



THE CASE FOR HD FUEL CELL AND LARGE SCALE HYDROGEN ROLL-OUT



JESSE SCHNEIDER

EVP, TECHNOLOGY, H2 & FC



PRESENTATION OVERVIEW

- **NIKOLA OVERVIEW**
- **CLASS 8, FUEL CELL NIKOLA TWO**
- **HD HYDROGEN INFRASTRUCTURE: DEVELOPMENT TO SCALE**
- **70MPA HD FUELING:**
 - **DEVELOPMENT, VALIDATION TO STANDARDIZATION NEEDS**
 - **OPPORTUNITIES FOR WORKING TOGETHER**

NIKOLA CORPORATION:

INTRODUCTION TO NIKOLA PLATFORM

The first-ever zero emissions, fuel cell semi and hydrogen infrastructure for the long-haul market

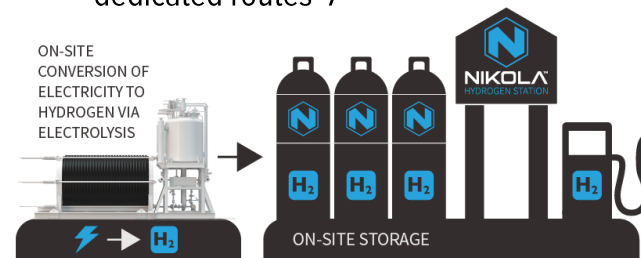


TRUCKS

- 15% - 20% total ownership cost savings over diesel. Zero emissions
- Partnering with world class strategic manufacturers has reduced the R&D expenditures required to build prototype and time to market
- Nikola's highly disruptive business plan offers an industry-first “**bundle pricing**” model (truck, fuel, repair & maintenance)

HYDROGEN FUELING

- 70 MPA HD Fueling (under development)
- Production – Via electrolysis
- Electricity input – Grid, Solar, Wind (depends on energy cost & renewables)
- Station Network – Targeted “dedicated” single-station H2 fueling model along “dedicated routes”⁷



UTILITY TASK VEHICLE (UTV)

- A 100% electric 4x4 Utility Task Vehicle with recreational and military applications
- Why? To help accelerate the development of truck drivetrain. Easy to drive, easy to implement technology and software





NIKOLA MOTOR'S WORLD-CLASS PARTNERS.

Nikola has partnered with some of the best industry leaders in the world. These partnerships enabled Nikola to come to market and make its' Zero Emission vision become reality.





- OVER 8,000 TRUCKS ON ORDER
- 800 TRUCK ORDERS FROM ANHEUSER-BUSCH INBEV
- SMALL VOLUME PRODUCTION BEGINS IN 2021
- TRUCKS ARE LEASED WITH FUEL INCLUDED





- 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



H2 FUELING FROM ELECTROLYSIS

HYDROGEN GENERATION
WITH RENEWABLES + GRID
WITH LOW COST ELECTRICITY





NIKOLA HYDROGEN STANDARD STATIONS RETAIL FOR HD & LD

- Developing HD 70 MPa Hydrogen Fast Fueling Protocol & Hardware (In Process-Open to Collaboration)
- 10-15 Minute HD Fueling Goal
- 60-80 kg HYDROGEN ON-BOARD 700 BAR
- SAE J2601 H70 Light Duty Hydrogen Also Available for Sale
- Bulk Hydrogen Sale @50MPa
- 4-8 Ton/day station (modular, scalable up to 32 ton/day H2 for truck Depot)





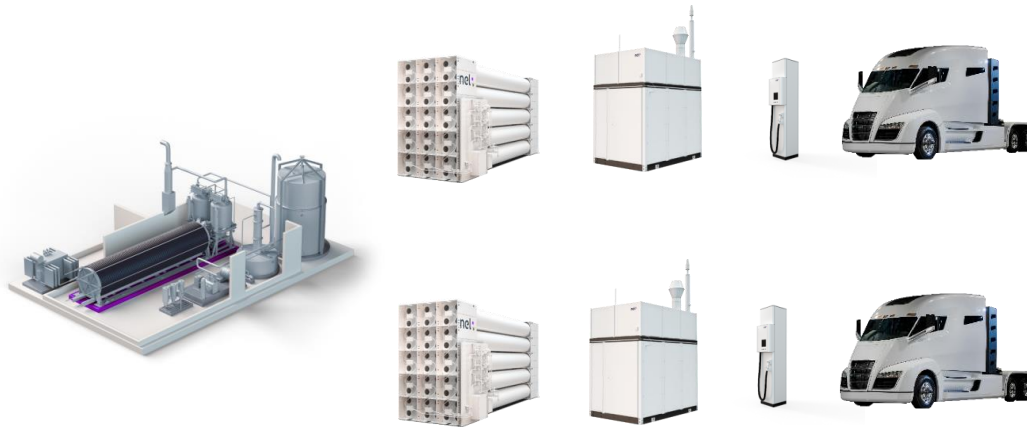
ZERO EMISSION HYDROGEN STATIONS. THE BEGINNING IN THE US.

- On-site hydrogen creation
- Public access to all Nikola H2 Stations
- The first development stations go online first quarter 2019, second 2020
- 28 more stations ordered for Anheuser-Busch InBev by 2023
- Nikola H2@Scale Ramp-up 2023+



Development Stations 2019

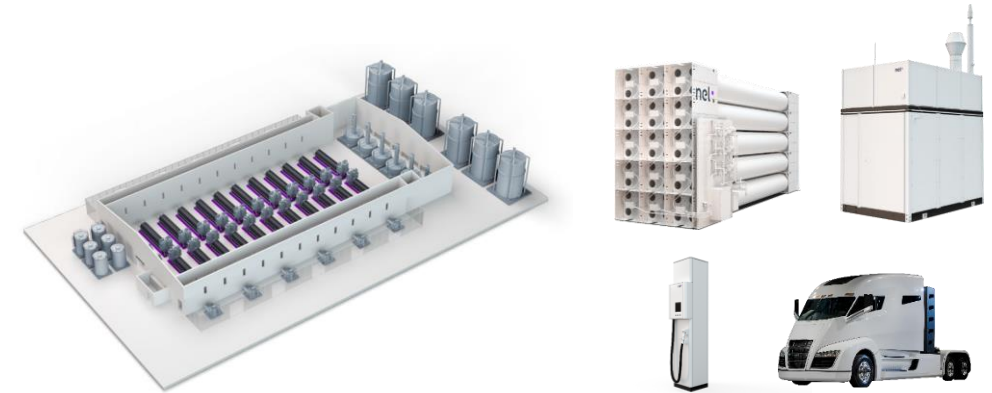
1,000kg hydrogen per day | 35 trucks



Dual fueling lines

Commercial Station → 2021+

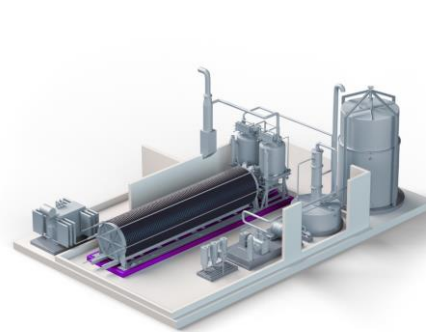
8-32 tons hydrogen per day | 250-1,000 trucks



NEL HYDROGEN STATIONS FOR NIKOLA MOTOR:

- **ALKALINE ELECTROLYSIS**
“TRIED AND TRUE” TECHNOLOGY
(20 YEAR+ LIFETIME)
- **70 MPA HYDROGEN FUELING FOR HEAVY DUTY (IN DEVELOPMENT)**

Hydrogen infrastructure



NEL A-485 electrolyzer
1,000kg/day 2.2MW



Dual H2Station® fueling
1,000kg/day two dispensers



70 MPA HD FUELING: DEVELOPMENT NEEDS

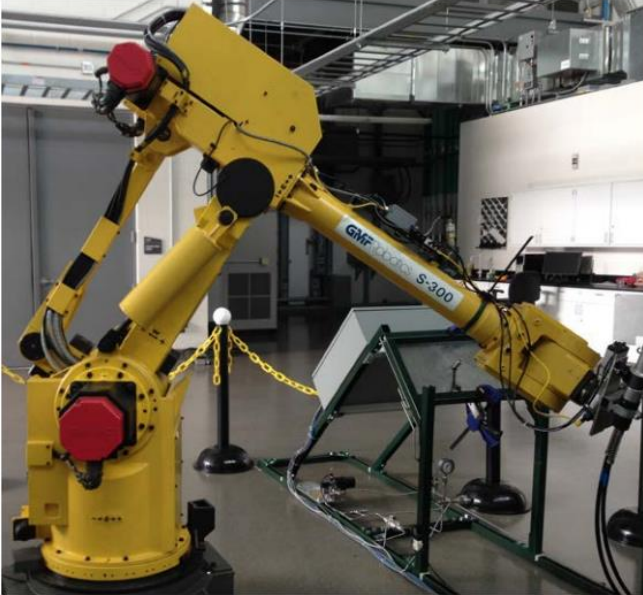


- 70 MPa Hydrogen Fueling protocol: 10+ minutes +NFPA Leak Checks (~12 min.), Simulation (started) + Lab Testing needs
- New HD H70 high flow nozzle, break-way and hose assembly
- SIL rated, Bi-direction comm. (V2x)
- Hydrogen Storage H70 Receptacle Check
- New compressor for high flow to 80kg
- New station cooling capacity for T40 HF
- Nikola R&D station in Arizona to be used for field test of components (2019-2020)

70 MPA HD -INTERFACE- COMPONENTS VALIDATION/CERT.

Proposal for a CRADA for Validation/ information for certification (at National lab, i.e. NREL if equipment is provided) to expedite HD Fueling timeline:

- H70 high flow nozzle, No-freeze on!
- Break-way (pull tests, etc.)- No leak!
- Hose (bending, burst tests, etc.)- Low Permeation!
- H70 Receptacle & Check Valves-No chatter!



70 MPA HD FUELING: “ONE TEAM” WORLD STANDARD PROPOSAL



- New HD-only FCV /H2 SAE team
- Propose SAE-ISO MOU jointly developed standards (one team, one document, Like Cybersecurity team)
- MOU with CSA, others possible
- New Standards Needed
 - HD H70 Hydrogen Fueling
 - Receptacle/ Nozzle
 - Hose/ Breakaway
 - Wireless Communications
 - H2 Station Test Apparatus (HSTA)
 - Interface w/ Weights & Measures



CONCLUSION



- **NIKOLA MOTOR TO BRING FUEL CELL TRUCK WITH UP TO 750 MILE RANGE TO THE CLASS 8, 40-TON TRUCK MARKET WITH FLEET CUSTOMERS**
- **H₂@ SCALE WITH HYDROGEN STATIONS 4-8 TON/DAY ELECTROLYSIS- FOR BOTH HEAVY DUTY/ LIGHT DUTY FCVS**
- **R&D CENTER TO BE BUILD IN ARIZONA WITH FUEL CELL DEVELOPMENT AND HD HYDROGEN FUELING (2019)**
- **CONSORTIUM NEEDED FOR VALIDATION OF FUELING COMPONENTS & STANDARDIZATION**
- **NEW 'ONE STANDARD' TEAM TO BE FORMED FOR HD FUELING PROTOCOL, COMPONENTS AND VALIDATION**



THE ZEV RACE IS ON...

