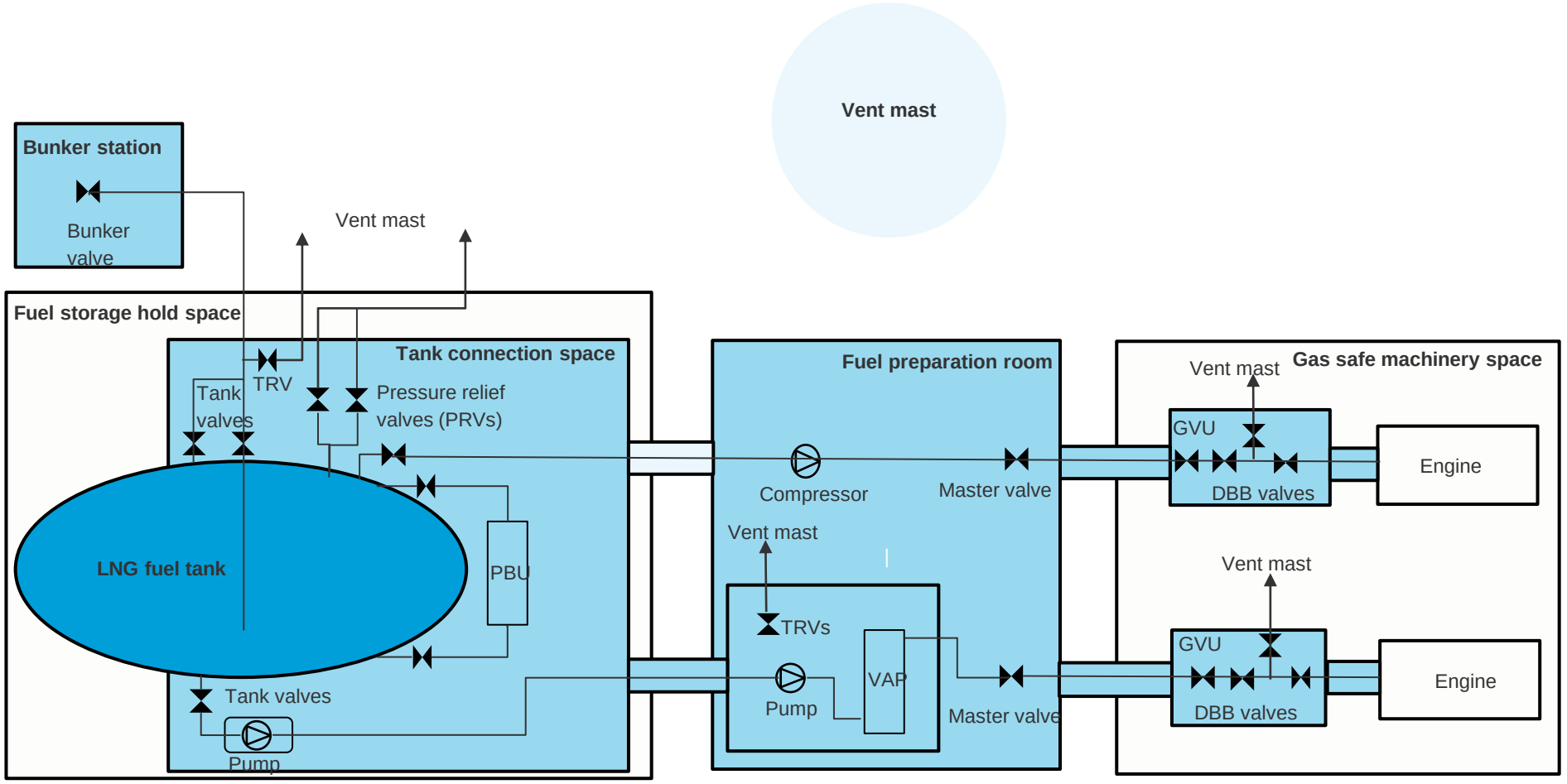
- Applies to ships, which are planned for, and/or partly prepared for, later conversion to one or more alternative fuels.
- It indicates that DNV has verified compliance with the Rules for the applicable fuel for a future ship design or fuel tank installed at newbuilding.
- The alternative fuel(s) the ship is prepared for is represented by a qualifier in the class notation:

Fuel ready (LPG, LNG, ammonia and/or methanol/ethanol)

What are the consequences of choosing alternative fuels?

The alternative fuel installation is affecting the ship arrangement!

Gas fuel system



Gas Fuelled ships

are not the same as

Gas Carriers

Risk picture and hazards, LNG as fuel vs. cargo

A more complicated risk picture – same hazards

Moving from land based to maritime

Aspects to be considered for ship applications:

- Safety – nowhere to escape
- Environmental conditions
- Vibrations and inclinations
- Weights and volumes

100 kW 50 MW

50 MW

LAND BASED SOLUTIONS ARE NOT DIRECTLY TRANSFERABLE ONBOARD SHIPS

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Spørsmål?

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