



# Hydrogen Infrastructure for Heavy Duty Vehicles

Northeast Diesel Collaborative (NEDC) 2019 Partners Meeting  
Providence, RI  
July 11, 2019

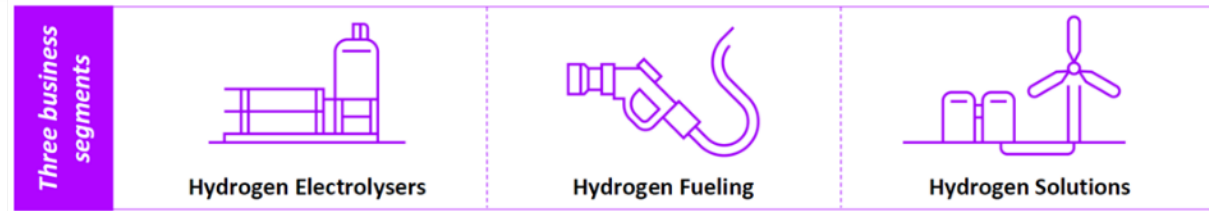
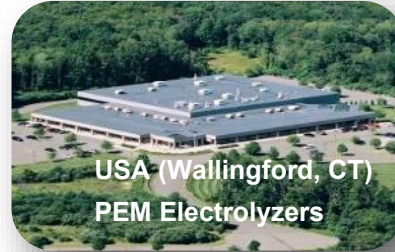
Everett Anderson  
VP, Advanced Product Development



# Who is Nel Hydrogen?

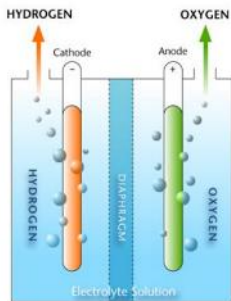
## Public Company, Pure H<sub>2</sub> Play

- 3 Manufacturing Sites
- 250+ Employees
- 3,500+ Electrolyzers Installed
- 40+ H<sub>2</sub> Fueling Stations
- 90+ Years Experience

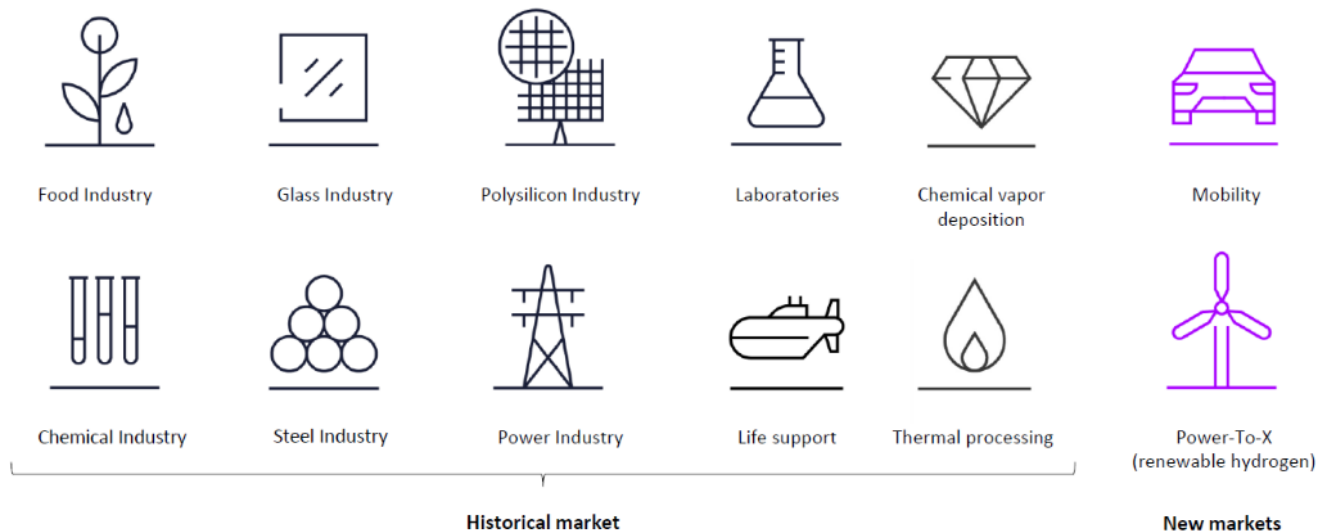


## Our Technology

Electricity + Water = Pure Hydrogen  
Renewable electricity = a carbon free source  
of hydrogen fuel



## Our Markets

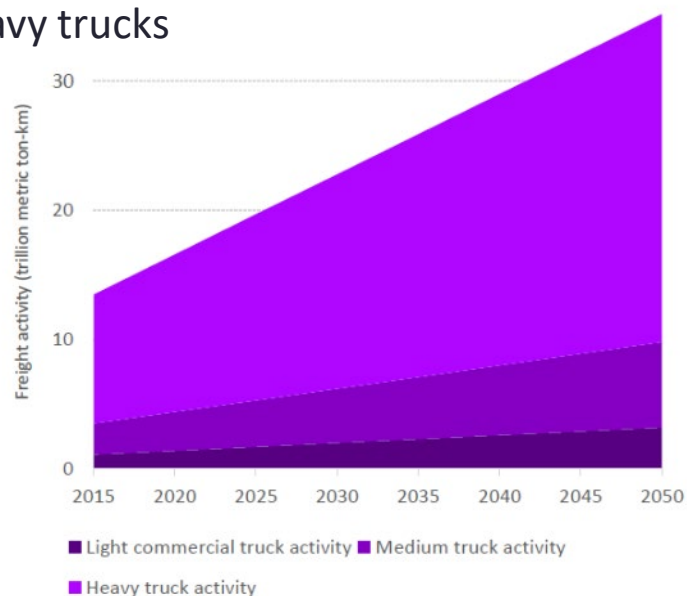




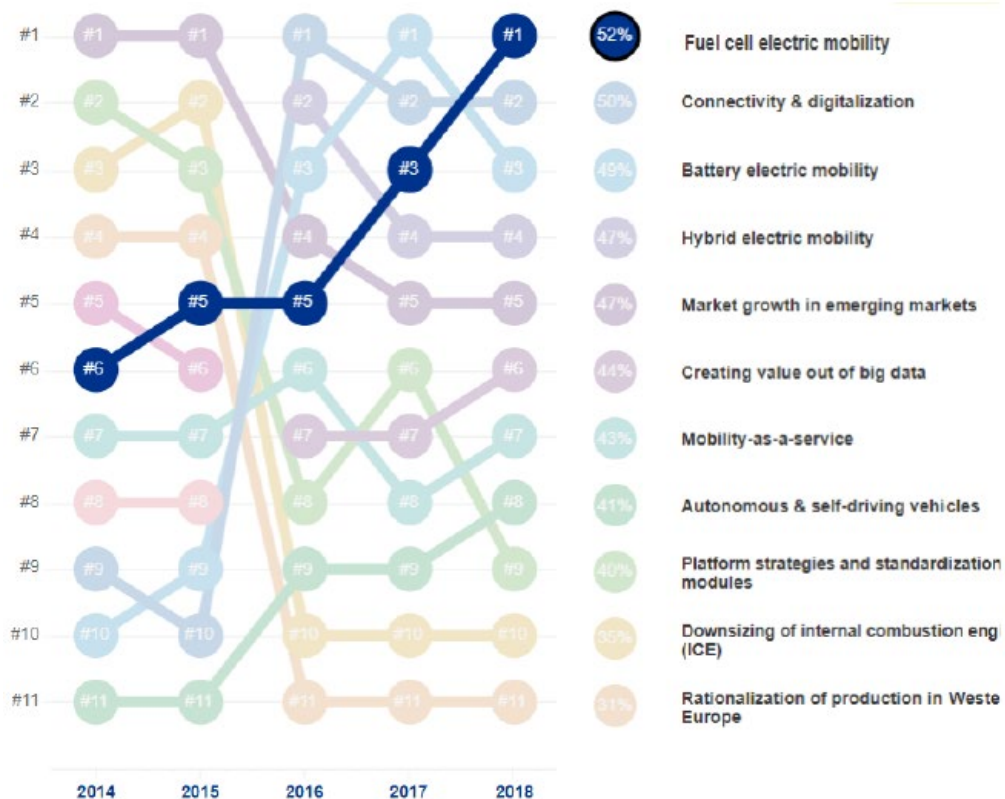
# Heavy duty market is poised to accelerate... and the promise of fuel cells is finally being realized

Freight activity / heavy duty transport projected to double by 2050

- Heavy duty vehicles responsible for 47% of CO<sub>2</sub> emissions from land-based mobility and ~8% of total global CO<sub>2</sub> emissions
- Freight activity (ton-km) projected to double by 2050
- Hydrogen most promising zero-emission fuel for heavy trucks



## Fuel cell electric mobility is now the #1 trend until 2025



KPMG Global Automotive Executive Survey is the compound input from 1000 executives from the automotive industry

# Hydrogen fuel cost parity with diesel/CNG for buses: within reach today...

**Achieving hydrogen price parity with diesel/hybrid and CNG will be important for the TCO experienced by Transit Agencies.**

**FCEB consumption ranging from 0.13 – 0.16 kg/mile results in the following fossil parity price with Diesel/Hybrid and CNG:**

- Diesel: \$4.5 - \$5.6 per kg hydrogen
- Diesel hybrid: \$3.6 - \$4.5 per kg hydrogen
- CNG: \$3.5 - \$4.3 per kg hydrogen



**Price parity with diesel is within reach today.**

**Diesel hybrid and CNG price parity requires scale.**

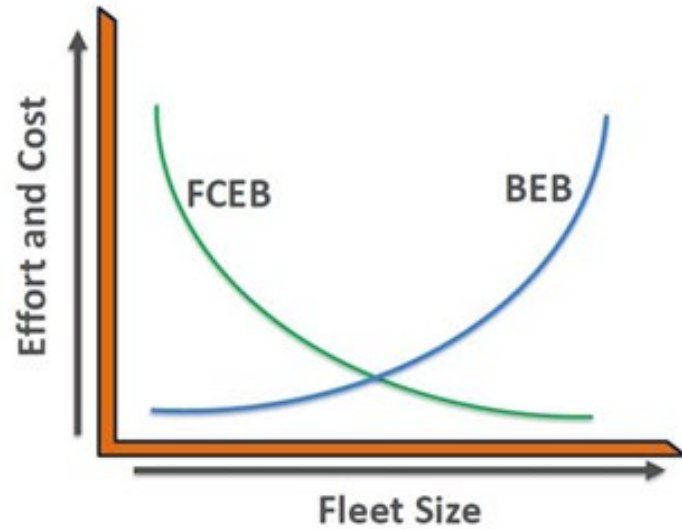
## Hydrogen price parity with diesel/CNG for busses in California

Fuel	Diesel	Unit	Diesel Hybrid	Unit	CNG	Unit
Fuel consumption	3.87	miles/DGE	4.84	miles/DGE	2.91	miles/DGE
Fuel price (incl. O&M)	\$2.79	/DGE	\$2.79	/DGE	\$1.62	/DGE
Fuel cost per distance	\$0.7	/mile	\$0.6	/mile	\$0.6	/mile
H2 parity price - 1	\$5.6	/kg	\$4.5	/kg	\$4.3	/kg
H2 parity price - 2	\$4.5	/kg	\$3.6	/kg	\$3.5	/kg

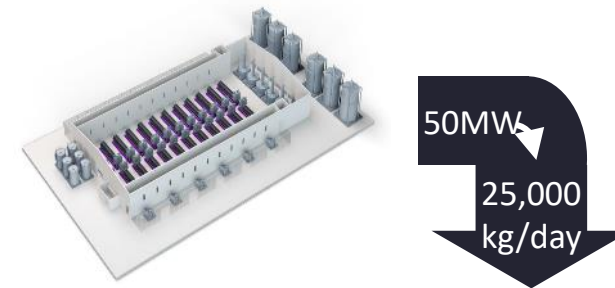
Hydrogen	1	2	Unit
Fuel consumption	8.00	9.85	kg/100km
	0.08	0.10	kg/1km
	0.13	0.16	kg/mile
	7.77	6.308	mile/kg

Data based on ARB:  
 "Innovative Clean  
 Transit - Cost Data and  
 Sources - Update on  
 6/26/2017"

# Hydrogen infrastructure scales at a low incremental cost with increasing fleet size...






*HDV's consume much more hydrogen than LDV's and fleet operation enables high fueling equipment utilization.*



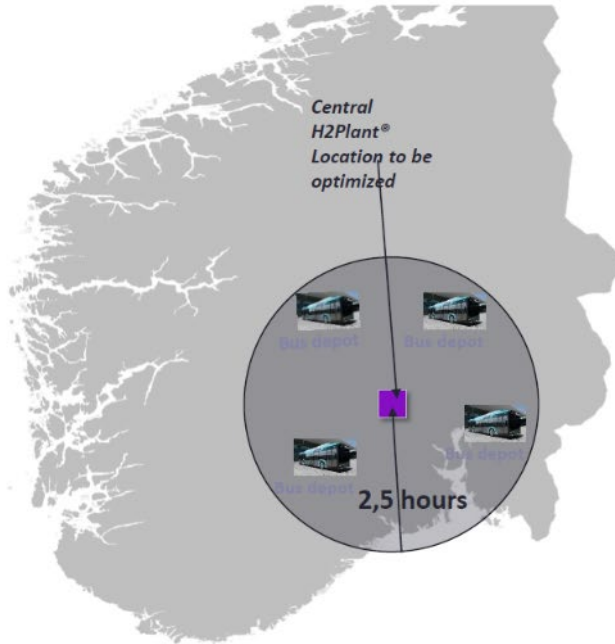
10 buses	50 buses	100 buses
H2 price: 8.5 EUR/kg	H2 price: 6 EUR/kg	H2 price: 5 EUR/kg
		

Price examples for different fleet sizes\*

\* Prices are dependent on local factors

500 class 8 trucks	1,000 transit buses	40,000 cars
		
<p>High fueling equipment utilization (fleet)</p>		<p>Low fueling equipment utilization (network)</p>

# A scalable model for Europe...



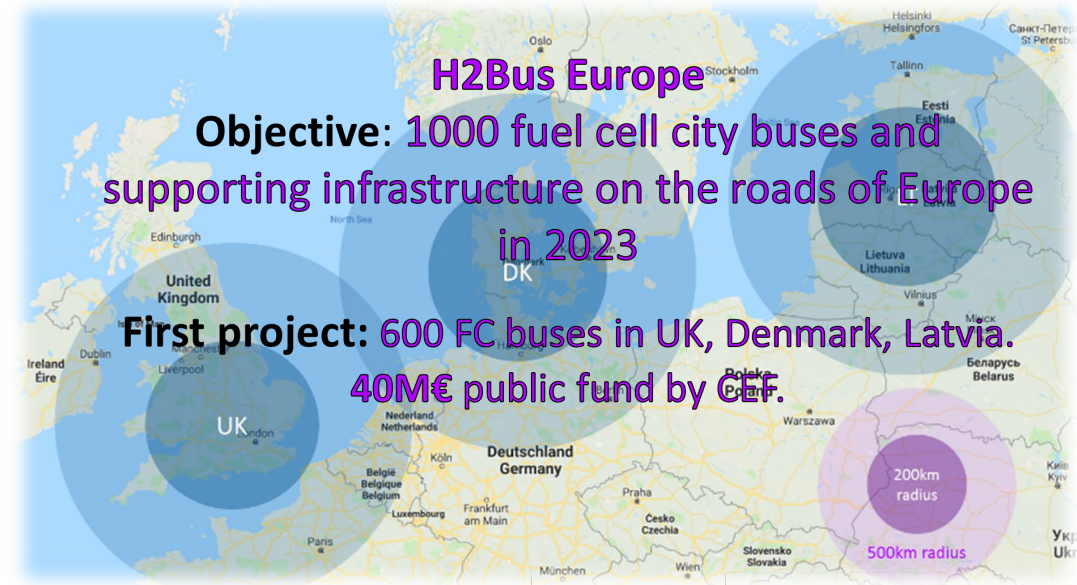
## Central large scale production, distribution, fueling, services

### Efficient Hydrogen distribution:

- 1.500kg pr. truck
- Container swap or dump-off

### Produced locally on 100% renewable basis:

- Bus depot capacity can easily be added or expanded
- Fuel with 100% renewable hydrogen at attractive price



**\$0.40/MWh**

Large scale central production

+ 10MW

High capacity distribution

+ 1.000 kg / truck

Down to 5 min fill redundant dispensing  
40-80 bus station

99.9% availability

**~\$5/kg**

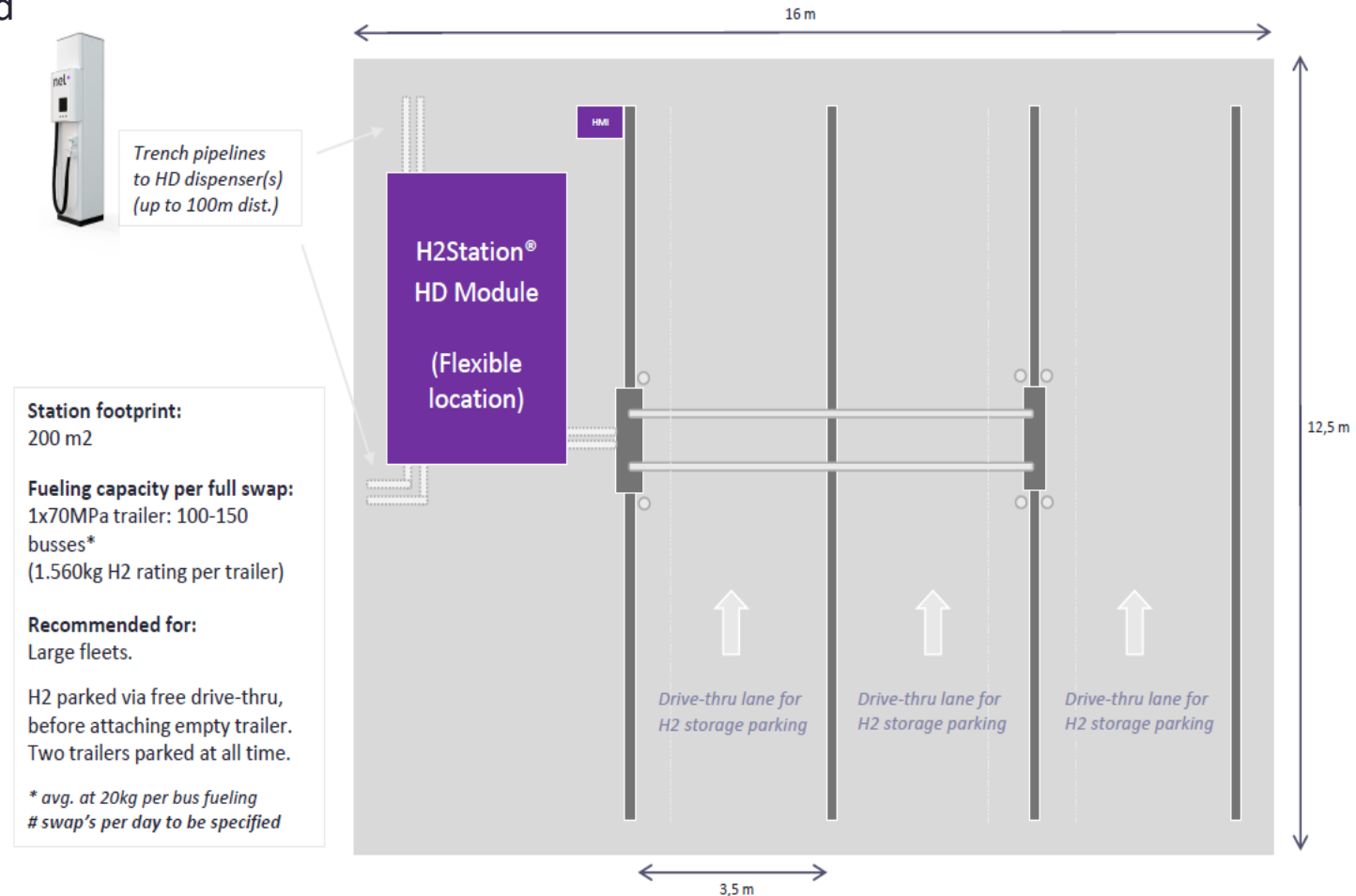
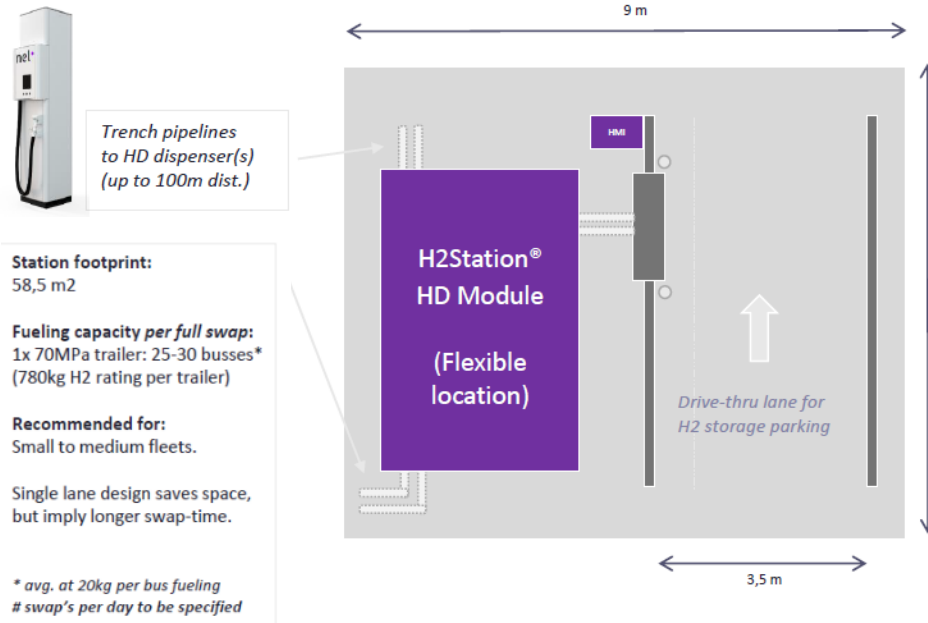


# Hydrogen Infrastructure for Bus Fueling

Large bus depot solution: 150 buses, 200 m2 area

## Nel Hydrogen H2 bus refueling station, 700 bar in 20 ft container

- Arriving (full) swap storage is parked and connected
- Truck driver then leaves with empty trailer
- Scalable and efficient solution, also applicable for other HD segments



# Initial market activity for long-haul transit

Recent announcements of efforts at scale to reduce overall cost of hydrogen-based fuel cell vehicles

- Partnership with Nikola Motors fueling infrastructure
- Partnership with H2 Energy for fuel production



OVER 8,000 TRUCKS  
ON ORDER  
800 TRUCK ORDERS  
FROM ANHEUSER-  
BUSCH INBEV  
TRUCKS ARE LEASED  
ACCORDING TO  
MILEAGE WITH ALL  
FUEL INCLUDED



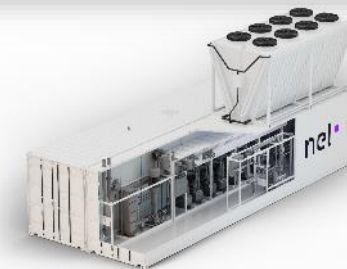
NIKOLA'S PLANNED USA 400+ HYDROGEN STATION NETWORK  
FOR BOTH LD & HD FCVS TO SUPPORT H2@SCALE ROLL OUT



Source: Nikola



Hyundai Motor and H<sub>2</sub>Energy  
announce 1600 fuel cell trucks  
for European market







**Thank you!**

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