HYDROGEN CROSS BORDER CONFERENCE

SESSION I:

Waterstof in havens en schepen
Wasserstoff in Häfen und Schiff

H2Region EMSLAND · MARIKO · FME POWERED BY DUTCH TECHNOLOGY · OLEC Energie bewegt den Nordwesten · New Energy Coalition · NL.IN. BUSINESS · Niedersachsen · H2-Ostfriesland

HYDROGEN CROSS BORDER CONFERENCE

Impulse

Ramona Zettelmaier - Buerau Veritas

Louis Stolper - KVNR

HYDROGEN CROSS BORDER CONFERENCE

17.05.2022

Dipl.Ing. Ramona Zettelmaier
Head of Sales and Customer Relation

With it started with……

- Cut carbon emissions of all ships by at least 40% by 2030
- Cut carbon emissions of all ships by at least 70% by 2050

2018 — **IMO Fuel Oil Data Collection System**

EU Monitoring Reporting Verification
First mandatory period

IMO Green House Gas
Adoption of initial strategy

2019 — **IMO Fuel Oil Data Collection System**
First mandatory reporting

EU Monitoring Reporting Verification
Verified annual emission report

2020 — **IMO Energy Efficiency Design Index**
Phase 2
(up to 20% reduction)

IMO Data Collection System
Fuel Oil Consumption report

2021

2023 — **IMO Green House Gas Strategy**
Adoption of revised strategy (COP 23)

2025 — **IMO Energy Efficiency Design Index**
Phase 3
(up to 30% reduction)

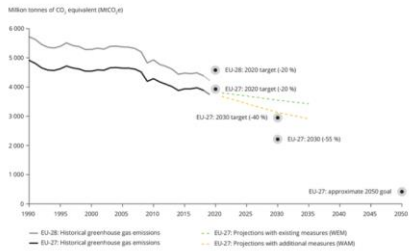
2030 — **IMO Green House Gas**
- CO_2 Reduction (tonne-mile) by **at least 40%** compared to 2008

2050 — **IMO Green House Gas**
- CO_2 Reduction **70% compared to 2008**
- GHG Reduction **50% co**
  2008
- Pursue efforts towards pl
  GHG emissions entirely

Three Pillars of IMO Strategy : 1
2. Operational Measures, 3. Alte

EU PROPOSAL
Fit for 55 – Package

- Overall objective:
  - *Become the first carbon neutral continent*
  - *55% GHG emissions reduction compared to 1990*

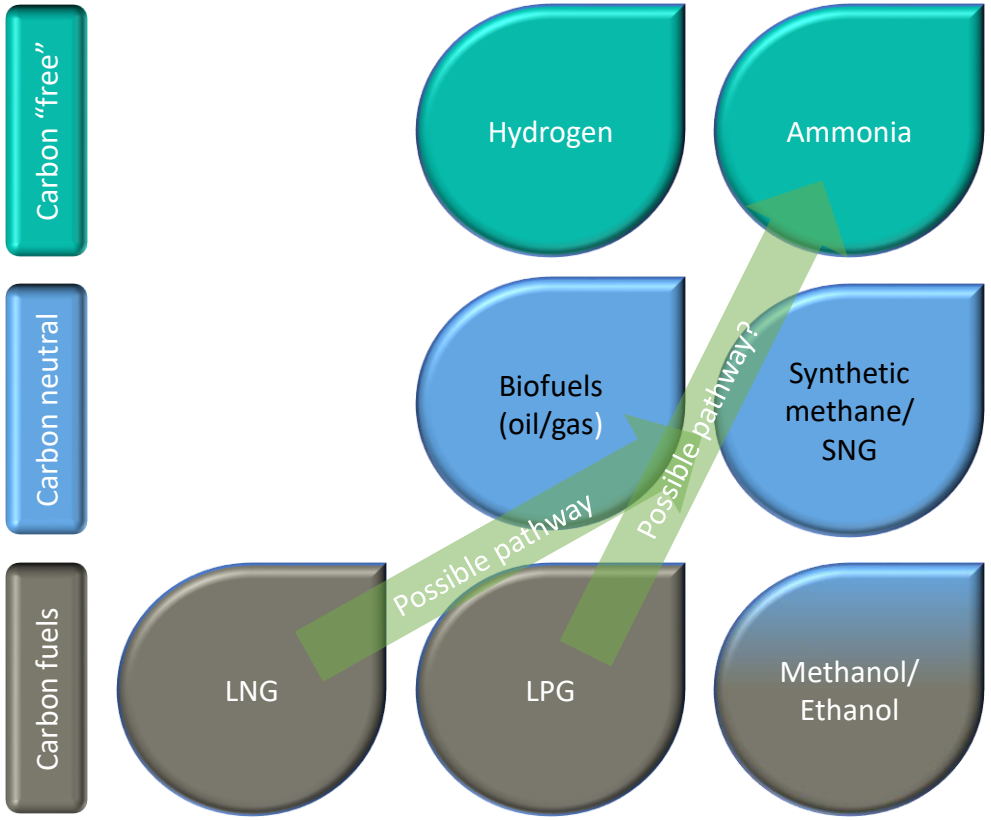


- Package of proposals to European Parliament & European Council to fulfill EU commitments & targets :

Fit for 55	Relevance
Emission Trading System (ETS) - review	⚓
Market Stability Reserve (MSR) - review	⚓
Carbon Border Adjustment Mechanism (CBAM)- new Regulation	⚓
FuelEU Maritime - new Regulation	⚓
Renewable Energy Directive (RED) - review	⚓
Alternative Fuels Infrastructure Directive (AFID)- review	⚓
Energy Taxation Directive (ETD) - review	⚓

⚓ High impact for Maritime sector ⚓ Low impact for Maritime sector

ENERGY TRANSITION TO LOWER-CARBON SHIPPING
TOWARDS 2050 – ALTERNATIVE FUEL OPTIONS



Key considerations

Life Cycle Assessment : How much Carbon is produced on the whole lifecycle ?

- Method of manufacture
- Emission of pollutants during Manufacture and Consumption
- Need to consider Renewable Energy and Carbon Capture on the production side

Specific energy by weight and volume

Safety considerations : flammability, toxicity

Regulatory framework

Global availability of fuel
bunker = 300 MT equivalent HFO in 2020

Cost & Application

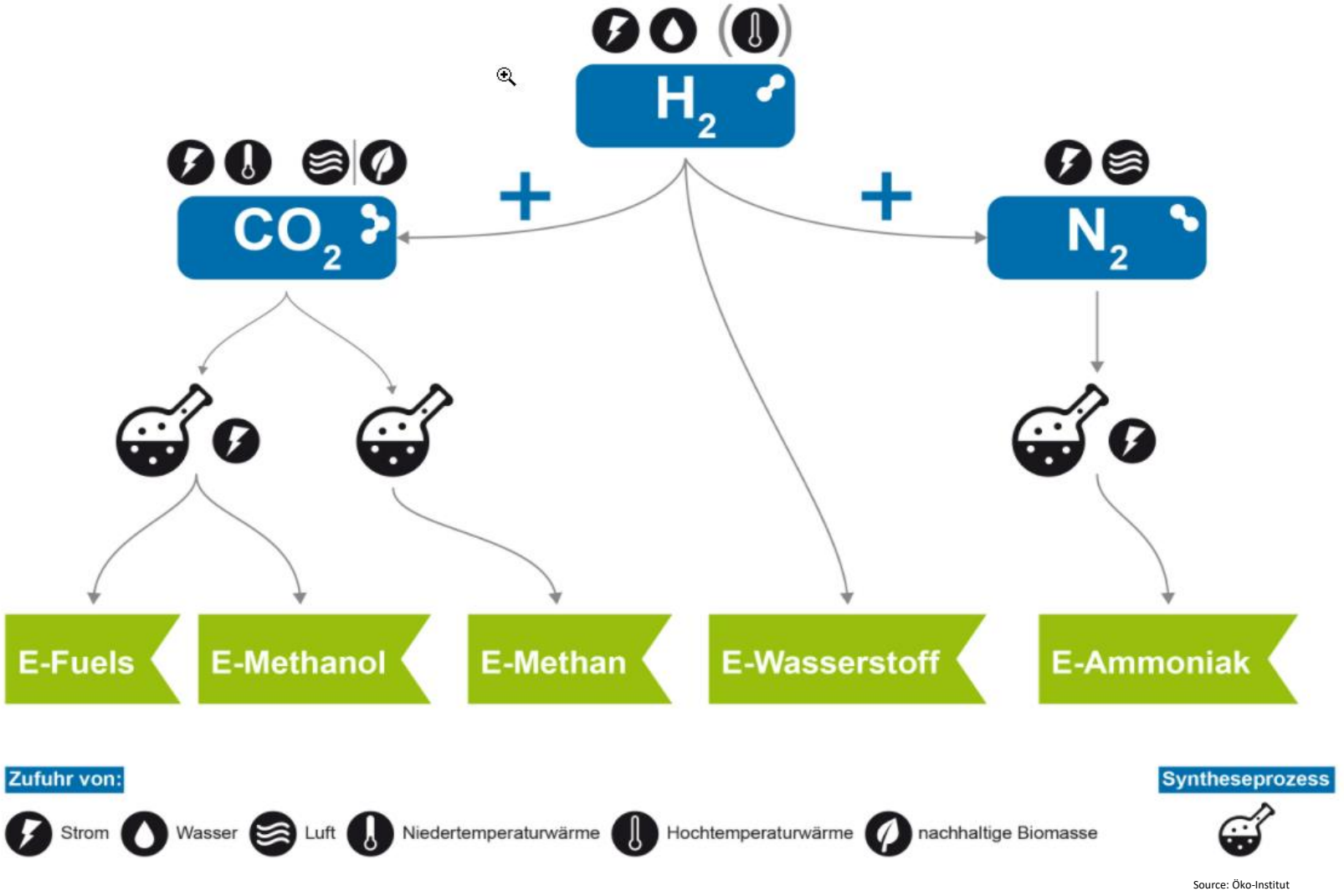
Production routes

Power -To -X

- which X ?

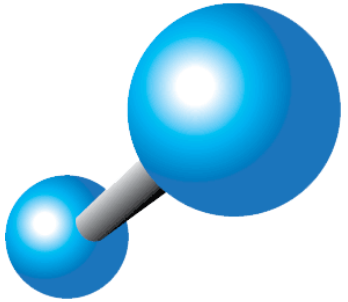
Water = Water ?

Energy In = Energy Out?



Source: Öko-Institut

Hydrogen safety



- Low temperature hazard
- High pressure hazard
- Hydrogen embrittlement
- Permeability
- High diffusivity
- Extensive flammable limits
- Low ignitability

	Hydrogen	Methane
Boiling temp (K)	20.3 (-253 °C)	111.7 (-161.5°C)
Gas density at standard cod. (273K & 1atm (kg/m^3)	0.09	0.72
Gas density at boiling point (kg/m^3)	1.34	1.82
Liquid density (kg/m^3)	70.8	422.5
Evaporation Latent heat (kJ/L)	31.6	215.8
Flammability range (% vol)	4 - 75	5 - 17
Min. Ignition Energy (mJ)	0.017	0.274
Diffusion Coefficient in air (cm^2/s)	0.61	0.16

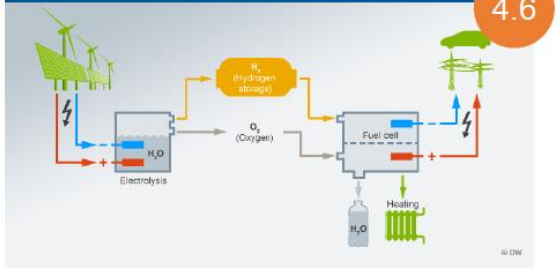
UNDERSTANDING ENERGY DENSITY

Heavy fuel oil plus SOx scrubber

1

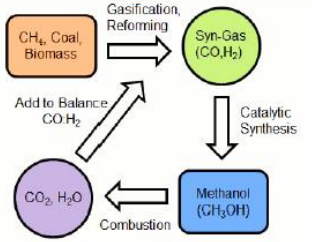
Hydrogen

4.6



Methanol based on H2 or Syngas

2.5



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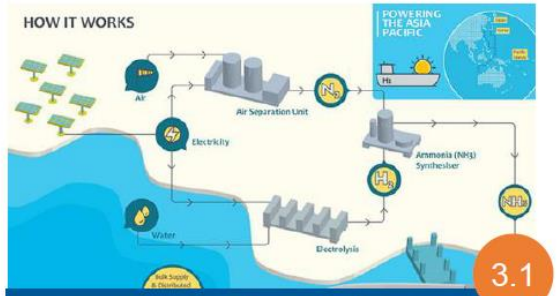
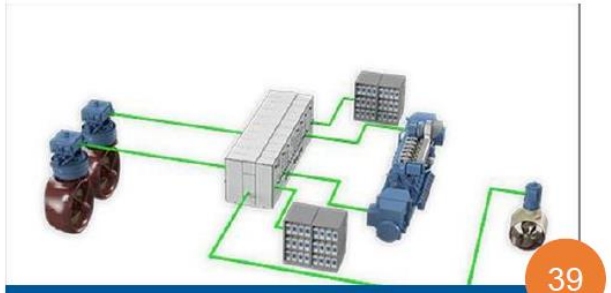
LNG (fossil, bio-, and e-)



3.1

Ammonia based on Hydrogen



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Battery packs

Source: Anthony Veder

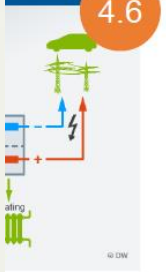
Source: SEA-LNG

UNDERSTANDING ENERGY DENSITY

Heavy fuel oil plus SOx scrubber

Hydrogen

4.6



Methanol based on H2 or Syngas

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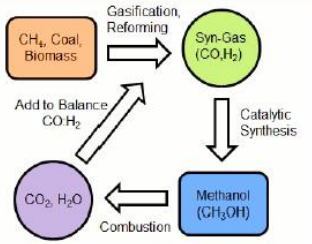
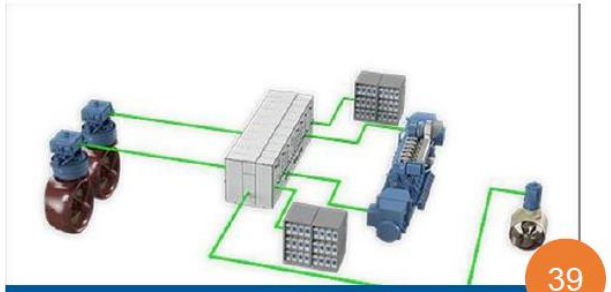


3.1

en



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Battery packs

Source: Anthony Veder

Source: SEA-LNG

Hydrogen facts - investments

70 MILLION METRIC TONS

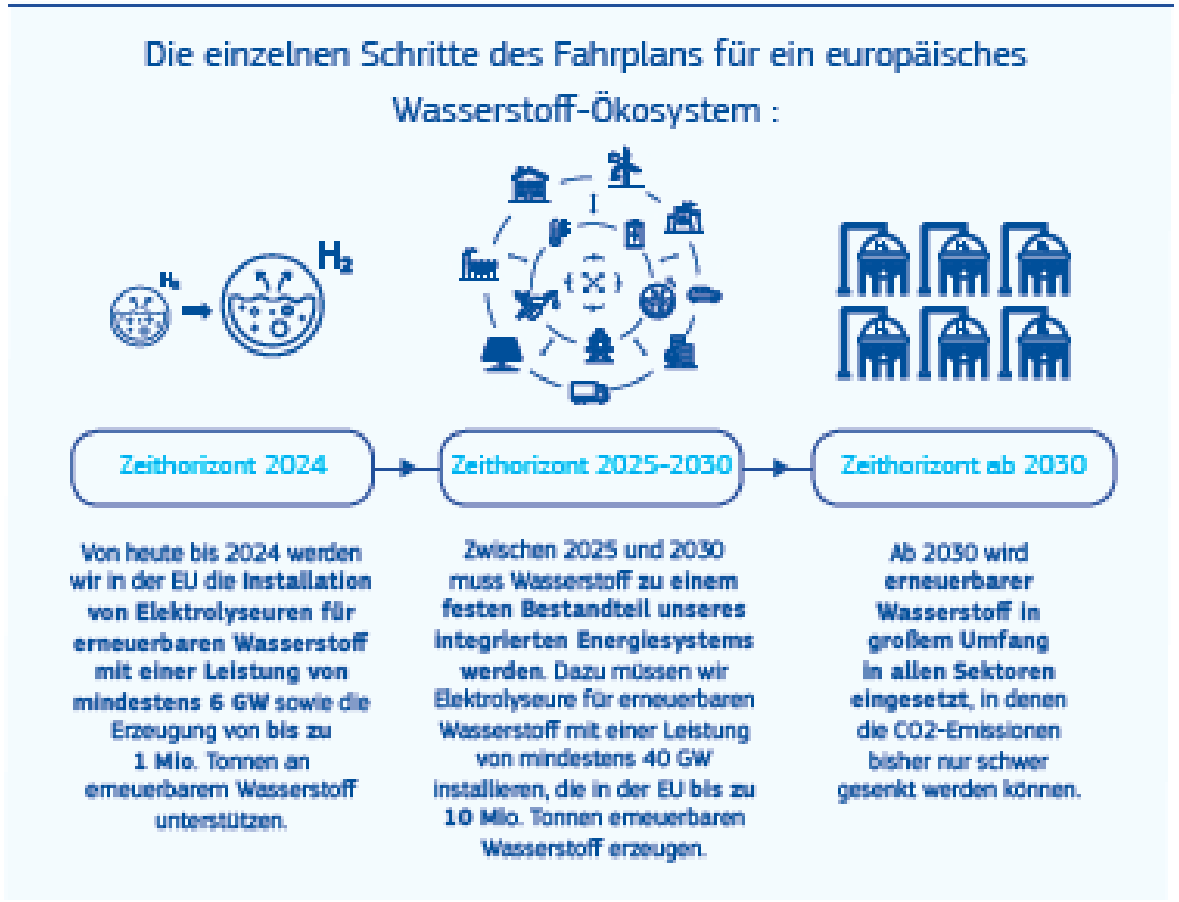
Global demand for **pure hydrogen**

€140 BILLION

European Commission **investment** in hydrogen by 2030

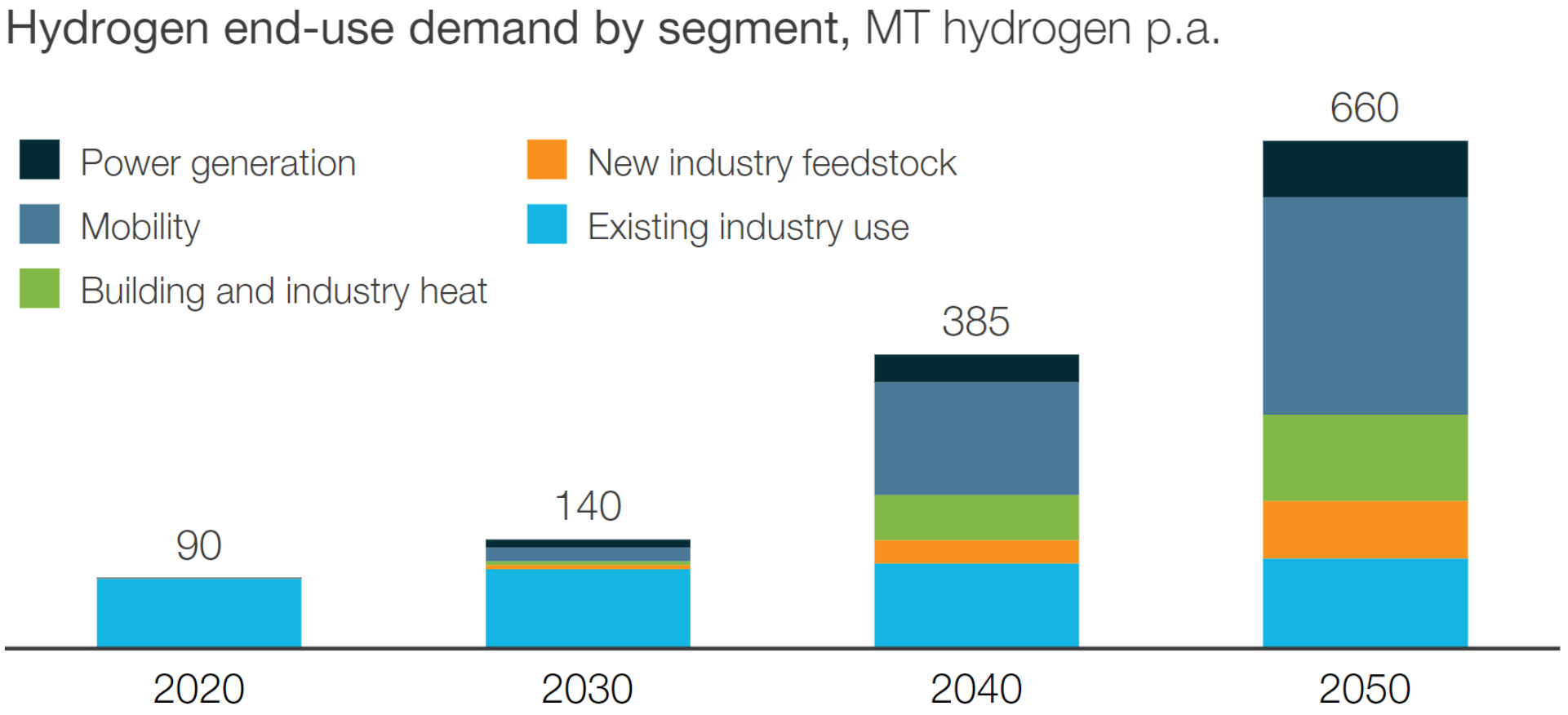
60%

Efficiency offered by **hydrogen fuel cells**[3]



Shipping?

Global hydrogen demand by segment until 2050



660 MT

hydrogen required p.a. in 2050 for net-zero

22%

of global final energy demand[1]

1. IEA net-zero scenario with 340 EJ final energy demand in 2050. HHV assumed. Excluding power.

Energy Observer

ENERGY OBSERVER
ENERGY OBSERVER, FRANCE

Project status: In service

This research vessel is currently in service for worldwide operation, having entered into service in 2017 [14]. **Originally designed and built as a sailing racing catamaran, it was converted into a research/campaign vessel. It features compressed H_2 storage, a 60 kW PEM fuel cell, electric and wind propulsion. It has an onboard electrolyzer, supplied by an extensive PV system and hydrogeneration under wind power.**

ENERGY OBSERVER

VESSEL INFORMATION

PROJECT LEADER
Energy Observer

PROJECT PARTNERS
Accor, thélem assurances, Delanchy, engie, Toyota, CMA CGM, CCR, Afhypac, Hydrogen Council

PROJECT COMPLETION
In operation since 2017

ROUTES
Worldwide operation

TECHNICAL DATA

HYDROGEN STORAGE
Compressed gaseous

STORAGE LOCATION
Partially enclosed in hull

STORAGE PRESSURE
350 bar

HYDROGEN CAPACITY
62 kg

WIND PROPULSION
2 OceanWing soft wingsails

PHOTOVOLTAIC SYSTEM
141 m²

FUEL CELL POWER
60 kW

LENGTH 30 m
BREADTH 12.80 m

HYDROGEN
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CONFERENCE

Panellists

Ramona Zettelmaier - Buerau Veritas

Louis Stolper - KVNR

Bart van der Kolk – Groningen Seaports

Matthias Lüdicke – Niedersachsen Ports GmbH & Co. KG

Paul Melles - Royal Doeksen

Wolfgang Franzelius - HB Hunte engineering

Hans van Breugel - Van Dam Shipping