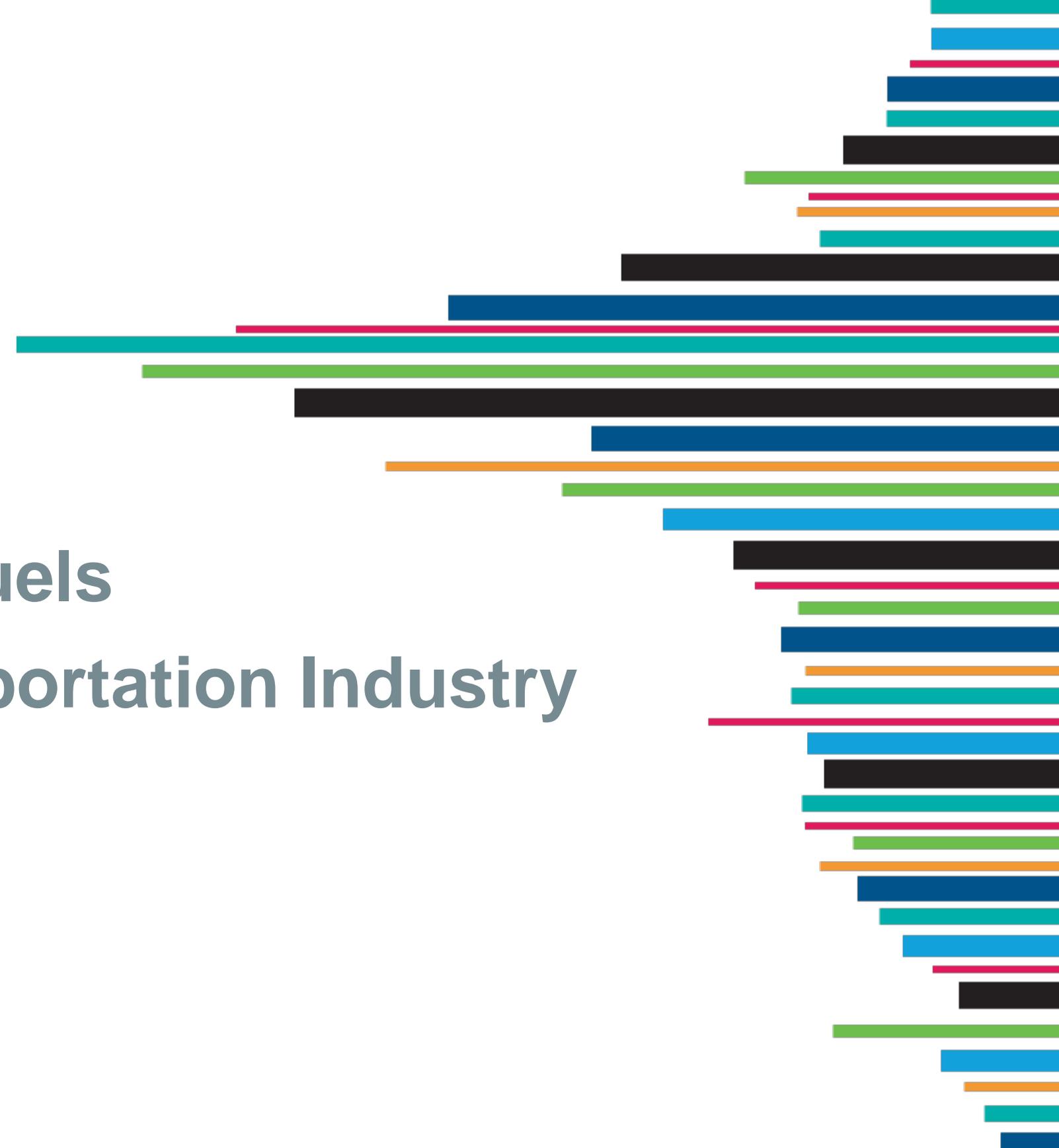




# Overview of Alternative Fuels Used in the Freight Transportation Industry

Stacy Noblet, Principal

April 18, 2018



# Agenda

- **Alternative Fuels**

- Overview
- Key Considerations
- Vehicle/Powertrain Availability
- Fueling/Charging Infrastructure

- **Programs**

- **Resources**



# Alternative Fuels in Freight

## Liquid & Gas



Propane



Natural Gas



Biodiesel

## Electrification



Hybrid



Plug-In Electric



Fuel Cell

# Key Considerations

## ▪ Fleet Operations

- Route
- Duty cycle

## ▪ Vehicle/Engine Availability

- OEM
- Aftermarket conversion

## ▪ Cost

- Up-front – vehicle, infrastructure
- Incentives
- Total cost of ownership (TCO)

## ▪ Fueling Infrastructure

## ▪ Other Infrastructure

- Facilities

## ▪ Training

- Drivers
- Maintenance technicians

## ▪ Organizational Motivations

- Environmental
- Financial
- Technology Demonstration

# Vehicle Availability

## Liquid & Gas



Compressed Natural Gas



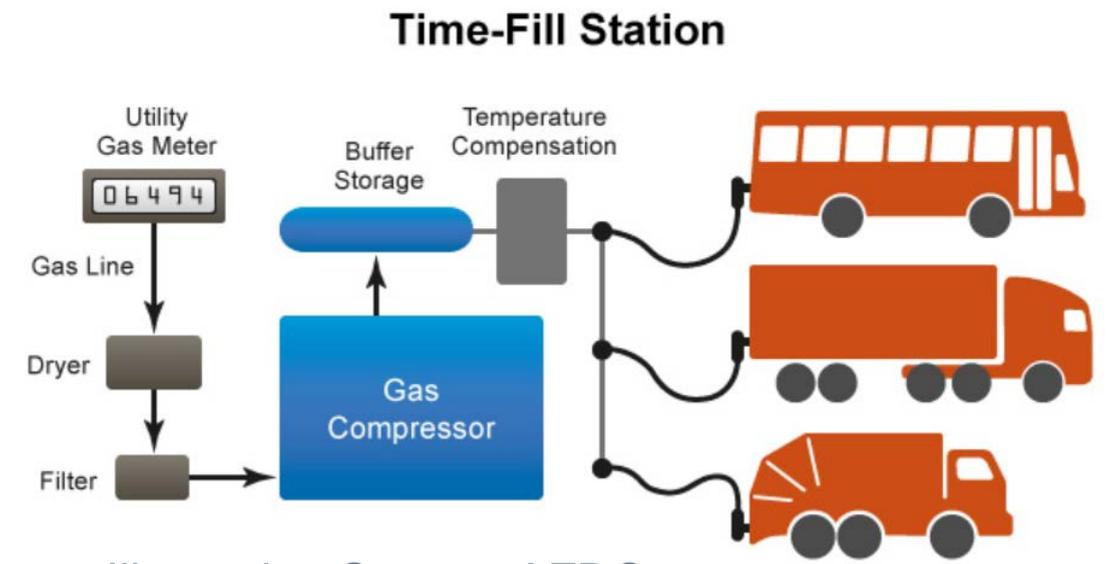
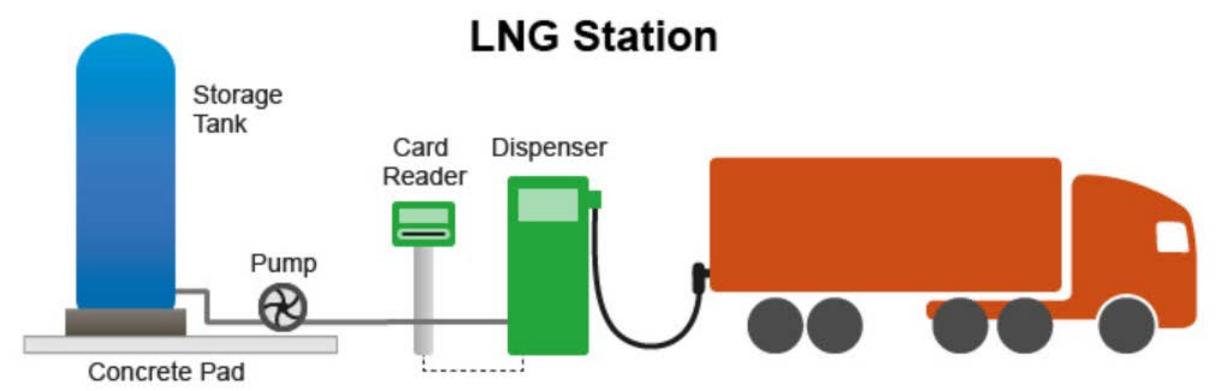
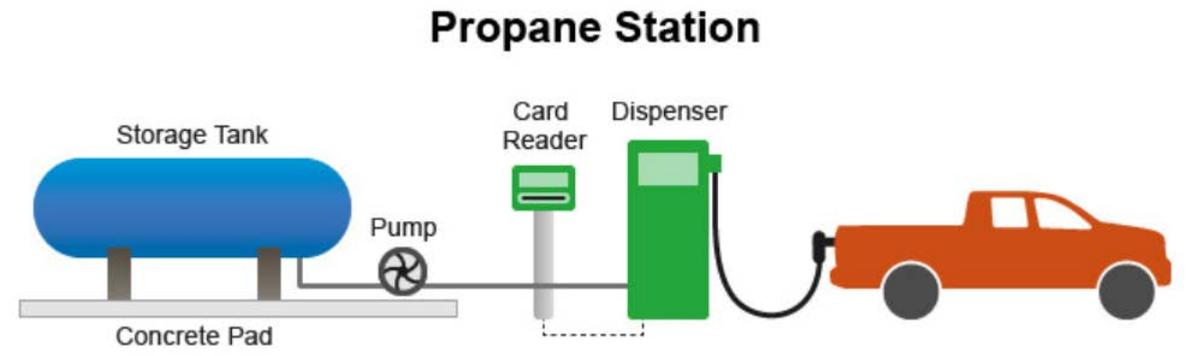
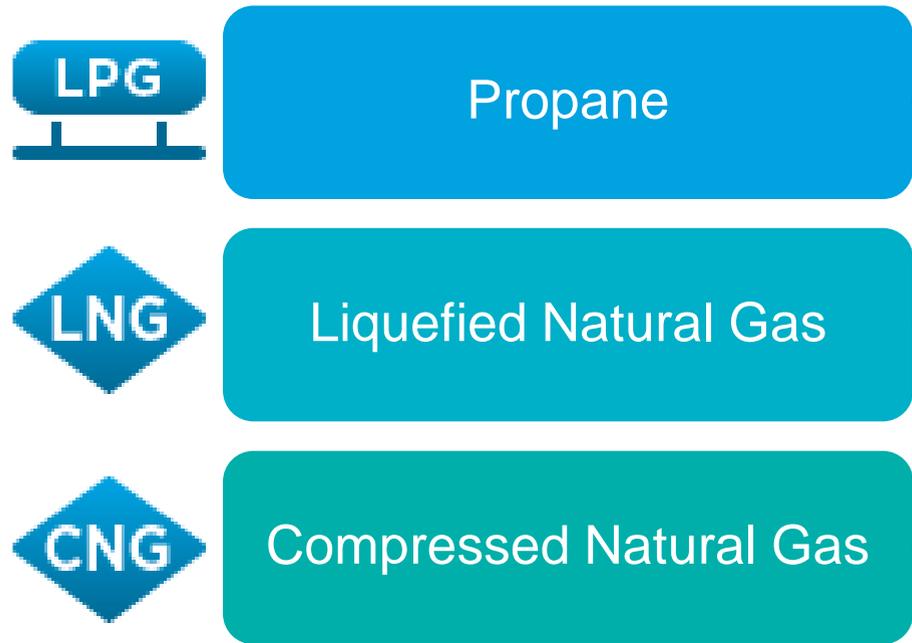
Liquefied Natural Gas

Tractor	<b>Freightliner</b> Business Class M2 112, 114SD 114SD, Cascadia 113	ISL G ISX12 G
Tractor	<b>Kenworth</b> T440, T470, W900S W900S, T660, T680, T800SH, T880 T680, T880	ISL G ISX12 G ISL G Near Zero
Tractor	<b>Mack Trucks</b> Pinnacle	ISX12 G
Tractor	<b>Navistar</b> International Trucks - TranStar	ISL G
Tractor	<b>Peterbilt</b> 365, 384, 579 337, 348, 365, 384	ISX12 G ISL G
Tractor	<b>Volvo Trucks N.A.</b> VNL VNM	ISX12 G ISL G

Source: [cumminswestport.com](http://cumminswestport.com)

# Fueling Infrastructure

## Liquid & Gas



# Vehicle Range

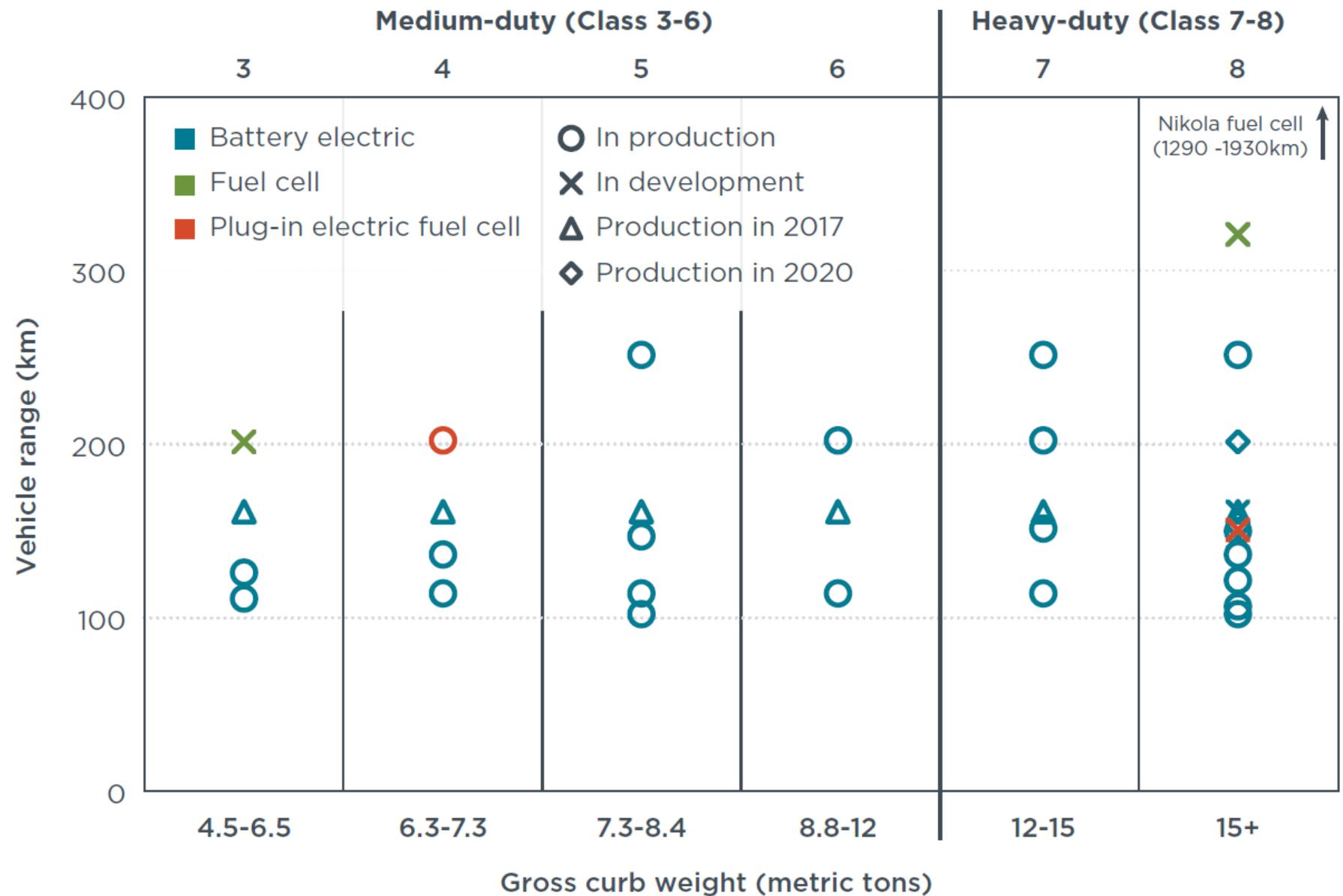
## Electrification



Plug-In Electric



Fuel Cell



Source: ICCT, "Transitioning to Zero-Emission Heavy-Duty Freight Vehicles," September 2017.

# Future Offerings

## Electrification



Plug-In Electric



Fuel Cell

### ▪ Electric

- BYD
- Chanje Energy (Class 5)
- Cummins
- Mercedes Benz
- Mitsubishi Fuso/Daimler (Class 4)
- Orange EV (port/terminal)
- Peterbilt (refuse)
- Tesla
- Thor Trucks
- Volkswagen
- Wrightspeed (refuse)

### ▪ Fuel Cell\*

- GM
- Kenworth
- Nikola
- Toyota
- U.S. Hybrid

*\*In concept, development, or testing phase*

# Fueling Infrastructure

## Electrification



Plug-In Electric



Fuel Cell

### ■ Electrical Capacity

- Typical DC fast charger = 50-120 kW
- “Super fast” chargers = 350 kW
- Tesla Megacharger = 1.6 MW

### ■ Placement

- Centrally fueled?
- Long-distance network?

### ■ Type

- Plug-in
- Dynamic (catenary, on-road, in-road) – “e-roads”

# Programs

- **U.S. DOE Clean Cities**

- <https://cleancities.energy.gov>
- National: e.g., National Clean Fleets Partnership
- Local: Network of nearly 100 coalitions
- Stakeholder Engagement: e.g., NGV Technology Forum



- **U.S. EPA SmartWay Transport Partnership**

- [www.epa.gov/smartway](http://www.epa.gov/smartway)
- April 26 Freight Matters Webinar: How Electric Trucks, Big Data & Connectivity are Changing the Freight Industry



# Resources

- Alternative Fuels Data Center (AFDC)

- General Information
  - Fuels, vehicles, infrastructure
- Laws & Incentives
- Station Locator
- Case Studies
- Publications
- Tools, Calculators

### Alternative Fueling Station Locator

Find alternative fueling stations near an address or ZIP code or along a route in the United States. For state information, see [stations data by state](#).

Find Public Stations | Analyze & Download Data

Enter location | Compressed Natural Gas | Map a Route

932 results

### Fleet Application for Delivery Services Vehicles

Find transportation data and information about the delivery services vehicle application. Fleets in niche markets operate vehicles designed to serve specific functions, which makes these vehicles ideal for the adoption of alternative fuels and advanced vehicle technologies.

#### Vehicle Availability

53 vehicles

- 9 Biodiesel (B20)
- 1 Hybrid - Diesel
- 1 Hydrogen Fuel Cell
- 4 Plug-in Hybrid Electric
- 8 Propane
- 1 Hybrid - LNG
- 2 Hybrid - Propane
- 6 Electric
- 9 CNG - Compressed Natural Gas
- 7 Electric

#### Vehicle Selection

- Lightning Systems - Mercedes-Benz Sprinter
  - Hybrid - Diesel
  - Hydraulic hybrid
- Navistar-Moderc EV Alliance eStar
  - Electric
- Ram Promaster 1500/2500
  - Biodiesel (B20)
- US Hybrid H2Cargo
  - Hydrogen Fuel Cell
  - Plug-in Hybrid Electric

#### Vehicle Operation Data

##### Average Speed

13 mph average  
range: 1 - 46 miles

##### Maximum Speed

61 mph average  
range: 23 - 100 miles

##### Daily Distance

52 mile average  
range: 1 - 262 miles

Average operating time  
5 hours per day

Average stops  
114 stops per day  
3 stops per mile

Data from FleetDNA based on the average of 2,187 days of driving data from 139 delivery services vehicles operating in the United States

#### Case Studies

Coca-Cola Bottling Co. Brings Hybrids to New Orleans  
April 14, 2017

#### Videos

Freedom CNG Reduces Em...

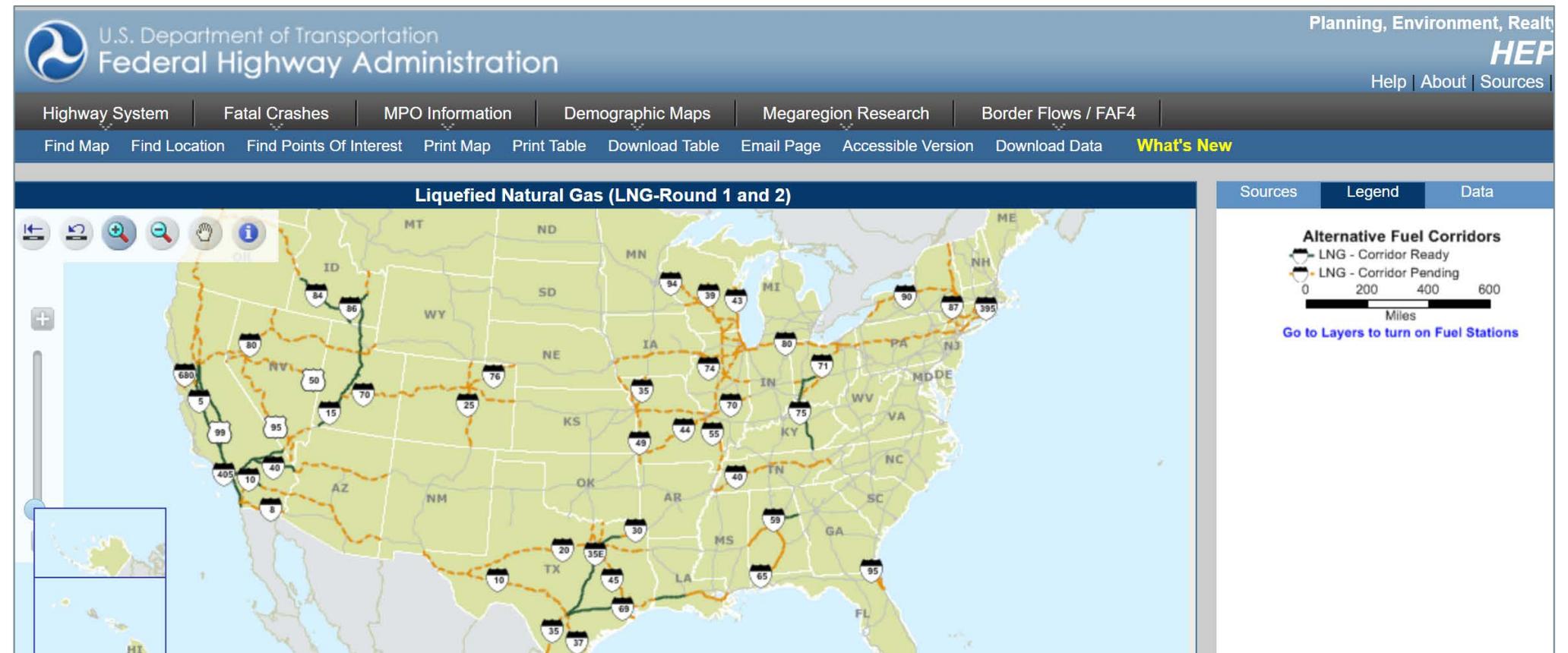
Freedom CNG Reduces Emissions with Natural Gas in Texas  
April 1, 2017

Recycled Cooking Oil Powers Biodiesel

# Resources

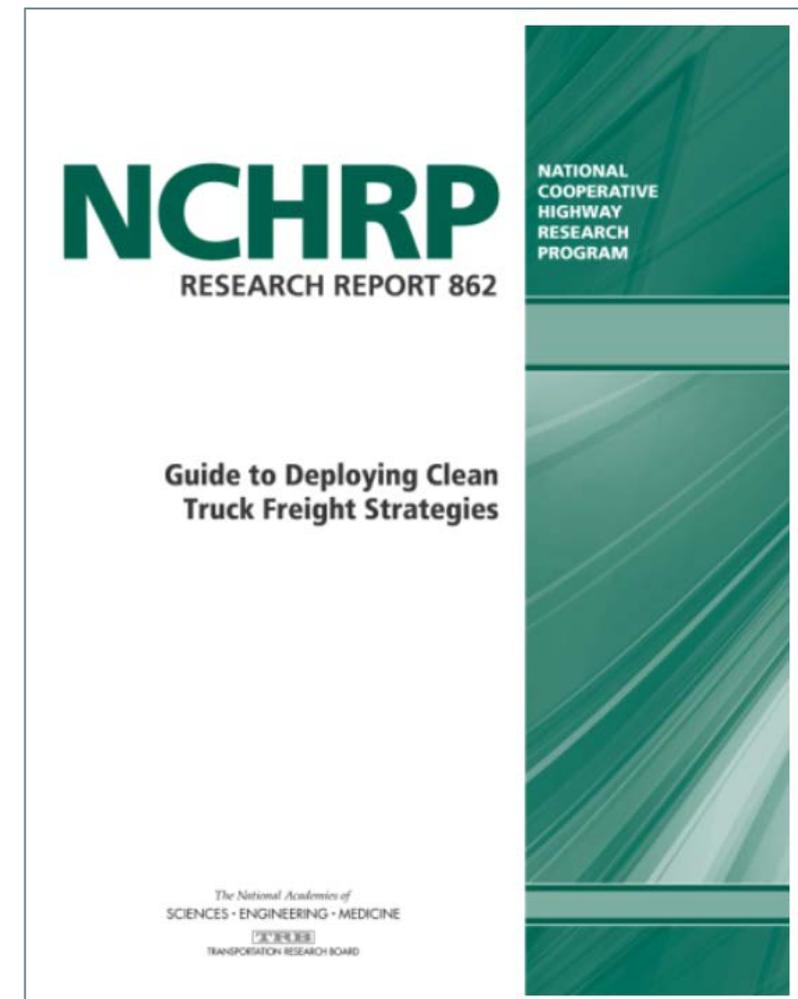
- FHWA Alternative Fuel Corridors

- [https://www.fhwa.dot.gov/environment/alternative\\_fuel\\_corridors/](https://www.fhwa.dot.gov/environment/alternative_fuel_corridors/)
- FY 2016 and FY 2017 rounds designated 44 states
  - Corridor-ready
  - Corridor-pending



# Resources

- ***Guide to Deploying Clean Truck Freight Strategies***
  - NCHRP Research Report 862
  - [www.trb.org/Main/Blurbs/176904.aspx](http://www.trb.org/Main/Blurbs/176904.aspx)
  - Truck technologies, operational strategies, alternative fuels, clean truck infrastructure, clean truck programs
  - Tool to estimate cost and benefits of different strategies





**Thank You!**