

April 2021

HYDROGEN EUROPE

Hydrogen technologies in the maritime
industry



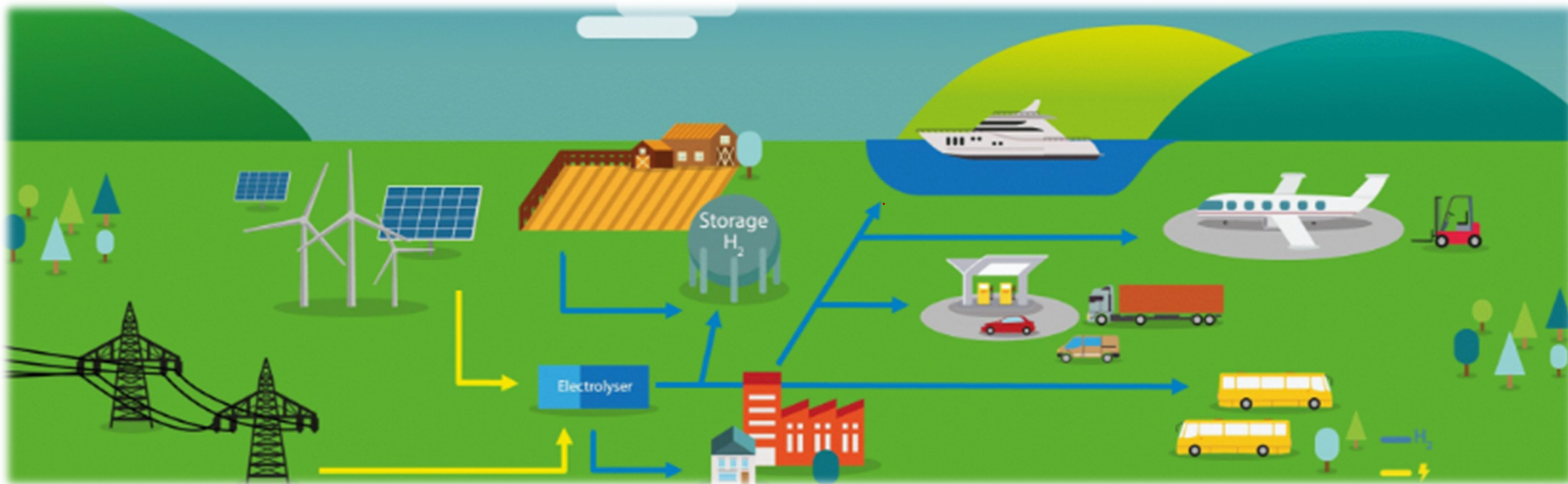
Hydrogen Europe – who are we?

Our Vision

Hydrogen enabling a zero emission society

Our Mission

We bring together diverse industry players, large companies and SMEs, who support the delivery of hydrogen and fuel cells technologies. We do this to **enable the adoption of an abundant and reliable energy which efficiently fuels Europe's low carbon economy.**



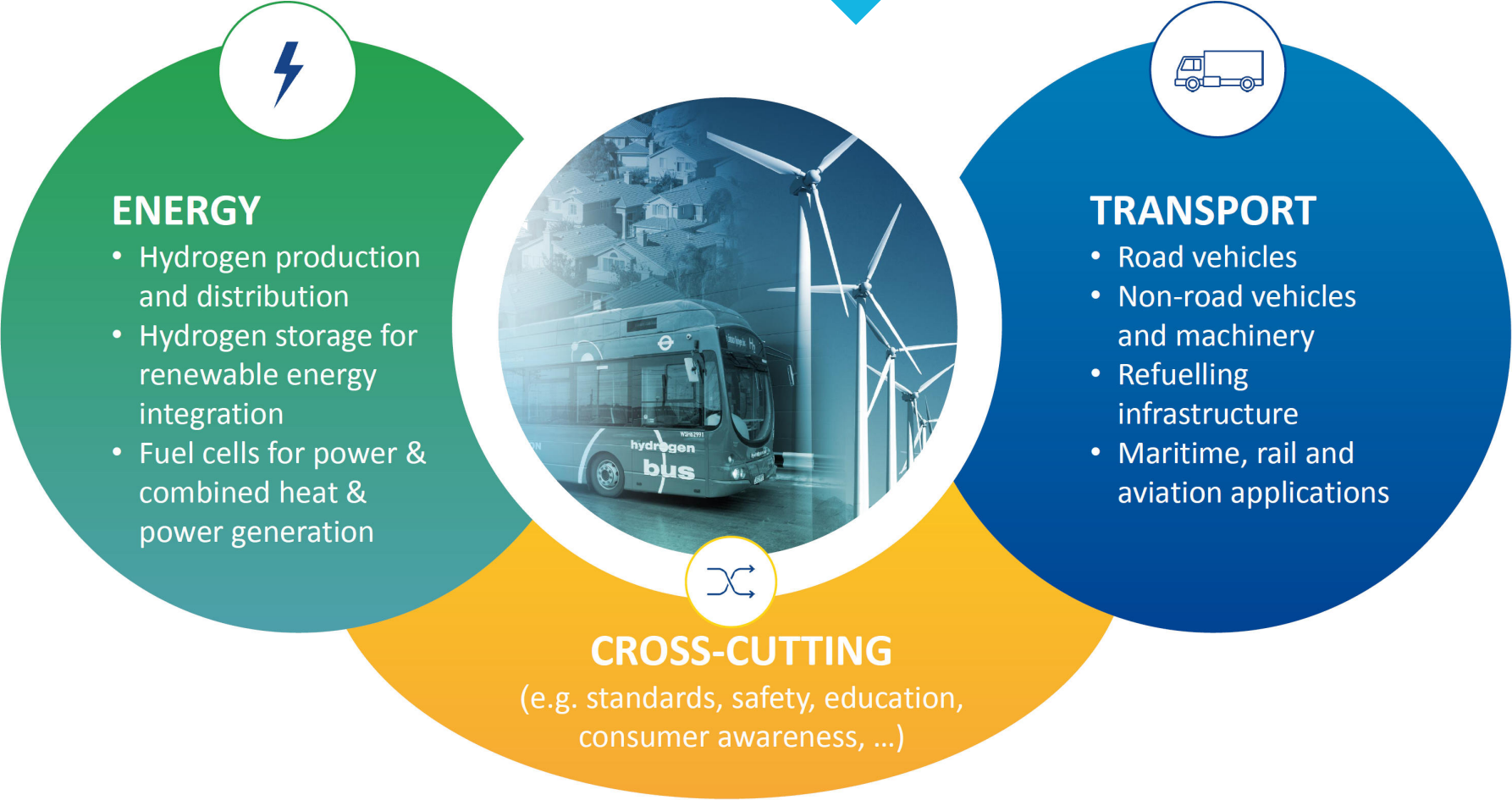
Structure & Activities: Innovation



&



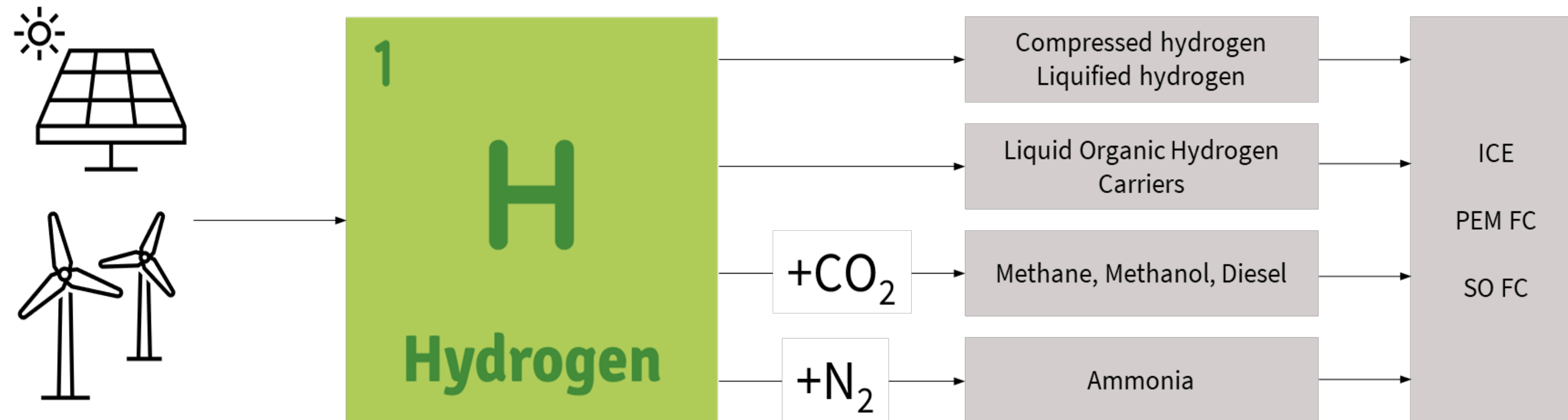
FUEL CELLS AND HYDROGEN
JOINT UNDERTAKING



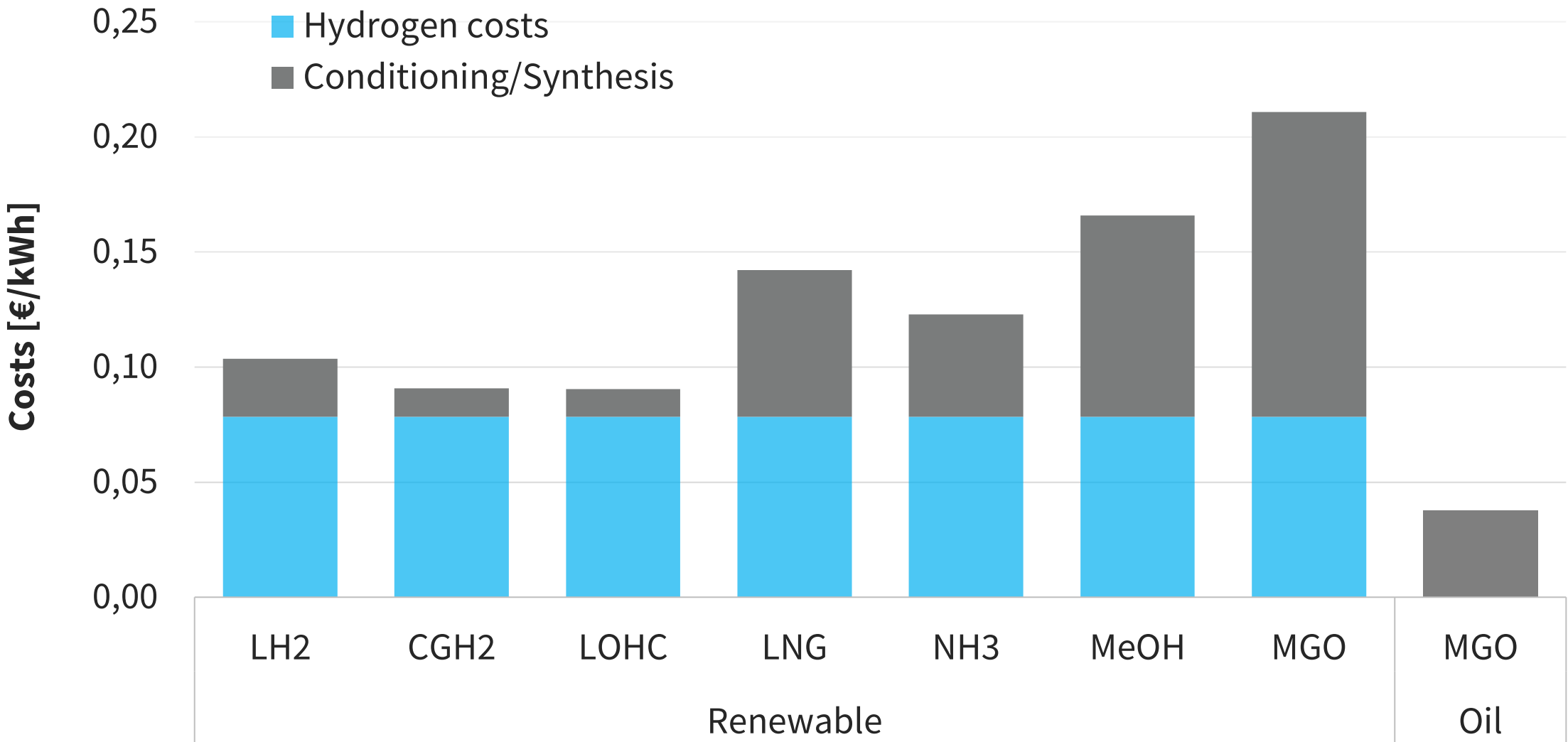
A portfolio of clean, efficient and competitive solutions based on fuel cells and hydrogen technologies in energy and transport.



Hydrogen based options



Results | FUELS



Key message:

When it comes to fuel production costs alone, **pure hydrogen** options are always cheaper than fuels that require further ‘transformation’ – regardless of electricity price

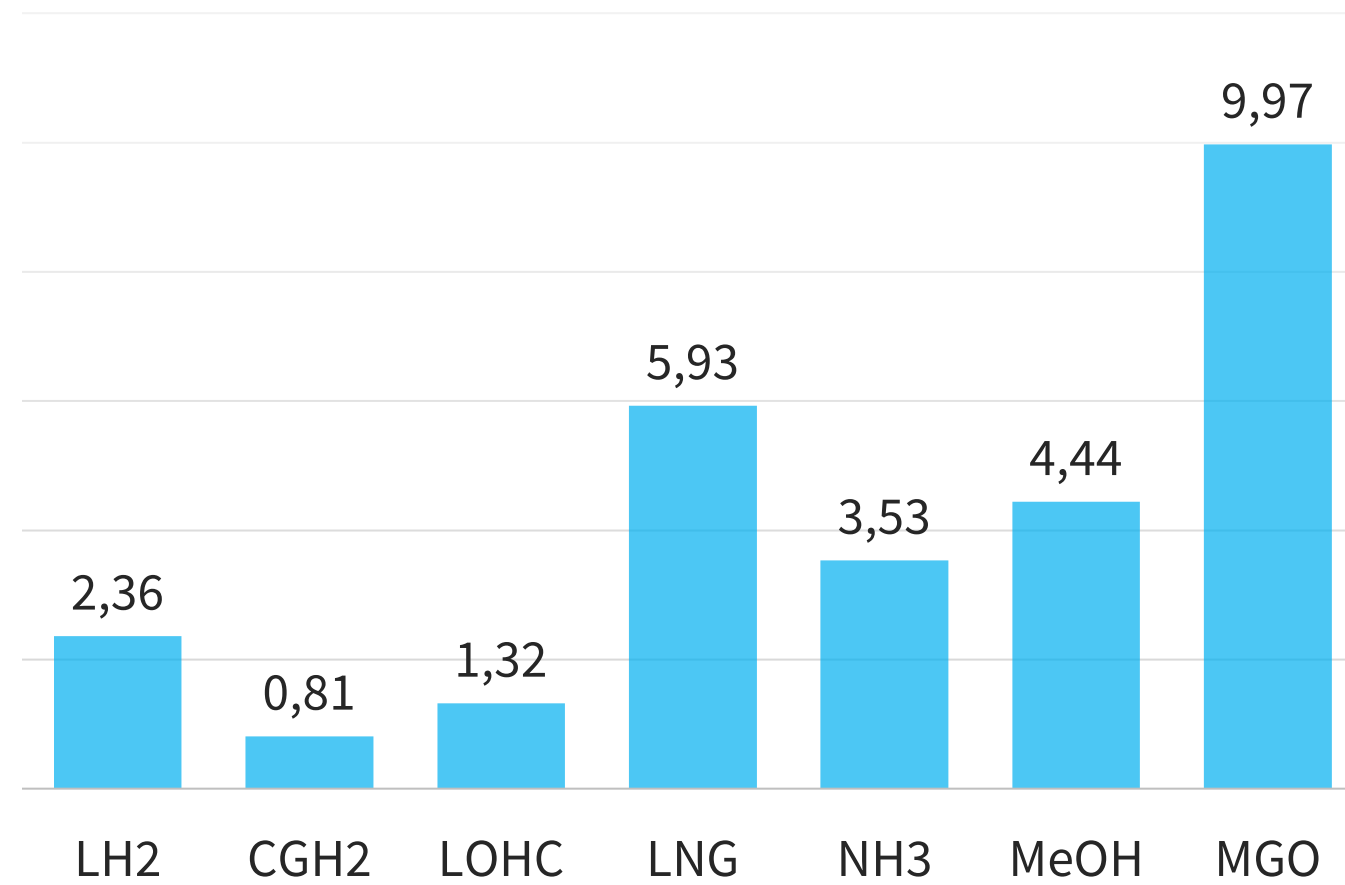
Ammonia is the cheapest synthetic fuel

(1) renewable energy costs at 40 EUR/MWh
(2) Natural gas costs at 30 EUR/MWh

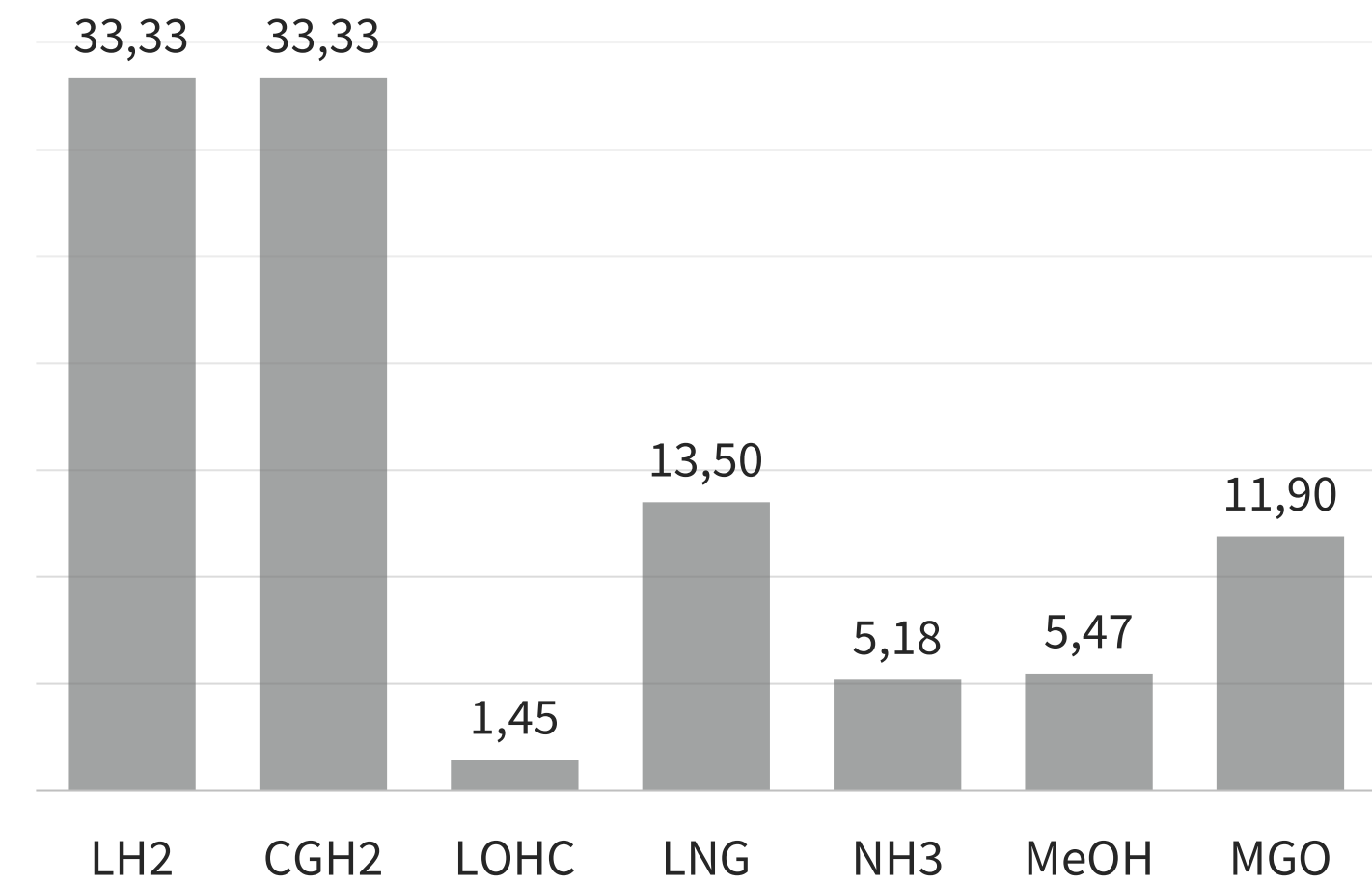
Source: Hydrogen Europe

Results | STORAGE

Volumetric energy density (kWh/l)



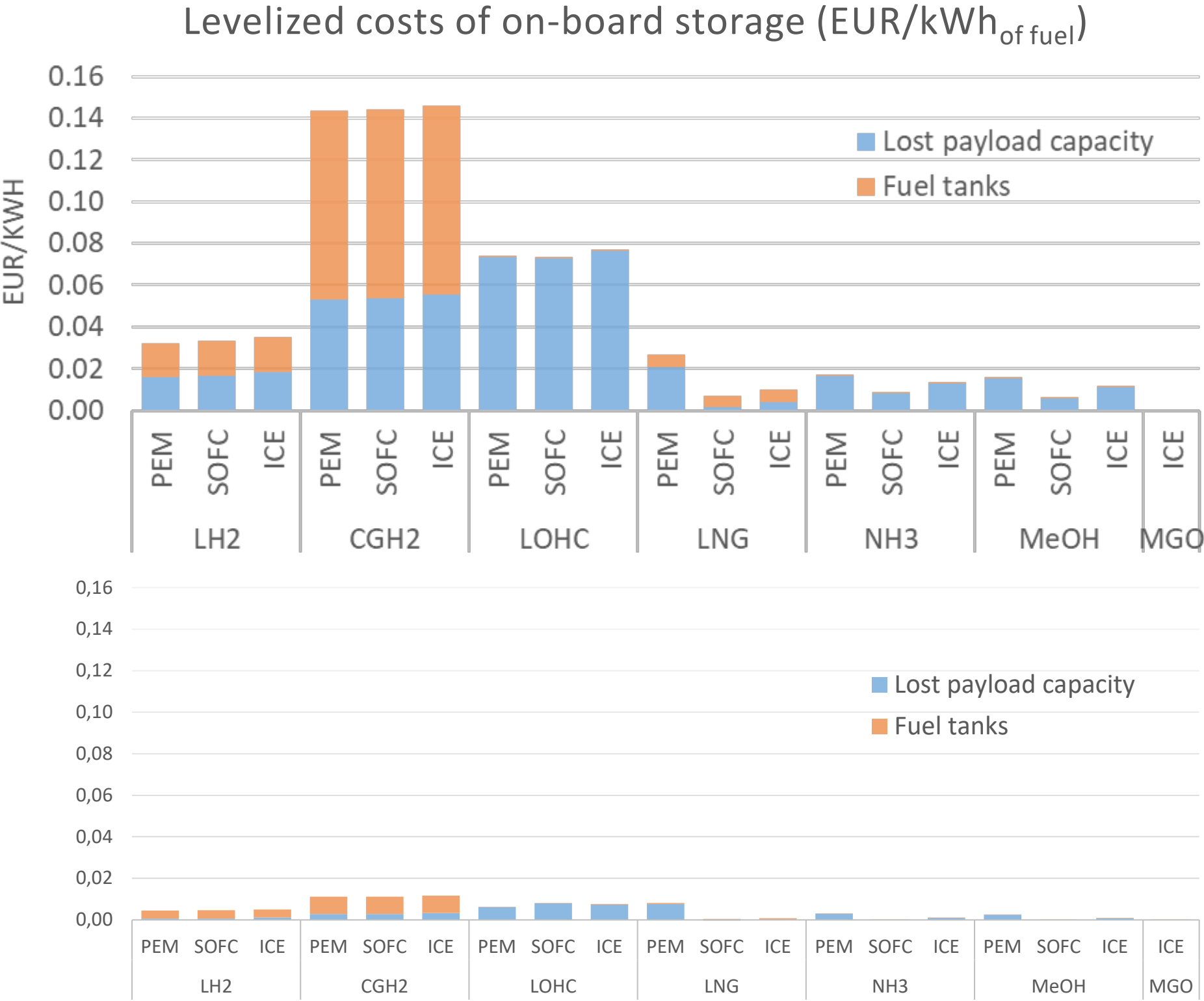
Gravimetric energy density (kWh/kg)



Results | STORAGE

Container
14,500+ TEU

Feeder
vessel



Source: Hydrogen Europe

Total costs of storage

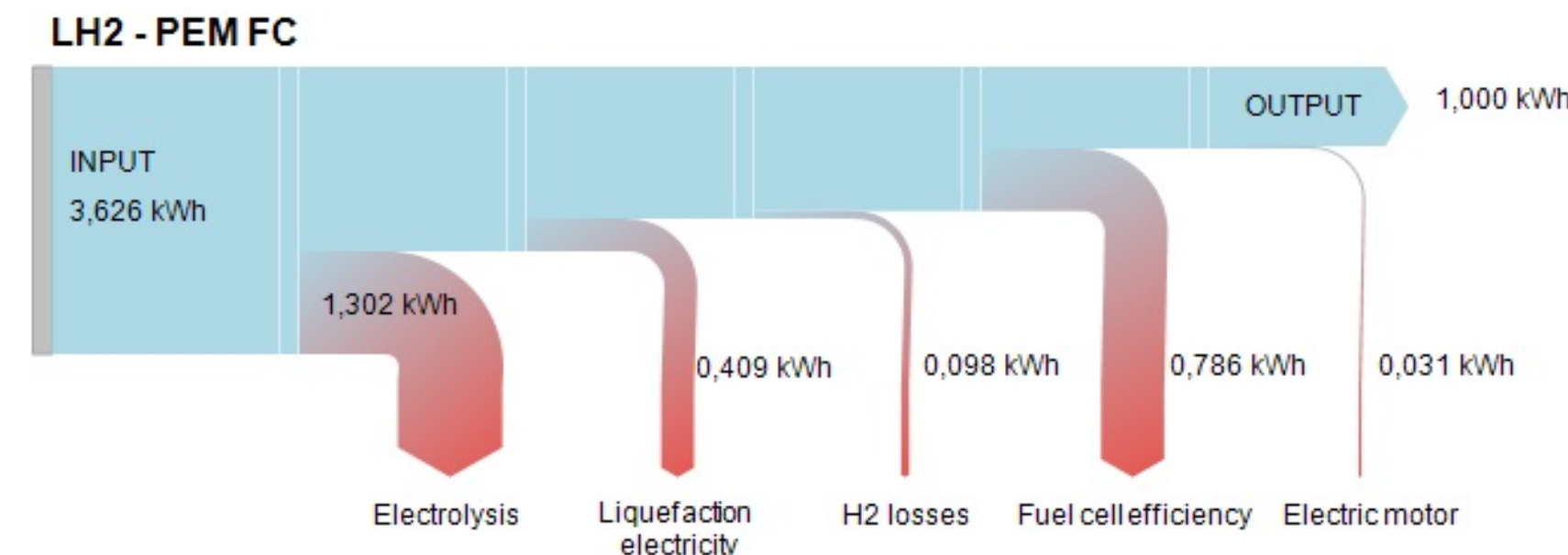
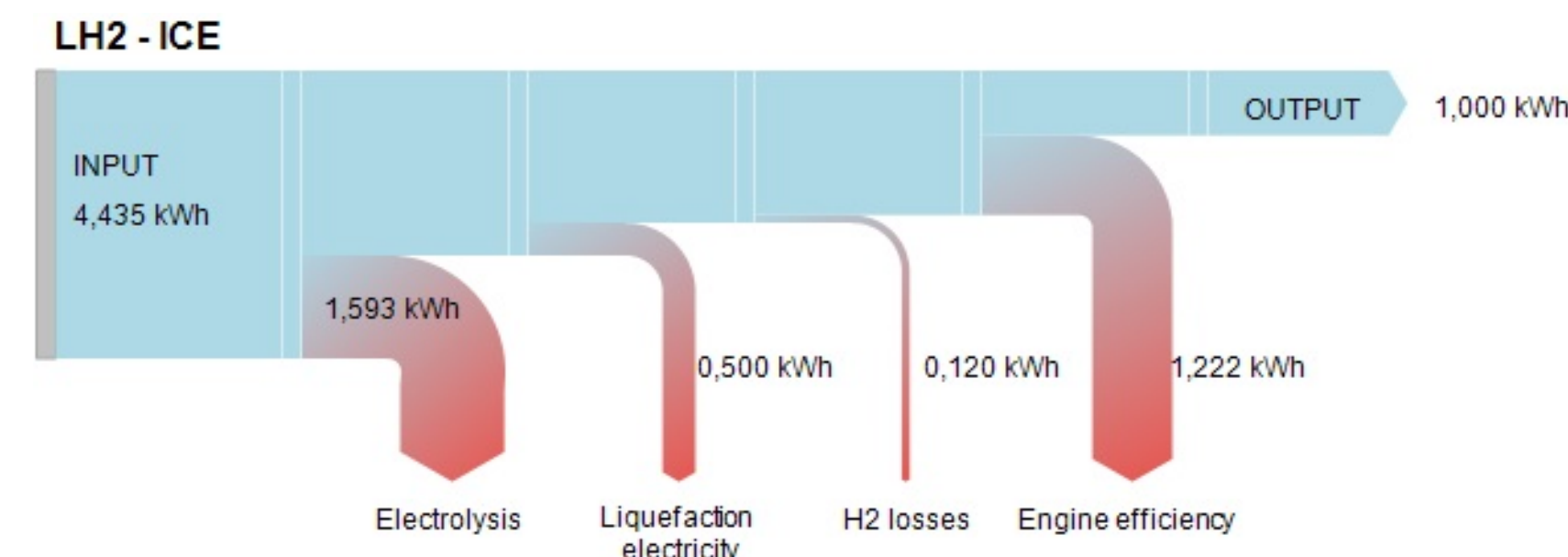
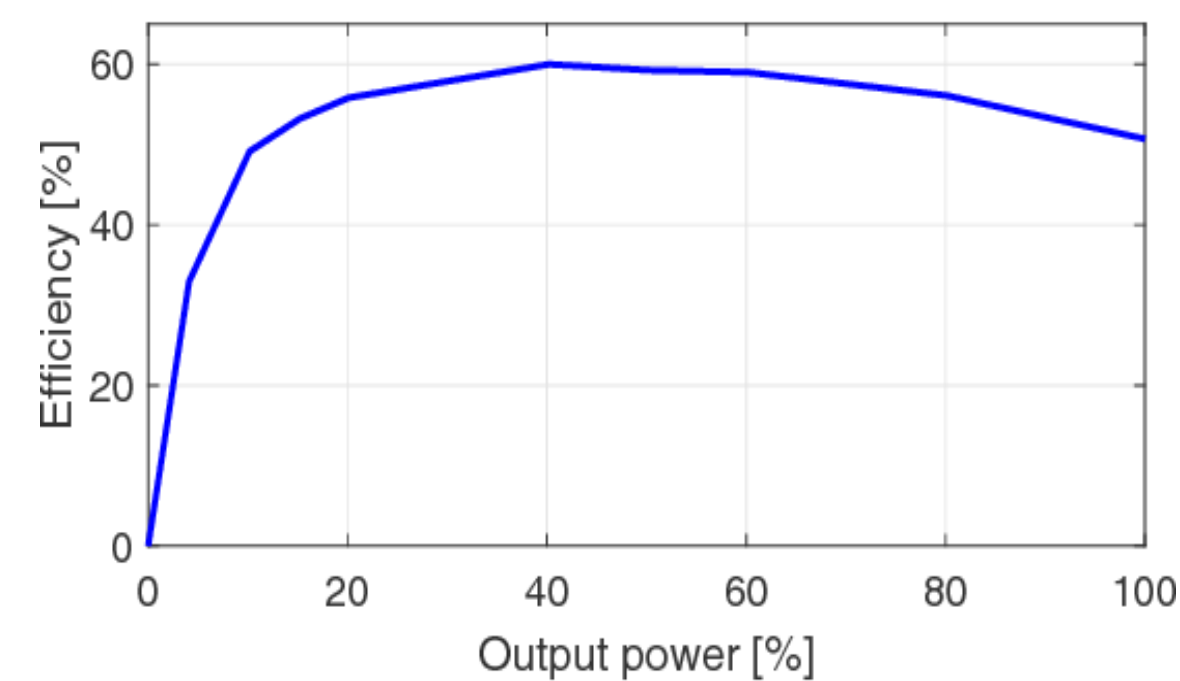
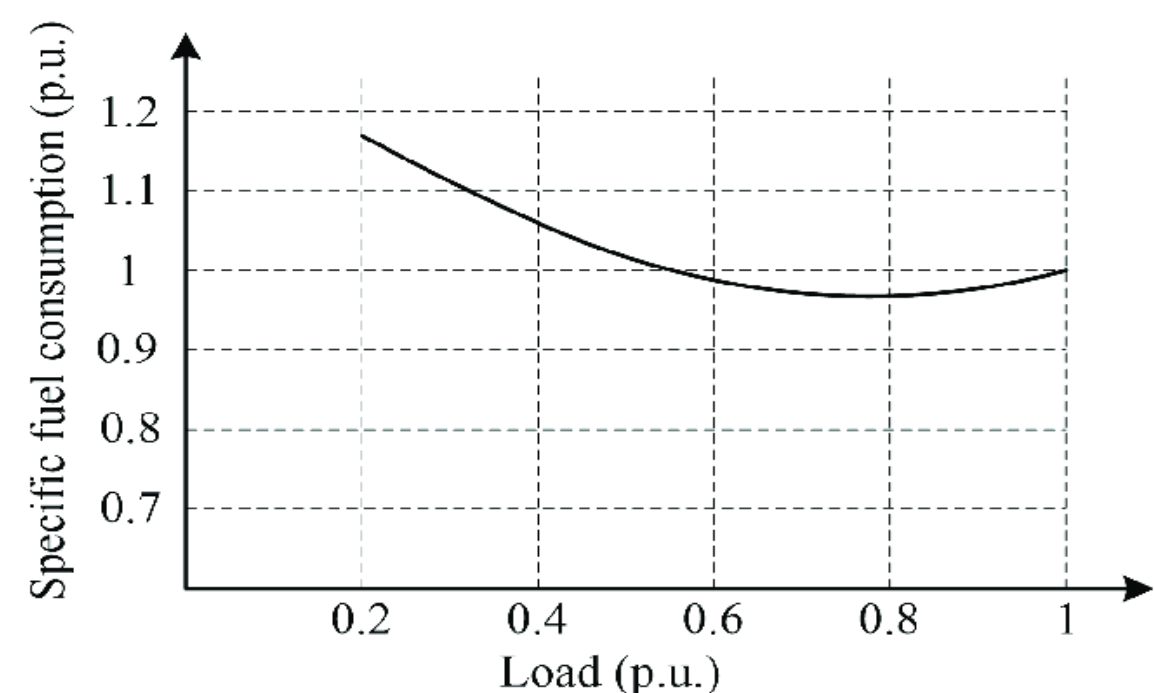
Key message:

While onboard storage costs are always higher for pure hydrogen options – the impact of those extra costs varies significantly between ship types.

For **deep sea shipping** vessels it becomes prohibitively high ...

...while for **short sea shipping** vessels its 'manageable'

Results | Energy conversion



Emerging conclusions

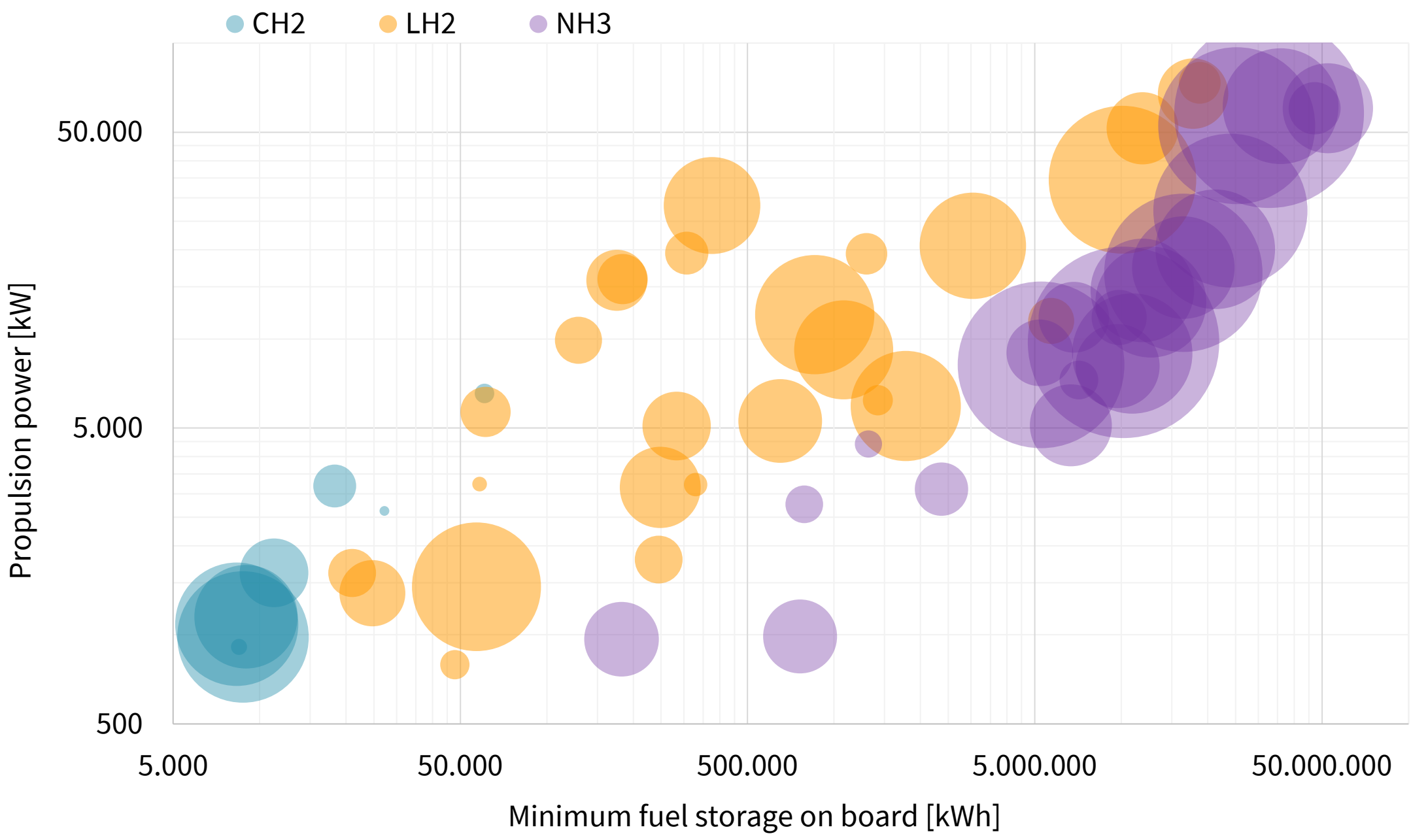
COST OF FUEL



ENERGY DENSITY



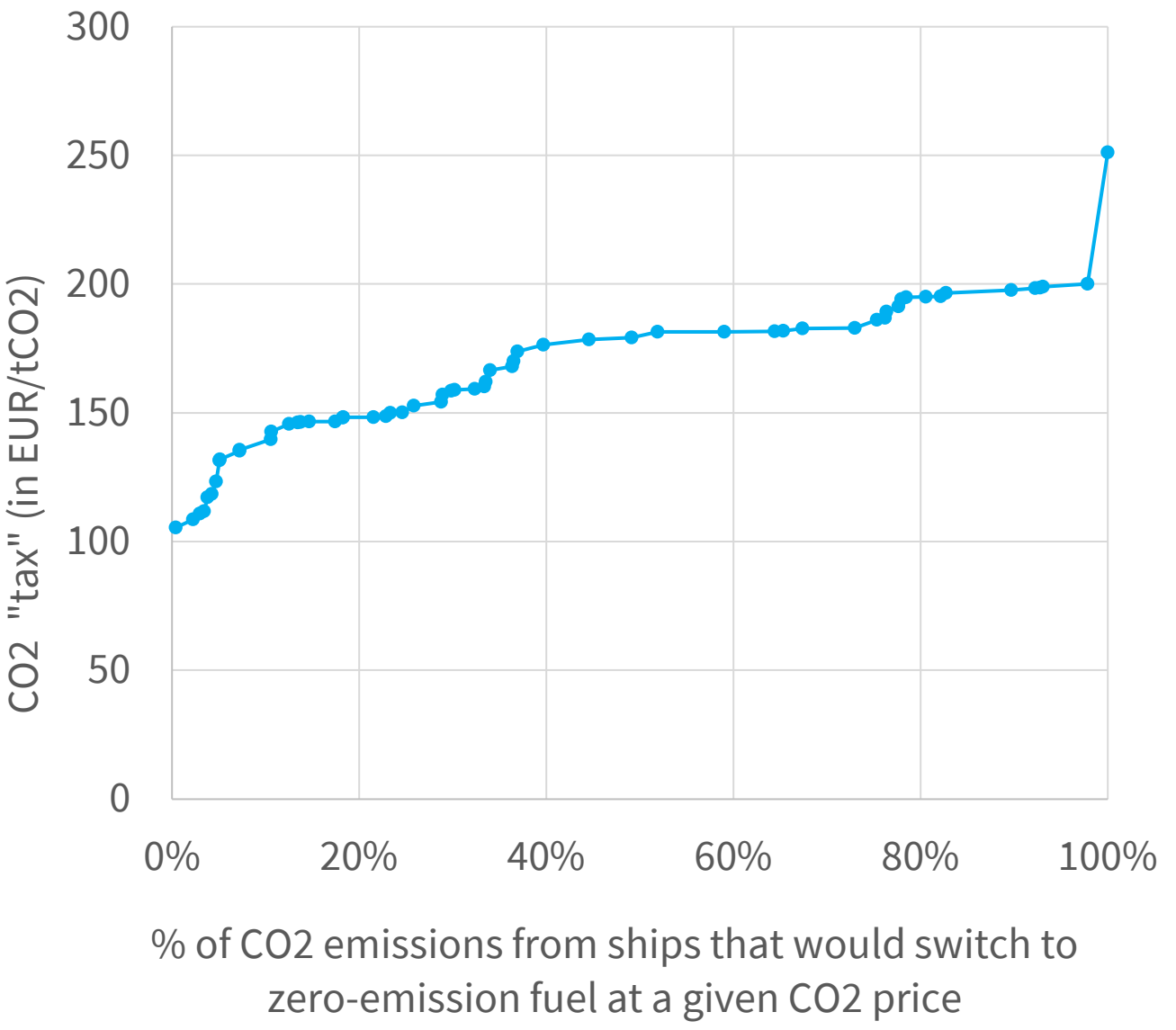
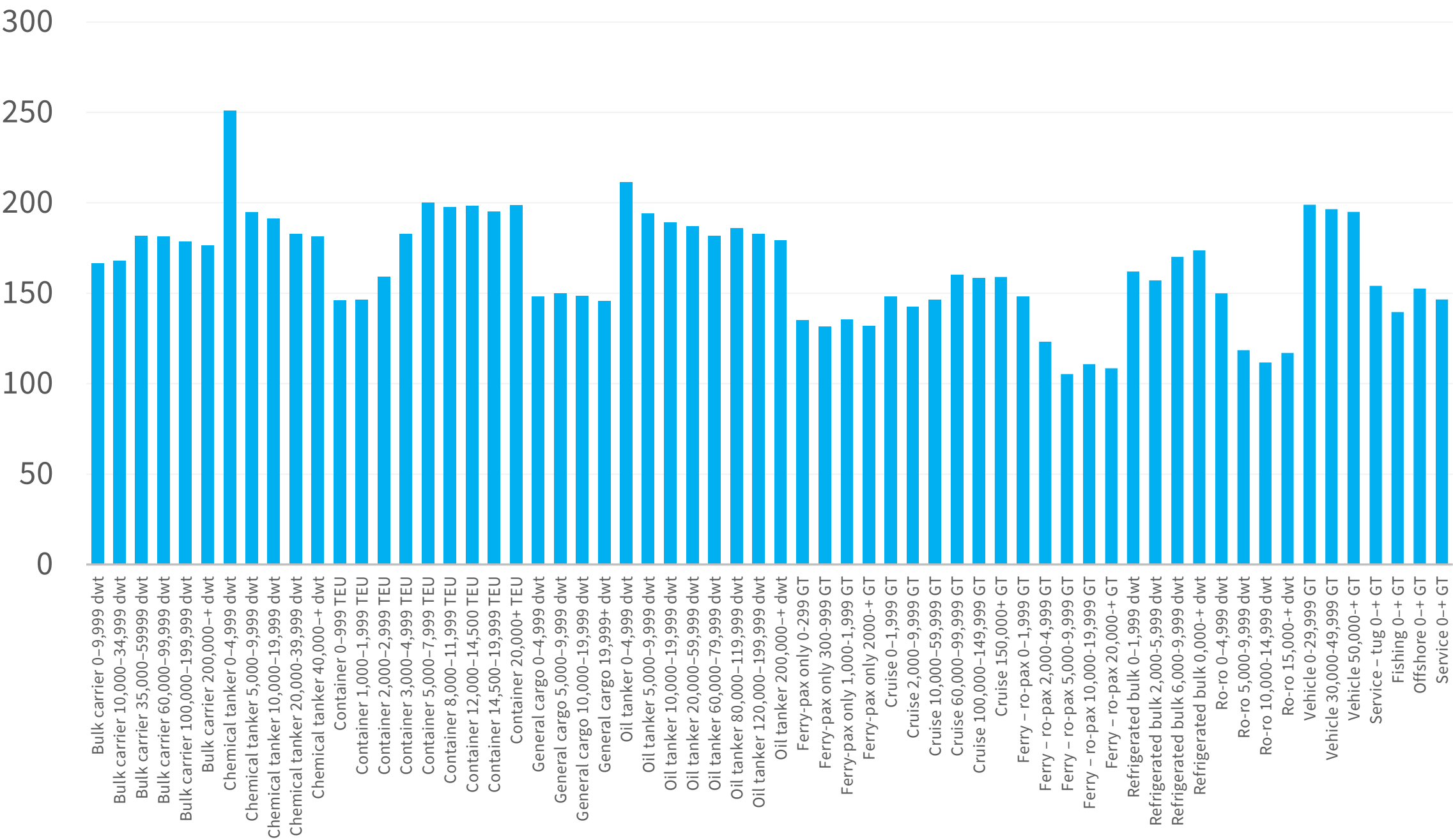
Emerging conclusions / MARKET SHARE



- 90% - e-ammonia
- 9% - LH₂
- 1% - CH₂

Is inclusion of the maritime sector in the ETS a good idea?

CO2 price for hydrogen option to break even with MGO



Thank you for your attention!

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