Clean Corridors #2: Gaseous and Liquid Alternative Fuel Technologies and Infrastructure

Northeast Clean Freight Corridors Workgroup

June 22, 2017
2:00 – 3:30 p.m. EDT

Pictures Above:
FHWA Designated AFV Corridors
Agenda

- Welcome & Overview
- Progress Against Roadmap
- Webinar Topic #2 – Gaseous and Liquid Alternative Fuel Technologies and Infrastructure
- Workgroup Discussion
2017 NECFC Workgroup Roadmap

1# Clean Corridors: Where We Stand, 2017 Roadmap & Partner Updates
   May 25, 2017

2# Gaseous and Liquid Alternative Fuel Technologies and Infrastructure
   June 22, 2017

3# Electric-Powered Trucks & Intermodal Idle Reduction Technology & Infrastructure
   July 27, 2017

4# Priority Locations & Facility Types for Truck and Intermodal Reduction and Alternative Fueling
   August 24, 2017

5# Setting the Stage for NEDC Partners Meeting – “Filling the Infrastructure Gap”
   September 7, 2017
Discussion Objectives

1. Understand the status of gaseous and liquid alternative fuels for freight in the Northeast.
   - Existing Infrastructure
   - Participating Fleets/End-Users
   - Opportunities to Expand Infrastructure Growth

2. Identify ways the NECFC Working Group can add value; provide a platform for information-sharing, and support regional planning and coordination efforts.
Discussion Leader Line Up

Webinar Topic #2 – Gaseous and Liquid Alternative Fuel Technologies and Infrastructure

Compressed Natural Gas/ Liquefied Natural Gas

- Barry Carr, Regional Manager, Westport Fuel System Solutions & Clean Cities Coordinator
- Bill Zobel, VP Market Development & Strategy, Trillium CNG
- Susan McSherry, Director, Alternative Fuels Program, NYCDOT
- Leonel Cortizo, Business Development Manager, Clean Energy Fuels Corp.

Hydrogen

- Lee Grannis, Coordinator, Greater New Haven Clean Cities Coalition, Inc.
- David Edwards, Director of Technology Partnerships, Air Liquide

Biodiesel

- Steve Russell, Alternative Transportation Program Manager, Clean Cities Coordinator, Massachusetts Department of Energy Resources
- Robert Morton, Managing Partner, Newport Biodiesel, LLC
Compressed Natural Gas/Renewable Natural Gas (CNG/RNG)

- **Barry Carr**, Regional Manager, Westport Fuel System Solutions & Clean Cities Coordinator
- **Bill Zobel**, VP Market Development & Strategy, Trillium CNG
Northeast Clean Corridors Webinar
CNG / RNG - Fuel & Infrastructure
Value Proposition & Policy Recommendations
Trillium provides turn-key CNG solutions:

- We cover anything you need for CNG fueling infrastructure
- Own / operate 180 top-quality CNG fueling stations across the United States

Owned by Love’s Travel Stops:

- Family owned business founded in 1964
- 420 retail stores in over 40 states
- One of the largest privately-held companies in the US
Products & Services

Core Services:
- Design & Build CNG Stations
- CNG Operations & Maintenance
- Retail CNG Fueling

Value-Added Services:
- Renewable Natural Gas (RNG)
- P3 Expertise
- Grant Writing Assistance
- 24/7 Support
- Gas Procurement
CNG Value Proposition

- Low cost transportation fuel
- Stable long term fuel prices
- Cleanest commercially available MD/HD fuel
- Renewable gas supply can reduce carbon footprint
- State and Federal incentives available
- Domestic fuel source, Made in America
Low and Stable Fuel Prices

Average Retail Fuel Prices in the U.S.

Source: Alternative Fuels Data Center; http://www.afdc.energy.gov/fuels/prices.html
CNG Value Proposition

- Low cost transportation fuel
- Stable long term fuel prices
- **Cleanest commercially available MD/HD fuel**
- Renewable gas supply can reduce fuel costs and carbon
- State and Federal incentives available
- Domestic fuel source, Made in America
Reduce Smog Forming Pollution with CNG

Product line

ISB6.7G
6.7L
Spark Ignited, SEGR, TWC
Peak Rating: 260 hp
660 lb-ft torque
33,000 lb. GVW
School bus/MD Truck/Shuttle bus/Sweeper/Yard spotter

ISL G
8.9L
Spark Ignited, SEGR, TWC
Peak Rating: 320 hp
1000 lb-ft torque
66,000 lb. GVW
Refuse/Transit/Regional P&D Truck/Mixers

ISX12 G
11.9L
Spark Ignited, SEGR, TWC
Peak Rating: 400 hp
1450 lb-ft torque
80,000 lb. GVW
Regional Haul Truck/Tractor/Refuse

Over 60,000 engines delivered worldwide

*Information provided by Cummins Westport
Reduce Smog Forming Pollution with CNG

*Information provided by Cummins Westport*
CNG Value Proposition

- Low cost transportation fuel
- Stable long term fuel prices
- Cleanest commercially available MD/HD fuel
- **Renewable natural gas (RNG) can reduce carbon footprint**
- State and Federal incentives available
- Domestic fuel source, Made in America
Carbon Benefits of using RNG

Carbon Intensity Scores

Bar Graph: Data provided by Gladstein, Neandross & Associates “Game Changer” Report, May 2016. For more information, please go to www.gladstein.org.
CNG Value Proposition

- Low cost transportation fuel
- Stable long term fuel prices
- Cleanest commercially available MD/HD fuel
- Renewable gas supply can reduce carbon footprint
- State and Federal incentives available
- Domestic fuel source, Made in America
### VW Settlement

#### Initial Subaccounts vs. Combined Totals

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Source: NGVAmerica
Clean Corridor Policy Recommendations

- Clearly Identify Goals:
  - Improve Air Quality
  - Develop “Convenient” Refueling Infrastructure

- Rank and Prioritize Projects:
  - Against Goals
  - Cost-effectiveness
  - Commercialization

Clean Corridor Policy Recommendations

- Leverage Multiple Federal and State Programs:
  - VW / DERA / State programs
- Expand Role of Clean Cities:
  - Regional Coordination by Regional Experts
  - Align Funding with Prospective Customers

Source: NGVAmerica
CNG & RNG

Clean Corridors Program

- CNG / RNG provide exceptional value
  - Cost effective
  - Near Zero Emissions
  - Low Carbon Fuel
  - Domestic
- Leverage available programs and resources
- Timing has never been better!
Thank You!

William Zobel
Vice President, Business Development, Marketing & Customer Care
Trillium CNG

wazobel@trilliumcng.com
760-590-3420
Compressed Natural Gas/Liquefied Natural Gas (CNG/LNG)

- Susan McSherry, Director, Alternative Fuels Program, NYCDOT
- Leonel Cortizo, Business Development Manager, Clean Energy Fuels Corp.
Clean Corridors Webinar
Gaseous and Liquid Alternative Fuels
Agenda

1. Who is Clean Energy
2. Understanding Today’s Fueling Challenges
3. Benefits of Natural Gas Fuel
4. Fueling the Transportation Industry
5. What does it take to be successful
6. Heavy and Medium Duty Trucking
Largest Alternative Transportation Fuel Provider

- 970+ Fleet Customers
- 9K+ Transactions per day
- 45K+ NGVS fueled daily
- 550+ Natural Gas fueling stations
Clean Energy Fuels: Who We Are

Our mission is to make a cleaner, more stable future in North America for generations to come. Through operational excellence, industry-leading customer satisfaction and superior financial performance, **Clean Energy** and its businesses remain the leaders of natural gas fueling in North America.

**Clean Energy**

- **COMPRESSION**
  Leading manufacturer and service provider of natural gas compressors and CNG equipment

- **CRYOGENICS**
  Leading provider of LNG and L/CNG combination fueling facilities

- **RENEWABLES**
  Leading retailer of biomethane fuels, including Redeem, the first renewable natural gas for commercial vehicles

**Clean Energy** partner providing natural gas delivery to large industrial sites for process heating
Today’s Fuel Challenge

With volatile fuel costs and environmental concerns, energy independence and conservation are high priorities for our nation.

**ECONOMICS**
Volatile Fuel Costs

**ENERGY**
Dependency On Foreign Oil

**ENVIRONMENT**
Harmful Greenhouse and NO\(_x\) Gases
Cost of Oil vs. Natural Gas

Data provided by the U.S. Energy Information Administration
Natural Gas Prices are Less Volatile than Diesel
**Clean Energy®**

**Offers Natural Gas Fuel to Meet Your Needs**

Compressed Natural Gas (CNG) is methane stored under high pressure in a gaseous form. CNG can be used for a variety of vehicle types.

Liquefied Natural Gas (LNG) is methane cryogenically cooled to a liquid form, reducing its volume for ease in storage and transport. LNG stores more fuel with less weight creating an efficient and price-stable fueling solution for heavy duty fleets.

Redeem™ (RNG) is biomethane, a renewable natural gas, and the world's first commercially available transportation fuel made entirely from organic waste. Redeem™ is up to 70% cleaner than gasoline and diesel, and is available as CNG and LNG.
The Benefits of Clean Natural Gas

Switching from gasoline or diesel to natural gas fuel not only saves money and dramatically reduces emissions for the vehicle owner, it benefits everyone in the community—you’ll have quieter, cleaner vehicles on your streets.

ECONOMICAL
Lower Fuel Costs with Stable Prices

ABUNDANT
Readily Available in North America

CLEANER
Reduces Carbon Footprint
Benefits of Fueling with Natural Gas

**Cleaner**
Reduces a fleet’s carbon footprint and nitrogen oxide ($NO_x$) emissions

**Safe**
17 million+ vehicles around the world are fueling safely with natural gas

**Domestic**
Abundant in North America and fuels the growth of our economy

**Competitive Edge**
Gives fleets a green advantage to win bids and attract new customers

**Price Stable**
Offers prices that are less volatile than gasoline and diesel

**Reduced Operational Costs**
For long-term savings
How Green Can Your Fleet Be?

**Scenario 1:**

- 50 Diesel Heavy-Duty Trucks Switching to 50 CNG Heavy-Duty Trucks
- Using Conventional CNG

**Total greenhouse gas emissions reduced per year by switching to Clean Energy Natural Gas Fuel:**

987 METRIC TONS

**THAT’S LIKE:**

- PLANTING 25,262 TREES
- REMOVING 208 CARS OFF THE ROAD
- 354 TONS OF WASTE RECYCLED INSTEAD OF LANDFILLED

*Emissions reductions estimates are annual figures based on data provided by the Environmental Protection Agency and the California Air Resources Board.*
How Green Can Your Fleet Be?

Scenario 2:

- 50 Diesel Heavy-Duty Trucks Switching to 50 CNG Heavy-Duty Trucks
- Using Redeem CNG

**4906 METRIC TONS**

Total greenhouse gas emissions reduced per year by switching to Clean Energy Natural Gas Fuel

**THAT’S LIKE:**

- PLANTING 125,633 TREES
- REMOVING 1035 CARS OFF THE ROAD
- 1759 TONS OF WASTE RECYCLED INSTEAD OF LANDFILLED

*Emissions reductions estimates are annual figures based on data provided by the Environmental Protection Agency and the California Air Resources Board.*
Reducing our carbon footprint, the amount of greenhouse gases including carbon dioxide ($\text{CO}_2$) released into the atmosphere, is a nationwide priority and part of a larger plan to combat global climate change.
Fueling the Transportation Industry

We provide natural gas as a transportation fuel for fleet vehicle customers.
Cummins Westport’s Near Zero Engine

- First Mid-range engine in North America to reduce NOx emissions by 90% from EPA 2010 limit of 0.2 g/bhp-hr
- Orders for the 8.9L (Transit and Refuse) have begun and the 11.9L (Trucking) will be available in 2018
- Meets the ARB certification 8 years in advance of the 2023 goals
Station Types

A. Fast-Fill
Our fast-fill CNG and LNG dispensers are designed to mirror the pump experience to which drivers are accustomed. The flow rate from our dispensers is similar to gasoline and diesel.

B. Time-Fill
Our compact, modular time-fill CNG dispensers let your fleet fuel up safely and conveniently overnight. Variable hose connections and lengths provide maximum installation flexibility.
Components of a CNG Station

1. **TWIN CNG**
   - **COMPRESSOR**
     Compresses natural gas from utility line to 4500 psi.
   - **NATURAL GAS DRYER**
     Removes excess moisture from utility line gas.

2. **STORAGE VESSELS**
   Stores compressed gas to speed up fueling.

3. **FAST-FILL DISPENSERS**
   Flows similarly to gasoline and diesel.

4. **TIME-FILL POST (OPTIONAL)**
   A fill hose at a parking stall connected to a common supply.
   - **SAFE-FILL TECHNOLOGY**
     Clean Energy’s advanced patented leak detection system.
Components of a LNG Station

1. **Offload Pump Skid**
   Used to pump the LNG out of the trailer at 120 to 150 gallons per minute (GPM); offload time is between 1.5 to 2 hours.

2. **Process Skid**
   Used for dispensing and saturation operations.

3. **LNG Storage Tank**
   Above ground storage with a recommended volume up to 18,000 gallons; other capacities available.

4. **Fast-Fuel LNG Dispenser**
   Single hose dispenser with flow rates up to 22 DGE/min (40 GPM).

5. **Time-Fill Post (Optional)**
   A fill hose at a parking stall connected to a common supply.

**Safe-Fill Technology**
Clean Energy’s advanced patented leak detection system.
Components of a LNG/CNG Combination Station

1. CNG/LNG COMBINED PUMP SKID
   Specialized positive displacement pump that compresses LNG to CNG.

2. HIGH PRESSURE VAPORIZER
   Elevates temperature of cold CNG to safe temperature range for dispensing into vehicle tanks.

3. CNG BUFFER STORAGE VESSELS
   Required volume of 40,000 scf at 5,500 psi.

4. ODORIZER SYSTEM
   Odorizes the newly compressed natural gas for ease of detection.

5. FAST-FUEL CNG DISPENSER
   Single hose dispenser with flow rates up to 7.6 DGE/minute.

6. TIME-FILL POST (OPTIONAL)
   A fill hose at a parking stall connected to a common supply.

SAFE-FILL™ TECHNOLOGY
Clean Energy’s advanced patented leak detection system.
# LNG & CNG Fueling Experiences

## LNG
- Diesel like fueling
  - 12 – 24 DGE per minute
  - No impact to HOS
- Fuel Quality Consistency
  - Almost 100% of impurities & heavier hydrocarbons drop out during refrigeration
  - No water
  - No Natural Gas Liquids
  - No compressor oil carryover
- Boil off NO LONGER a concern

## CNG
- Fast Fill, Heavy Duty Station
  - Fueling rates 7 – 10 DGE per minute
  - Average over the entire fill
  - Easy 53’ trailer access
- Heat of Compression
  - Prevents 100% storage utilization
  - 20-25% impact
  - Time Fill application eliminates issue
- Light/Medium Duty Station
  - 2 – 5 DGE per minute
  - May have to drop trailer for access
- Potential Fuel Quality
  - Managed by daily filter drain
    - Water
    - Compressor Oil
    - Natural Gas Liquids

## LCNG
- Fast Fill
  - Fueling rates 7 – 10 DGE per minute
  - Slightly better on Heat of Compression
- LNG Fuel Quality Benefits
What is success at Clean Energy?
Satisfy the customers needs

- Engineering & Construction
- Technology & Equipment
- Facility Modifications
- Financing & Grants
- Operations & Support
Facility Modifications
Protect Your Investment.
Upgrade Your Maintenance Facility.

- Ventilation
- Electrical
- Heating
- Monitoring
- Detection Systems

Making cost-effective modifications is an essential part of maximizing the benefits of your switch to NGVs.

Our dedicated facility modification team works with virtually any fleet and any maintenance shop.
Numerous Recognized Fleets

Fueling with Natural Gas
UPS’s Big Brown Fleet Wins Customer Praise as One of Today’s Greenest Fleets

- Largest package delivery company in the world
- Operates a fleet of close to 100,000 vehicles
- Goal of driving 1 billion miles in their NGV fleet by the end of 2017
Thank you

Leo Cortizo

Leonel.Cortizo@cleanenergyfuels.com

917 832 0643
Hydrogen Fuel

- **Lee Grannis**, Coordinator, Greater New Haven Clean Cities Coalition, Inc.
- **David Edwards**, Director of Technology Partnerships, Air Liquide
Advanced Business & Technologies

Hydrogen mobility: Status of worldwide deployment initiatives

June 22, 2017  I  Dave Edwards – Director of Technology Partnerships I Clean Corridors Webinar
2015 → 2017
The confirmation of a growing momentum
2015 → 2017: Building up scale all over the world!
US / California – the ZEV effect

Anaheim H2 station

FCEV’s:

- 100 in 2015
- 1,200 in 2016
- 5,000 in 2017
- 18,000 in 2020

H2 stations:

- 13 in 2015
- 49 in 2017
US - Conquering the Northeast

Network of 12 Stations

Start-up over Q3-Q4 2017

Dedicated H₂ supply chain by

Project in collaboration with

New York
Bronx, NY
Hempstead, NY
Brooklyn, NY

Connecticut
Hartford, CT

Massachusetts
Braintree, MA
Mansfield, MA

New Jersey
Site location TBA

Rhode Island
Site location TBA
Air Liquide, Daimler, Linde, OMV, Shell and Total have agreed an action plan for the construction of a Hydrogen station network in Germany:

- **400 Hydrogen Stations by 2023** (100 by 2017)
- **350m € investment**
- **Max. 90 km distance between each station on motorways**
- **10 Hydrogen Stations in each metropolitan area**
Japan: Largest H2 station infrastructure in the world

**FCEV’s:**

- 200 (2015)
- 1,500 (2016)
- 3,000 (2017)
- 40,000 (2020)

**H2 stations:**

- 2015: 40
- 2017: 92

**Timeline:**

- 2015: 200 FCEV’s, 40 H2 stations
- 2016: 1,500 FCEV’s
- 2017: 3,000 FCEV’s, 92 H2 stations
- 2020: 40,000 FCEV’s

**Location:** Nagoya Atsuta
France: Innovative business models for clean mobility

HYPE Taxi Fleet Project - Paris

Launched in Dec. 2015, during COP 21

Air Liquide
Key Enabler of the project

An emission-free Paris

FCEV taxi fleet

600

2016
10

2017
70

2020
Denmark – A nationwide H2 network powered by wind

Country-wide HRS network by 2015 | DENMARK

- **Copenhagen H2 Network**
- **DHF HRS** Opened in 2015
- **HRS’s planned for 2016**
- **HyBalance: green hydrogen source planned for Q4 2017**

- **Aalborg**
- **Holstebro**
- **Herning**
- **Aarhus**
- **Vejle**
- **Korsor**
- **Odense**
- **Copenhagen**
- **Malmö (SE)**
- **Hamburg (DE)**
- **Berlin (DE)**
- **Oslo (NO)**
- **Gothenburg (SE)**
Korea – Rolling out an ambitious roadmap!

**FCEV’s:**
- 10 in 2015
- 100 in 2016
- 500 in 2017
- 9,000 in 2020

**H2 stations:**
- 5 in 2015
- 20 in 2017

- Green Car roadmap being actively implemented
- Innovative fleet business models
- Creation of H2 Korea to accelerate infrastructure investments
Retrofit of an existing station
Beyond Personal Mobility
FC Buses: EU and China showing the way

FC Buses in EU:

1 000

100

40

2015 2017 2020

Next stops:

This document is PUBLIC
Nikola Motor gets $2.3B worth of preorders for 2,000HP, electric semi-trailer truck

The Nikola One utilizes a fully electric drivetrain powered by high-density lithium batteries. Energy will be supplied on-the-go by a hydrogen fuel cell giving the Nikola One a range of 800 - 1,200 miles while delivering over 1,000 horsepower and 2,000 ft. lbs. of torque – nearly double that of any semi-truck on the road. Never has a production model class 8 truck achieved best-in-class fuel efficiency while also dramatically improving performance over its diesel competition – all with zero-emissions.
Freight Movement - Toyota

Toyota Opens a Portal to the Future of Zero Emission Trucking

“Project Portal” hydrogen fuel cell system designed for heavy-duty truck at the Port of Los Angeles

Feasibility study will examine potential usage of fuel cell technology in heavy-duty applications

April 2017
Freight Movement – US Hybrid

H₂ Truck™

Fuel Cell Electric Class-8 Truck Powertrain System Configuration

- Li-Ion Battery 36kWhr
- Safety Disconnect Unit “SDU”
- Fuel Cell, 80kW
- SAE J2601 Standard 25 kg, 350 BAR
- Control Electronic Unit “CEU”
- Wireless Cellular Diagnostics
- Direct Electric Drive Power: 320kW (500hp)
- Torque: 3,750 Nm

In-Development Not Released
Freight Movement - California

MEDIUM- & HEAVY-DUTY FUEL CELL ELECTRIC TRUCK ACTION PLAN FOR CALIFORNIA

Summarized Version
October 2016

Zero Emission Cargo Transportation Fuel Cell Drayage Truck Project

Kenworth fuel cell truck. (Illustration: Kenworth)
Parcel Delivery

UPS to Deploy Hydrogen Fuel Cell Truck in California
May 02, 2017

FedEx Fuel Cell Chassis Concept Layout (based on Workhorse W88 EGen)

Charger inlet on PS aft of rear tire

Additional Space
40” L x 24” W x 15” D

Hydrogen Tank Space:
40” L x 26” W x 16” D

Additional Space
40” L x 24” W x 28” D

Hydrogen filler port on LS aft of rear tire

Fuel Cell Space:
30” L x 24” W x 30” D

Electric: Air Conditioning system. Mount condenser up front and compressor to frame rail under driver’s seat

Additional Fuel Cell System Space:
34” L x 10” W x 14” D

This document is PUBLIC
Freight Movement

Refrigerated trucks to keep their cool thanks to fuel cell technology

Refrigerated trucks equipped with hydrogen fuel cells to make deliveries in three markets

News Release

August 23, 2013

IX.6 Fuel Cell-Based Auxiliary Power Unit for Refrigerated Trucks

DOE Fuel Cell Technology Office
Ontario studying using hydrogen fuel cells to power GO trains

THE CANADIAN PRESS


Alstom’s hydrogen train Coradia iLint first successful run at 80 km/h

14/03/2017
Air Liquide’s involvement to enable the expansion of hydrogen mobility
January 17, 2017 – Davos – Launching of the Hydrogen Council

13 Companies and their CEO’s joining forces to voice the vision and the ambitions of the Hydrogen industry

Hydrogen acknowledged as a key solution to empower the energy transition

A further lever to accelerate H2 infrastructure & FCEV deployments!
2015 → 2017: Building up scale all over the world!

From 1,000 to 10,000 FCEVs!

Hydrogen Council

From 100 to 300 H2 Stations!
Looking beyond 2017…

- Hydrogen and Fuel Cell Electric Vehicles are at the **Tipping Point**!

- Early movers have proven that **it is sustainable**!

- More players need to join the game to further increase the momentum: *Car OEM’s, Energy companies, financial investors, governments*…
Thank you.
Biodiesel Fuel

- Steve Russell, Alternative Transportation Program Manager, Clean Cities Coordinator, Massachusetts Department of Energy Resources
- Robert Morton, Managing Partner, Newport Biodiesel, LLC
Implementation of Biodiesel for Clean Corridors

Robert Morton
Newport Biodiesel, Inc.
2016 US Biodiesel and Renewable Diesel Marketplace

- 2.9 BILLION GALLONS USED
- 5.2 MILLION CARS
- REDUCED BY 24.7 MILLION METRIC TONS
- PLANTING 641 MILLION TREES
- ANNUAL GREENHOUSE GAS EMISSIONS OF
- PRESERVING 23.4 MILLION ACRES
- 80% LESS LIFECYCLE GREENHOUSE GAS THAN PETROLEUM DIESEL
U.S. Biomass Based Diesel Feedstocks

Soybean Oil: 52%
Canola Oil: 11%
Distillers Corn Oil: 10%
Animal Fats: 10%
Recycled Oils: 14%
Other: 3%

Source: DOE-EIA Monthly Biodiesel Production Report (22M Survey)
## LCFS Carbon Intensity Values

<table>
<thead>
<tr>
<th>Fuel</th>
<th>Carbon Intensity (g/MJ)</th>
</tr>
</thead>
<tbody>
<tr>
<td>UCO</td>
<td>19.87</td>
</tr>
<tr>
<td>Corn Oil</td>
<td>28.68</td>
</tr>
<tr>
<td>Tallow</td>
<td>32.83</td>
</tr>
<tr>
<td>Canola</td>
<td>50.23</td>
</tr>
<tr>
<td>Soy</td>
<td>51.83</td>
</tr>
<tr>
<td>Cane Ethanol</td>
<td>48.06</td>
</tr>
<tr>
<td>CNG</td>
<td>79.46</td>
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<tr>
<td>Corn Ethanol</td>
<td>80.09</td>
</tr>
<tr>
<td>ULSD</td>
<td>102.76</td>
</tr>
</tbody>
</table>

CA GREET 2.0 example carbon intensity values.
Diesel technology remains a key strategy in the lineup of technologies for the future:

- Undisputed primary power source for heavy-duty on and off road vehicles, rail and marine applications, industrial, agriculture and construction applications
- Consumers finding value in the diesel option – proven fuel economy, renewable fuel ready
- Manufacturers turn to diesel options for product mix to meet the NHTSA/EPA fuel economy mandates of 54.5 MPG by 2025

Renewable fuels are a key differentiator for diesel to compete in a low-carbon, alternative fuel future.
Biodiesel Ranks First Among Fleets for Alt Fuel Use

• According to a new 2016 Fleet Purchasing Outlook study conducted by the NTEA – The Association for the Work Truck Industry – biodiesel is now the most commonly used alternative fuel option on the market.
• Survey data shows 18 percent of fleets use biodiesel now – up from 15 percent in 2015.
• In terms of future alternative fuel interest, biodiesel also takes top honors, with more fleets planning to acquire or continue using biodiesel than any other alternative fuel option.
Why Biodiesel Matters to Fleets:

1. Least cost option to green your fleet
   - Utilizes existing equipment and infrastructure

2. High quality fuel that has been working for fleets nationwide for 20+ years

3. OEM Support = Confidence
OEM Biodiesel Support

• In the GVW Class 5-8 vehicles that account for 92% of on-road diesel fuel use, nearly 90 percent of the medium- and heavy-duty truck OEMs support B20.

• For a complete listing of OEM position statements on biodiesel, as well as the current U.S. Diesel Vehicles List, visit: www.biodiesel.org/using-biodiesel/oem-information
OEMs Supporting B20
OEMs Supporting B20

*Models equipped with Cummins engines are B20 approved. See NBB website for details.
All 2011 MY and beyond GM Heavy Duty Products continue to be approved for B20, and...
Ford: B20 Approved

Ford approves B20 in all its 2011 MY and beyond

Class 2 - 5 Super Duty

&

Class 6,7 Medium Duty Trucks

And in the Ford Transit Van
New York City’s 9,000 diesel-powered municipal fleet vehicles use biodiesel blends.

19 percent reduction in carbon emissions since 2005, on track to reach an 80 percent reduction by 2050.
Biodiesel Retailers
Northeast Retailers
Thank You!

QUESTIONS?
Workgroup Discussion
What percentage of CNG in vehicle use is Renewable Natural Gas?

Bill Zobel (Trillium) – Varies depending where you are in the country. The percentage is probably somewhere around 20% nationally (transit/refuse/heavy-duty over the road). There are certain states like California that incentivize the use of RNG. RNG use could be 70-80% in CA.

Leo Corizo – Almost every gallon of natural gas sold by Clean Energy is RNG in California. The reason why you are seeing higher percentage use in California is it is more profitable. Incentive programs like those in CA, could be replicated in other states to help incentivize RNG use. The question then will be how to provide fuel source, whether by landfills, digesters, or a myriad of ways to get the fuel into the system.
What is the difference between LNG and LCNG?
Leo Cortizo (Clean Energy) – LNG is a super-cooled form of natural gas -260 degrees. If there is no pipeline available, Clean Energy will deliver LNG to a station and use a vaporizer to convert LNG to CNG. It is the same gas, it is just the process of converting the LNG to its gas state, its just heated up at its liquefied form (super-cooled) to a gas. When natural gas hits the engine, it is always in form of a gas.

What about methane emissions with natural gas? What are natural gas companies doing to reduce methane emissions?
Leo Cortizo (Clean Energy) – Technology has improved greatly. With CNG there is no boil off and with LNG, there was a time when that was an issue. Because of improved technology, its really not an issue anymore. As far as releases from the source itself, the industry has improved because of U.S. EPA requirements.
continued...U.S. EPA requirements continue to improve and hopefully we will get to a point where there is zero methane emissions. But from Clean Energy’s perspective, the company has improved emission reductions from its stations and from its natural gas tanks.

Bill Zobel (Trillium) – Consider Leo’s slide on natural gas production to providing the fuel to a vehicle (value chain). Environmental groups like NRDC have produced reports on methane emissions but are more related to the upstream side of gas production and on the pipeline side. U.S. EPA and the Federal Regulatory Commission are looking at how to improve emission reductions from upstream/pipeline sources.
Bill Zobel mentioned renewable natural gas - I thought the slide showed those as "landfill" sourced. Is that correct? If so, I thought landfill gases were primarily methane - is that true?

Renewable natural gas comes from a variety of sources and landfills are one of them. The gas that comes off the landfill is primarily a low BTU gas that has contaminants in it such as nitrogen, CO2, water and methane of which needs to be cleaned before it is put into the pipeline. There are systems on the collection process that clean up and eliminate CO2, nitrogen, etc. before putting into the pipeline (for use of heating a home or for vehicle use). There are three other sources, anaerobic digestion (wastewater treatment plants), animal waste and feedstocks and digesting them, getting them to pipeline standards and injecting them into the pipeline. All sources are unique and have their own carbon intensity and all generated with different technologies.
Why should policy makers and planners prioritize biodiesel over renewable diesel?

Bob Morton – I’m not sure that they should. You end up with the same properties and it is a matter of how you use it. There are not a lot of renewable biodiesel plants available in the U.S. right now. Most of the renewable biodiesel coming into CA is from Indonesia. But a lot of the big biodiesel producers do have renewable diesel plants that the companies are producing as well. Though both forms have similar properties, renewable biodiesel has better temperature values than regular biodiesel. At the end of the day, the goal is to reduce GHG emissions, keep both fuels going!
How can the NEDC and other regions advocate that biodiesel (B20) be added to the FHWA alternative fuel corridor designation process?

Biodiesel industry would like to see biodiesel added to the designation process. The National Biodiesel Board is ready to work with anybody to help establish the infrastructure to have it included and promoted more effectively.

Abby Swaine – Important to note that the NECFC is fuel/technology neutral and different from the FAST Act Alternative Fuel Corridor designation process. NECFC supports FHWA’s efforts to promote clean corridors but is also looking at all viable means to promote clean transportation across all freight sectors and that those technologies/solutions that make sense in a corridor framework.
Is there a reduction in engine maintenance costs between CNG and diesel? If so, by what percentage?

Bill Zobel (Trillium) - The costs can vary but most in the industry using natural gas say that the costs of natural gas over diesel are the same or less depending on duty cycle. Sometimes, users in other duty cycles say that natural gas can cost more. Short answer, varies and depends on duty cycle. Fleets that have committed more fully to natural gas are seeing better results/lower costs than those that have dabbled with it.

Leo Cortizo (Clean Energy) – I agree with Bill, some customers say they pay 4 cents more per equivalent diesel gallon, or a penny more or can be a nickel less than the cost of diesel. Its all about the maintenance, who you do your maintenance with and the duty cycle.

Bob Morton (Newport Biodiesel) – Biodiesel has more lubricity than regular diesel and the costs are lower when a fleet uses biodiesel versus straight diesel.
Question for David Edwards - What Northeast highways are going to benefit from the 12 Air Liquide hydrogen stations? Is Air Liquide working with the NE state DOTs and are there plans to put in for FHWA alternative fuel corridor designation in the next round?

One of the stations is in Hartford (I-91) and the other is in Providence, Rhode Island. Keep in mind that the first generation stations are being placed where the vehicle manufacturer (Toyota in this instance) wants to help build a market for the fuel cell vehicles (local market focus vs. regional). Not sure what highways they will be along. Second generation of hydrogen stations will be focused on the key transportation corridors.
Question for Bob Morton (Newport Biodiesel) – Is the MN model on going with a straight biodiesel blend throughout the seasons the way to go?

To be cost effective, committing to a blend depending on summer or winter is better. Newport Biodiesel uses B20 all year round but to be safe, a user may want to use B10 in the winter.
Discussion Questions

1. What else do we need to know about liquid and gaseous fuel technology, availability and use?

2. Who else needs to be part of the conversation in funding and siting new infrastructure, and equipping fleets to use it?

3. What platform or other means should NECFC provide to advance work on this?
Discussion Notes

Bill Zobel (Trillium) – Ways to try and tie people together and finding mechanisms to move fleets into alternative fuels – money will help (incentives), who else to create robust program, get to know state agencies that provide funds but make sure that goals are aligned.

Bob Morton (Newport Biodiesel) – High-level roadmap are more effective rather than starting with a local approach (i.e. CA’s state roadmap). If NECFC can help with long-term visions to develop a roadmap to move clean transportation forward. Also, work with Clean Cities Coalitions to help promote goals/objectives.

Abby Swaine (U.S. EPA) – working with Bi-State Motor Carriers, FHWA and other agencies to align priorities and support planning and coordination efforts.
How do we more effectively reach out to the end users?
Leo Cortizo – Air quality challenges are key in helping to promote use of cleaner fuels. However, we need incentives to help drive cost of cleaner techs and fuels down. Need to help end-users afford the cleaner option.
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