



# H<sub>2</sub> SITE

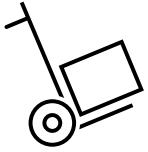
Membrane reactors for H<sub>2</sub> generation

On-site hydrogen  
solutions

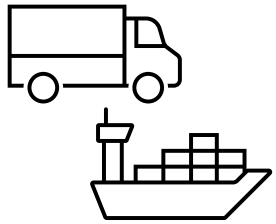


H2SITE produces **cost-efficient, on-site, renewable H<sub>2</sub>** for small and medium consumers in industry and mobility segments using **feedstock-versatile** membrane reactors.

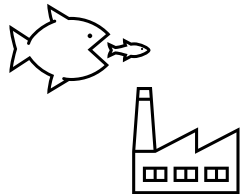
# PROBLEM



Transport cost **adds 80% - 300%** to the H2 generation cost



Trucks and ship transport are **energetically and environmentally inefficient**: leaks of  $>10\%$  H2 & CO2 emissions of trucks

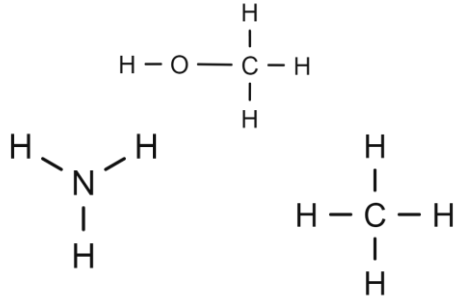


**Small and medium hydrogen consumers pay the price**

# TECHNOLOGY - Solution

Versatile, on-site, simple and cost-effective  
H2 membrane reactors

1



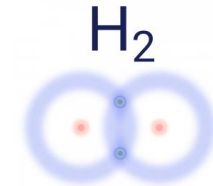
*Hydrogen carriers*

Ammonia, ethanol, methanol  
biogas, formic Acid...



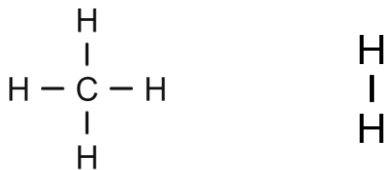
*Membrane reactors*

Catalytic, fixed or fluidized bed  
integrated membrane reactors



*Fuel cell grade H2*

2



*Hydrogen blend*

As low as 5% H2 – 95% CH4

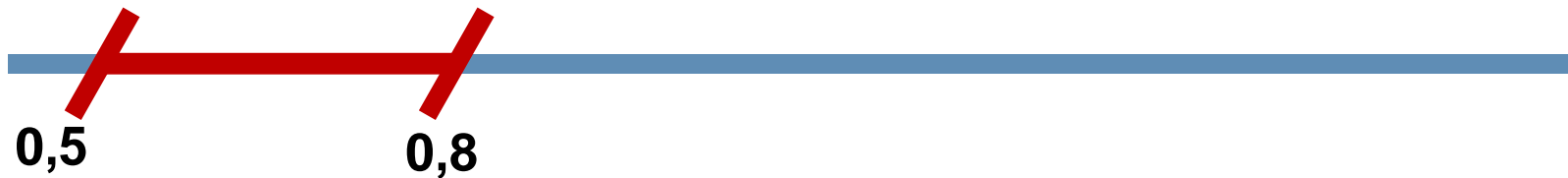


*Membrane separator*

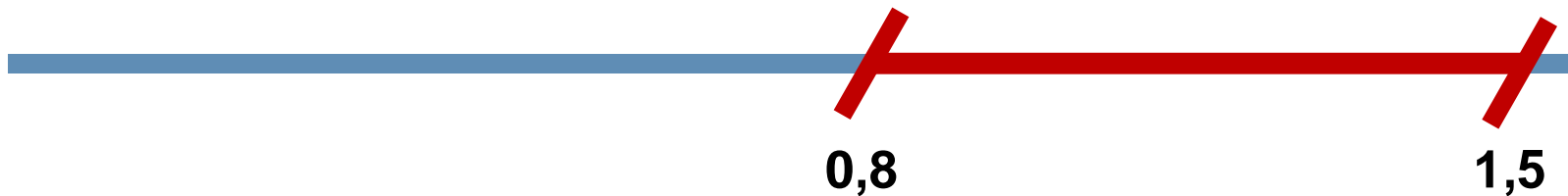
# TECHNOLOGY - Costs

We add very limited costs to H2 generation to make pure H2 available onsite

Fuel cell purity Hydrogen separation cost in USD/kg from a blended gas (base 20% H2 / 80% CH4)



Fuel cell purity Hydrogen cost obtained from ammonia cracking in USD/kg



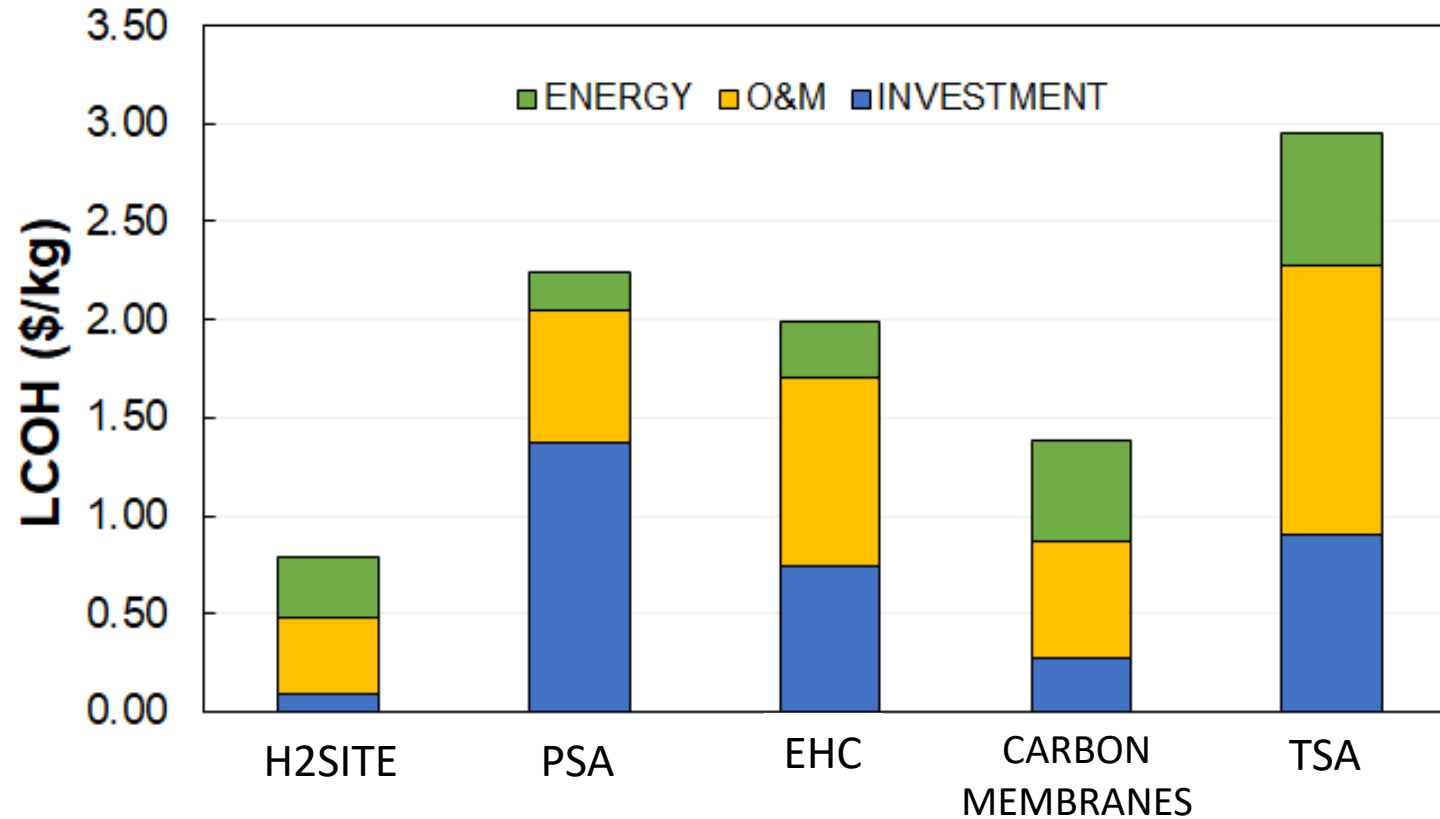
# TECHNOLOGY - competition

Inorganic membranes offer fuel cell purity H<sub>2</sub> at lower costs and are easy to operate

	H2SITE membranes	Polymeric membranes	Electrochemical compression	PSA
<i>H<sub>2</sub> Purity</i>	Fuel cell	ca. 85%	Fuel cell	Fuel cell
<i>Cost</i>	Medium	Low	High	Medium
<i>Moving parts</i>	No	No	No	Yes
<i>Pressure</i>	Ambiant	Ambiant	Very high	High
<i>Robustness vs impurities</i>	High (except sulphur)	Very high	Low (specially CO and CO <sub>2</sub> )	Low
<i>Scalability</i>	Medium	High	Medium	High
<i>Footprint</i>	Low	Low	Low	High

Dealbreakers





### Assumptions

20% H<sub>2</sub> in the grid  
Distribution grid (16 bar)  
Membrane lifetime: 7 years  
Electricity cost: 75 €/MWh

**Pd membranes:** data from H2SITE based on lifetime forecast.  
**PSA:** 2013 NREL report. [Blending Hydrogen into Natural Gas Pipeline Networks: a Review of Key Issues](#).  
**EHC, Carbon Membranes and TSA:** results retrieved to given assumptions from EU – [HYGRID project](#) (Hydrogen recovery from Natural Gas Grids).

# H2SITE's target markets



Industrial H2 for small and medium users

Up to 55€/kg, average of 13 €/kg...

...is the price small and medium end users pay for H2.

We keep customers hooked thanks to our unique membranes

H2 for mobility (focus on maritime mobility)

6 – 36 MMT/year

Green H2 demand in 2050 if CO2 reduction targets are to be met

58%

Bunker fuel demand that could be met using renewable NH3 (2050)

H2 for decentralized power generation



0-carbon fuels easy to store & transport replace diesel



H2SITE produces H2 locally



Fuel cell generates clean power



Data center gets reliable, low carbon power

H2 unblending in CH4 infrastructure

0,31 USD/kg H2

Cost of transporting H2 in a 500 km pipeline, including compression and storage. Compared to >3€/kg for trucks or ships

0 - 12%

Current limits of H2 blending into natural gas grids around the world



# Main achievements

Unique membrane manufacturing facilities  
+ significant commercial traction



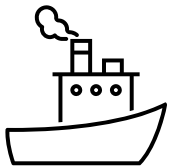
**Building world's largest Hydrogen Refueling Station with ammonia as a feedstock converted into H2 onsite**



**Building pure H2 unblending units for several DSOs and TSOs in Europe**



**Developing several biogas to H2 units in EU with one single process step and without upgrading or extra purification units**



**Developing onboarded ammonia to H2 units for maritime transport**



**Studying ammonia to H2 units to generate NH3/H2 blends for large turbine manufacturers for power generation**



# H2 SITE

Membrane reactors for H2 generation

# THANK YOU FOR YOUR ATTENTION

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