



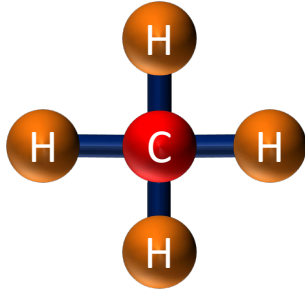
# «Hvorfor er ammoniakk i ferd med å seile opp som et lovende klimavennlig alternativ til å erstatte olje og diesel i skip?»

Klimafrokost grønn skipsfart  
Litteraturhuset i Bergen, 10.4.2019

**cmr** Prototech

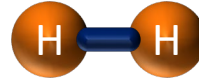
**Svar:  
...eneste fuel som på  
“kort sikt” kan gjøre  
deep-sea shipping  
grønn**

# Grønne drivstoff



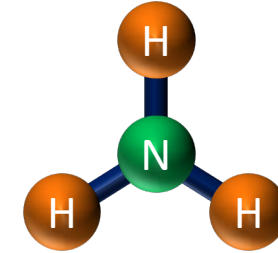
## LBG/P2G

- -163°C
- 6.43 kWh/litre
- 15.30 kWh/kg
- Not toxic
- Highly flammable



## LH2

- -253°C
- 2.79 kWh/litre
- 33.33 kWh/kg
- Non toxic
- Extremely flammable



## NH3

- -33°C
- 3.75 kWh/litre
- 5.22 kWh/kg
- Toxic, causing skin corrosions and burns
- Not highly flammable



# Energi fra ammoniakk

## Combustion Engine

1. Heritage
2. Low CAPEX
3. Medium to high efficiency
4. NOx formation



## PEM FC + Cracker

1. Compact
2. Medium CAPEX
3. Medium-low efficiency
4. Complexity
5. Risk of membrane poisoning



## Direct SOFC

1. High efficiency
2. «Simple» system
3. Medium/high CAPEX
4. High temperature
5. Must be made compact
6. Limited experience



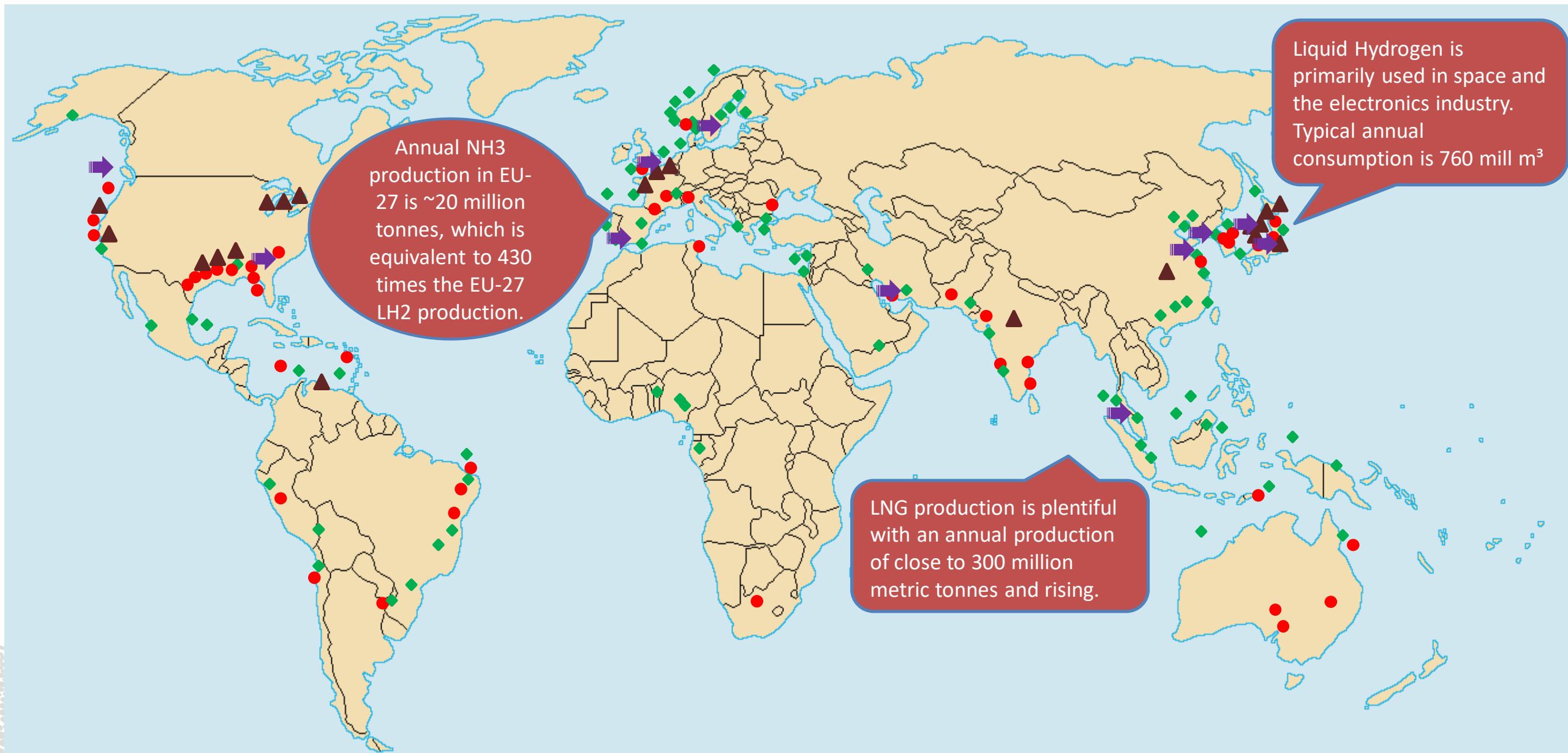
# FUEL INFRASTRUCTURE MAP

◆ LNG Supply & Bunkering (existing)

➡ LNG bunkering – planned

● Ammonia – Existing infrastructure

▲ Hydrogen Liquefaction Plants



PROS

CONS

LNG

LH2

NH3

LNG

LH2

NH3

High ignition temperature 649°C (Gasoline 316°C)

Potential to become carbon free

Feedstock widely available

Limited to frequently driven fleet vehicles or to vehicles stored outdoors

Low volumetric energy density

Safety challenges

High energy density

Feedstock widely available

Production successfully scaled up (180MT annually)

If not operated for period of a week or more, LNG fuel tanks will vent flammable gas mixture

Extreme Temperatures

High fuel cost

Not toxic nor corrosive

Can be used in fuel cells and ICEs

Potential to become Zero carbon fuel

Limited availability, distribution chain still under development.

None existent infrastructure

Public acceptance

Long track record as ICE fuel

Can be used in fuel cells, ICEs and other thermal engines

For Production of 1 kg H2, 9 kg water is required

## Oppsummert...

---

God måte å lagre og transportere grønn energi

Tilgjengelig – produksjons- og transportkapasitet

Energieffektivitet og -tetthet

Lagring – temperatur og trykk

Regelverk og Sikkerhet

Mulig nullutslippsalternativ for deep-sea shipping

**Ocean and Space  
– our homebase**

**Thank you for  
your attention !**

Bernt Skeie

Chief Executive Officer

CMR Prototech

Tel: +47 950 46 031

Email: [bernt.skeie@prototech.no](mailto:bernt.skeie@prototech.no)

[www.prototech.no](http://www.prototech.no)





# Litt informasjon om Prototech

## PROTOTECH AS

- Dates back to CMI/ Odd Dahl
- Established as legal entity in 1988
- 42 employees from 7 countries
- Prototype development – from idea to finished product
- Highly skilled workforce and spectacular projects within space and energy make Prototech a very interesting place to be

