Jesse Schneider
Executive Vice President, Hydrogen & Fuel Cell Technologies

CLEAN FUEL,
ZERO EMISSION TRUCK
NO COMPROMISE
Nikola Motor

Zero Emission Trucking + Low Carbon H₂:

Fuel cell trucks:
- Long Range, Heavy Duty 40T Commercial Vehicle
- High Torque & Horsepower
- Zero Tailpipe Emissions and very low WTW

Hydrogen station:
- Fast Fueling
- On-Site Hydrogen (8T) Generation from Grid with Supplemented Renewable Energy
- Onsite Storage (10T)
- Heavy Duty & Light Duty Fueling
Environmental Impacts: GHG Emissions* (Update: October 15, 2019)
-Class 8 Combination Long-Haul Trucks

Acronyms:
WTW: Well-to-Wheels
GHG: Greenhouse Gas
WTP: Well-to-Pump
PTW: Pump-to-Wheels
ICEV: Internal Combustion Engine Vehicle
H2: Hydrogen
NG: Natural Gas
SMR: Steam Methane Reforming
FCEV: Fuel Cell Electric Vehicle

Environmental Impacts: NO$_x$ Emissions* (Update: October 15, 2019) - Class 8 Combination Long-Haul Trucks

WTW NO$_x$ Emissions (g/ton-mi)

<table>
<thead>
<tr>
<th></th>
<th>PTW</th>
<th>WTP</th>
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<tbody>
<tr>
<td>Petroleum Diesel (ICEV)</td>
<td>0.25</td>
<td>0.01</td>
</tr>
<tr>
<td>H$_2$ via NG SMR (FCEV)</td>
<td>0.01</td>
<td>0.01</td>
</tr>
<tr>
<td>H$_2$ via solar-electrolysis (FCEV)</td>
<td>0.01</td>
<td>0.01</td>
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</table>

Acronyms:
- WTW: Well-to-Wheels
- NO$_x$: Nitrogen Oxides
- WTP: Well-to-Pump
- PTW: Pump-to-Wheels
- ICEV: Internal Combustion Engine Vehicle
- H$_2$: Hydrogen
- NG: Natural Gas
- SMR: Steam Methane Reforming
- FCEV: Fuel Cell Electric Vehicle

First Purpose-Built Class 8, Fuel Cell Electric Truck
• 240 kW FUEL CELL POWER
• 125kW-250 kWh BATTERY
• Four Wheel Independent E-DRIVE
• 600+ MILES OF RANGE
• AUTONOMOUS CAPABILITIES
• 14,000 ORDERED
• 800 TRUCK ORDERS FROM ANHEUSER-BUSCH INBEV
• TRUCKS ARE T.C.O. LEASED ACCORDING TO MILEAGE WITH ALL FUEL & MAINTENANCE INCLUDED
8t/Day Pilot Station

Green Power + Electrolysis = Green Hydrogen
Hydrogen Generation Onsite for both Heavy Duty and Light Duty: 8T example

150 trucks Per day

100 cars Per day

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Key to Cost Parity with Fossil Fuels: using Renewable/ Nuclear < $0.04 / kWh

Hydrogen Generation with renewables & grid with low cost electricity

< $0.04 / kWh @ Cost of electricity

Alkaline Electrolysis "tried and true" technology

< $6.00 / kg Sale price of hydrogen

70 MPa Hydrogen Fueling for heavy duty applications

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• 8 Ton/day hydrogen generation & fueling using NEL tech.
• First Nikola Hydrogen Station in Arizona in 2021
• Planning multiple 8T/day H2 Stations also in California both LD/ HDV
• Stations Scalable up to 32 Ton/day H2 for truck depot
New Fueling Equipment & Standards for Heavy Duty Fuel Cell Electric Trucks are being developed by an industry consortium MOU to enable safe, fast fueling.
Project is funded by the partners and HD hardware prototypes will be tested in 2020 (Lab/Field)

- HD H70HF Fueling Nozzle
- Receptacle
- Hose
- Breakaway
Fast Fueling with Hydrogen
Development in Arizona:

70 MPa | 15 min | 80 kg
High flow | HD fueling | Full fill
8T/day hydrogen development station for Fuel Cell Truck Fleet Testing

HD Fuel Cell Lab
Fuel cell & battery test stands

Extreme Environmental chambers:
Fuel cell systems (350kW)
Battery & E-Motor Vehicle Dynamometer (1350kW)

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Hydrogen Infrastructure R&D

Nikola Demonstration Stations

Demo station #1: Nikola HQ (Phoenix, AZ)
- **Station Timing:** Completed Q1 2019
- **Station Features:** 1,000 kg of Hydrogen (H2) Storage, 70MPa Compression, and Dispensing to 60 g/s

Demo station #2: 2-Ton/Day / Fuel Cell R&D Facility (Phoenix, AZ)
- **Station Timing:** Est. Q3 2020
- **Station Features:** 2 T/D H2 Production, Storage, Compression, and Dispensing
- **Other:** hydrogen tank test chambers, High Flow development dispenser system, FC test stations and high flow component test bench
- **Fleet Test Trucks Starting Q1 2021**

8-TON PILOT STATION: 8 T/Day (Phoenix, AZ)
- **Station Timing:** Est. Q3 2021
- **Station Offers:** 8T Light Duty & HD H2 Production, Storage, Compression, and Dispensing

70mpa heavy duty & light duty hydrogen station R&D
# Heavy-Duty Fuel Cell Truck Standards Priorities

<table>
<thead>
<tr>
<th>Topics</th>
<th>Focus</th>
<th>Output</th>
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</thead>
<tbody>
<tr>
<td><strong>HD Fueling Protocol</strong>&lt;br&gt;High-Flow 70MPa</td>
<td>• New Fueling Protocol&lt;br&gt;• 80kg in 15 minutes H70 Fueling&lt;br&gt;• New HD Communications</td>
<td>• ISO TC 197, WG 27 NWIP (December NWIP Proposal: US/Germany) &amp; Asian countries&lt;br&gt;• Harmonize with SAE</td>
</tr>
<tr>
<td><strong>HD Fueling Hardware</strong>&lt;br&gt;High-Flow 70MPa</td>
<td>• New ISO/SAE H70HF Interface: Nozzle, Receptacle, Hose, Breakaway</td>
<td>• Hardware - Lead ISO&lt;br&gt;• Harmonize with SAE</td>
</tr>
<tr>
<td><strong>HD Vehicle Safety</strong>&lt;br&gt;Safety Requirements</td>
<td>• Update existing standards with HD FCEV&lt;br&gt;• Update GTR13 Phase II</td>
<td>• UN GTR #13, Standardize requirements that can be adopted globally</td>
</tr>
<tr>
<td><strong>HD Fuel Economy</strong>&lt;br&gt;Test Standard</td>
<td>• New World HD Dyno Cycle Test Procedures &amp; Hydrogen Consumption</td>
<td>• New Document SAE&lt;br&gt;• Harmonize with ISO</td>
</tr>
<tr>
<td><strong>Tunnel HD FCET Vehicle Safety</strong></td>
<td>• Independent HD Hydrogen Safety Study</td>
<td>• International Report for LD &amp; HD Tunnel Safety</td>
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to conclude

- Together with large OEM (Iveco) & Tier 1 Partners Nikola Motor Fuel Cell Hybrid Truck Purpose Built, Class 8 Chassis enabling 600+ Miles (1000km+). Over 14,000 Truck orders+

- Hydrogen, Fuel Cell, & Battery Development & Testing Center in Arizona

- Nikola + NEL are vertically integrated for H2@Scale
  - Nikola 8 tons H2 / day Stations starting in Arizona & Fleets
  - Nikola to mass produce FC Class 8 Trucks & Own stations
  - NEL to start mass production of electrolyzers

- Nikola stations will be available to customers and public fueling Heavy Duty / Light Duty fueling at 70MPa. 8 ton/day stations across USA starting in Arizona, California, then US rollout.

- For Hydrogen to be competitive, LC electricity costs < $0.04/kWh

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to conclude

• Fuel Cell Hydrogen Trucks using renewable hydrogen give significant reduction in GHG & NOx WTW emissions. Renewables and nuclear are the lowest cost electricity, need to get this cost (<$0.04/kWh) for hydrogen generation to kickstart the H2/FC industry.

• The industry & government should work together to accelerate Heavy Duty Codes & Standards Research and Collaboration with international and US standards

• Need for Public/ Private Partnership H2@Scale & Fuel Cell Truck Demonstration Projects for fleet vehicles to help kick start public demonstration

• Large Scale (8T+) Publicly available fueling site near key commercial routes that have potential to grow to critical mass (100’s of Class 8 HD/ LD vehicles, multiple tons of hydrogen) using renewable/nuclear power
Stay tuned...
Nikola’s first H₂ station at new headquarters:
Largest Gaseous H₂ VEHICLE STATION in USA – 1T STORAGE