

HAV hydrogen

Ulstein Rotary

Hydrogen som maritimt drivstoff

2023-01-30

Kristian Ósnes

ENABLING
MARITIME
ZERO
EMISSION





H2hydrogen
Ullstein Rotary
Hydrogen som maritimt drivstoff
2023-11-08
Knutten Østrem
ENABLING MARITIME ZERO EMISSIONS



HAVhydrogen

Ulstein Rotary

Hydrogen som maritimt drivstoff

2023-01-30

Kristian Ósnes

SELSKAPENE

HAVhydrogen

Leverandør av hydrogensystemer til skip – HAV Hydrogen er en totalleverandør fra konsept til operasjon.

HAVdesign

Leverandør av innovativ skipsdesign – HAV Design er en pioner innenfor design og konstruksjon av nullutslipp skip.



norwegian
electric systems

Leverandør av bærekraftig energidesign og smartkontroll-systemer til de fleste typer skip på det globale markedet.



norwegian
greentech

Leverandør av ballastvann-systemer til skip, samt andre komplementære vannbehandlingssystemer til akvakultur og maritim næring.

HAVhydrogen

HAV HYDROGEN

VÅR MISJON

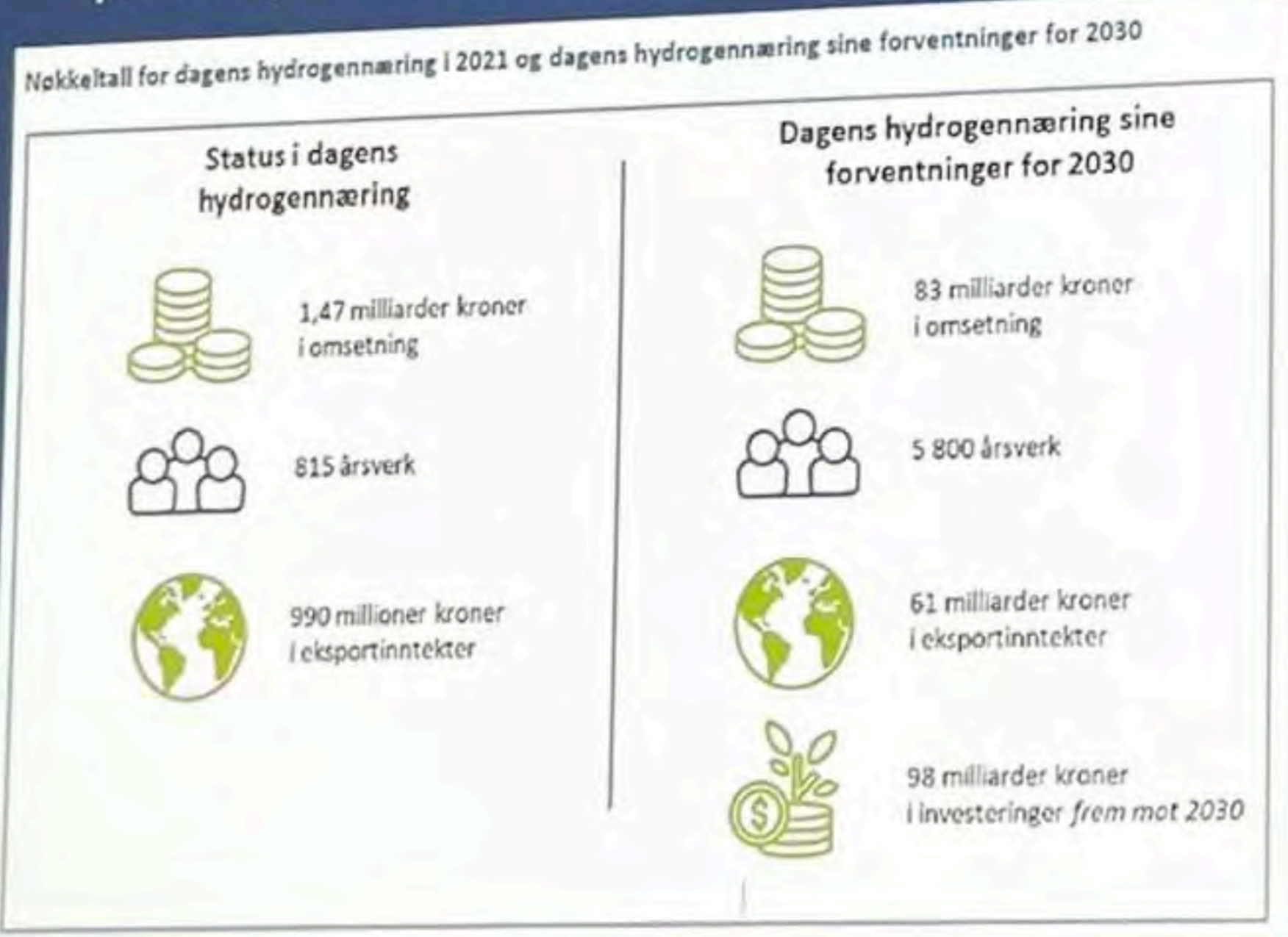
Å levere hydrogenbaserte, maritime
nullutslippsenergisystemer og kompetansen
til å optimalisere og godkjenne løsningene



havhydrogen.no

Rask utvikling i hydrogentilgang

- Kartlegger relevant produksjon og havner i Europe
- Kobler redere med relevant hydrogen leveranse
- EU plan: REPower har målsetning om 10M tonn H2 produksjon i EU og 10M tonn importert H2 innen 2030.

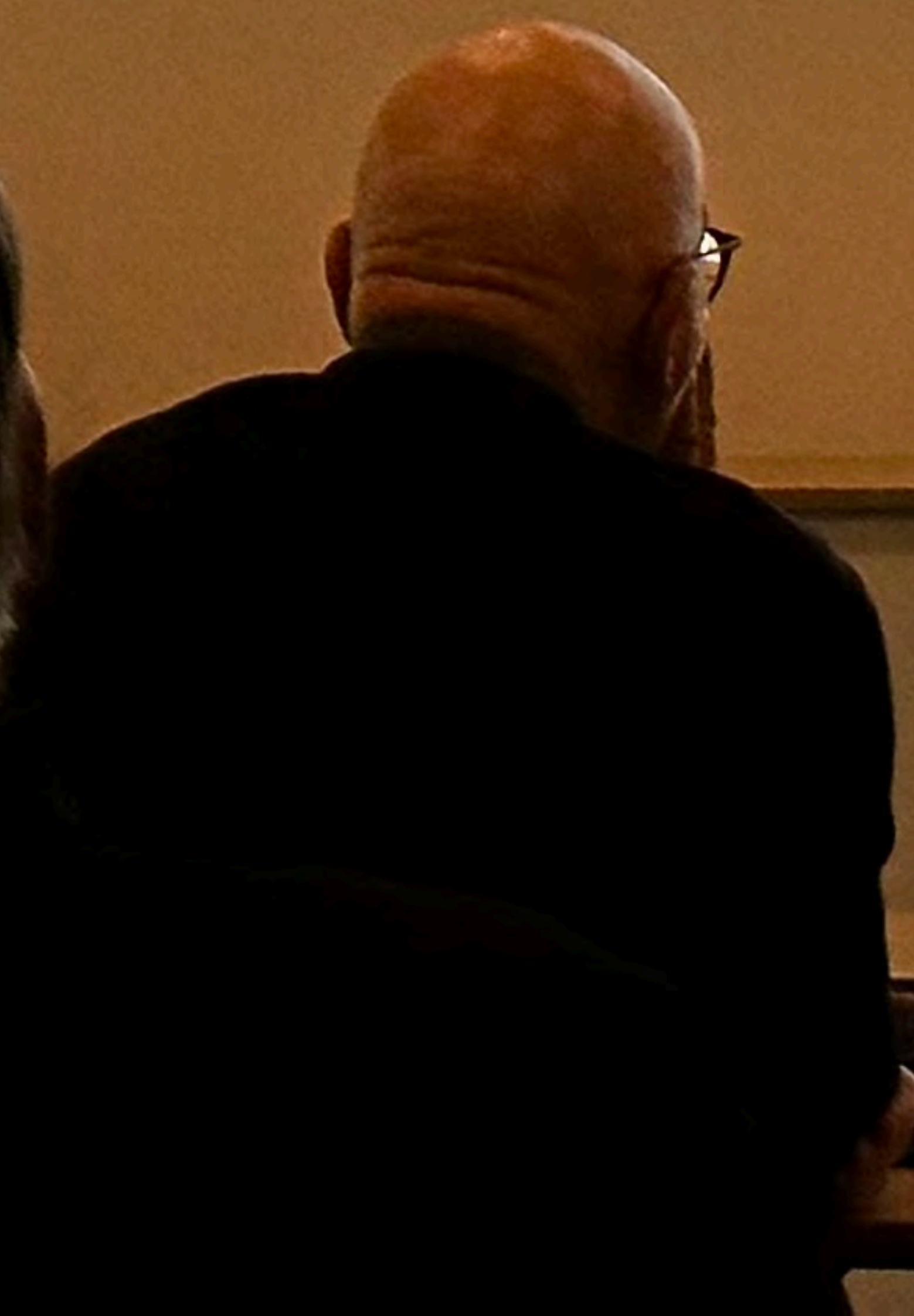
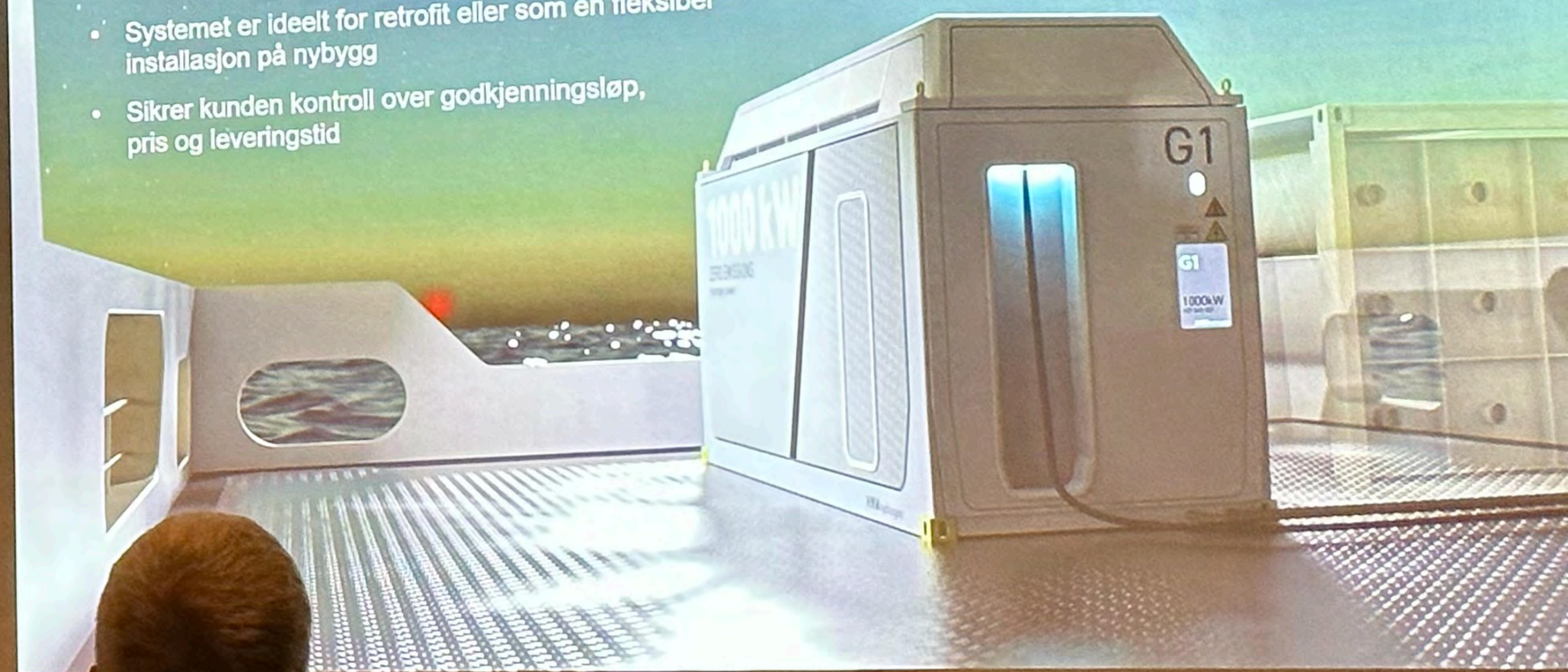


Source: Menon: Current state of the hydrogen industry
https://ec.europa.eu/info/news/renewable-hydrogen-decarbonise-eus-energy-system-2022-nov-15_en



Komplett hydrogen FC konteiner

- Integrerer brenselceller, sikkerhetssystem, ventilasjon, kjøling og kraftelektronikk i en konteiner
- Systemet er ideelt for retrofit eller som en fleksibel installasjon på nybygg
- Sikrer kunden kontroll over godkjenningssløp, pris og leveringstid



Komplett hydrogen FC konteiner

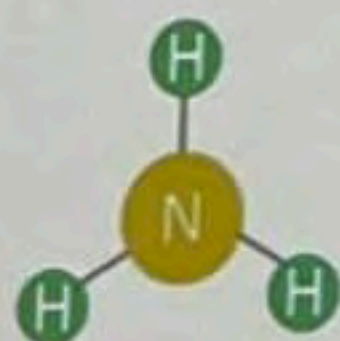
- Integrerer brenselceller, sikkerhetssystem, ventilasjon, kjøling og kraftelektronikk i en konteiner
- Systemet er ideelt for retrofit eller som en fleksibel installasjon på nybygg
- Sikrer kunden kontroll over godkjenningsløp, pris og leveringstid



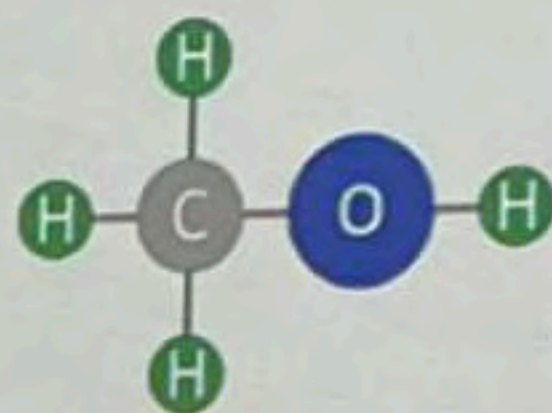
Alternative drivstoff (energibærere)



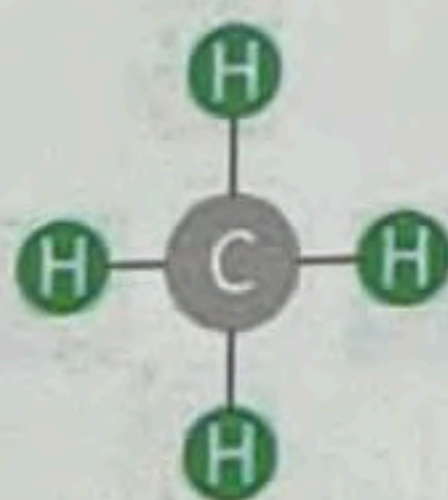
Hydrogen



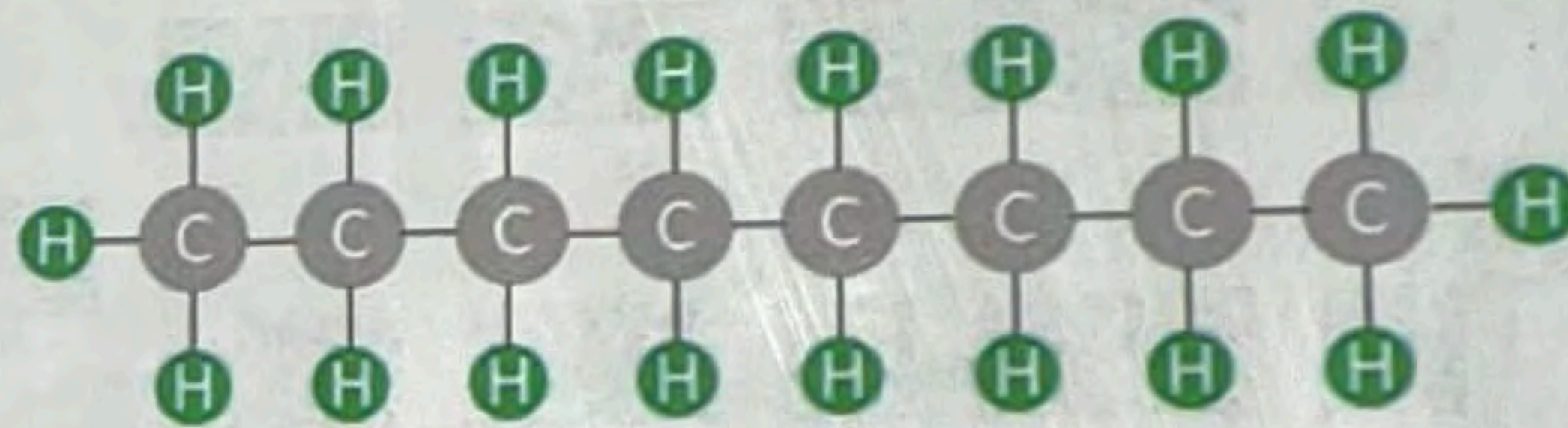
Ammonia



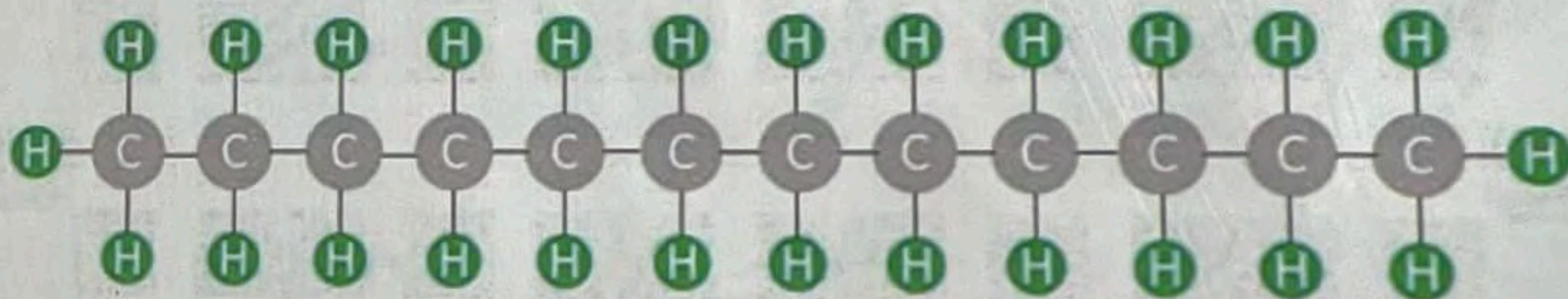
Methanol



Methane

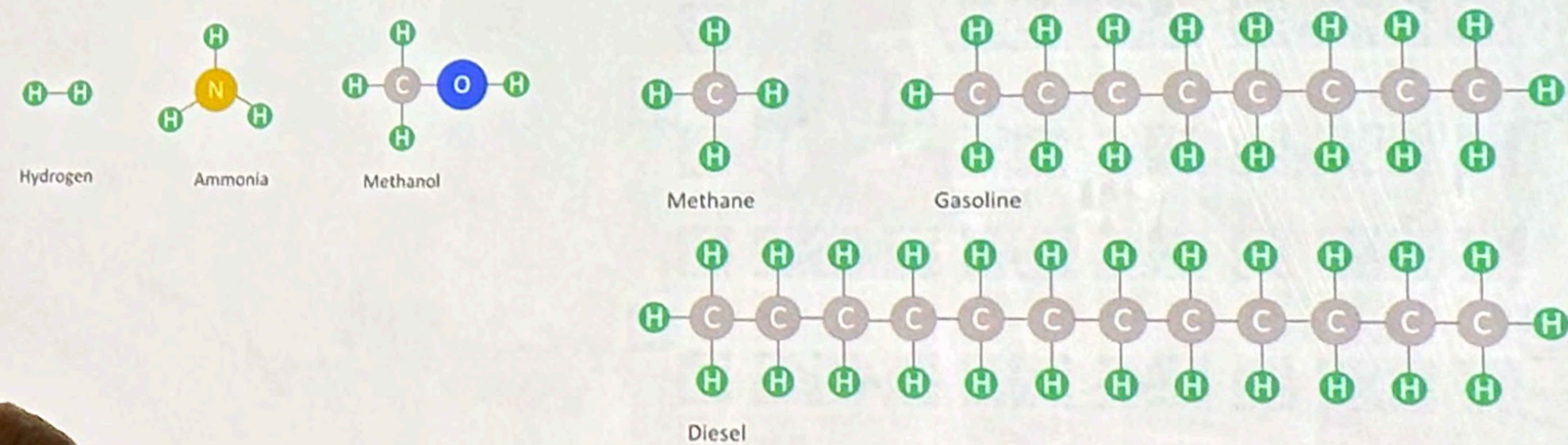


Gasoline



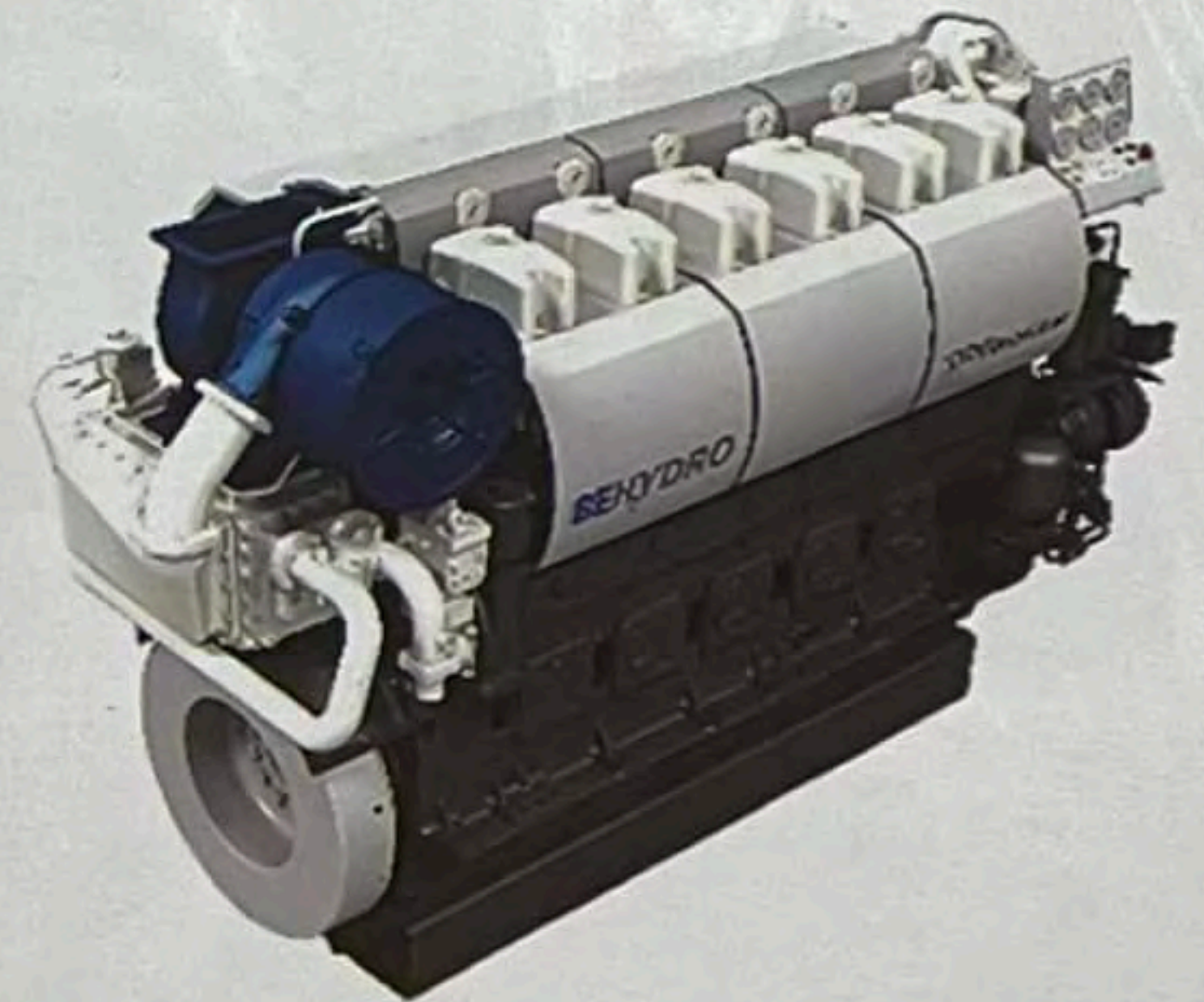
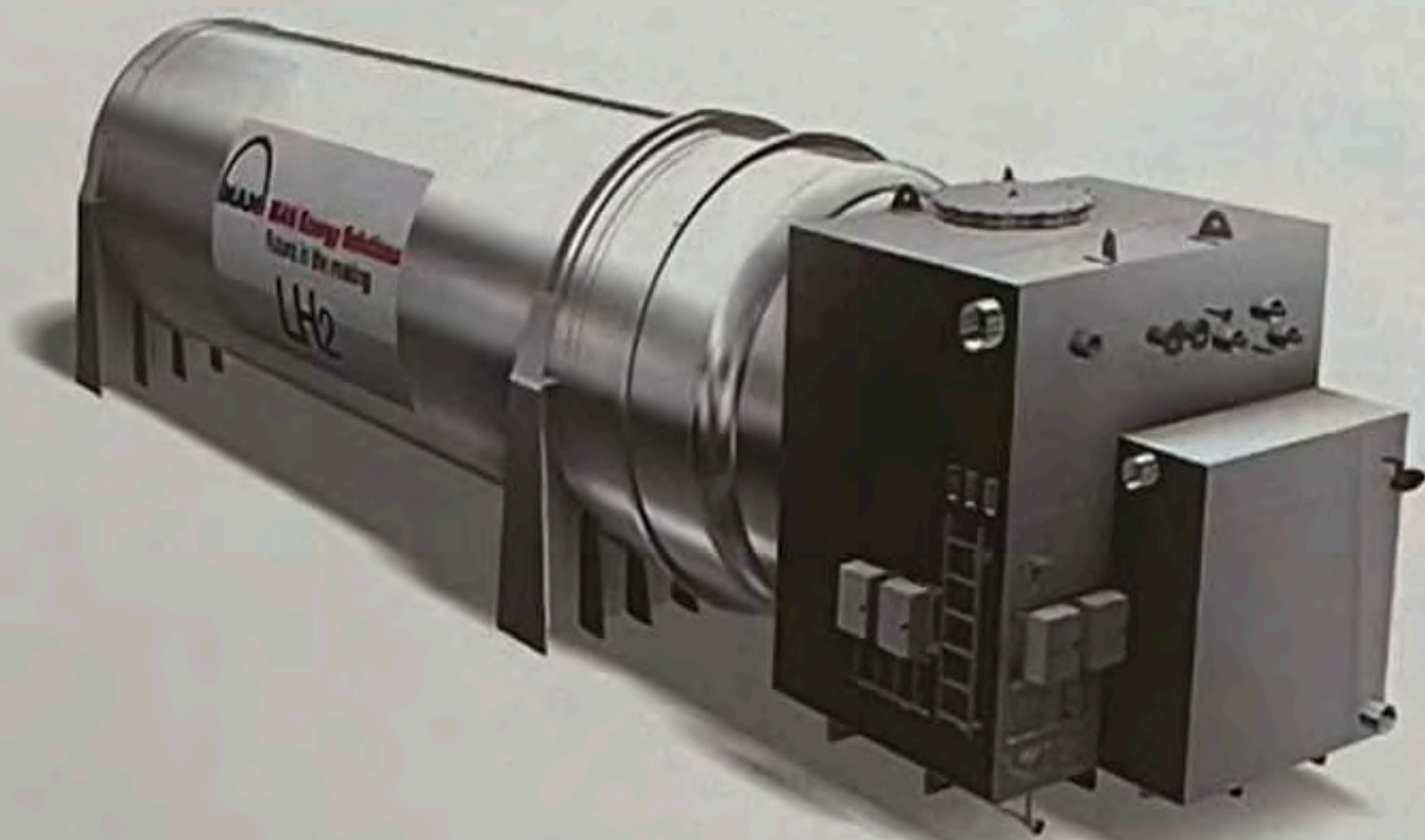
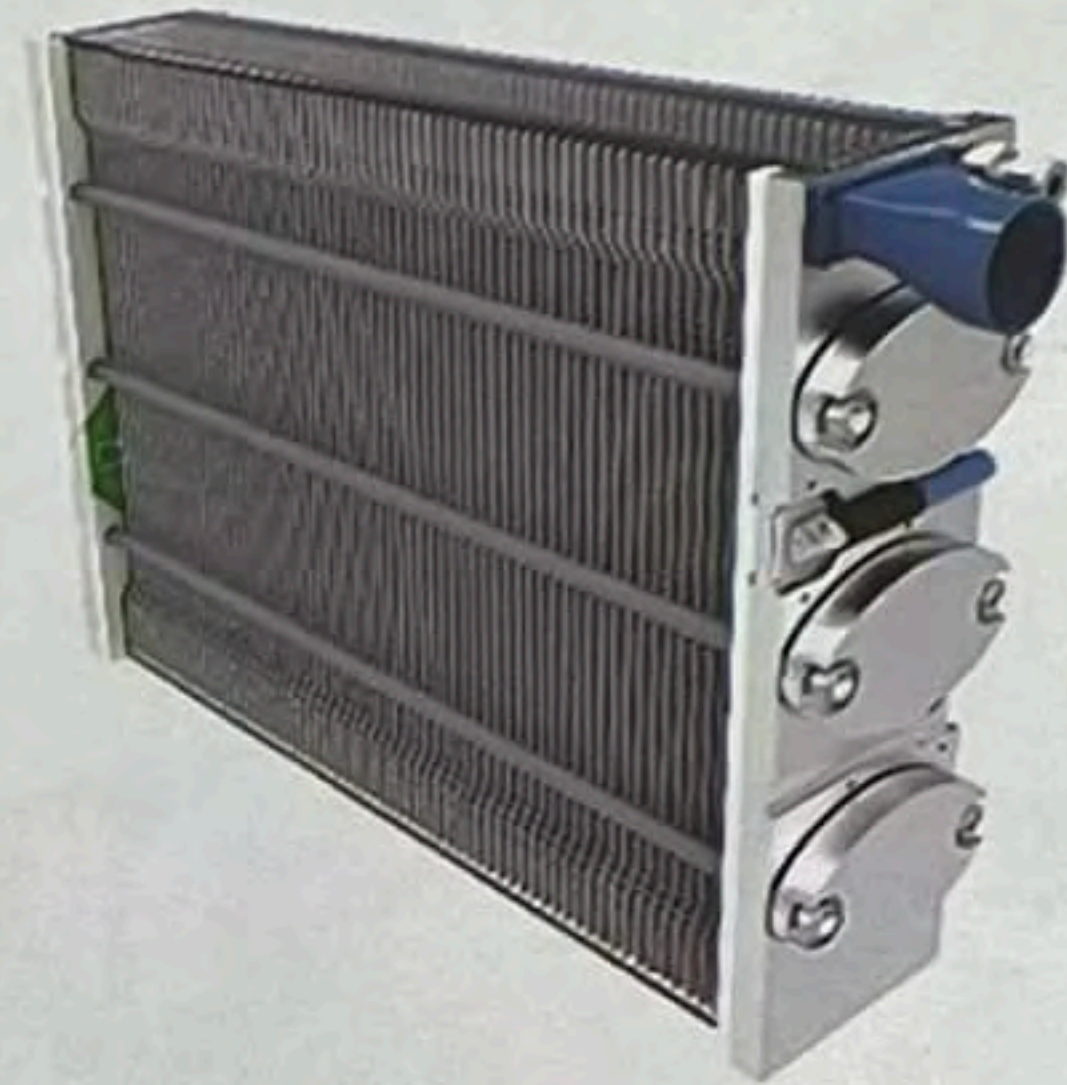
Diesel

Alternative drivstoff (energibærere)

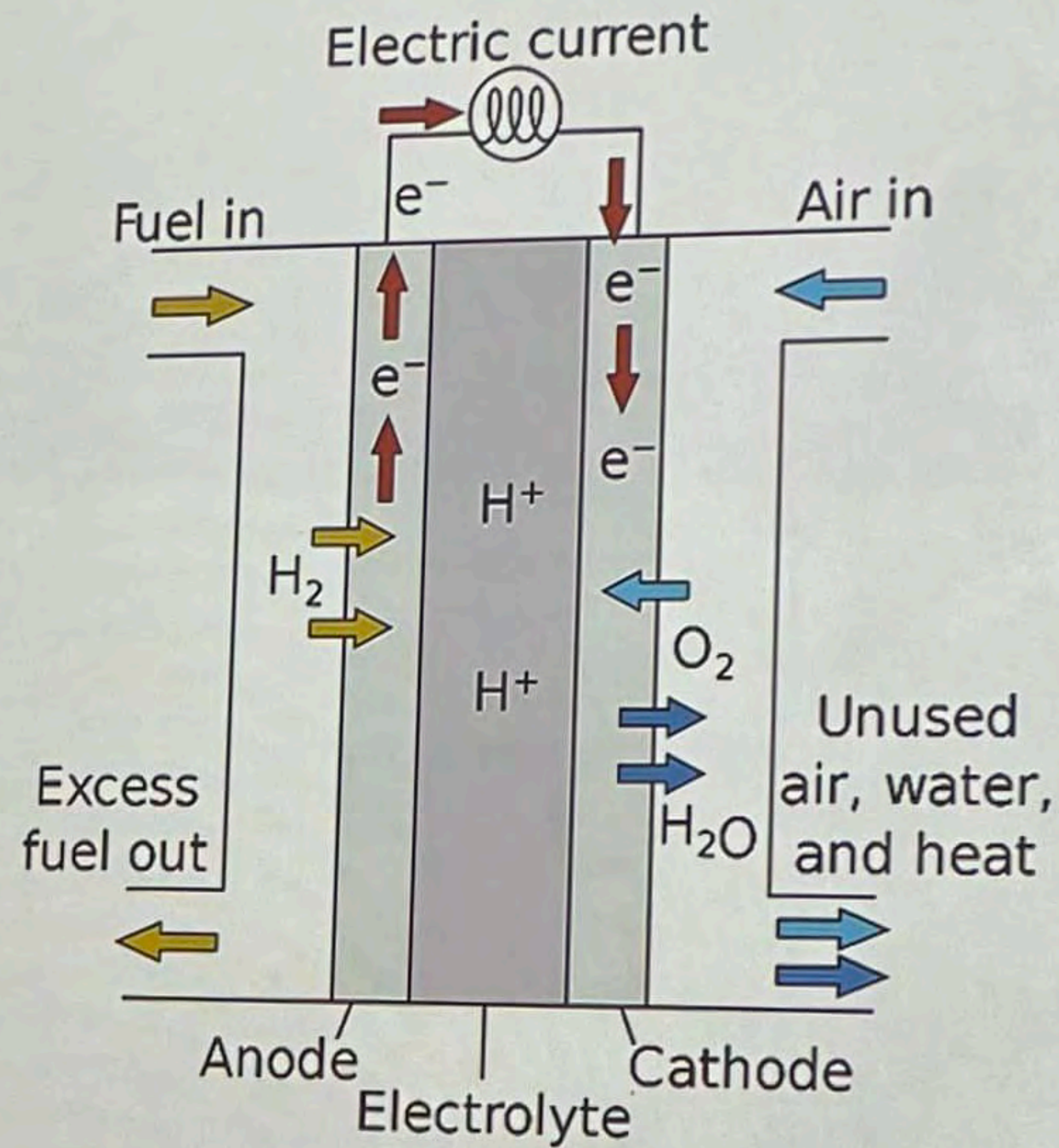


HAV hydrogen

Lagring og forbrenning av H₂

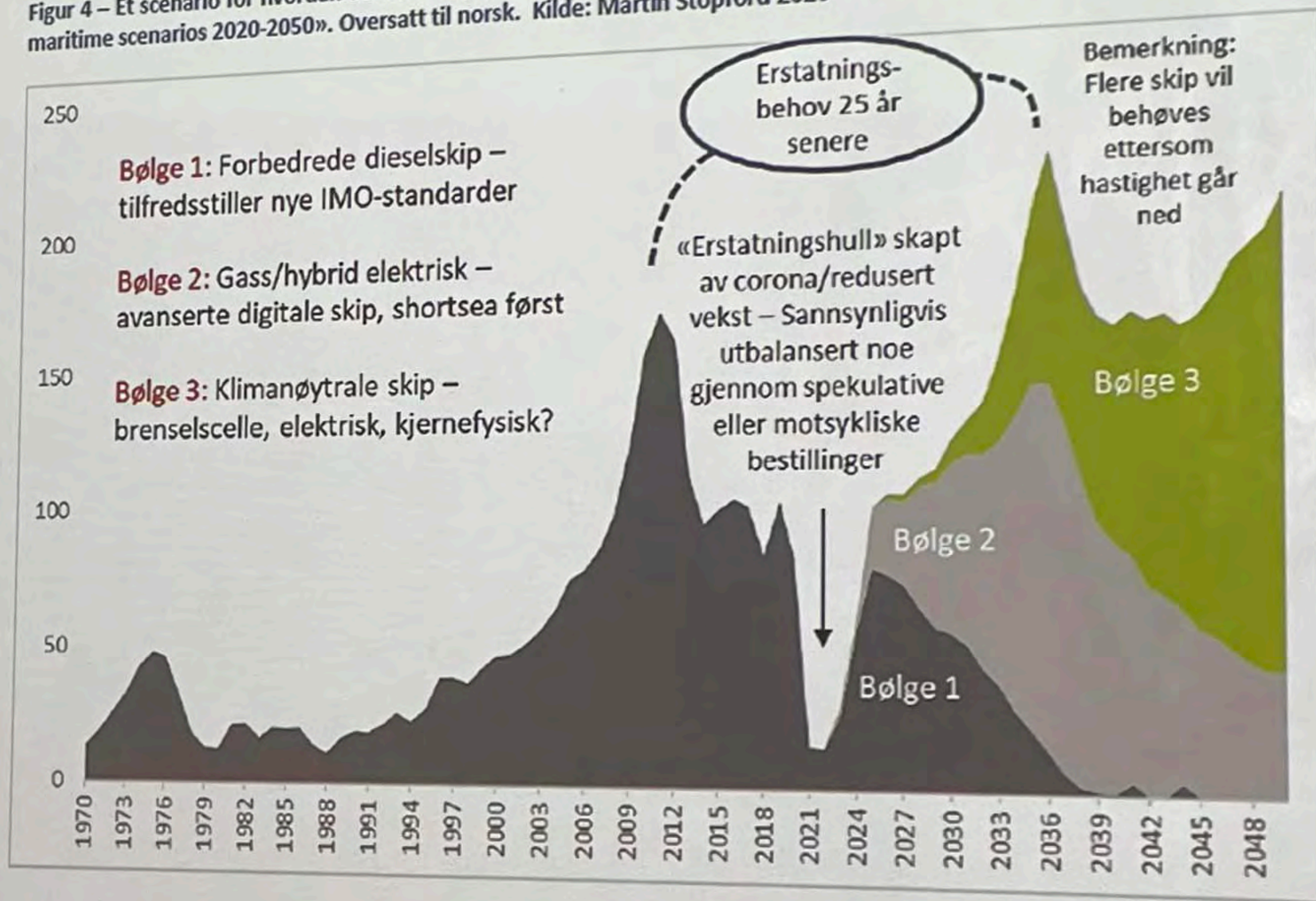


Proton Exchange Membrane (PEM fuelcell)



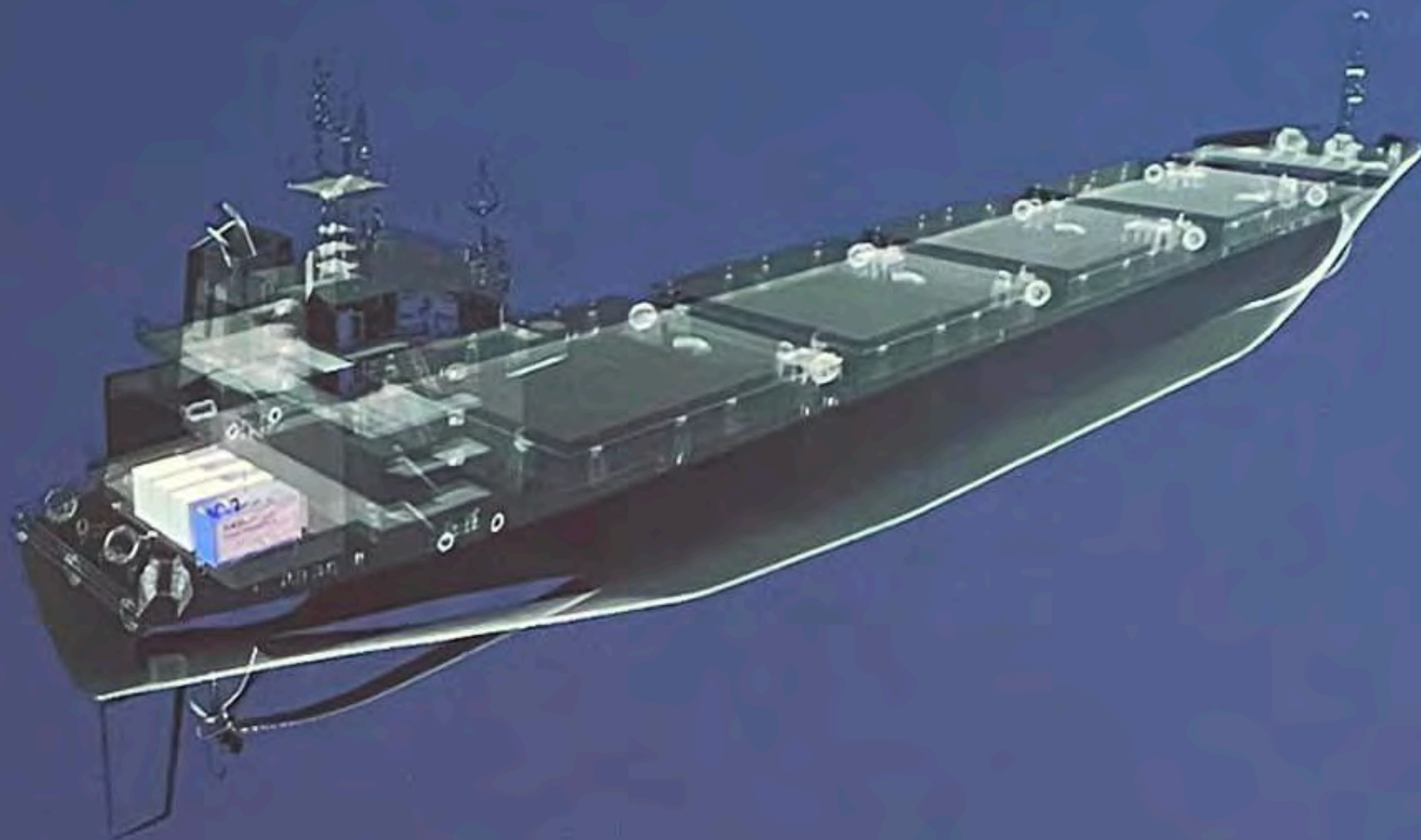
Maritimt nullutslippsmarked

Figur 4 – Et scenario for hvordan verdens skipsbehov vil utvikle seg fram mot 2050. Hentet fra «Martin Stopford – Three maritime scenarios 2020-2050». Oversatt til norsk. Kilde: Martin Stopford 2020



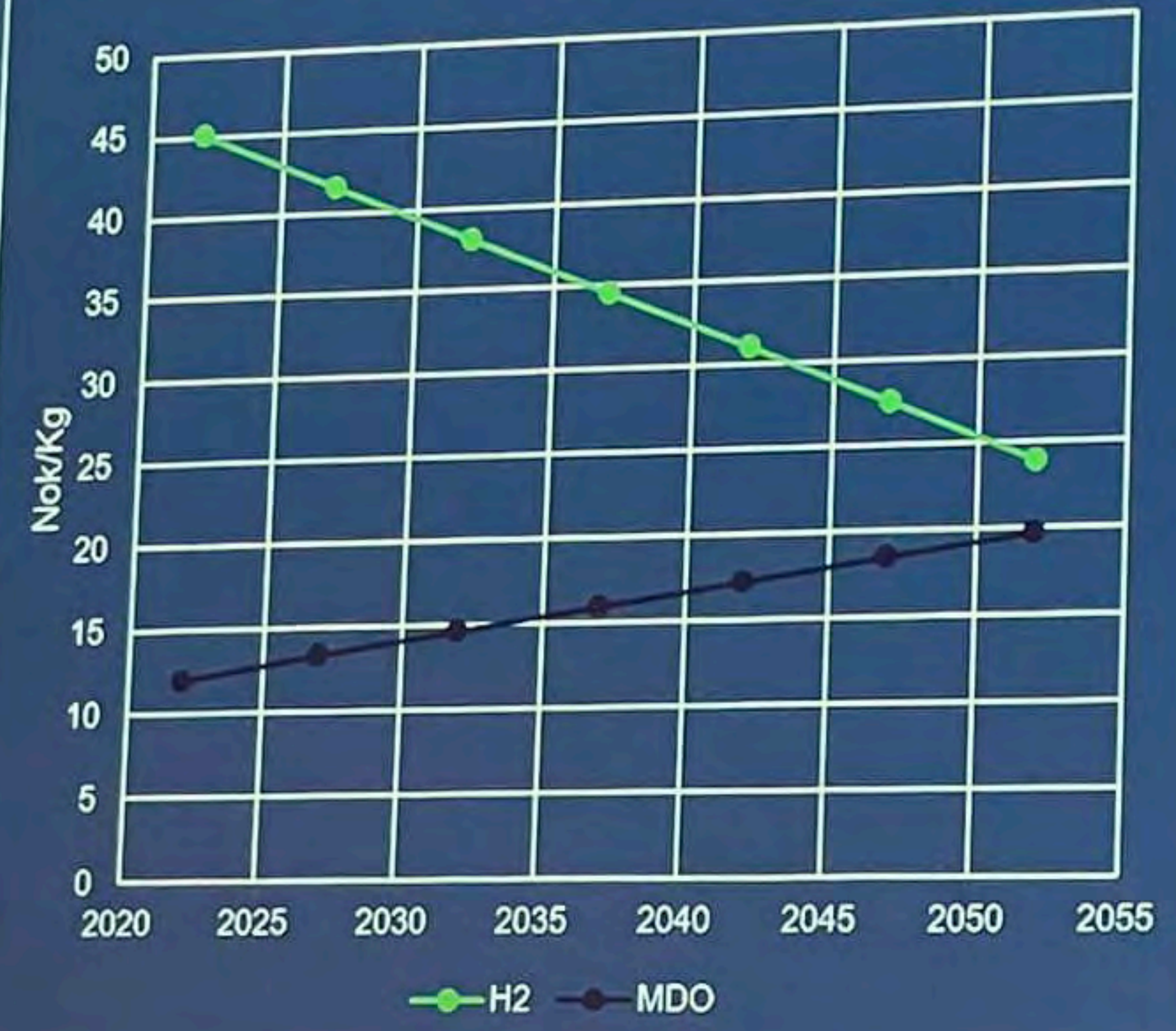
Typical case study

- Shortsea Cargo Ship
- Size: 5000DWT
- Speed: 8 knots
- Installed Fuelcell Power: 2MW
- Sailing distance: Trondheim – Berlevåg 730NM)
- 100M NOK Typical Cost (Fuelcell Container, H2 Storage tanks)

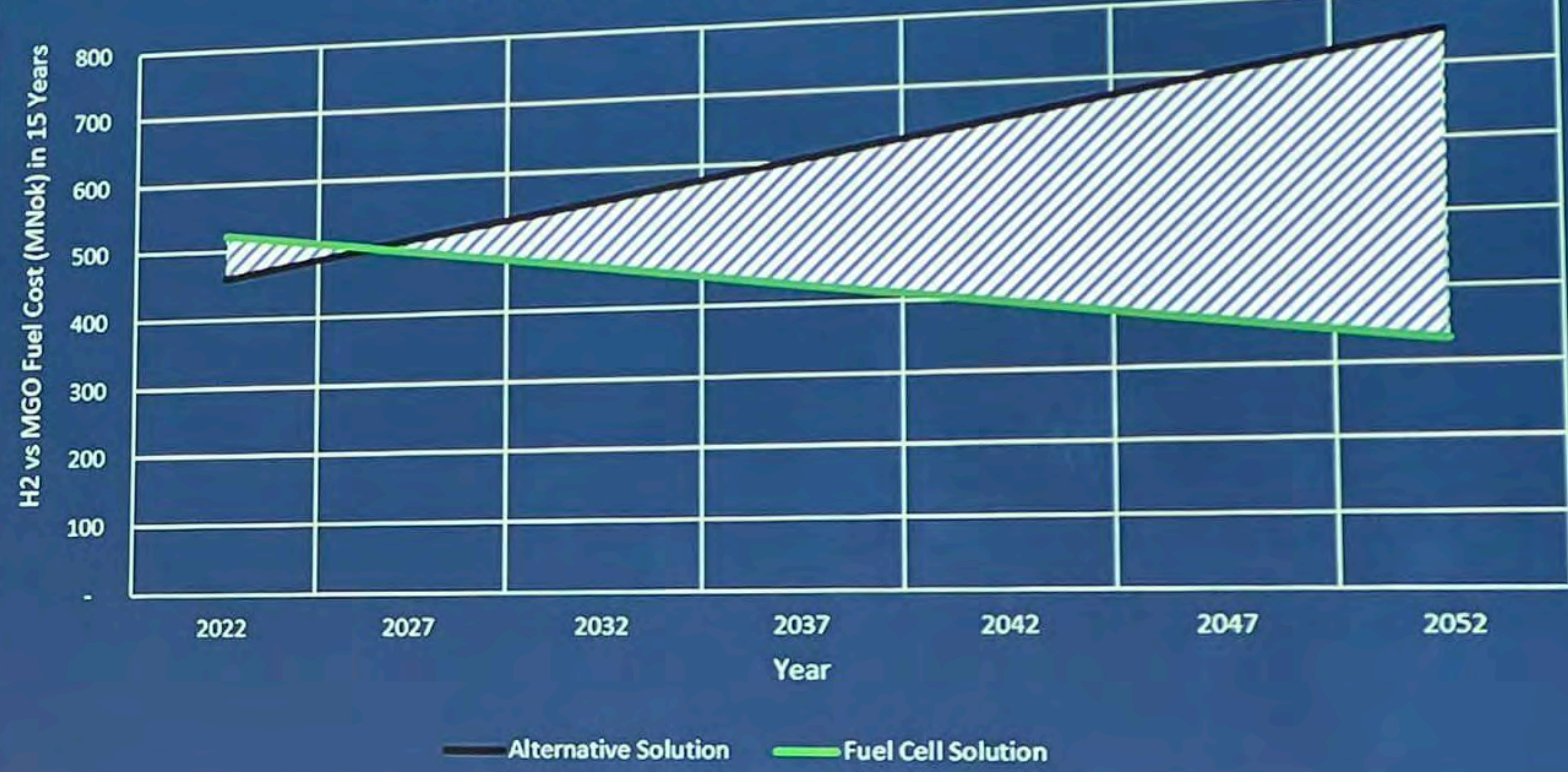


Profitable investment on 15 year TCO

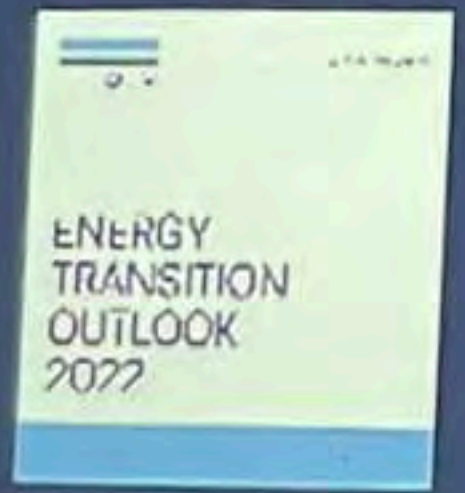
H2 vs MDO price development



TCO diesel vs H2 future development

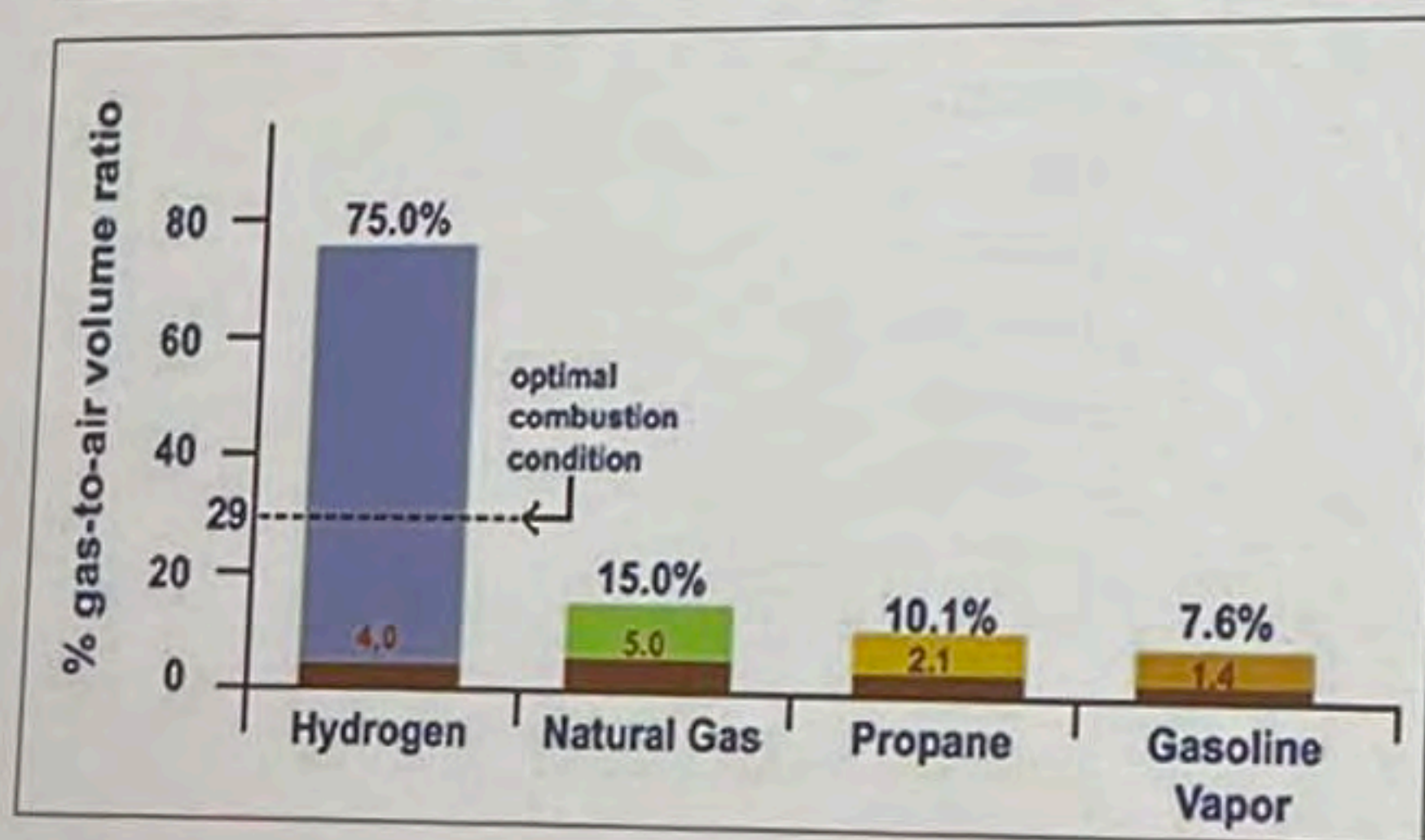
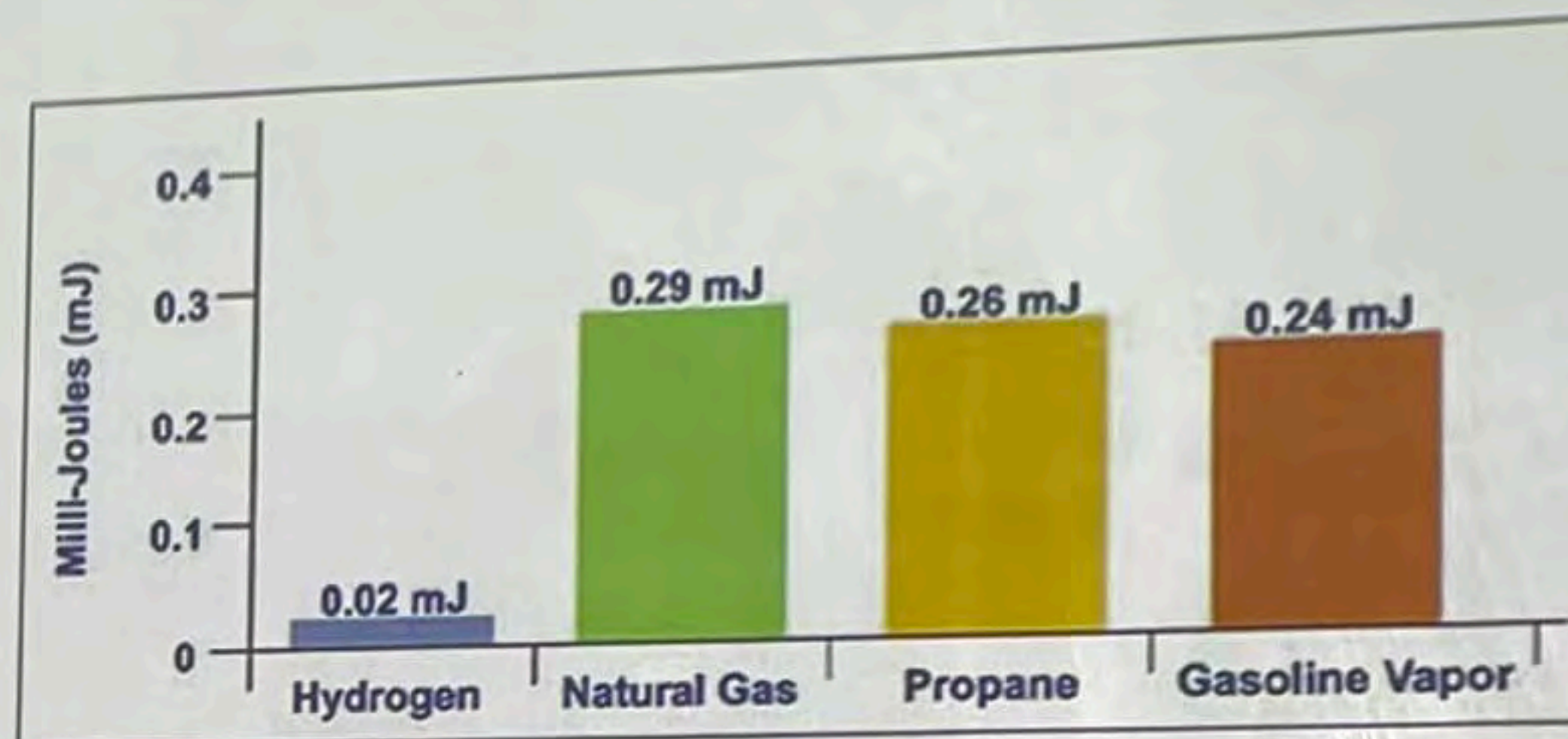
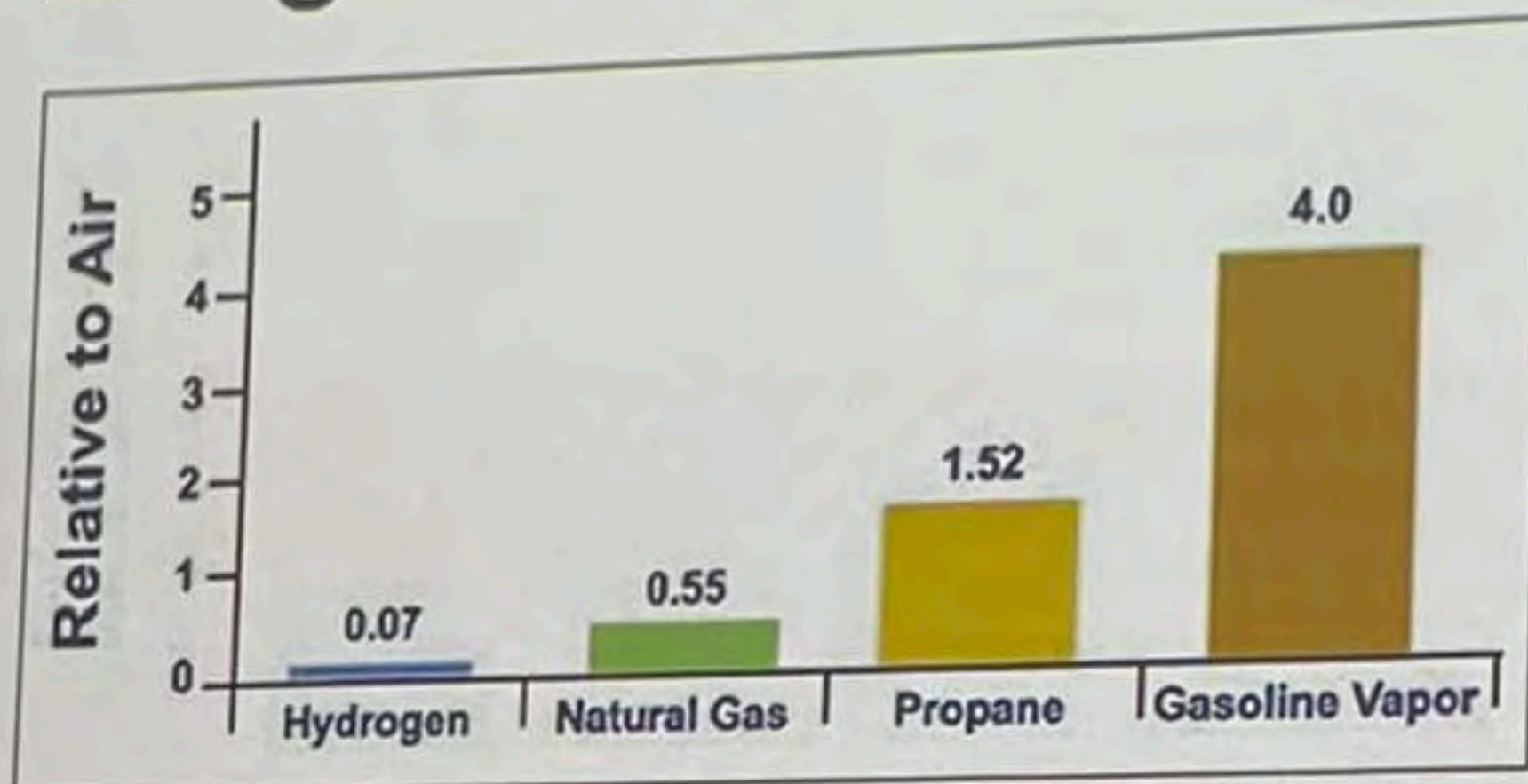


Fuel price prognosis source



CO2 abatement 15 years of operation: 28 000 ton.

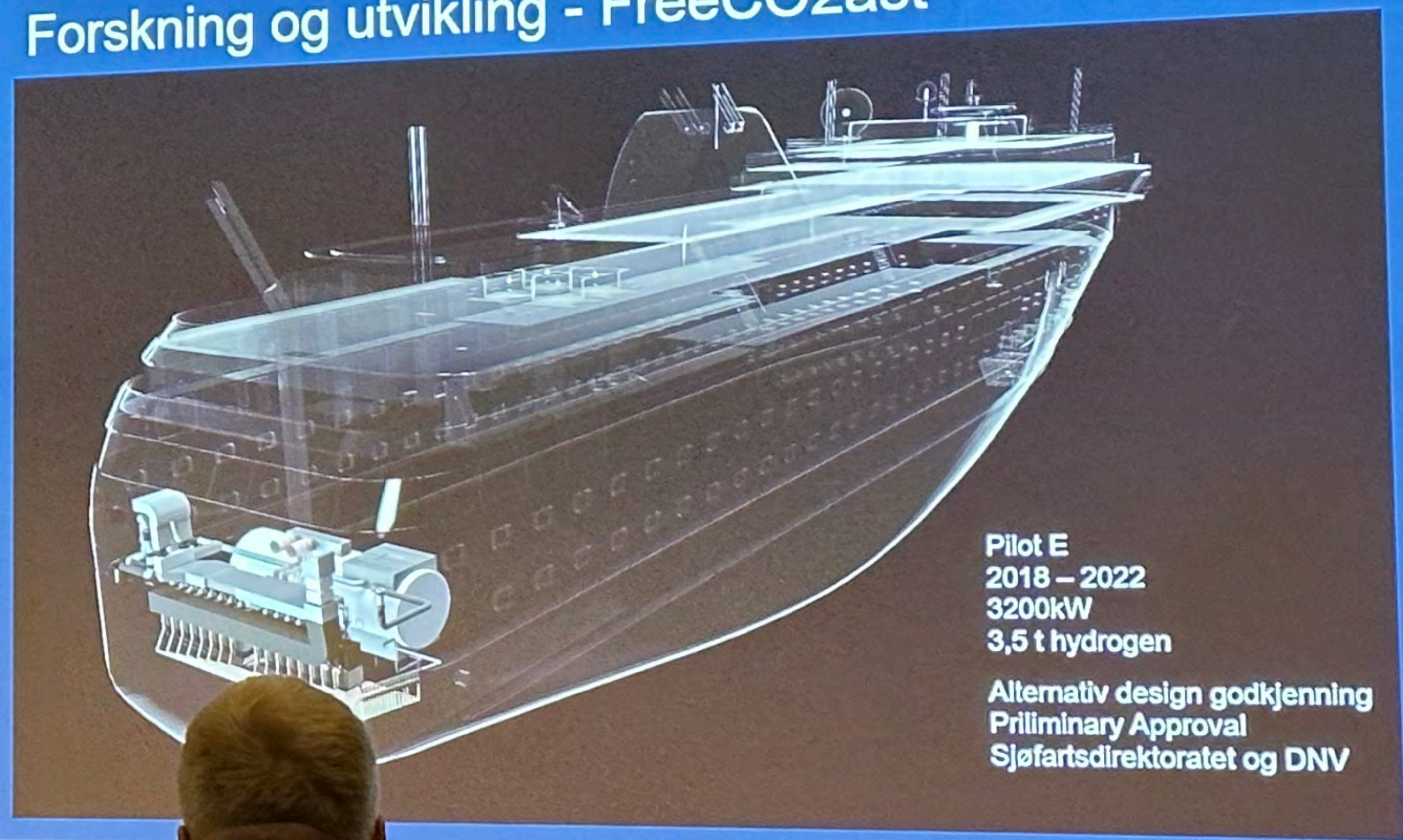
H2 egenskaper



	Hydrogen	Natural Gas	Gasoline
Color	No	No	Yes
Toxicity	None	Some	High
Odor	Odorless	Mercaptan	Yes
Buoyancy Relative to Air	14X Lighter	2X Lighter	3.75X Heavier
Energy by Weight	2.8X > Gasoline	~1.2X > Gasoline	43 MJ/kg
Energy by Volume	4X < Gasoline	1.5X < Gasoline	120 MJ/Gallon

Source: California Fuel Cell Partnership

HAV hydrogen
Forskning og utvikling - FreeCO2ast

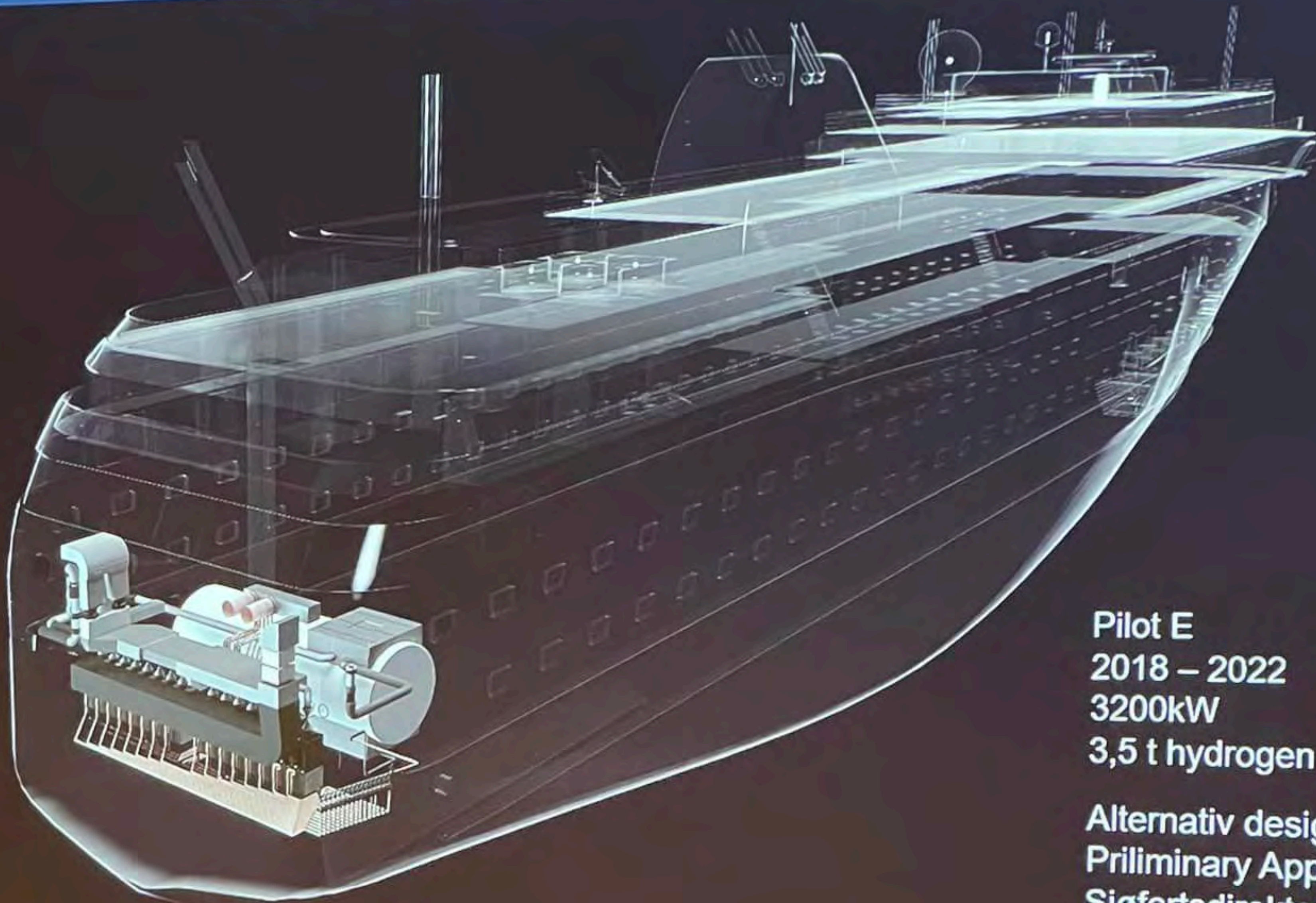


Man speaking at the front of the room, holding a device.

Several audience members seated at desks, viewed from behind.


HAVhydrogen

Forskning og utvikling - FreeCO2ast




Pilot E
2018 – 2022
3200kW
3,5 t hydrogen

Alternativ design godkjenning
Priliminary Approval
Sjøfartsdirektoratet og DNV

 | **Kystruten**

HAVhydrogen

HAVdesign

 norwegian electric systems

 **Havyard**
Group ASA

 **SINTEF**

 **cmr** Prototech

havhydrogen.no

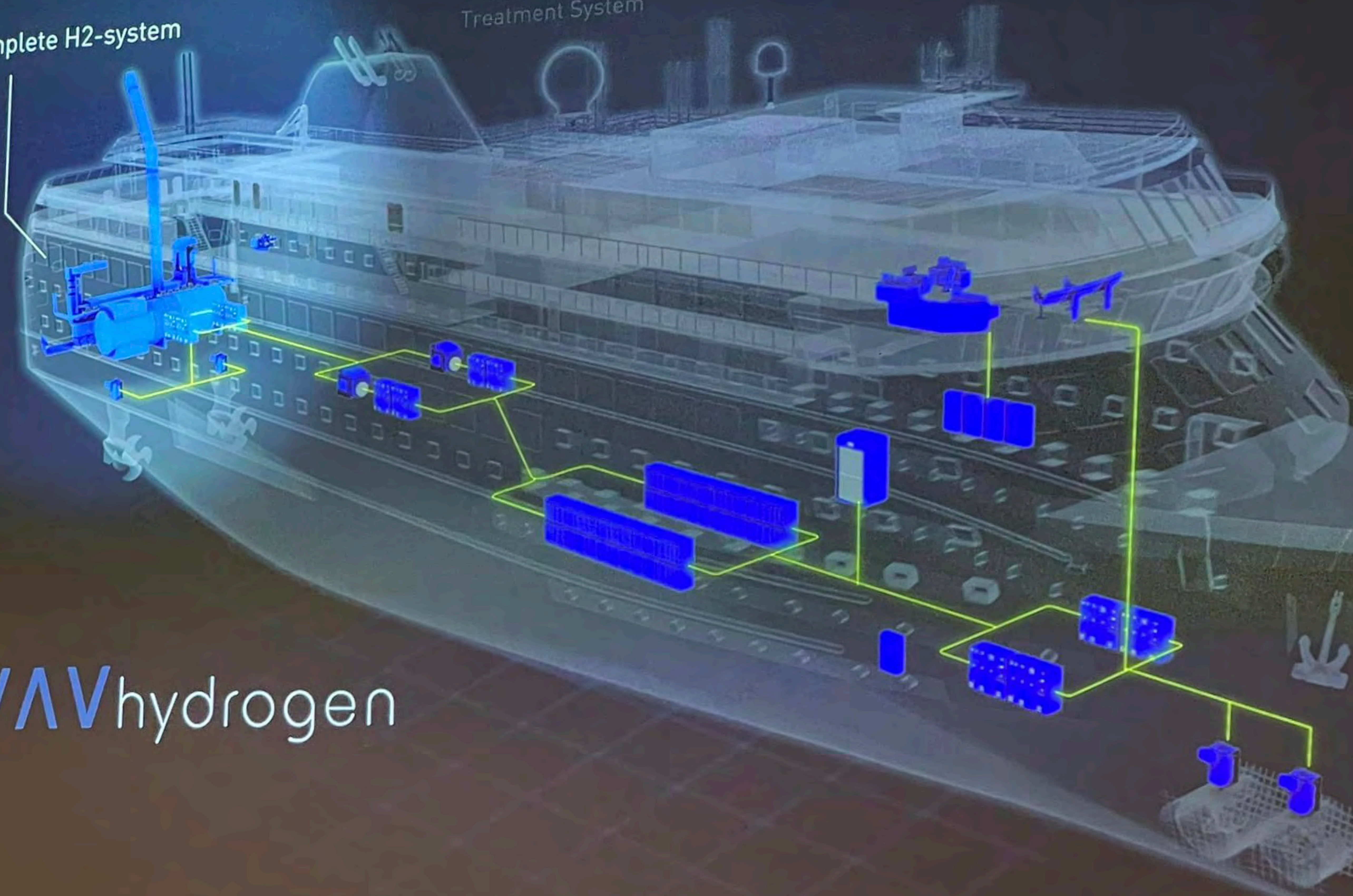
Complete H2-system

Ballast Water Treatment System

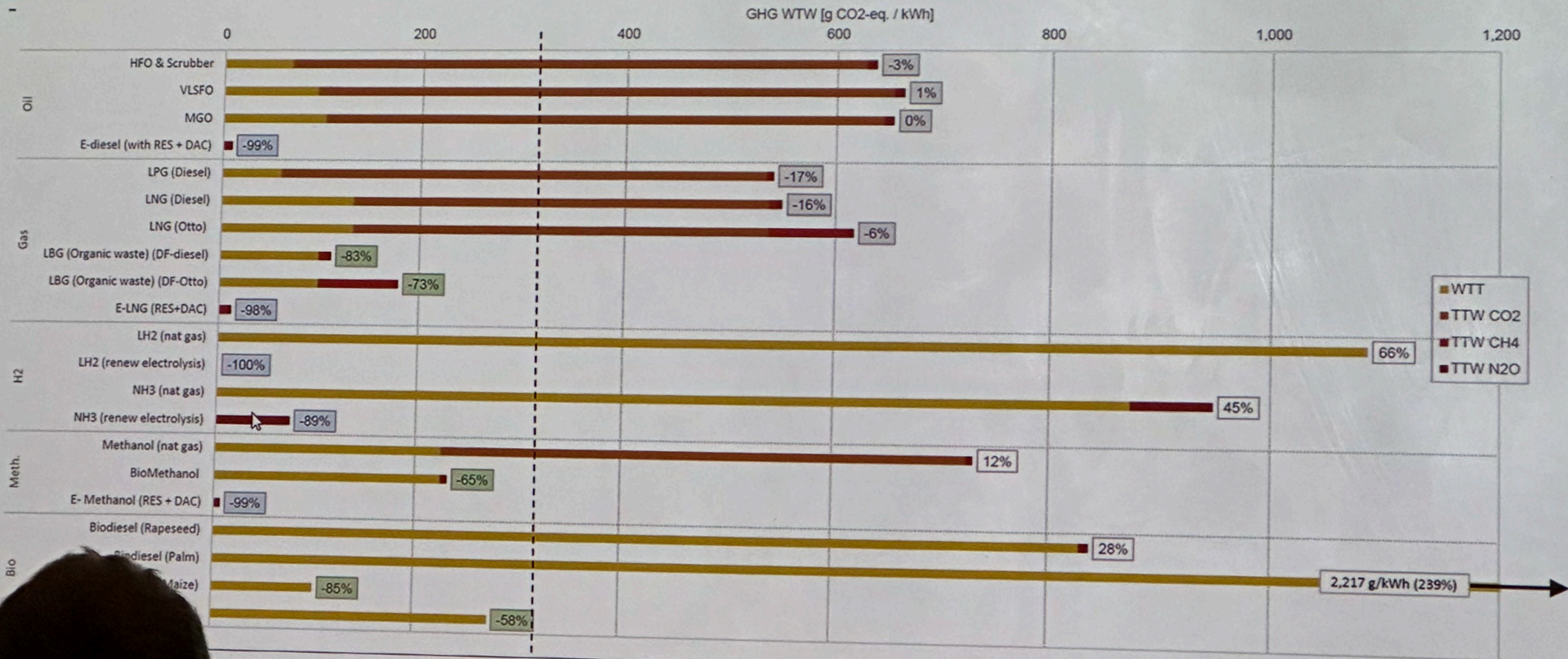
Integrated Navigation and Vessel Control

HAV hydrogen

Energy Design

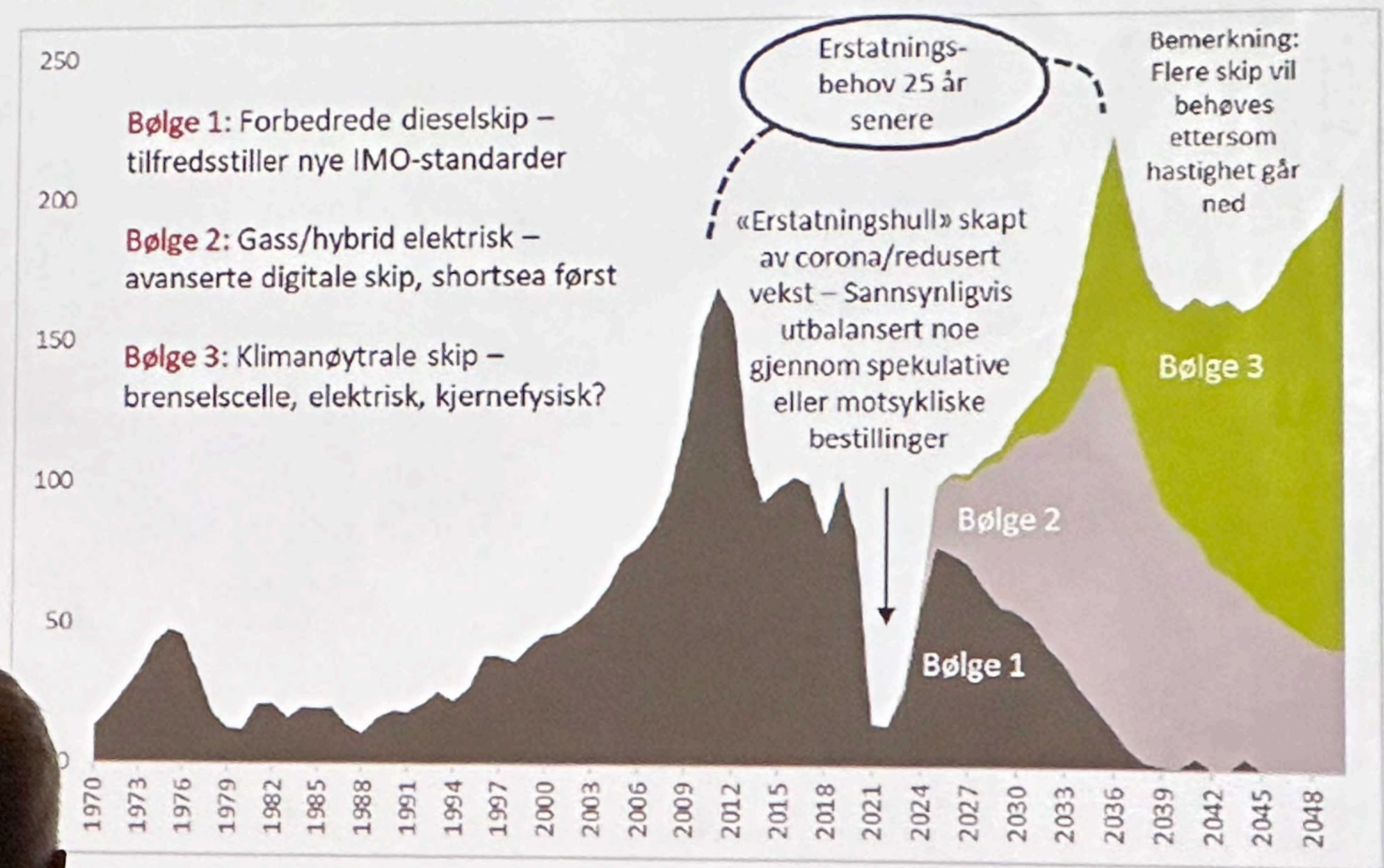


CO2 utslipp (Well to wake)



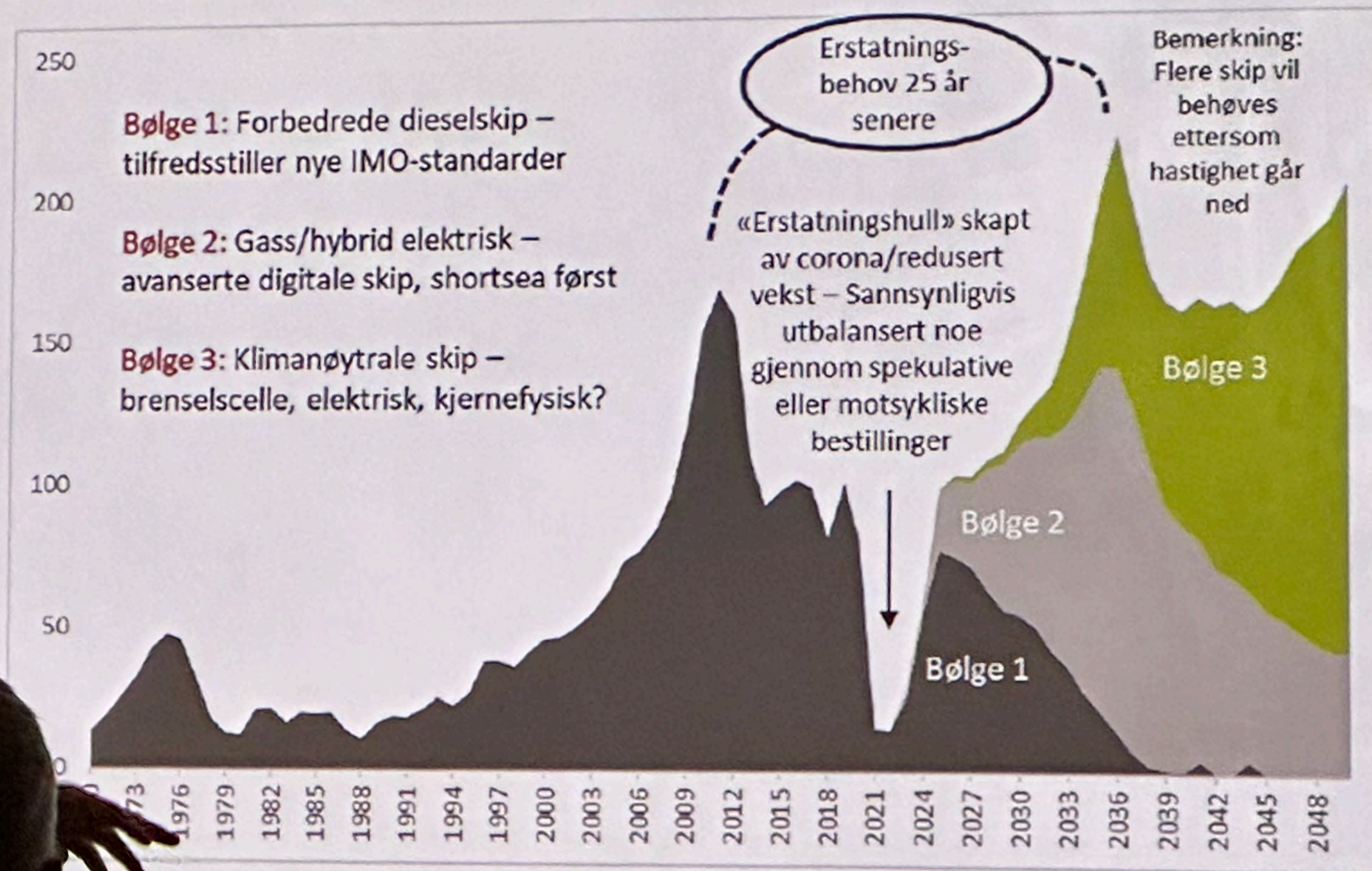
Maritimt nullutslippsmarked

Figur 4 – Et scenario for hvordan verdens skipsbehov vil utvikle seg fram mot 2050. Hentet fra «Martin Stopford – Three maritime scenarios 2020-2050». Oversatt til norsk. Kilde: Martin Stopford 2020

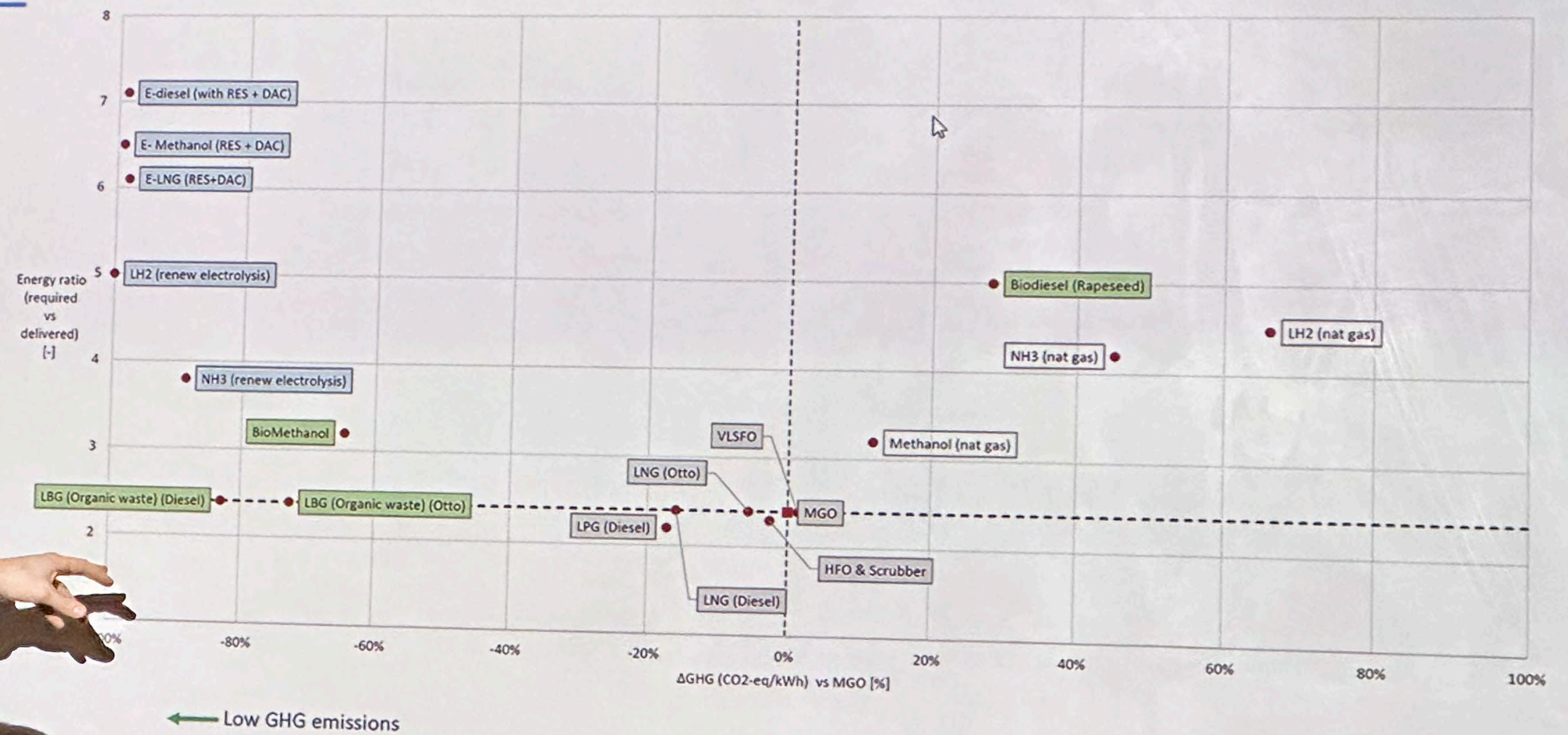


Maritimt nullutslippsmarked

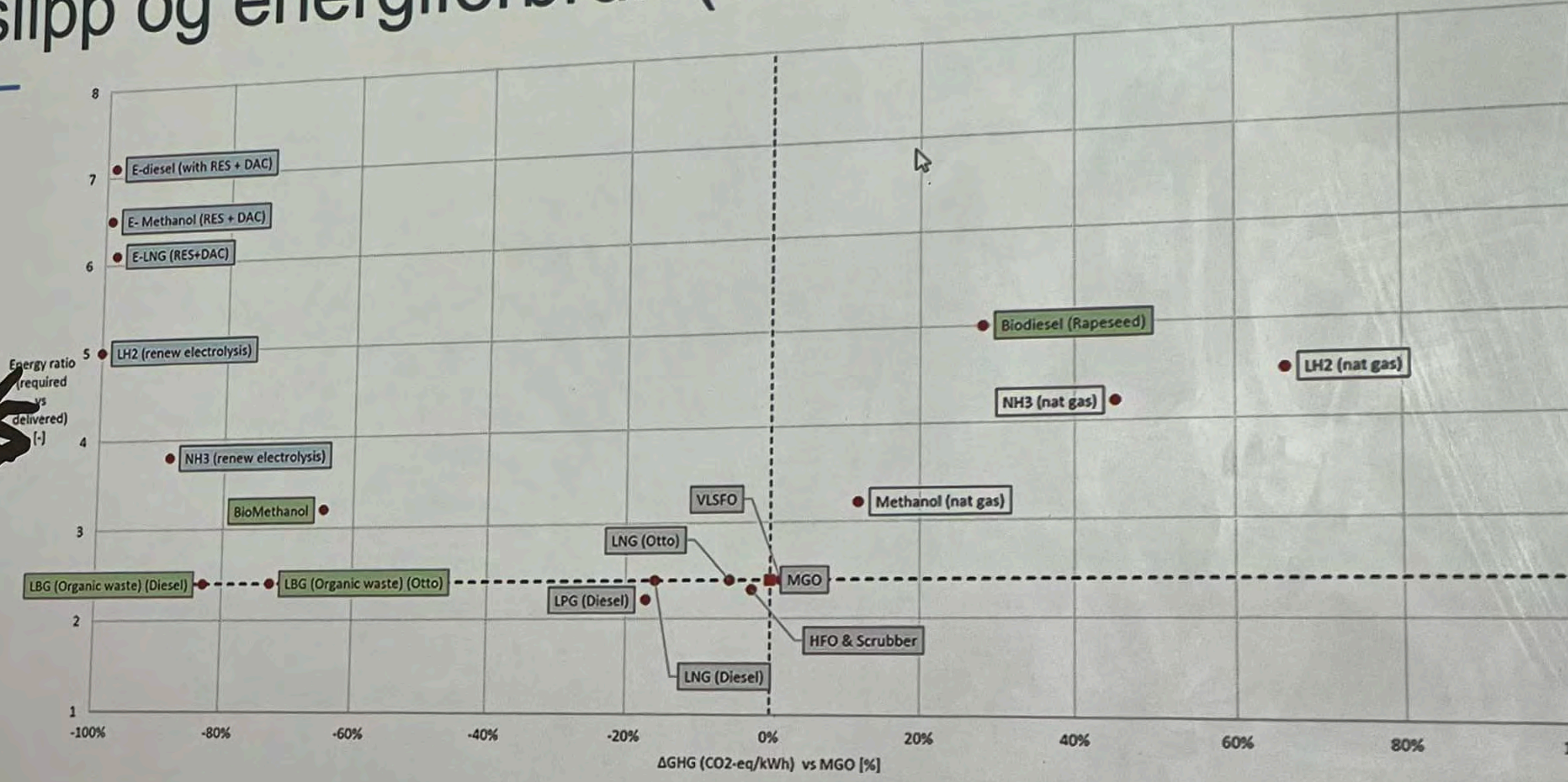
Figur 4 – Et scenario for hvordan verdens skipsbehov vil utvikle seg fram mot 2050. Hentet fra «Martin Stopford – Three maritime scenarios 2020-2050». Oversatt til norsk. Kilde: Martin Stopford 2020



Utslipp og energiforbruk (Well to wake)

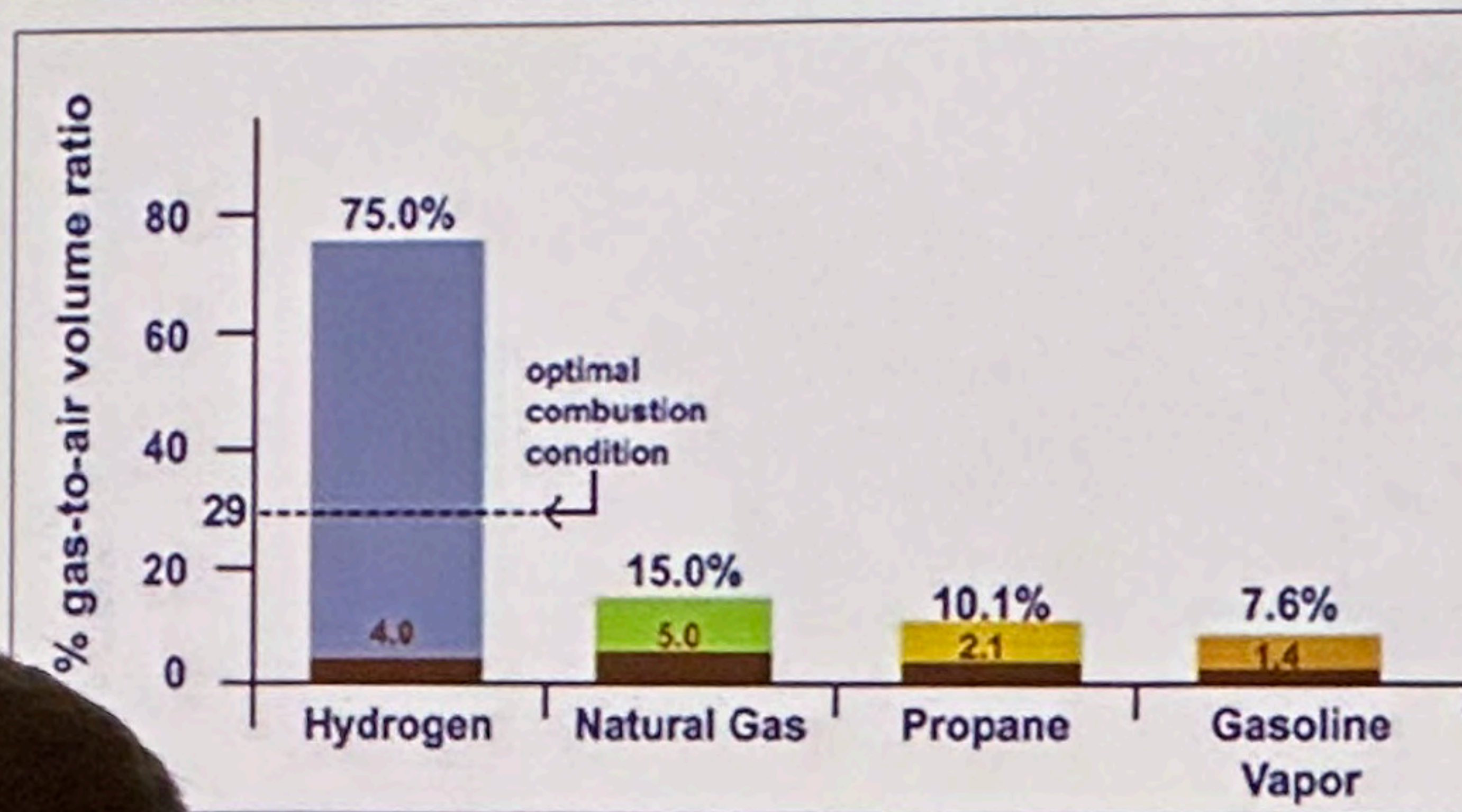
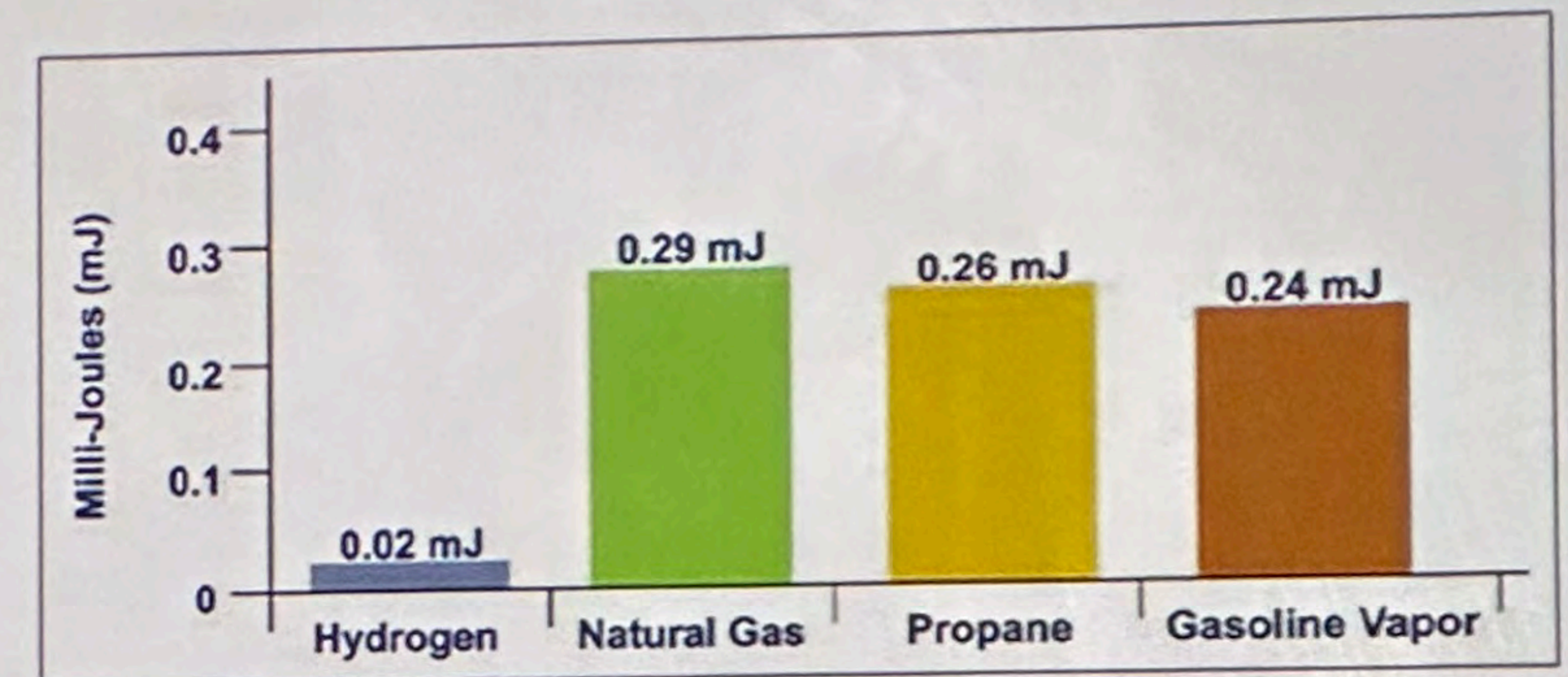
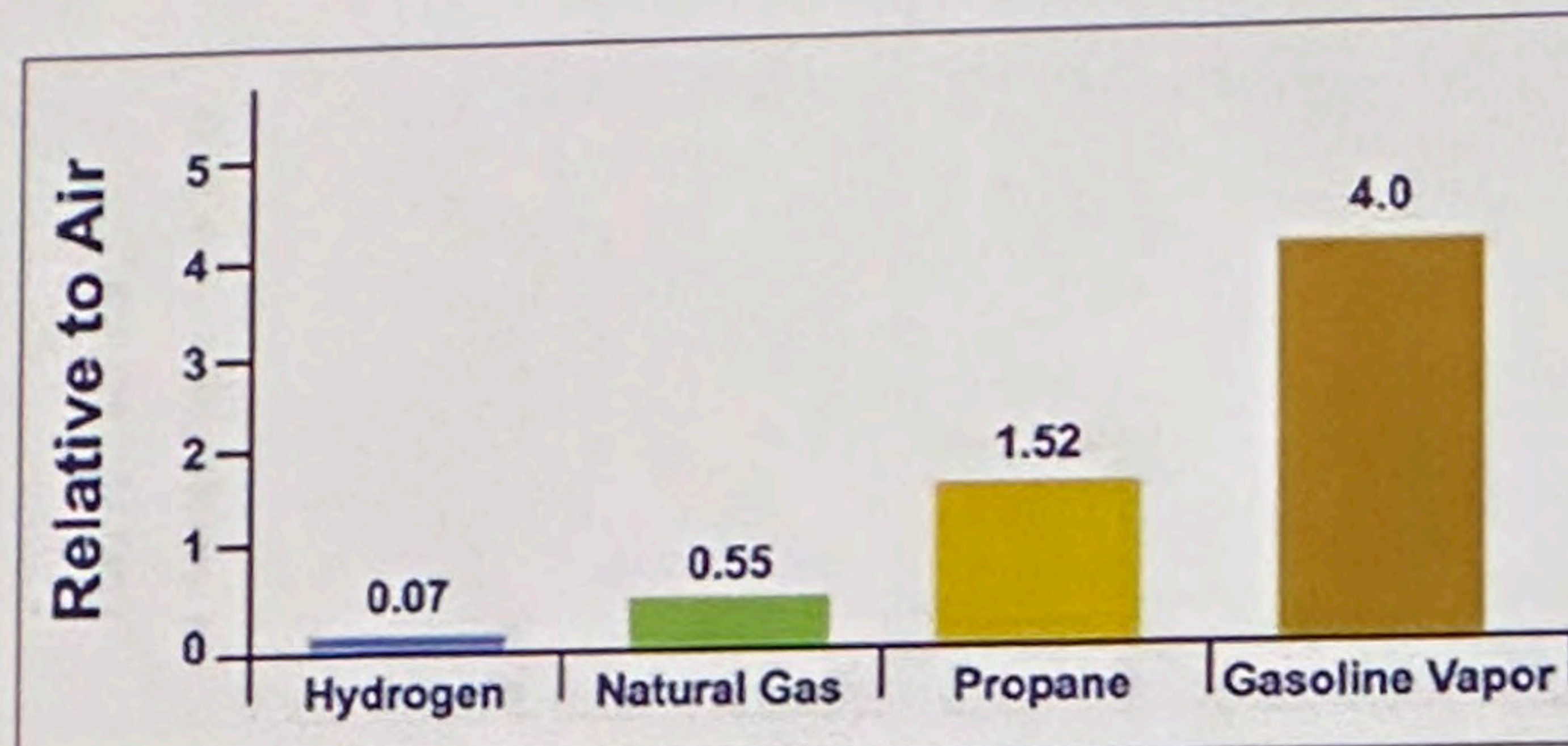


Utslipp og energiforbruk (Well to wake)



← Low GHG emissions

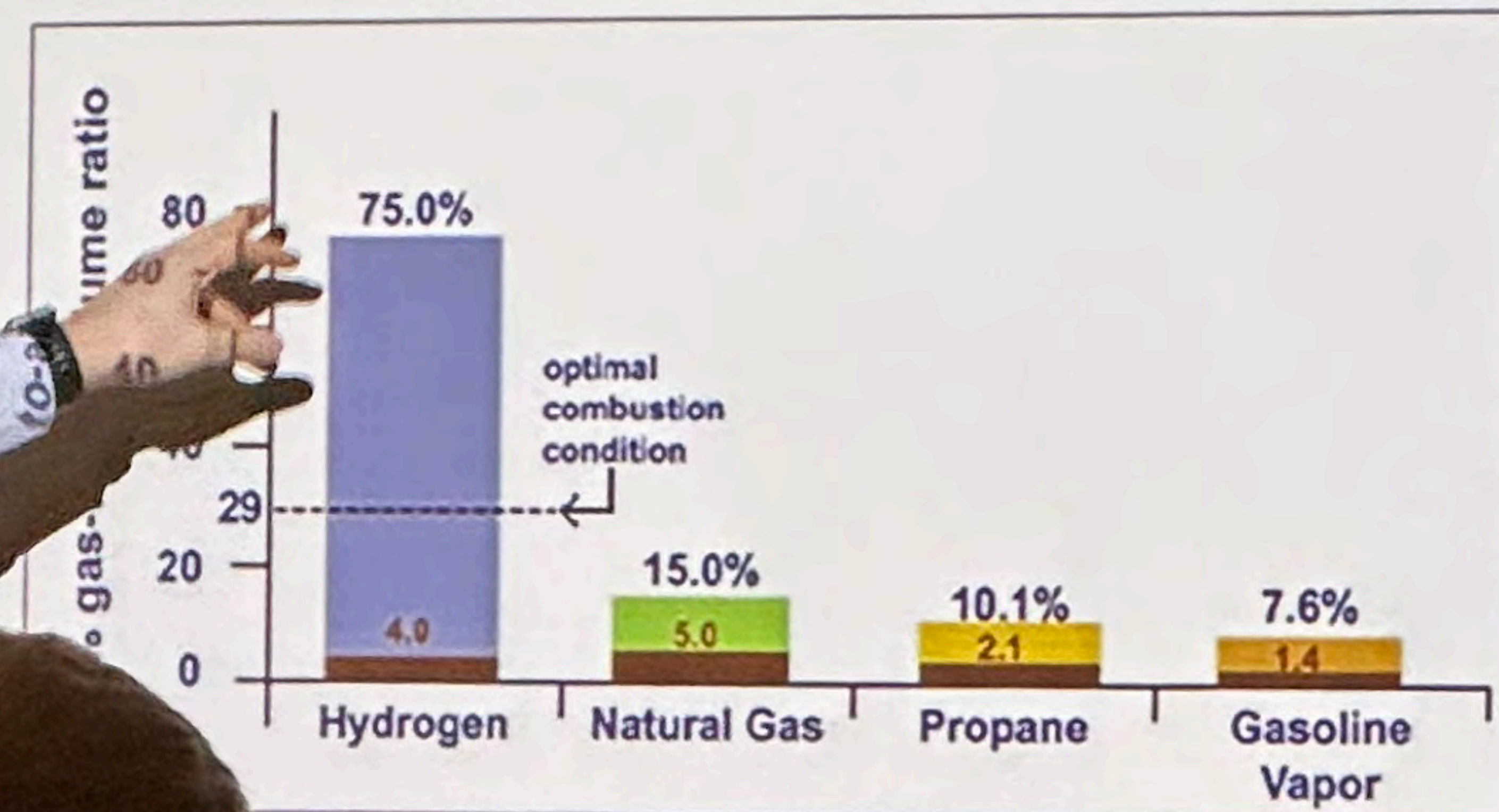
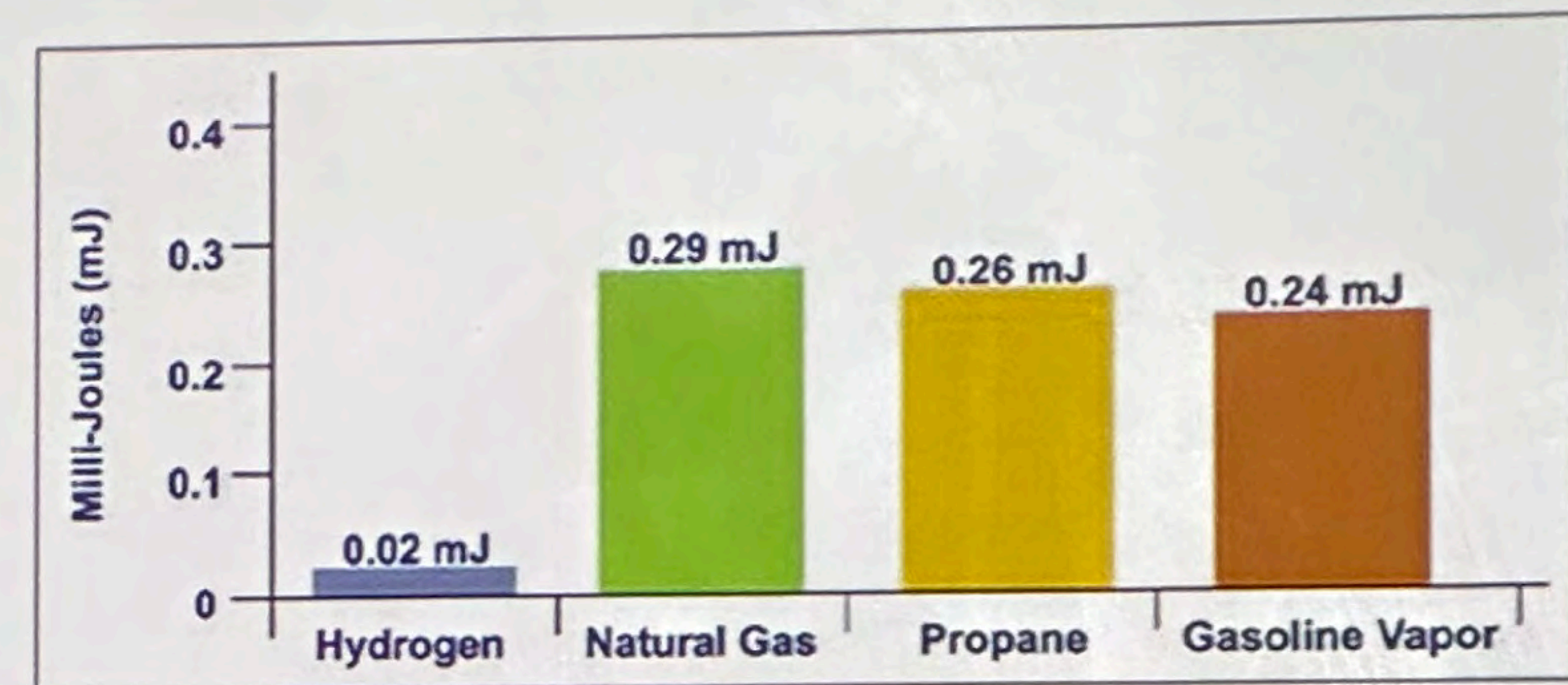
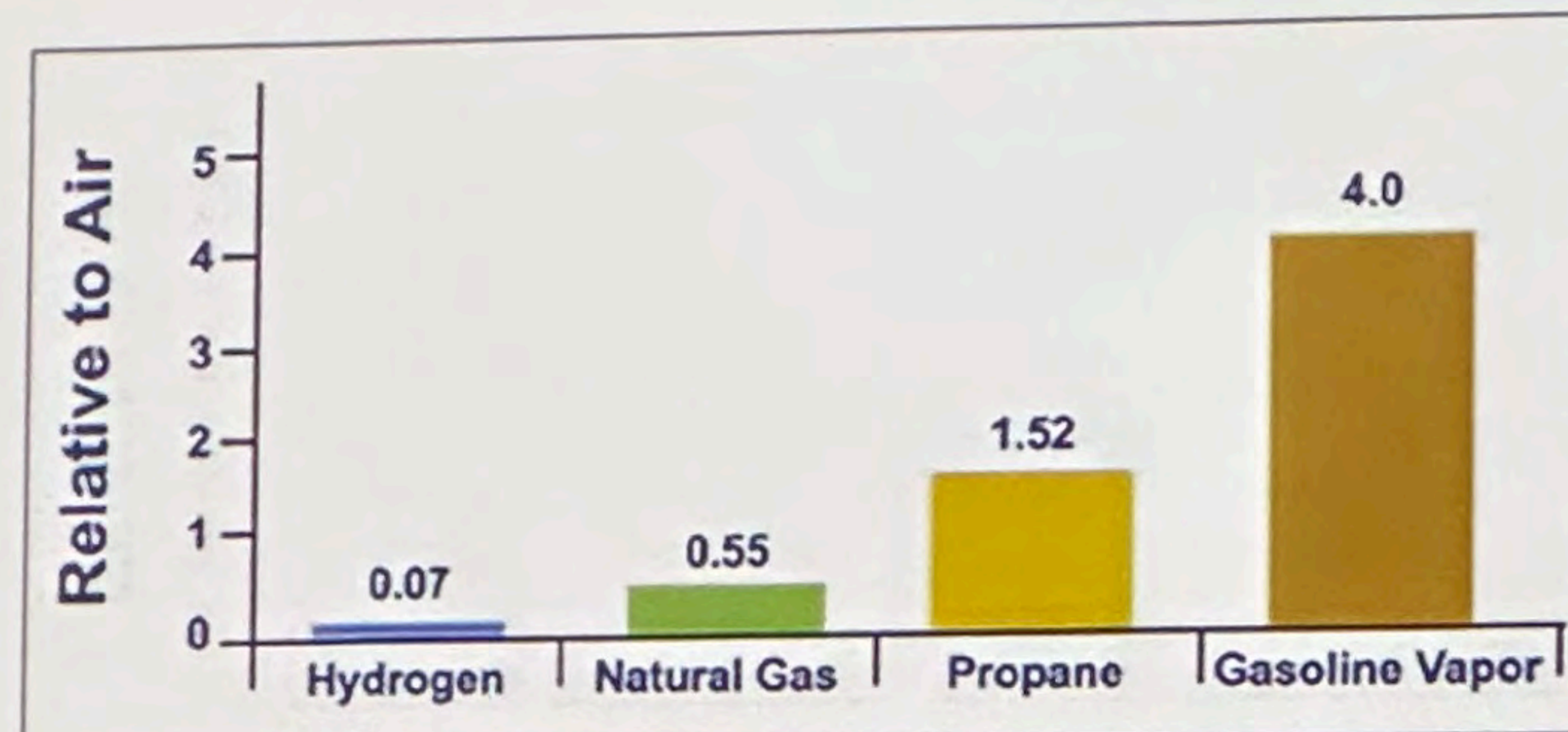
H2 egenskaper



	Hydrogen	Natural Gas	Gasoline
Color	No	No	Yes
Toxicity	None	Some	High
Odor	Odorless	Mercaptan	Yes
Buoyancy Relative to Air	14X Lighter	2X Lighter	3.75X Heavier
Energy by Weight	2.8X > Gasoline	~1.2X > Gasoline	43 MJ/kg
Energy by Volume	4X < Gasoline	1.5X < Gasoline	120 MJ/Gallon

Source: California Fuel Cell Partnership

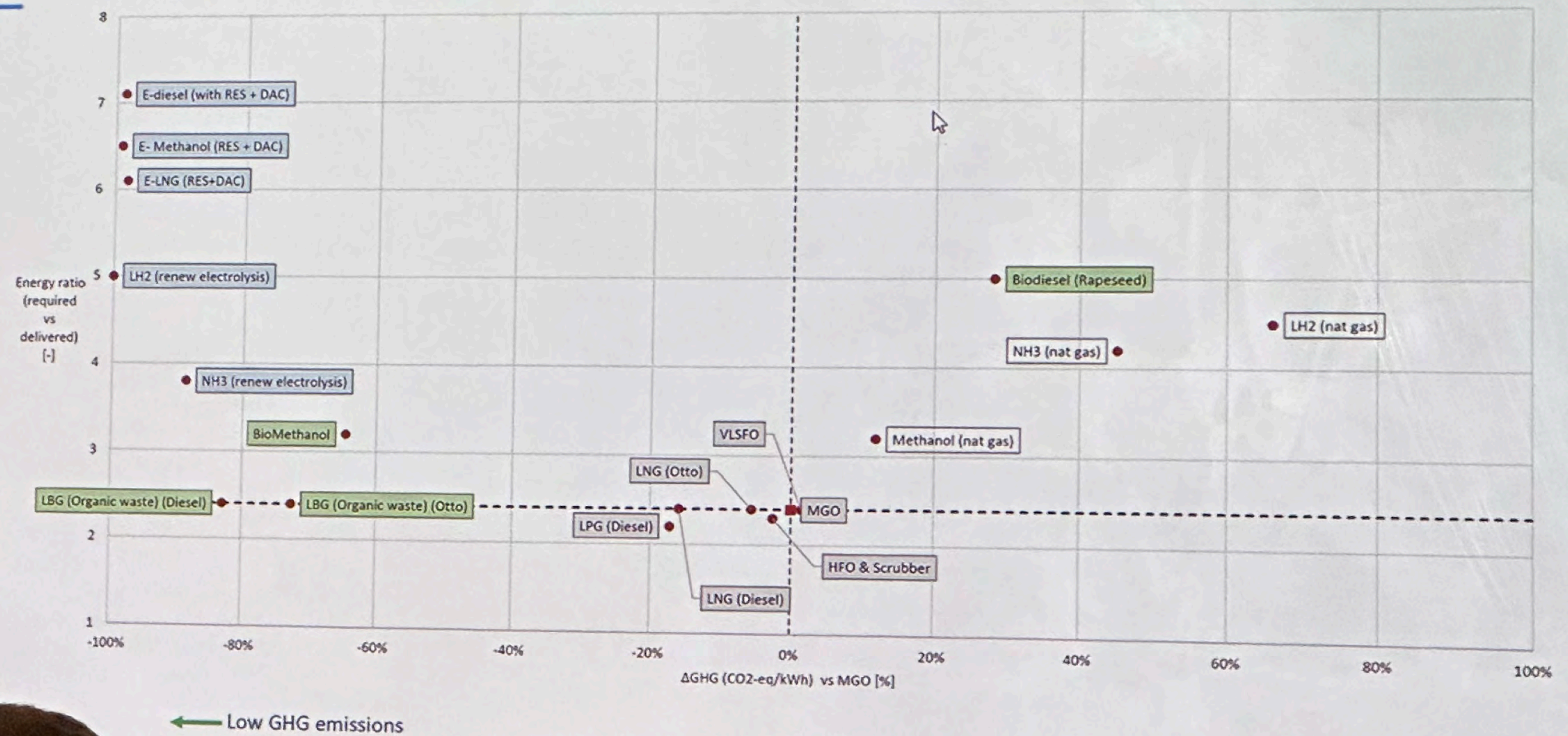
H2 egenskaper



	Hydrogen	Natural Gas	Gasoline
Color	No	No	Yes
Toxicity	None	Some	High
Odor	Odorless	Mercaptan	Yes
Buoyancy Relative to Air	14X Lighter	2X Lighter	3.75X Heavier
Energy by Weight	2.8X > Gasoline	~1.2X > Gasoline	43 MJ/kg
Energy by Volume	4X < Gasoline	1.5X < Gasoline	120 MJ/Gallon

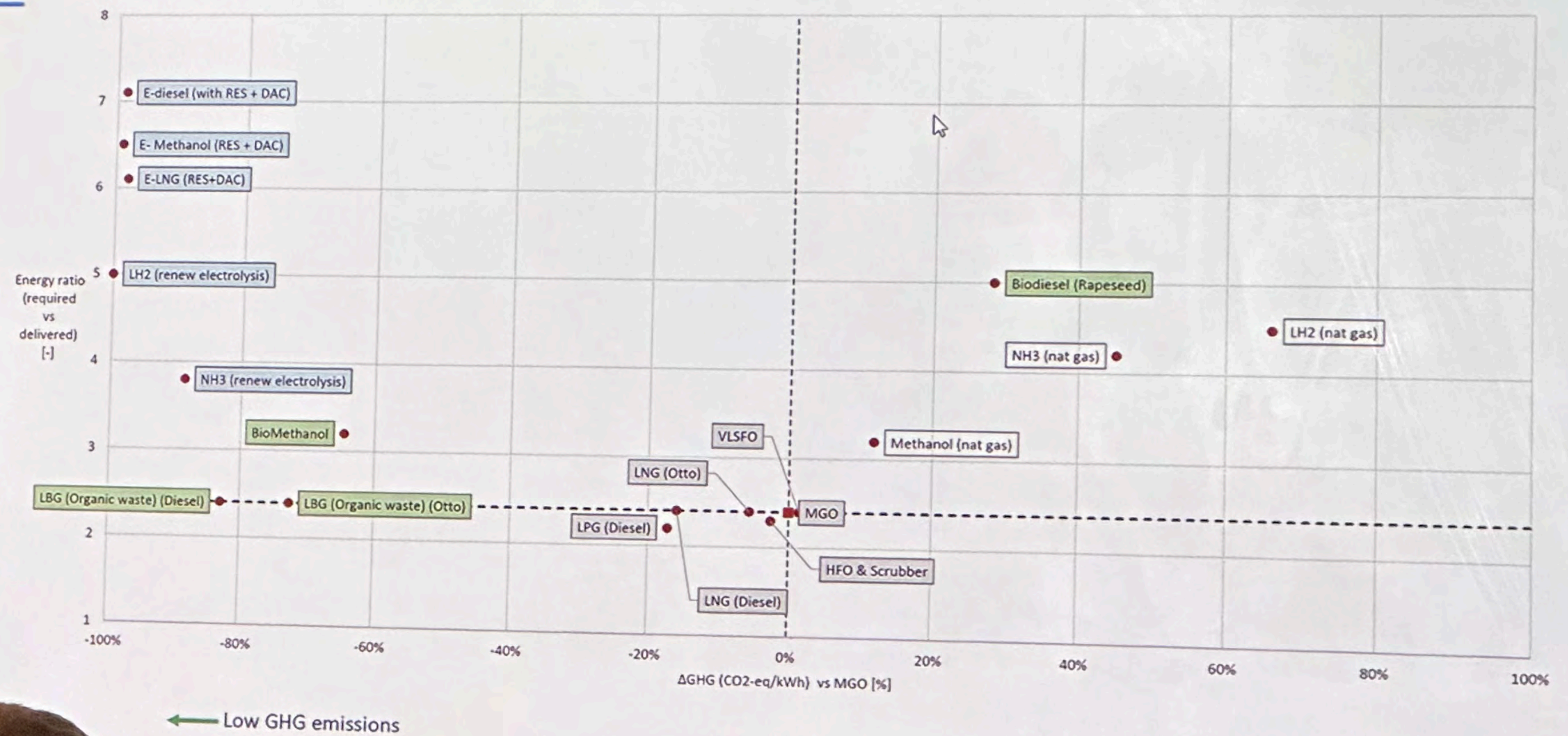
Source: California Fuel Cell Partnership

Utslipp og energiforbruk (Well to wake)



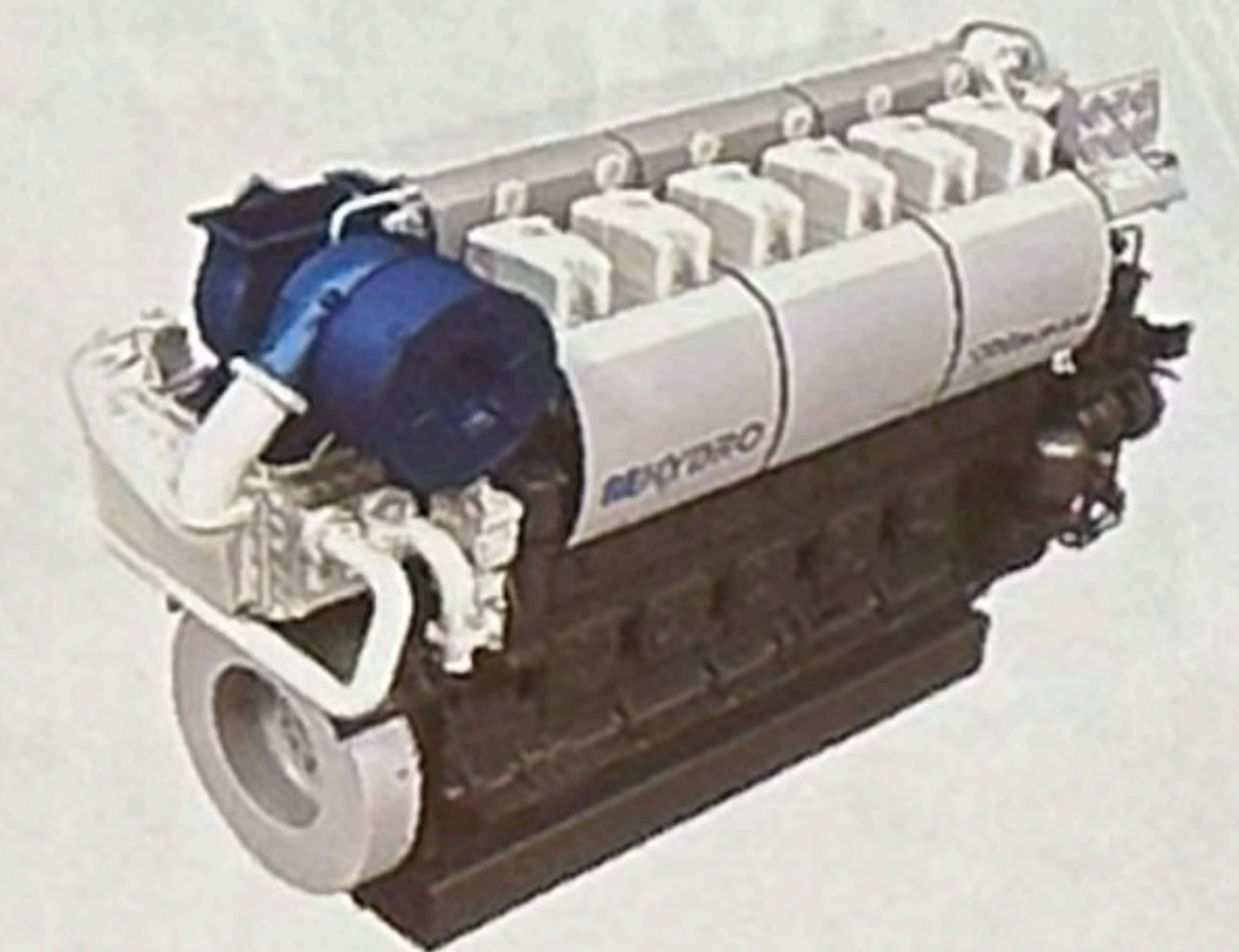
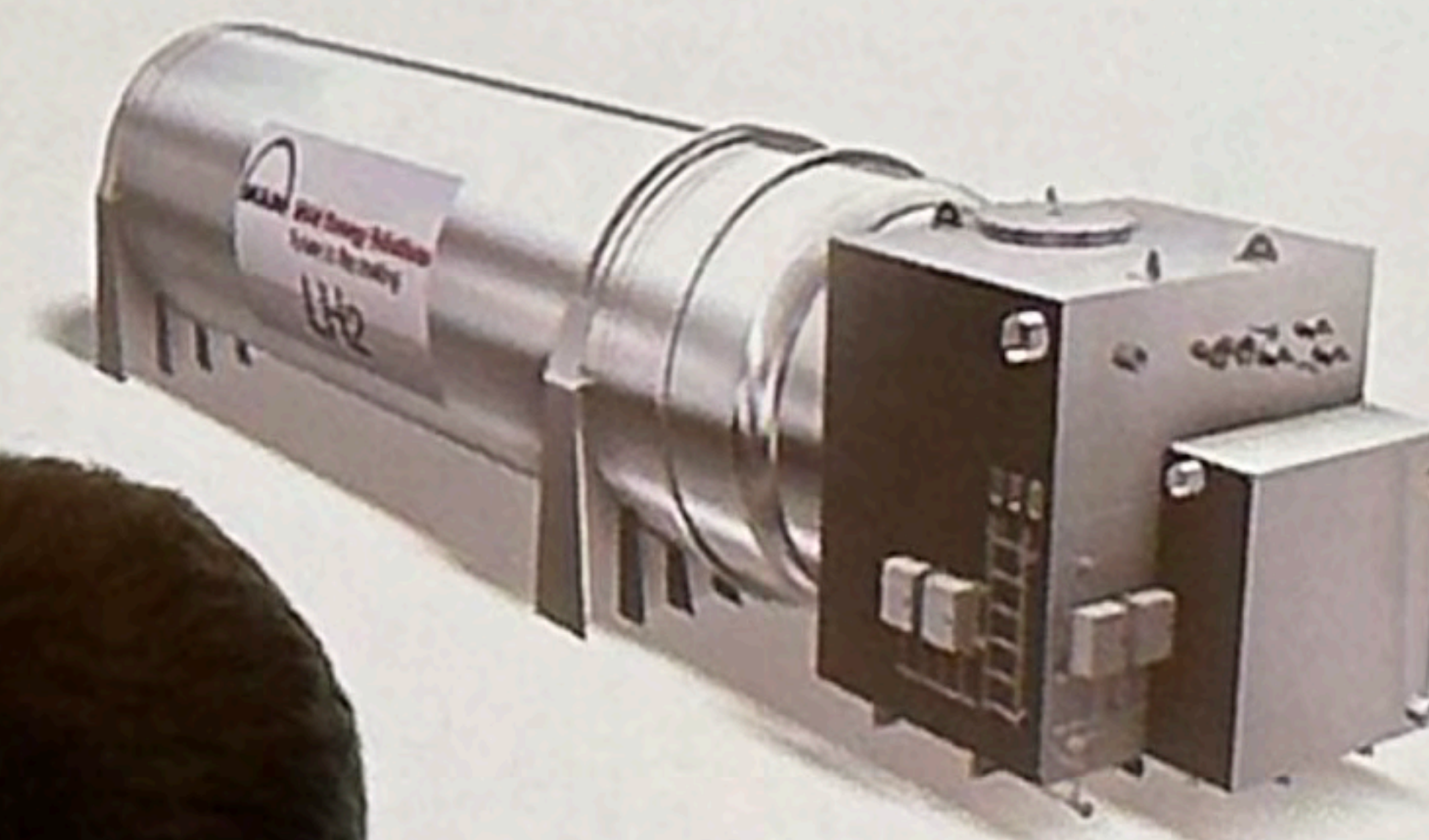
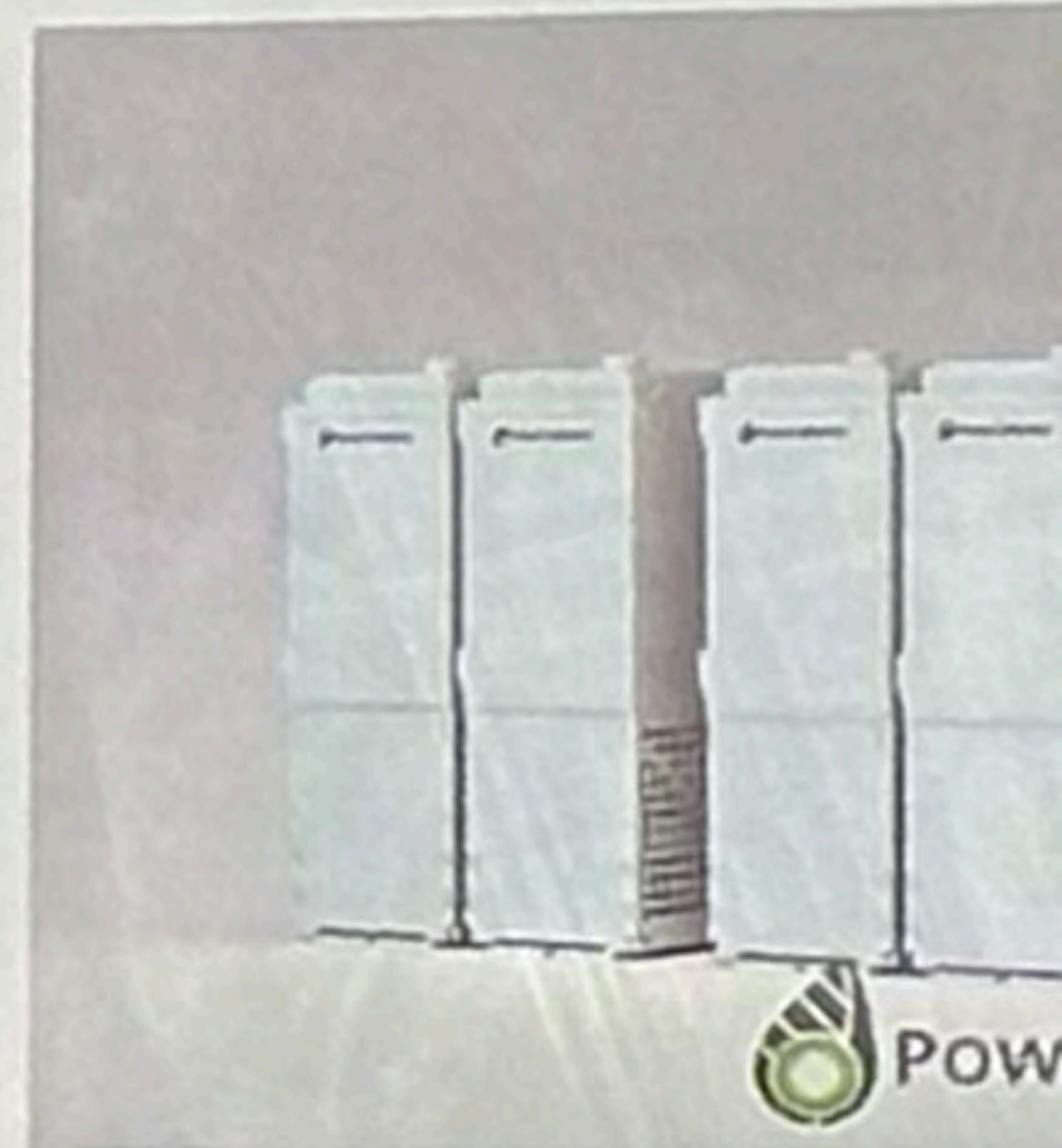
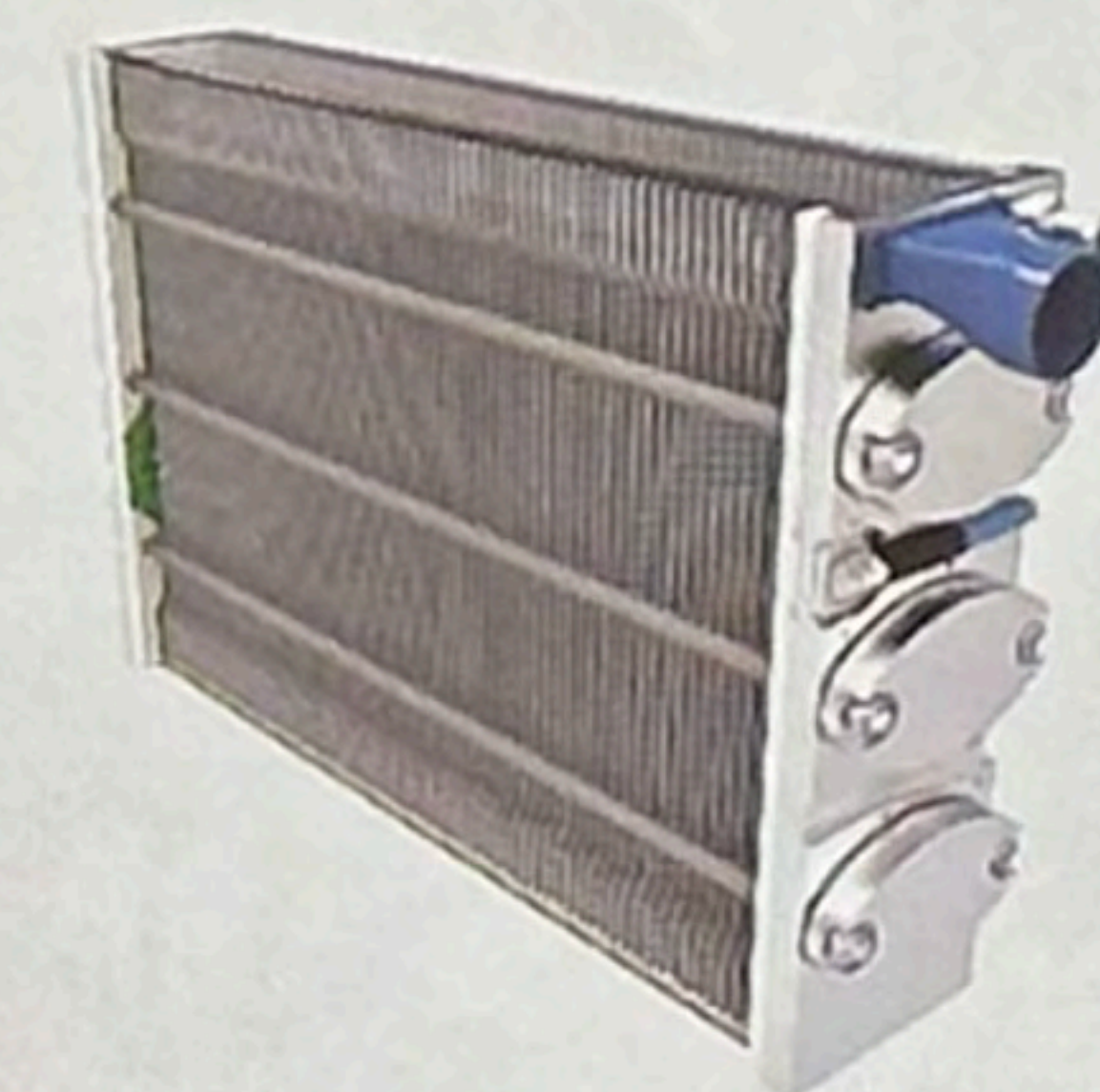
Low energy

Utslipp og energiforbruk (Well to wake)



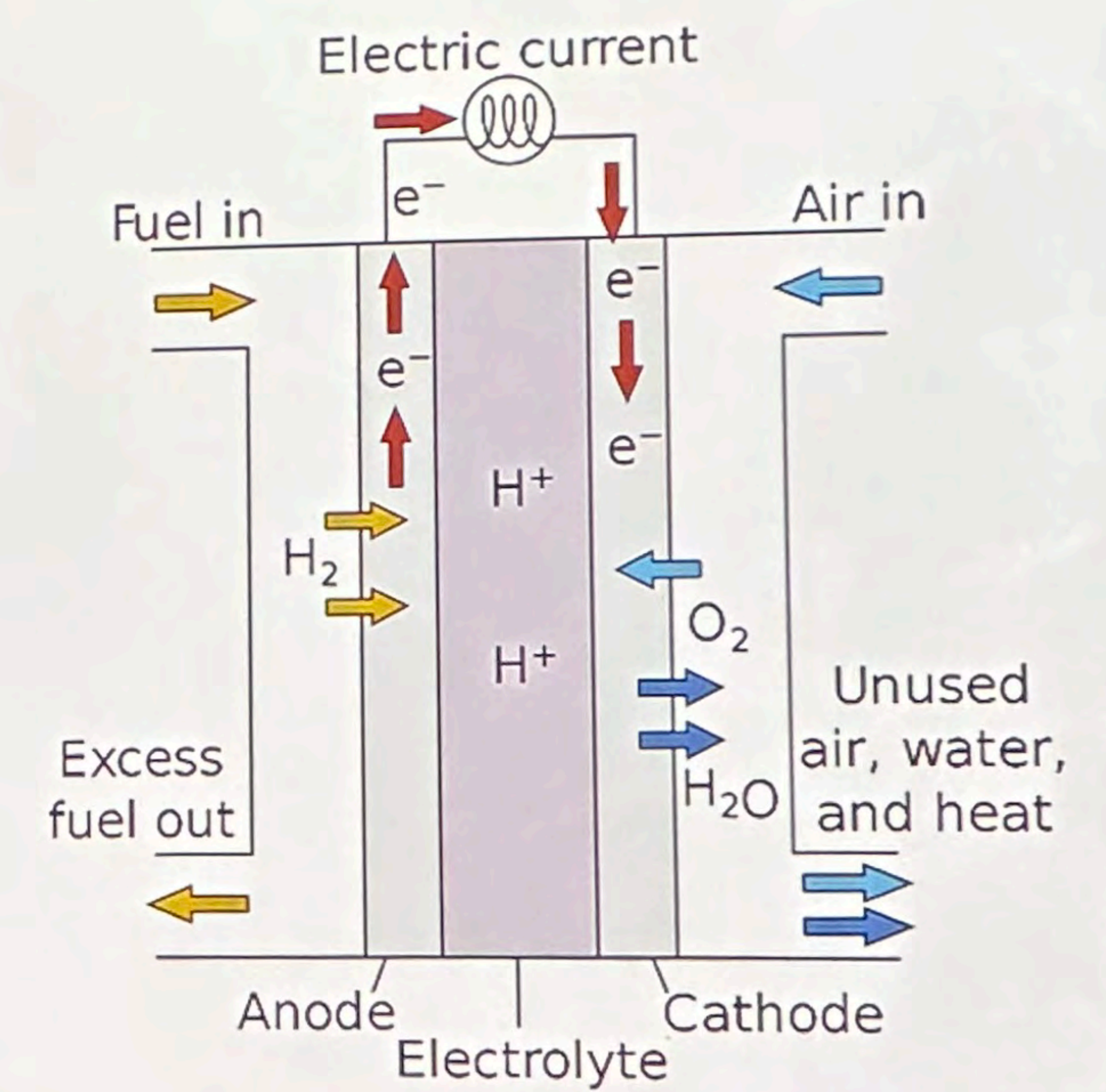
HAV hydrogen

Lagring og forbrenning av H₂



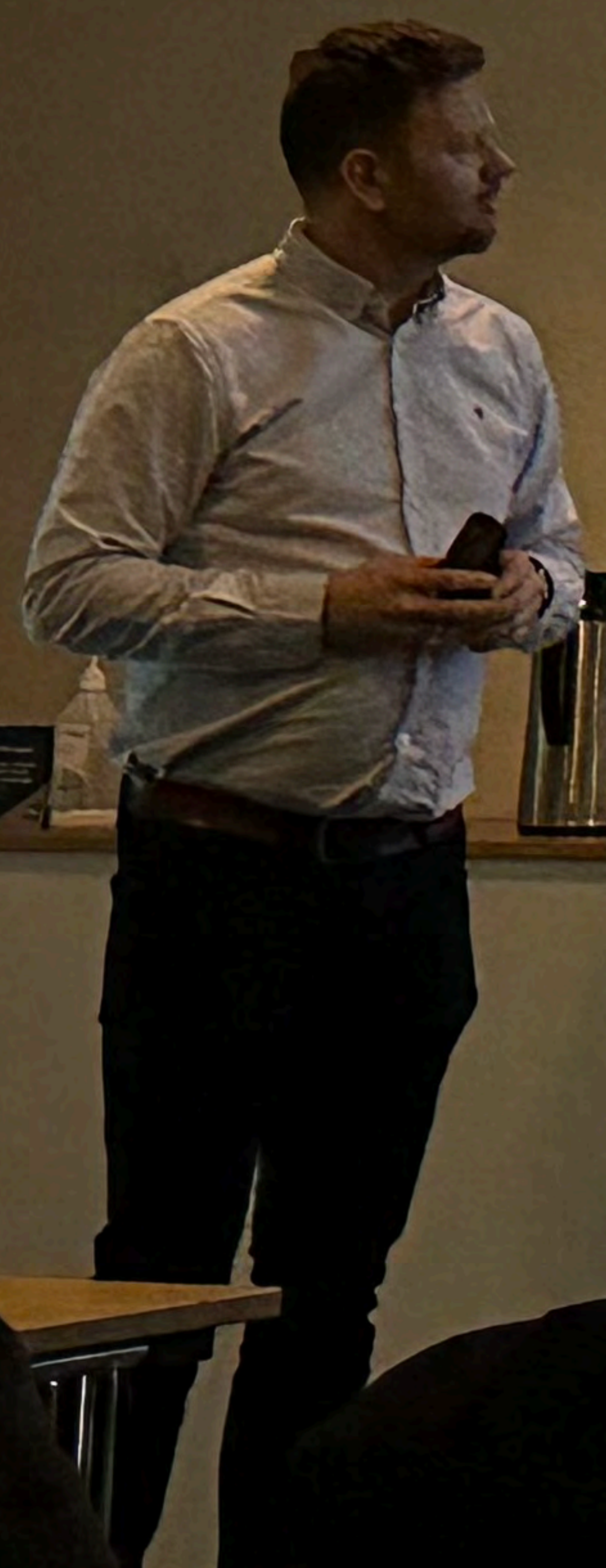
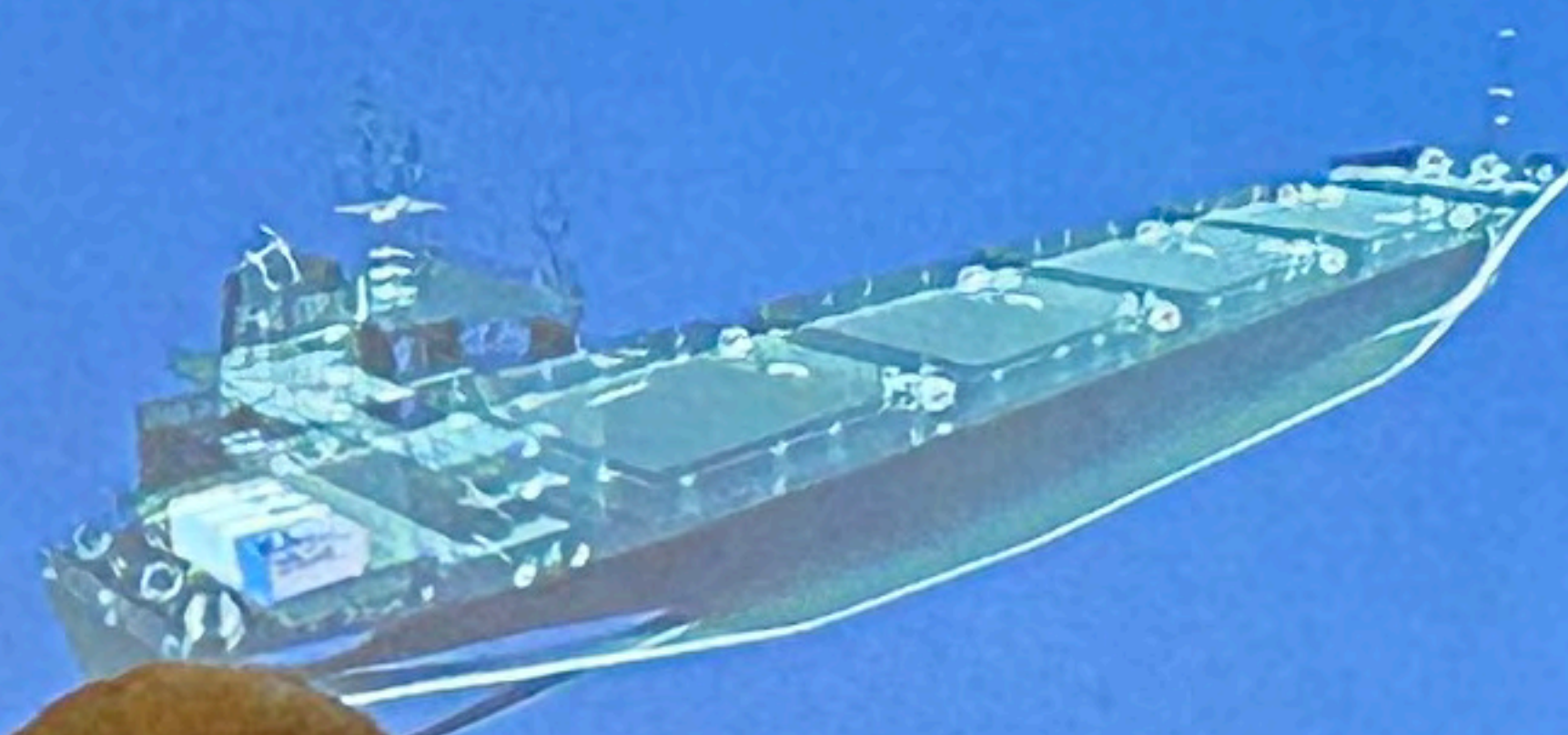
HAVhydrogen

Proton Exchange Membrane (PEM fuel cell)

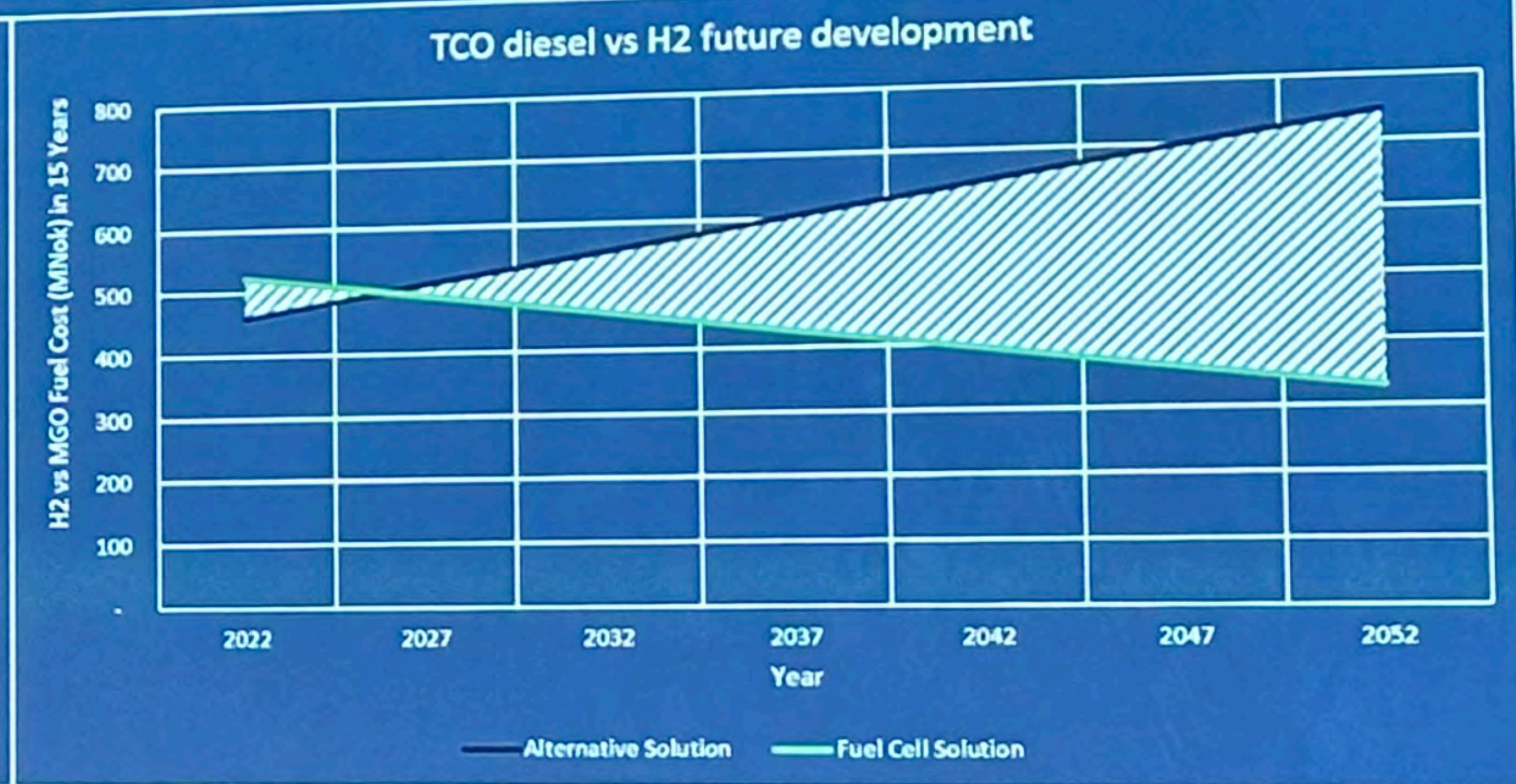
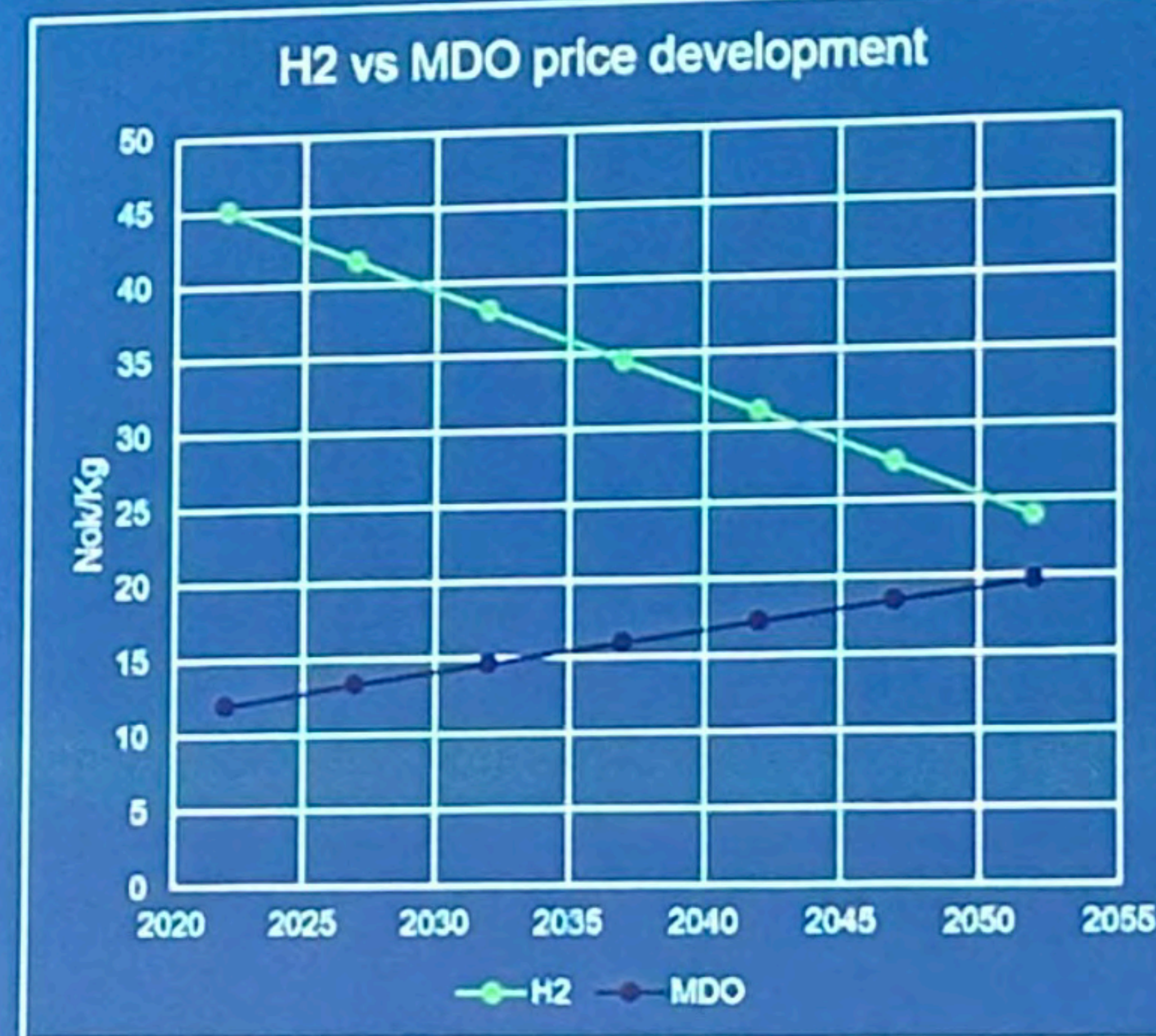


Typical case study

- Shortsea Cargo Ship
- Size: 5000DWT
- Speed: 8 knots
- Installed Fuelcell Power: 2MW
- Sailing distance: Trondheim – Berlevåg 730NM
- 100M NOK Typical Cost (Fuelcell Container, H2 Storage tanks)



Profitable investment on 15 year TCO



Fuel price prognosis source

CO2 abatement 15 years of operation: 28 000 ton.