

A Member of
The Linde Group

AGA



Hydrogen , Sweden

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- 1 Overview general market and hydrogen market
- 2 AGA/Linde Hydrogen production
- 3 Hydrogen for fuel cells/vehicle market
- 4 “Coming market”

Market share industrial gases (O₂, N₂, CO₂, Ar , H₂ + cylinder gases)

70-75 %

Hydrogen 85 %

Refuelling stations

Biomethan/ natural gas 24 public units (service maintenance)

Buses, trucks 4 at customers

Hydrogen 0

No other industrial gas company have public refuelling stations.

Hydrogen market

- Very small merchant market compared to total production. 2000 m³/h to 500 000 m³/h total produced
- Merchant market in Sweden, from electrolysers, market afraid of impurities in super high grade steel.
- Hydrogen merchant market is mainly reducing atmosphere in metallurgic industry
8-10 % H₂ to avoid oxidizing (steel, lead, iron powder, uranium etc)
- Some food applications as hydrogenating fatty oils.
- Big volumes normally uses own steam reformers, at refineries to hydrogenate oil fractions

Production AGA

Electrolysers with filling capacity 4 in Sweden 1200 m³/h

- Own electrolysers (to clean Argon) 120 m³/ h
- Hydrogen OnSite at customers 3 electrolysers in Sweden 240 m³/h

Competitors

- Total 400 m³/ h

Other

–Surplus volumes in Stenungsund (10 000 m³/ h) and Stockvik

Sweden

Normally first mover on green fuel solutions Example ethanol, biomethane, RME, DME due to “Fossil Free 2050” etc

- Low activity on FCEV due to no strong lobby, Swedish cars (Volvo, SAAB) not in front with FCEV development. No electrolyser industry, very small fuel cell production, no H2 filling industry in Sweden.

Sweden market starting now

- One station in south (Malmö) and probably one station at winter test station up north.
- EU infrastructure suggestions activated H2 interest in Sweden
- Hydrogen FCEV infrastructure group started to report what incentives needed and where to build infrastructure

Four alternatives (two realistic)

1. Electrolyser at refuelling station, only small “ back-up” amounts in bundels (12x 50 liter x 200 bar = 120 m³ H₂)
 - + minimum of costly transports
 - high investment cost minimal flexibility
2. Supplied by “swap bodies” – container-like distribution 147 x 50 x 200 bar = 1470 m³
 - Or more modern with carbon fiber swap bodies 38 x 450 x 250 = 4200 m³
 - + flexibel , can handle big volumes,relatively low investment
 - Transport cost
3. Pipe line
 - + can handle big volumes
 - high investments need big volumes
4. Liquid hydrogen in tank
 - + lower transport cost ,flexible
 - high investments need big volumes

Sweden

- Existing “green gas” market, 144 public biomethane refuelling stations (AGA/Linde owns and runs 24 of these)
- With a H2 infrastructure strategy could mean 5-10 H2 refuelling stations within a few years. BUT interest from Swedish state or local initiatives needed (read funding) !!
- We have best supply possibility, have good service coverage in the whole country and experience in running refuelling stations in Sweden

Thank you for your attention.