Nel Hydrogen

October 2018
Jacob Krogsgaard
Nel in brief

- Global, listed pure-play hydrogen company – facilities in Norway, Denmark and the U.S.
- Significant foothold in fast-growing markets with several breakthrough contracts
- World-leading on hydrogen electrolyzers and fueling equipment – unrivalled performance and track-record
  - >3,500 hydrogen solutions delivered in ~80 countries world wide since 1927
  - ~40 hydrogen fueling stations delivered to 9 countries, and delivering to South Korea in 2019
- Capable of delivering solutions to produce, store and distribute hydrogen from renewable energy
Nel Hydrogen Electrolyser
Production and installation of water electrolyzers for hydrogen production

- Global leader in water electrolysis based hydrogen production plants
- highest uptime, lowest conversion cost, robust and reliable
- Scalable production capacity for industrial and energy/transport applications – small scale to large scale solutions

Containerized solutions
Up to 1000kg/day

Alkaline and PEM electrolyzers
Scalable and modular

Large scale plant solutions
Up to any capacity
Nel Hydrogen Fueling

Production of hydrogen fueling stations for cars, buses, trucks, forklifts and other applications

- Global leader within hydrogen fueling solutions for vehicles, adapted to latest fueling standards
- Delivered ~45 stations in 9 countries across Europe, US and Asia
- Highest reported availability and innovative, in-house developed technologies

Dispenser assembly

5-stage H2Station® assembly

World’s largest manufacturing facility for H2Stations®:

300 station per year capacity
Nel Hydrogen Solutions
Utilizing market opportunities across the Nel group and offers complete solutions to customers

- Unified delivery of complex renewable hydrogen solutions, efficient system integration, project development and sales across segments

- Sole provider of integrated solutions along the entire value chain:
  1. Fueling Networks
  2. Renewable Hydrogen & Storage Solutions
Fossil parity

- renewable hydrogen from electrolysis reaching a tipping point
Global hydrogen market

Large opportunities for electrolysis within existing hydrogen market

• ~55 million ton/year market (~150 BUSD)
• Only ~1% from water electrolysis today, rest from SMR/gasification
• Large potential for growth, driven by increasing focus on:
  • decreasing electrolyser CAPEX
  • decreasing electricity prices
  • climate and renewable energy
• Assuming that total market is supplied by electrolysis, annual market potential would be >20 B$/year

Global hydrogen market, by end-use:

- Ammonia
- Methanol
- Refineries
- Other

 nel
Electrolysers outcompeting fossil alternatives

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

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

### Cost split of $H_2$/Kg

- **CapEx:**
  - Electrolysers from Nel
  - SMR – CapEx range

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

### CapEx:

- **Electrolysers from Nel**
- **Large scale steam methane reformers**

### OpEx:

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

### Solar PV

- **Onshore wind**
- **Offshore wind**

### Cost split of $H_2$/Kg

- **CapEx**
- **OpEx**

### Source:
Pareto Securities

**EUR/USD:** 1:1.2

*incl. service, maintenance & operation

**electricity
Expotential cost reduction potential – Learning rate

FUEL CELLS IN 2017 ARE WHERE SOLAR WAS IN 2002
- Solar at 0.3 $/W (2017) and keep dropping
- Low cost Solar, Wind → Low cost Green Hydrogen

FUEL CELL LEARNING RATE AT 25%:
- Fuel cell learning rate similar to PV
- Much more dependent on volume than time

ACCELERATE COST DOWN:
- Mass manufacturing of fuel cell and hydrogen technology
- Run up accumulated installed capacity
- Target: Bring down cost to 10% in less than 10 years
Electrolysis, today & future – **CAPEX** – large potential for improvement

<table>
<thead>
<tr>
<th></th>
<th>~2015</th>
<th>~2020</th>
<th>~X-years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nel electrolysis [$/kW]</td>
<td>&lt;700</td>
<td>&lt;500</td>
<td>&lt;350</td>
</tr>
<tr>
<td>Solar (utility scale) [$/kW]</td>
<td>~1,500</td>
<td>~700</td>
<td>&lt;500</td>
</tr>
<tr>
<td>Solar PPA [$/kWh]</td>
<td>0.04 – 0.06</td>
<td>0.02 – 0.04</td>
<td>0.015 – 0.02</td>
</tr>
<tr>
<td>Total hydrogen production cost [$/kg]</td>
<td>2.4 – 3.3</td>
<td>1.3 – 2.7</td>
<td>1.0 – 1.3</td>
</tr>
</tbody>
</table>

- Large electrolyzer facilities from Nel already at CapEx parity with medium scale SMR\(^1\)
- Nel targets to reach CapEx parity with large scale SMRs in foreseeable future
- Fully automated production line + next generation electrolyser

---

1: SMR – steam methane reformer 2: Bloomberg New Energy Outlook 2017
New markets, Power-To-X

Unparalleled position of electrolysis in producing other green energy forms

- Hydrogen from electrolysis will be key in producing large quantities of sustainable energy in various forms.
- Ability to adapt to diverse and intermittent renewable energy sources becoming increasingly important.

\[ \text{Power} \rightarrow \text{H}_2 \rightarrow \text{POWER-TO-PIPELINE (GAS)} \]
\[ \text{POWER-TO-FUEL (TRANSPORT)} \]
\[ \text{POWER-TO-POWER (ENERGY STORAGE)} \]
\[ \text{POWER-TO-LIQUID (BIOFUEL)} \]
\[ \text{POWER-TO-NH}_3 \text{ (GREEN AMMONIA)} \]
\[ \text{POWER-TO-CH}_3\text{OH (GREEN METHANOL)} \]
\[ \text{POWER-TO-CH}_4 \text{ (GREEN METHANE)} \]
\[ \text{POWER-TO-STEEL/TITANIUM (CO}_2\text{ FREE)} \]
\[ \text{POWER-TO-REFINERIES} \]
Competitive Hydrogen for HD applications

- Optimized hydrogen supply chain
- Renewable electricity converted to hydrogen centrally at industrial scale to insure low energy cost
- Distributed by truck, and dispensed competitively

- 5€ dispensed is now possible in favorable locations/conditions = Fossil Parity

- Resulting hydrogen cost depends on local frame conditions

- 30 - 40 €/MWh
- Large scale Central production
- 10-100 MW

- High pressure Distribution
- 1.000 – 1.500 kg / truck

- Efficient dispensing
- 100% availability

- ~5 €/kg
Hydrogen is becoming relevant in all forms of transportation
How we reach fossil parity...
Nel have developed the largest H2Stations plant in the world

- World class production and development facility
  - Enables UL-certified standardized production
  - Name-plate production capacity of ~300 stations/year
  - Benchmark cost to enable
Constructing the world’s largest electrolyzer manufacturing plant

Construction of mega-factory

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

- 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 1H’20 with ramp-up aligned to customer requirements
- Aiming at system cost reduction of more than 40%
Project: H2Bus Europe

600 FC busses spread across major cities in 2023

3 Clusters (central electrolysers) in Europe

15-20 H2Stations (dispensers)

20-40 35MPa Hydrogen trailer

Moving hydrogen buses to a commercial level

40M€ Support from CEF
Efficient centralized H2 production
- 100% green hydrogen production by centralized electrolysis plant situated near 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
EMISSION FREE HEAVY-DUTY LONG-HAUL TRUCKS
• 100% ZERO TAILPIPE EMISSIONS
• 100% ELECTRIC DRIVE
• HYDROGEN POWERED
• 750 km - 1,200 km RANGE
• AUTONOMOUS CAPABILITIES
• 2,000 FT. LBS TORQUE
• 1,000 HORSEPOWER
• 125kW-250 kWh BATTERY
• 240 kW FUEL CELL
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

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

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

Wind  Solar
Nikola H2 Standard stations

- Nikola Owned, 4-8 Ton/day stations (scalable up to 32 ton/day H2 for truck depots)
- Developing 10 Minute, 70 MPa HD Fast Fueling Protocol with Nikola
- SAE J2601 H70 Light Duty Hydrogen Also Available for Sale
- Hydrogen Delivery at Sale @50MPa
Number one by nature