Hydrogen HDV infrastructure with Fossil Parity

Jesper Fruergaard – Nel Hydrogen Solutions
About Nel Hydrogen

- World’s largest pure-play hydrogen company with a market cap of €500 million.
- +250 employees in Denmark, Norway and USA with world-class experience and skills.
- Offering hydrogen technology and solutions for industrial, energy and transport applications.
- More than 3500 hydrogen solutions delivered in 80 countries worldwide since 1927.
- World #1 on hydrogen electrolyzers and hydrogen fueling – unrivalled performance and track-record.

HYDROGEN FUELING
Acquired in 2015

PEM ELECTROLYSERS
Acquired in 2017

ALKALINE ELECTROLYSERS
Dates back to 1927

Three business segments

Hydrogen Electrolysers
Hydrogen Fueling
Hydrogen Solutions
Hydrogen – JUST ANOTHER FUEL

Hydrogen shall be seen as “just another fuel”
• Together with partners - Nel can offer a full service concept
• Transition from fossil to 100% renewable made easy

Buy hydrogen dispensed at pump, just like fossil fuels
• Low hydrogen price achieved through large scale semi-centralized production from cheap renewable power
• Minimizes footprint at depo, high pressure combined distribution/storage solutions gives redundancy
• HDV can be refueled, serviced and maintained like traditional HDV

Long-term contracts for 100% green Hydrogen is available
• Per kg price incl. refueling station, operation and maintenance
• Renewable hydrogen offered at attractive price ensures FOSSIL PARITY
Hydrogen – JUST ANOTHER FUEL

Combining Lego bricks to a solution

- Standard elements can be combined as needed
- All fast fuelling in accordance with SAE J2601.
- Flexible configuration of hydrogen storage and fuelling capacity – very compact total footprint.
- Can connect to various hydrogen supply sources e.g. onsite production or trucked-in delivery.
Fossil parity

Renewable hydrogen from electrolysis reaching a tipping point
What is fossil parity?

Fossil parity: Cost diesel (fossil) solution = or > renewable hydrogen solution

• Fuel Cell Electric HDV at 5 EUR/kg equals Diesel price of ~0.9 EUR/liter excl. VAT

• No cost assigned to harmful fossil emissions like: CO2, SO2, NOx, CO, HC, PM
Electrolysers outcompeting fossil alternatives

**CapEx:** Electrolysers from Nel - becoming competitive with SMR

**OpEx:** Renewable energy already enables fossil parity for hydrogen

*incl. service, maintenance & operation
**electricity

*Source: Pareto Securities
EUR/USD: 1:1.2

**Cost split of H2/Kg**

<table>
<thead>
<tr>
<th>Country</th>
<th>Average 2016:</th>
<th>FOSSIL PARITY: INDUSTRY</th>
<th>FOSSIL PARITY: FUEL</th>
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<tr>
<td>Netherlands</td>
<td>4,9</td>
<td>6,0</td>
<td>7,3</td>
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<tr>
<td>Denmark 2016</td>
<td>1,8</td>
<td>3,0</td>
<td>5,0</td>
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<tr>
<td>Average 2016</td>
<td>1,8</td>
<td>2,3</td>
<td>4,9</td>
</tr>
</tbody>
</table>

**SMR – CapEx range**

Large scale steam methane reformers
Nel large scale alkaline electrolysis

$\$/kW

**CapEx:**
- Electrolysers from Nel
- Becoming competitive with SMR

**OpEx:**
- Renewable energy already enables fossil parity for hydrogen

*CapEx* **OpEx**

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2015 2020 2025

Solar PV

Offshore wind

Onshore wind

**Source:** Pareto Securities
**EUR/USD:** 1:1.2

**Fossil Parity:**
- Fuel
- Industry

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**Note:**
- *incl. service, maintenance & operation
- **electricity
How we reach fossil parity...
H2Station® manufactured at world’s largest hydrogen fueling station factory

300 H2Station® per year – sufficient for fueling 200,000 new FCEVs annually

https://youtu.be/7YxjytkkNi4
Constructing the world’s largest electrolyzer plant

Name plate capacity of 360 MW per year, more than 10x current annual production

300 H2Station® per year – sufficient for fueling 200,000 new FCEVs annually

- Highly automated and designed according to lean manufacturing principles
- Industrial scale electrode production of the markets most efficient electrolyzes at a game changing cost
- Manufacturing plant will be constructed as an extension of the current facility at Notodden, Norway
- Operational in 2Q 2020 with ramp-up aligned to customer requirements
- Aiming at system cost reduction of more than 40%
Hydrogen train opportunity in North Germany

Efficient centralized H2 production
- 100% green hydrogen production by centralized electrolysis plant situated in Heide, in Schleswig-Holstein
- Produced via local renewable energy
- 7-10 T/day supply for 56 Trains

Flexible distribution setup
- Pre-compressed hydrogen distributed by truck in 50/70MPa swap containers – flexible logistics ready for further scale

Compact fueling equipment at stations
- State-of-the-art hydrogen fueling equipment located at train stations in Husum, Kiel, Neumünster and Lübeck
NEL + NIKOLA: Zero emission – Zero compromise

- Solution for green hydrogen production and fast refueling of hydrogen at MEGA stations
- Zero emission fuel and freight based on renewable energy: same convenience and higher performance

Wind  
Solar

**Electrolysers**
Hydrogen production  
A-3880 - 8T/day

**H2Station®**
Hydrogen fueling  
80 kg / 10 min

© Nikola Corporation
Hydrogen supply chain for the mobility sector

- Zero-Emission hydrogen supply chain enable **Fossil Parity** at the dispenser
- Hydrogen based on renewable electricity with flexible production
- On-site production or pipeline when energy cost and site allows

![Hydrogen Supply Chain Diagram]

- **Renewables**
- **Electrolysis**
- **Distribution**
- **Dispensing**
- **Fossil Parity**

**Pipeline**

**On-site**

- Large scale Central production: 20 MW, 2.5 €/kg
- High pressure Distribution: 1.000 – 1.500 kg / truck, 1.3 €/kg
- Efficient dispensing at 100% availability: Fueling time 5-10 minutes, 1.1 €/kg

= 5 €/kg

0.94 €/liter diesel
Implications of Scale?

At Scale

- Fuel Cell Electric Bus (FCEB) = cheapest ZE public transport solution (bus prices already quoted at FCB CPH17*)
- As production goes up further price will decrease accordingly

No expensive investment in fueling / charging infrastructure

- Supplier of hydrogen provides refueling infrastructure
- Refueling done at depot – no interference with traffic/problem for the city during setup and operation

Fuel Cell electric busses are 1:1 substitution for diesel buses

- Same range, can service existing routes, i.e. no need to adapt routes and schedule
- Refueling done at depot, once per day like a diesel bus
- Fueling capacity increase at depot made easy – just add additional trailers

* See published white paper for TCO analysis
End of presentation

Thank you for your attention

Questions?

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