

# Compressed Natural Gas Workshop

March 29, 2017



# Agenda

**9:30 - 10:00: Registration**

**10:00 -10:05: Welcome** - Michelle Marsh - **LCSWMA**

**10:05- 10:15: EP-ACT Intro** -Tony Bandiero - **EP-ACT**

**10:15- 10:30: UGI Utility - The Source-The Supply** – Stephen Bareuther - **UGI**

**10:30- 10:45: Station Types** - Brian Keelen - **Air & Gas Technologies**  
Jay Canuso - **Oxford Engineering**

**10:45-11:00: The Right Vehicle for the Job** – Caroline McCallum – **PG Works**

**11:00 -11:10: Break**

**11:10-11:25: The CNG Workhorse** - Bill Boyce - **Cummins Westport**

**11:25-11:35: Case Study – UGI Fleet** - Tom Bates - **UGI Fleet**

**11:35-11:45: Case Study – LCSWMA Fleet** – Michelle Marsh - **LCSWMA**

**11:45-12:00: Q&A**

**12:00- 12:45: Networking Luncheon**

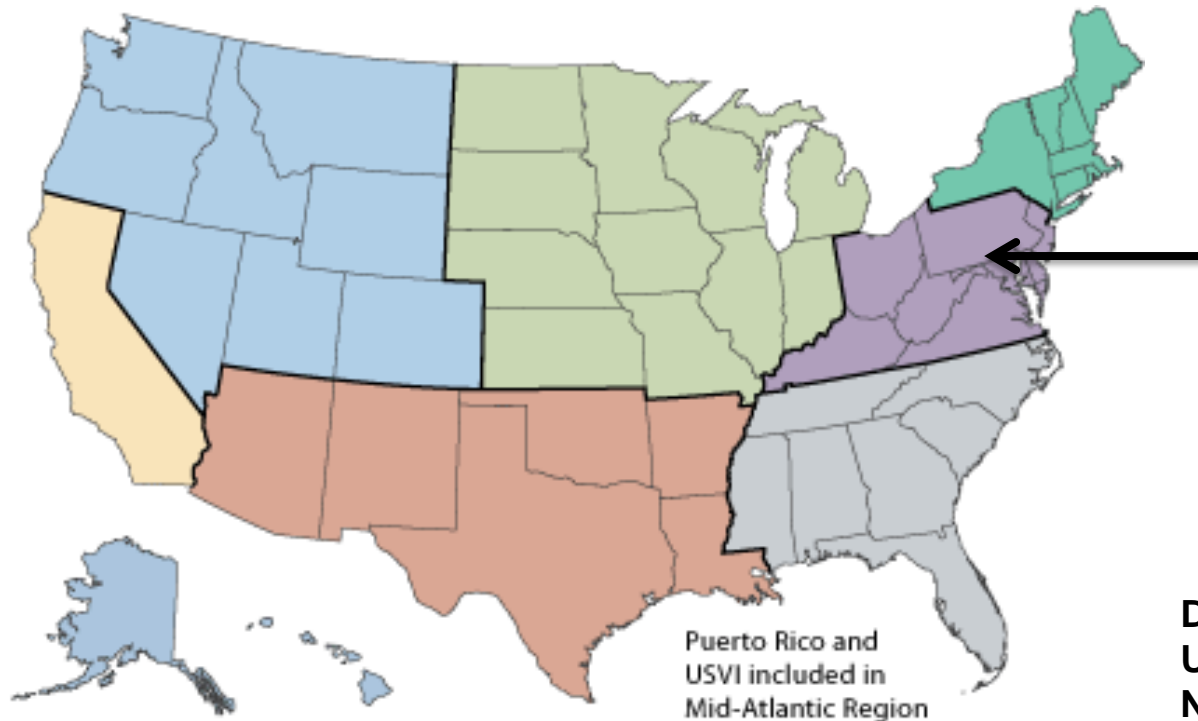
**12:45 -1:00: Live Refueling Demonstration, Equipment, and Vehicles**




# What is Clean Cities?

- Sponsored by the DOE's Office of Energy Efficiency and Renewable Energy's Vehicle Technologies Program (EERE)
- **A Public/Private Partnership for Clean Fuel Vehicles and Fuel Efficient Technologies**
- **Provides a framework for businesses and governments to work together as a coalition to enhance markets**
- Coordinate activities, identify mutual interests, develop regional economic opportunities, and improve air quality

# Where is: EP-ACT



Mid-Atlantic Region

 <i>Brett Aristegui, Acting, Northwest</i>	 <i>Trev Hall, Southeast</i>
 <i>David Kirschner, North Central</i>	 <i>Neil Kirschner, South Central</i>
 <i>Erin Russell-Story, Northeast</i>	 <i>Brett Aristegui, California</i>
 <i>Darren Stevenson, Mid-Atlantic</i>	

**Darren L. Stevenson**  
**U.S. Department of Energy**  
**National Energy Technology**  
**Laboratory**  
**626 Cochrans Mill Rd.**  
**P.O. Box 10940**  
**Pittsburgh, PA 15236-0940**  
**412-386-4746**  
**[darren.stevenson@netl.doe.gov](mailto:darren.stevenson@netl.doe.gov)**



Eastern Pennsylvania Alliance for Clean Transportation



# Who is: EP-ACT?



- Non-profit 501 (c) (3) organization
- Comprised of public and private companies
- Assist with grants/writing/project management
- Education and outreach
- Tiered levels of stakeholder membership



# Where, of EP-ACT



# Portfolio of Technologies

## Alternative Fuels and Vehicles

Biodiesel (B100)

Electricity (EV's EVSE's)

Ethanol (E85)

Hydrogen Fuel Cells

Natural Gas (CNG, LNG)

Propane/Autogas (LPG)

## Fuel Blends

Biodiesel/diesel blends (B2, B5, B20)

Ethanol/gasoline blends (E10)

Hydrogen/natural gas blends (HCNG)

## Fuel Economy

Fuel efficiency

Behavioral changes

Vehicle maintenance

Vehicle miles traveled (VMT)

## Hybrids

Light- and Heavy-duty HEVs

PHEVs (Plug- ins)

## Idle Reduction

Heavy-duty trucks

School buses

Truck stop electrification



# CNG Projects Vehicles Deployed

## Montgomery County NGV Initiative

**32 Various dedicated CNG deployed**

**Completed**

## Keystone LNG Conversion Initiative

**20 LNG Class 8 Tractors**

**Completed**

## Southeastern PA CNG Vehicle Conversion Initiative

**30 dedicated CNG under 14000 GVW**

**Completed**

## W.W. Transport and Easton PA CNG Vehicle Conversion Project

**5 dual fuel, 25 dedicated CNG**

**Completed**

## Northeast Extension CNG Conversion Initiative

**18 dedicated CNG vehicles deployed**

**Completed**

## CNG Delivery Truck Project

**20 CNG Delivery Trucks**

**Completed**

**150 CNG Vehicles on the road in past 2 years**

# Alternative Fuel Technical Assistance Program

## **What is the Alternative Fuels Technical Assistance program (AFTA)?**

- A new program offered by the PA Department of Environmental Protection (DEP) that provides technical assistance to eligible organizations to maximize the benefits of alternative fuel use in PA.

## **Who is eligible to apply for assistance under AFTA?**

- Organizations eligible to apply include political subdivisions, nonprofit entities, municipal authorities and school districts in PA.

## **How does the technical assistance process work?**

- Eligible organizations apply to receive technical assistance by submitting an AFTA application form to DEP.
- Upon acceptance, DEP will assign a technical assistance provider who will evaluate the technical and economic considerations of various alternative fueling strategies specific to the needs of the applicant.

## **How does the technical assistance process work?**

- The technical assistance project will result in a final report that will identify fueling options and recommended strategies based on technical and economic considerations specific to the circumstances of the organizations involved, their vehicle needs, and their operating profiles.

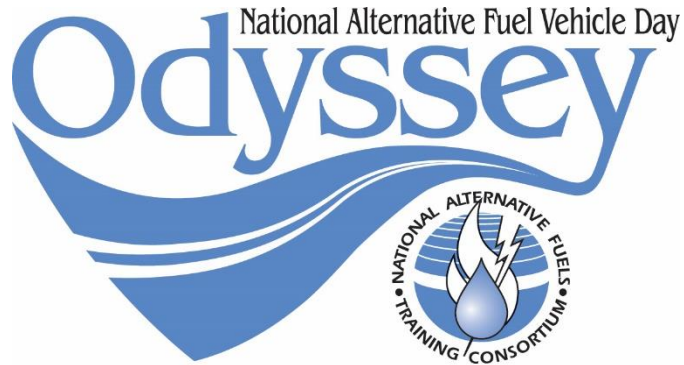
For more information, please contact Alternative Fuels program staff at 717-783-8411 or email [RA-AFIG@pa.gov](mailto:RA-AFIG@pa.gov)





# Upcoming EP-ACT Events

**April 19<sup>th</sup> -**



**May 7<sup>th</sup> -**



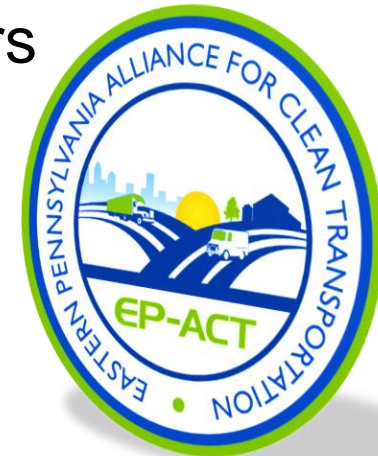
**May 15<sup>th</sup> -**

**1<sup>st</sup> Annual Golf Outing &  
Awards Dinner**



## What can we do for You?

- Workshops / Educational Seminars
- Training
- Fleet Analysis
- Facility Analysis
- Informational Resources
- Market Research
- Incentives
- Grant Writing
- Grant Administration
- Project Management



**Tony Bandiero**  
**Executive Director**  
**EP-ACT**

**215-990-8200**

**[tbandiero@ep-act.org](mailto:tbandiero@ep-act.org)**

**[www.ep-act-org](http://www.ep-act-org)**

# Eastern PA Alliance for Clean Transportation

## UGI Utilities March 29, 2017

Steve Bareuther  
Relationship Manager - Major Accounts



# Agenda

- UGI Overview
- Key Strategic Initiatives
- Gas Supply
- Midstream Projects
- UGI CNG Success Stories
- UGI CNG Fleet
- Site Location Considerations
- UGI Utilities' Gas Rates

# UGI Overview

UGI Corporation is a distributor and marketer of energy products and services including natural gas, propane, butane, and electricity.



- **#1 Propane distributor in U.S.**

\*100% GP interest and 20% of outstanding LP units  
Largest retail propane distributor in U.S. based on volume



- **Premier LPG distributor in Europe**

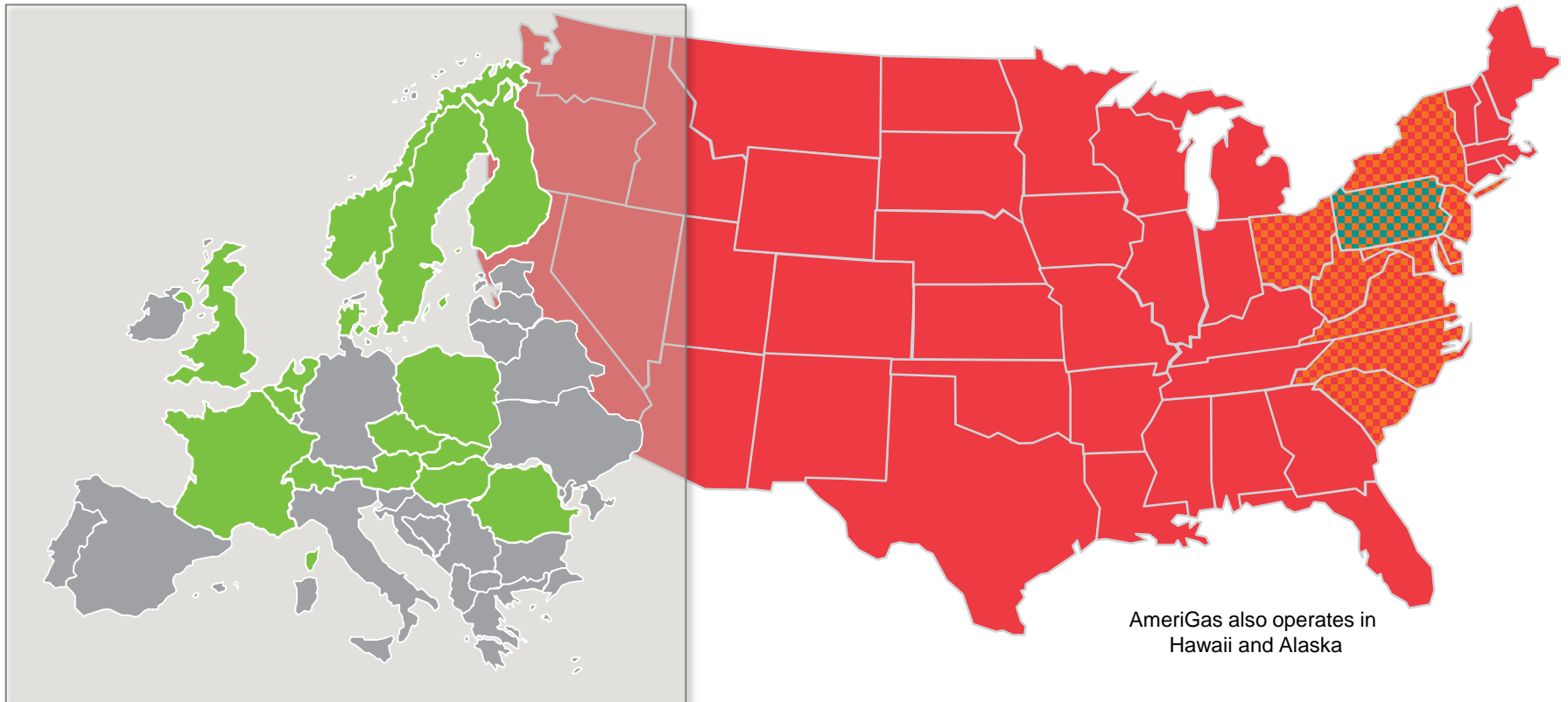


- **Energy marketing, midstream, and power generation**



- **Gas & Electric Utilities in Pennsylvania and Maryland**

# UGI Corporation



**AmeriGas**  
(50 States)

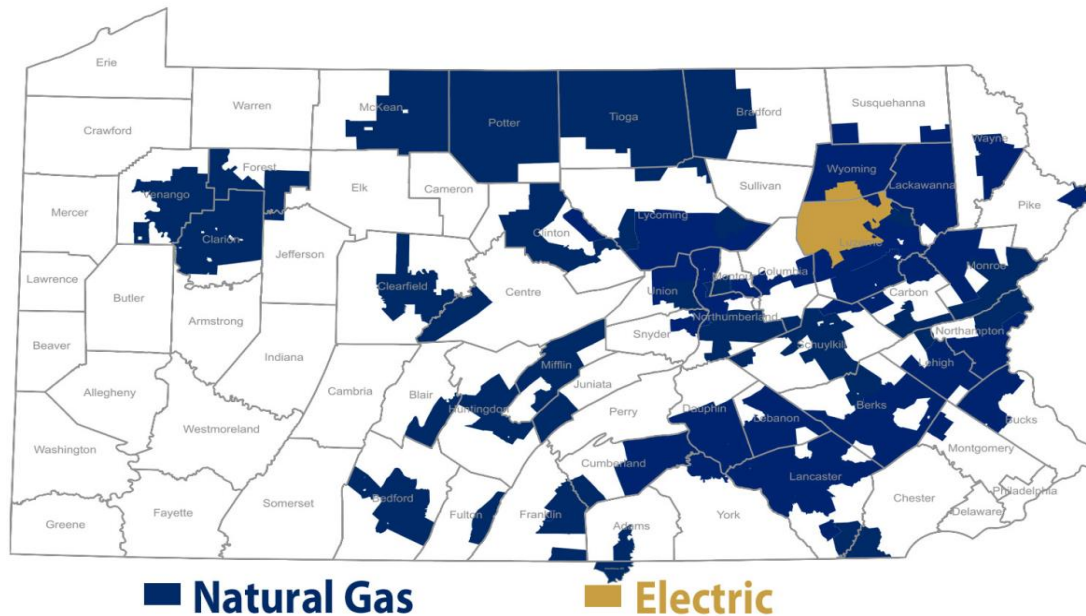
**UGI International**  
(16 European Countries)

**UGI Energy Services**  
(mid-Atlantic)

**UGI Utilities**  
(PA, MD)

# UGI Utilities

- >600,000 gas customers, >60,000 electric customers; 45 of the 67 PA counties served, 1 county in MD
- Approximately 1,500 employees
- Approximately 12,000 miles of main

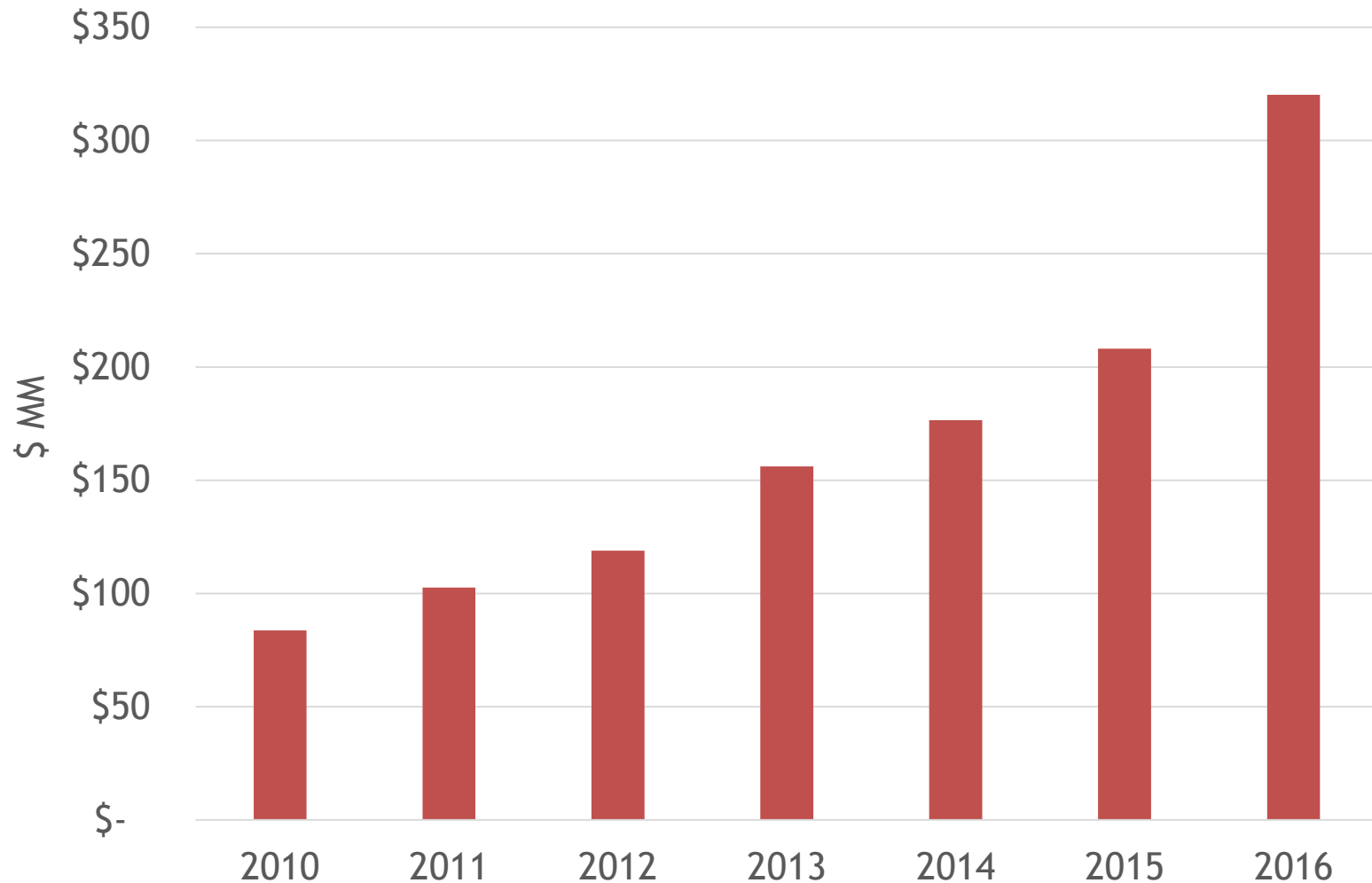


# Key Strategic Initiatives

# Strategic Foundation



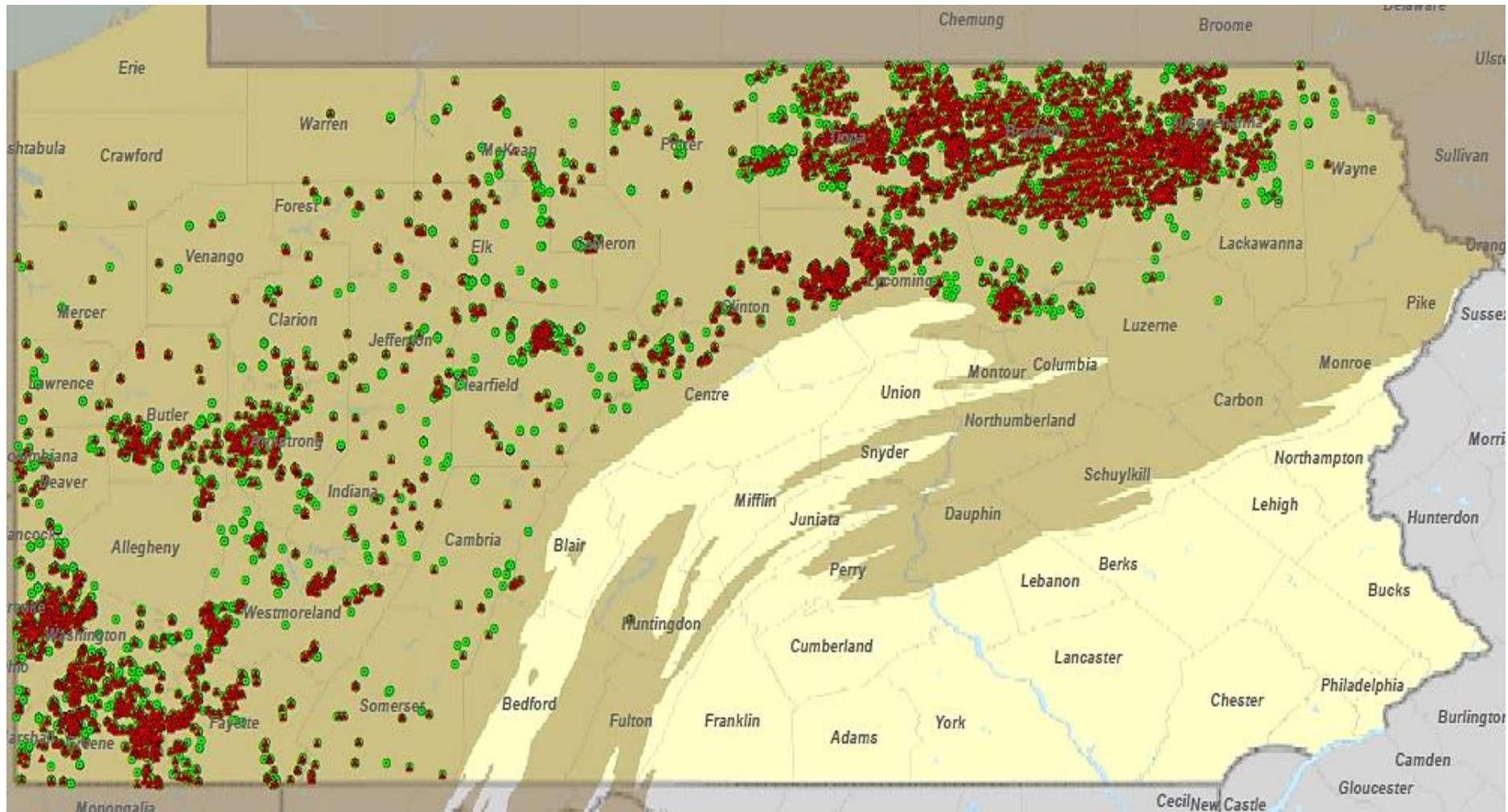
# Capital Spend by FY



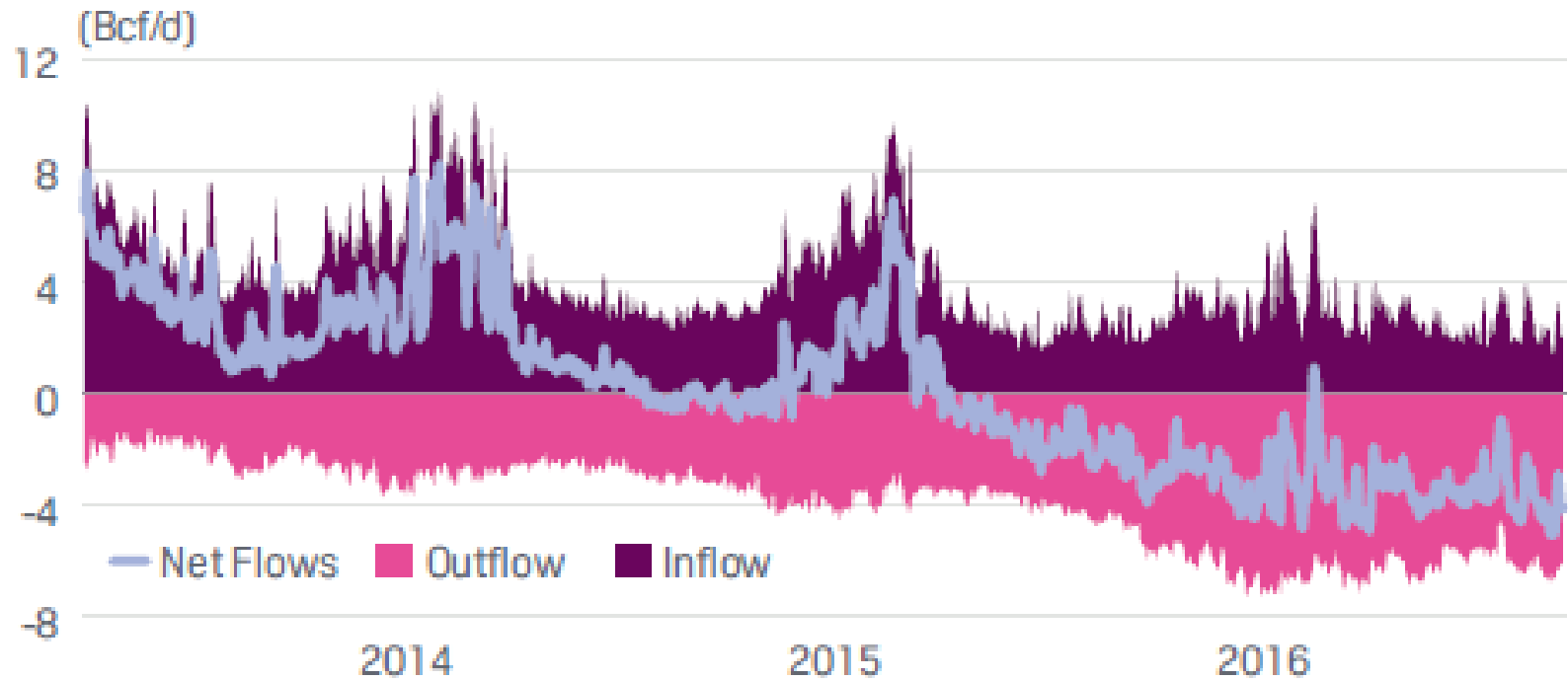
# Gas Supply



# Marcellus Shale

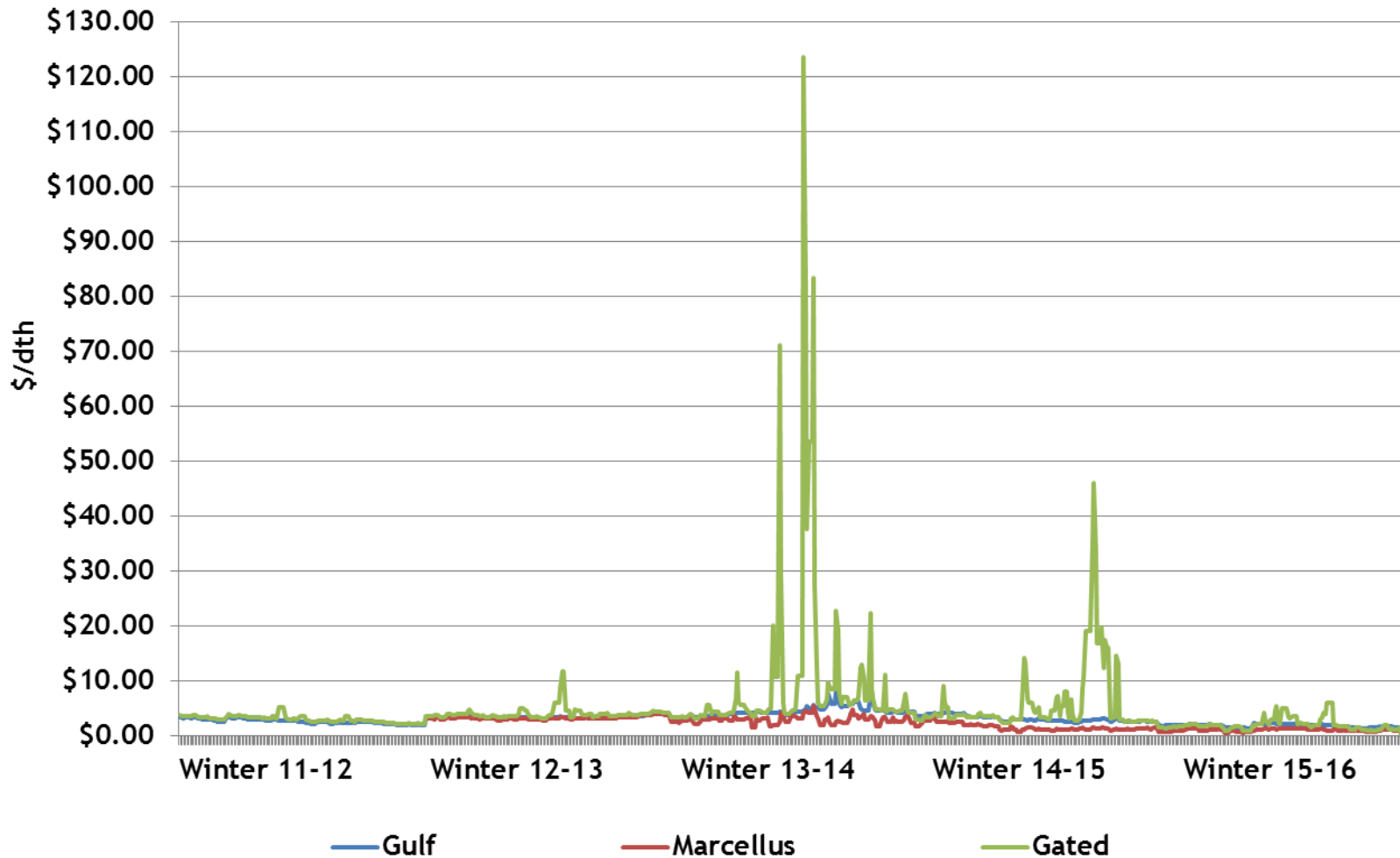


## NORTHEAST NET-FLOW TREND



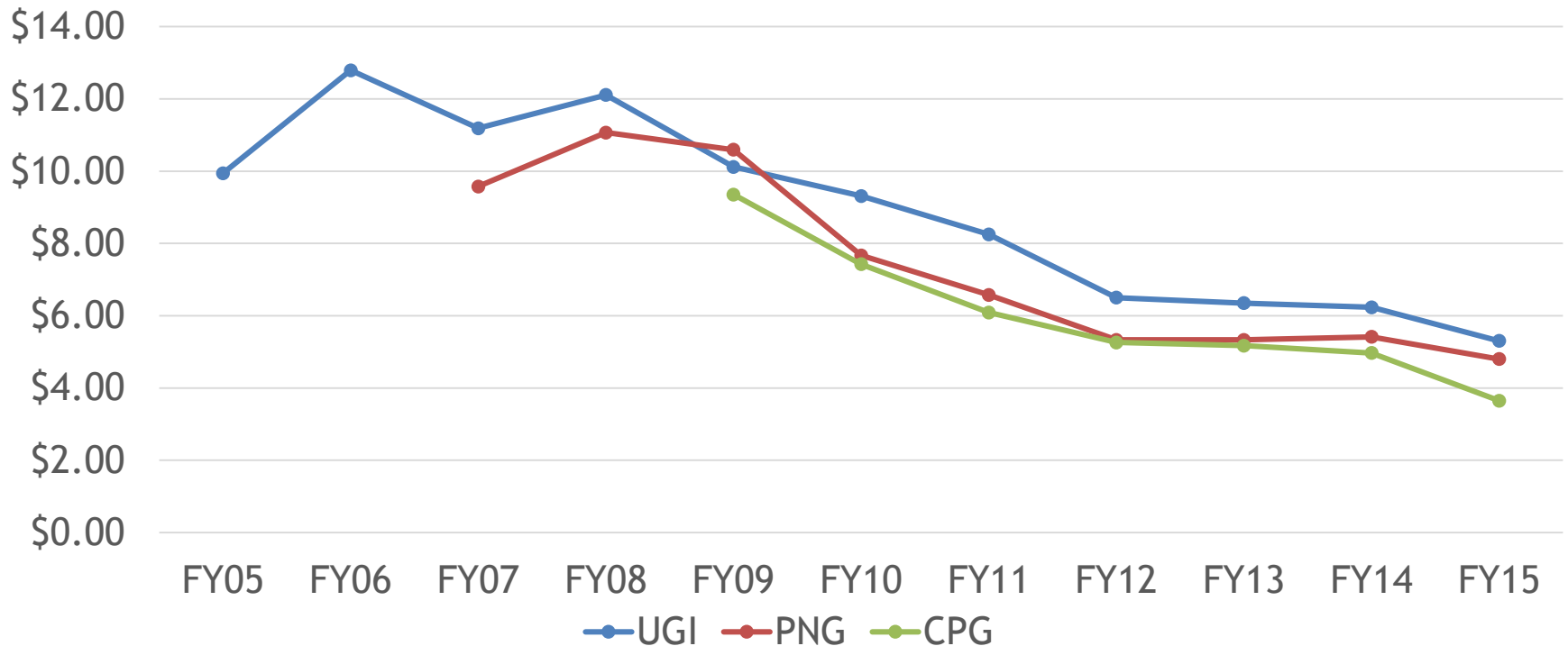
Source: Platts Analytics' Bentek Energy

# Daily Spot Pricing



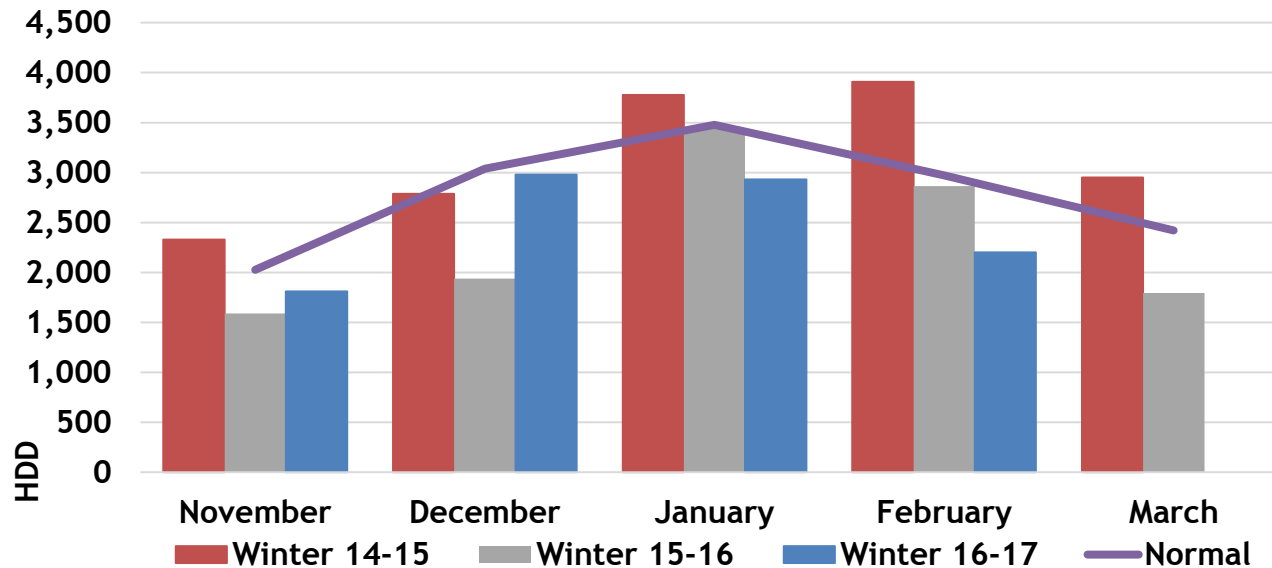
*\*source: Platts Pricing*

# Utility PGC Costs 2005-2015



Effective June 1, 2005, the average UGI-Gas residential heating bill was \$118.29.  
Effective December 1, 2015, the average UGI-Gas residential heating bill was \$70.76.

# Winter Weather Comparison



Winter 16-17 (Nov-Feb) was 13.5% warmer than normal

# UGI Energy Services Midstream Projects

# Sunbury Pipeline

Serving customers in Central Pennsylvania

## Sunbury Pipeline

## System Highlights



- ▶ 35 Mile, 20" intrastate pipeline moving 200,000 Dth/d of gas to:
  - ▶ Hummel Station
  - ▶ UGI Central Penn Gas, Inc.
- ▶ Capex: \$160 million
- ▶ Placed into service January 2017





# PennEast Pipeline

Delivering Marcellus production to high-value end markets

## PennEast Pipeline



## System Highlights

- ▶ Connecting abundant Marcellus gas supply to high-value southeastern PA and western NJ markets
- ▶ 118-mile, 36" interstate pipeline
- ▶ Approximately 1.1 Bcf/d capacity
- ▶ Capex: \$1.0 billion
- ▶ Partnership between UGI Energy Services (project manager), Spectra Energy, Southern Company Gas, NJR, South Jersey Industries
- ▶ Anticipating FERC approval in Q2 2017
- ▶ Anticipating in-service in Q4 2018



Southern  
Company  
Gas

NJR  
Pipeline  
Company

South Jersey  
Industries

Spectra  
Energy

UGI Energy  
Services



# UGI Utilities' Gas Rates

## Rate N/NT

- Firm gas rate for non-residential customers
- Rate N purchases both commodity and distribution from UGI
- Rate NT purchases commodity from a natural gas supplier and distribution from UGI
- No contract is required
- Monthly meter readings
- Customer charge = \$16 per month
- Distribution charge = \$3.6867/mcf

## Rate DS

- Firm gas rate for small commercial and industrial transportation customers
- Good “starter rate” to use until the CNG gas load increases
- Daily meter reading device is required
- One year minimum contract term
- Customer charge = \$290 per month
- Distribution charge = \$3.5383/mcf for first 500 mcf per month and \$3.0383/mcf over 500 mcf

## Rate LFD

- Firm gas rate for large customers
- Good for customers with strong summer usage due to 50% load factor requirement
- Daily meter reading device is required
- Two year minimum contract term
- Daily firm requirement must be at least 50 mcf/d
- Customer charge = \$700 per month
- Demand charge = \$5.45/mcf of DFR per month
- Distribution charge = \$1.547/mcf for first 1,000 mcf per month and \$1.0465/mcf over 1,000 mcf

# Site Location Considerations

# Site Location Considerations

- The location of a new CNG installation is key
- Work with UGI to review the btuh inputs of the station to determine proper location selection
- It is possible a CIAC (Contribution in aid of Construction) will be required.
- There may be minimum volume commitments required by UGI to allow us to meet our investment criteria
- Natural gas rates will be reviewed

# Who do I call from UGI to work on CNG/NGV Projects?

## UGI Relationship Managers - Major Accounts:

West Region (Lancaster/Harrisburg):	Steve Bareuther	610-736-5446
	sbareuther@ugi.com	
East Region (Reading/Lebanon):	Rhiannon Hazzard	610-796-3439
	rhazzard@ugi.com	
East Region (Allentown):	Adam Galczynski	610-807-3110
	agalczynski@ugi.com	
North Region (Scranton/Wilkes-Barre):	Joe Bauman	570-829-8901
	jbauman@ugi.com	
North Region (Williamsport):	Andy Rohrer	570-701-5010
	arohrer@ugi.com	

## UGI Technical Advisor:

Pedro Cuevas	484-269-1742
pcuevas@ugi.com	



**CNG STATION TYPES**





***Experienced Designers and Builders of Compressed Natural Gas Fueling Systems***

***OXFORD***

***Engineering Company***

## The **AGT** – **OEC** CNG Station Development Joint Venture

Typical Station Development Responsibilities:

### Air & Gas Technologies:

- CNG equipment selection, supply and installation.
- Mechanical and electrical construction.
- Long term station operation and maintenance.

### Oxford Engineering Company:

- Site planning, layout and engineering design.
- Permitting.
- Civil, mechanical and electrical construction.

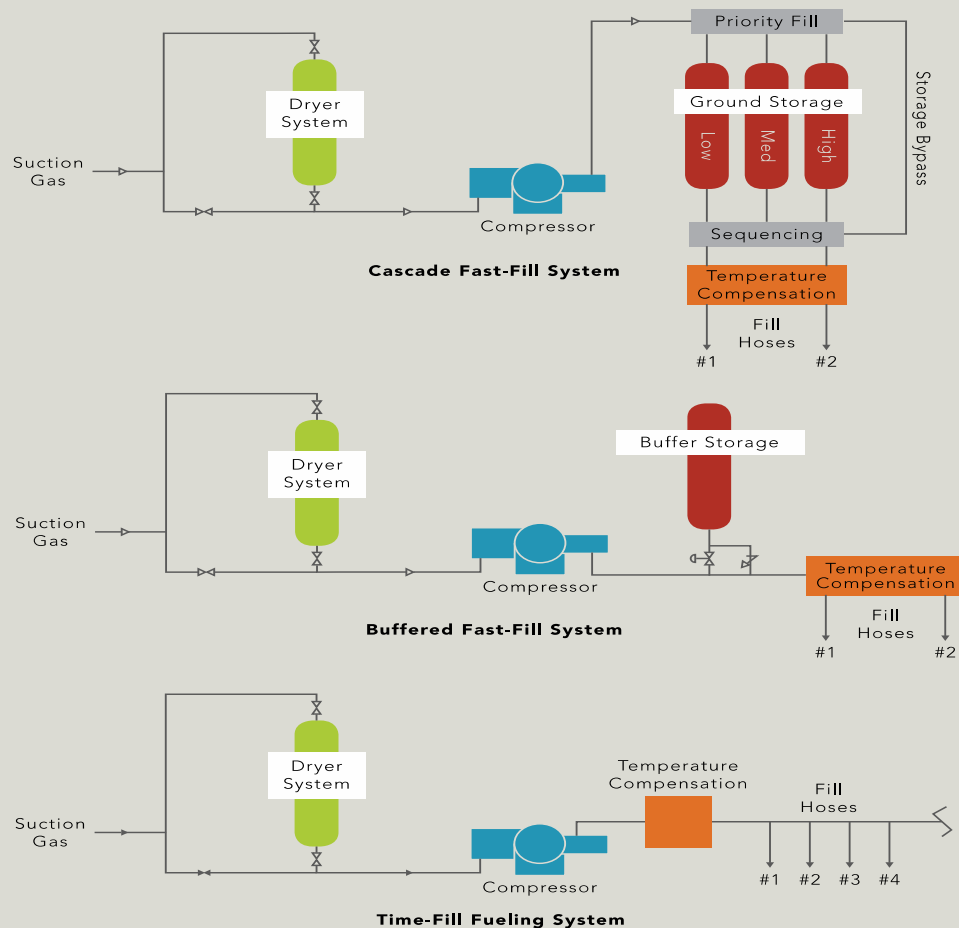
## The **AGT** – **OEC** CNG Station Development Joint Venture

Partial List of CNG Stations Developed in Pennsylvania & New Jersey:

<b>Lower Merion High School</b> , Ardmore, Pennsylvania	Fast-Fill Station
<b>Harriton High School</b> , Villanova, Pennsylvania	Fast-Fill Station
<b>Mack Truck</b> , Macungie, Pennsylvania	Fast-Fill Station
<b>Bryn Mawr College</b> , Bryn Mawr, Pennsylvania	Time-Fill Hybrid Station
<b>Aqua America, Inc.</b> , Various Sites, Pennsylvania	Time-Fill VRA
<b>American Honda</b> , Mount Laurel, New Jersey	Time-Fill VRA
<b>New Jersey Natural Gas</b> , Lakewood, New Jersey	Fast-Fill/Time-Fill Station
<b>New Jersey Natural Gas</b> , Wall, New Jersey	Fast-Fill Station
<b>Elizabethtown Gas</b> , Union, New Jersey	Fast-Fill Hybrid
<b>South Jersey Industries</b> , Millville, New Jersey	Fast-Fill Station
<b>Roselle Disposal</b> , Fairfield, New Jersey	Time-Fill Station
<b>Rose Tree Media School District</b> , Media, Pennsylvania	Fast-Fill Station
<b>L.T. Verrastro</b> , Old Forge, Pennsylvania	Fast-Fill/Time-Fill Station
<b>Wawa</b> , Paulsboro, New Jersey	Fast-Fill Station

Figure 3.1-1

CNG stations use four predominant configurations: cascade fast-fill, buffer fast-fill, time-fill, and combination-fill, which combines fast- and time-fill configurations.



## 3 CNG Station Design

### 3.2 Station Types and Equipment

#### 3.2.1 Cascade Fast-Fill Station

*A cascade fast-fill CNG station is typically used for retail applications or when vehicles arrive randomly for refueling.*

The pattern of use of a cascade fast-fill station is comparable to that of a retail gasoline or diesel station. There may be peak periods of fueling, such as early morning before work hours or evening after work hours, but the station also fuels vehicles that arrive in a random fashion throughout the day. These CNG stations must be designed to have enough storage to handle peak fuel demand. They also must have a compressor that is sized appropriately to meet the fueling pattern and adequately replenish the storage in a given amount of time.

Especially in public fueling applications, it is important to consider redundancy, which is accomplished by installing more than one compressor, to provide a continuous supply of fuel and ensure customer satisfaction. This allows the station to continue to operate in case one of the compressors fails, improving reliability and customer satisfaction. This is even more important during the early years of infrastructure development when the density of CNG stations is relatively low and an alternate CNG fueling station may not be easily located.

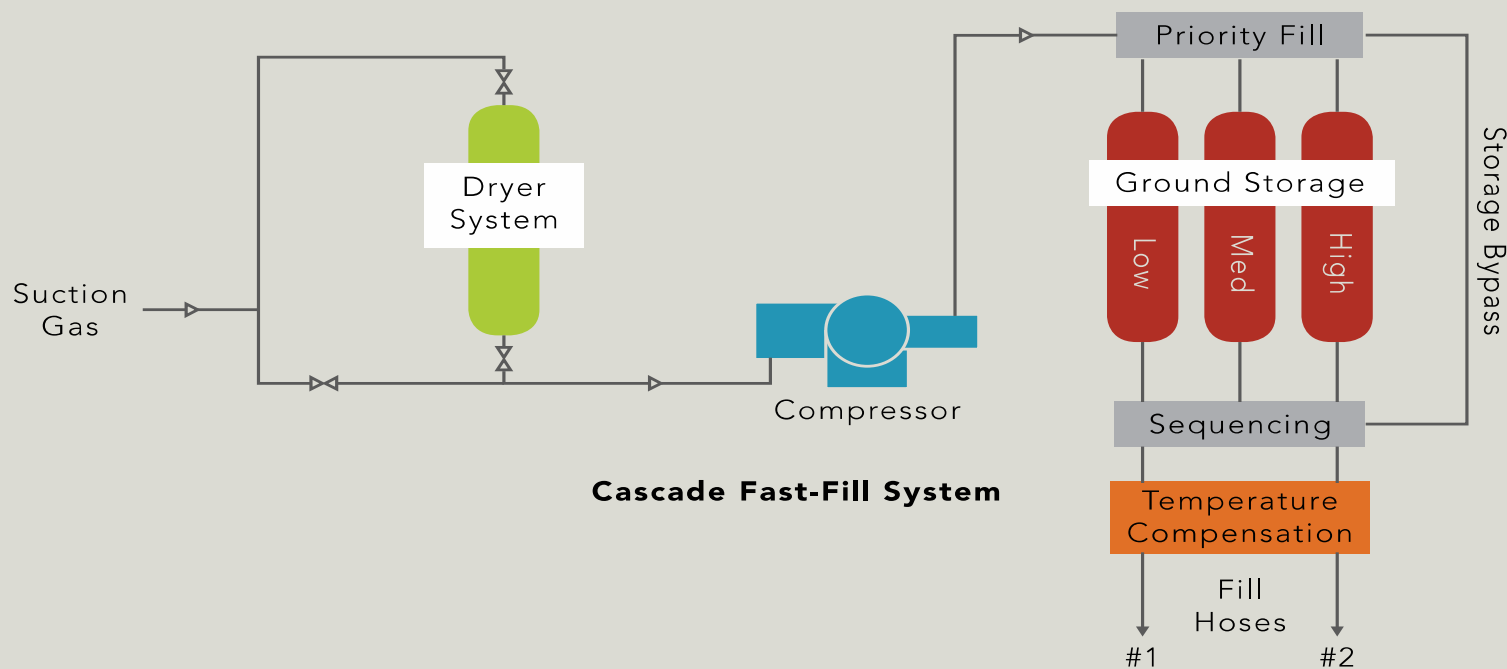
Typical components of a cascade fast-fill system include:

- Dryer – removes water or water vapor from the natural gas supply prior to compression
- Compressor – compresses natural gas to the appropriate pressure required to deliver a fully temperature compensated fill to the vehicle
- Priority valve panel – determines the sequence of flow of natural gas from the compressor into storage
- Storage – American Society of Mechanical Engineers (ASME) vessels used to store compressed natural gas
- Sequential valves – determines the sequence of flow of natural gas from storage into the vehicle
- Temperature compensation system – uses an algorithm to adjust for ambient temperature and temperature of compression into the vehicle fuel storage system to ensure that vehicles receive a full fill
- Dispenser – dispenses natural gas into vehicles

Figure 3.2.1-1 demonstrates a typical public access cascade fast-fill station.

**Figure 3.2.1-1**

The cascade fast-fill CNG station configuration allows for fueling similar to retail gasoline and diesel stations. Two key components of the cascade fast-fill configuration are compressed gas storage and CNG dispensers.



## 3 CNG Station Design

### 3.2 Station Types and Equipment

#### 3.2.2 Buffer Fast-Fill Station

*A buffer fast-fill CNG station is typically used for sequential fueling of high fuel use vehicles one immediately after another.*

Examples of the most frequently required applications for buffer fast-fill stations are transit buses and taxis. The main difference between buffer fast-fill and cascade fast-fill systems is that buffer systems primarily fuel directly from the compressor into the vehicle and use a smaller quantity of storage.

These stations are typically onsite fueling stations that serve a captive fleet and are sized and designed specifically for the needs and fueling patterns of that fleet. They allow large quantities of fuel to be dispensed in a relatively short time period, which can be important for fleets such as taxi cabs whose operating characteristics require relatively short dispensing periods.

Typical components of a buffer fast-fill CNG system include:

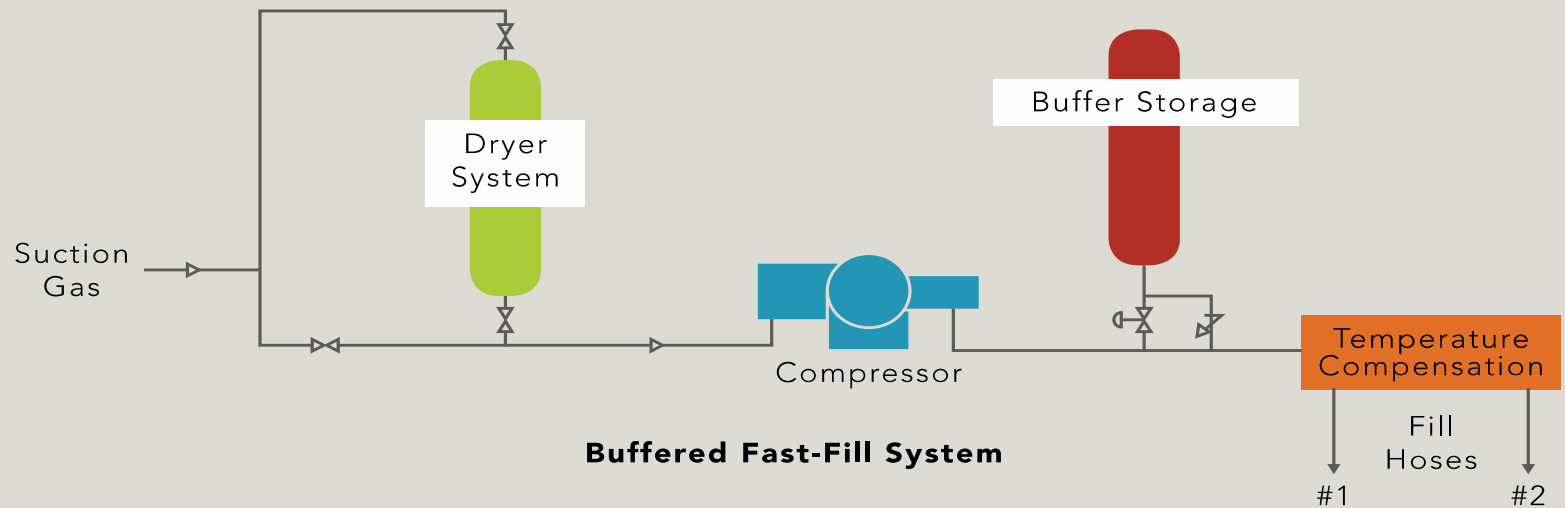
- Dryer – removes water or water vapor from the natural gas supply prior to compression
- Compressor(s) – compresses natural gas to the appropriate pressure required to deliver a fully temperature compensated fill to the vehicle
- Buffer control panel – determines the flow of fuel from the compressor(s) either to the vehicle or to ASME storage vessel(s)
- Temperature compensation system – uses an algorithm to adjust for ambient temperature and temperature of compression into the vehicle fuel storage system to ensure that vehicles receive a full fill
- Dispenser – dispenses natural gas into vehicles

Figure 3.2.2-1 depicts a buffer fast-fill system that fuels transit buses.



Figure 3.2.2-1

Buffer fast-fill systems primarily fuel directly from the compressor into the vehicle in a short amount of time and typically serve specific captive fleets.



## 3 CNG Station Design

### 3.2 Station Types and Equipment

#### 3.2.3 Time-Fill Station

*Time-fill fueling is a lower cost option designed for fleets of vehicles that return to central locations for a variable period of time, depending on fleet requirements.*

The most popular application of this type of fueling system is school buses and refuse trucks. The primary advantage of time-fill fueling is significantly lower equipment and installation cost because no priority, storage, and sequential fueling components are necessary. In a time-fill application, vehicles are fueled directly from the compressor into the vehicles. Time-fill fueling is ideal for fleets whose vehicles return daily to central locations. A small amount of storage and fast-fill dispensing equipment can be added to these stations to accommodate vehicles in the fleet that need fast-fill fueling, although the costs to build the station will increase slightly.

Figure 3.2.3-1 demonstrates time-fill CNG fueling for a refuse company. Dispensing occurs from the slim posts with hoses located in front of each vehicle.

Typical components of a time-fill CNG fueling system include:

- Dryer – removes water or water vapor from the natural gas supply prior to compression
- Compressor(s) – compresses natural gas to the appropriate pressure required to deliver an ambient temperature compensated fill to the vehicle
- Multiple single hose fueling posts – dispenses natural gas into vehicles

Figure 3.2.3-2 shows two components of CNG fueling: a gas dryer and a compressor package.

Figure 3.2.3-1

Time-fill systems are ideal for fleet vehicles that return daily to a central location.

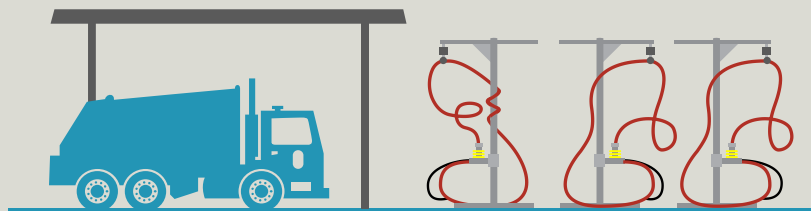
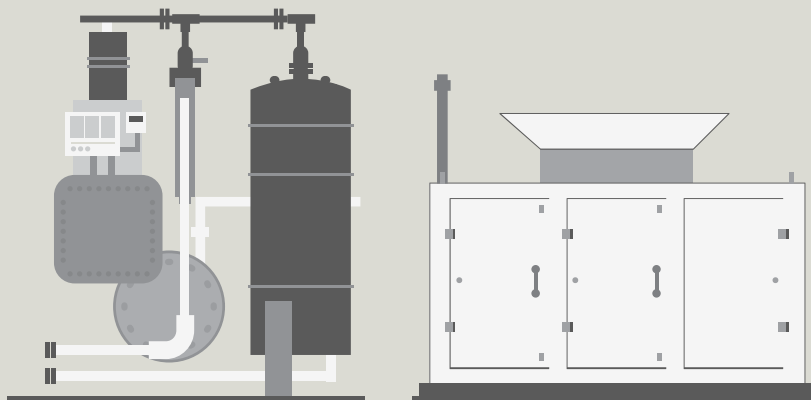


Figure 3.2.3-2

Two key components of the time-fill configuration are CNG dryers and CNG compressor packages.



## 3 CNG Station Design

### 3.3 Economics

*The cost to build a compressed natural gas fueling station varies significantly, depending primarily on the capacity needed. Standardization of station size across North America will enable developers to reduce costs through economies of scale.*

The smallest CNG refueling system was, until two years ago, produced by FuelMaker, a Canadian company. “Phill” was sold primarily for single vehicle use at a cost of about \$4,000 (\$5,000 installed). In 2009, the company was sold to Fuel Systems Solutions Inc., a California-based company. On the larger end of the size spectrum, installed natural gas fueling stations may range from \$675,000 to \$1,000,000 per station (Table 3.3-1).<sup>12</sup> Two of the estimates in the table are estimates for public access fast-fill stations, and one is an estimate for a fleet that can use a time-fill station. The fast-fill stations differ only in that one has one compressor and the other has two, providing redundancy. The costs of combination-fill stations will depend on the configuration of fast- and time-fill components and may be expected to incorporate costs from both types of stations.

There are several scenarios that determine how many vehicles can fuel at the example stations, depending on the fueling pattern and quantity of fuel required. Fast-Fill Station I may fuel:

- Fifteen light-duty vehicles with 15 gasoline gallons equivalent (GGE) per vehicle in a one-hour peak period (vehicles arriving one after another), with a thirty-minute period for the compressor to replenish the storage system
- Randomly arriving light-duty vehicles filling an average 10 GGE per vehicle throughout the day, with the storage system replenished periodically as needed
- Ten heavy-duty vehicles with 20 diesel gallons equivalent (DGE) per vehicle in a one-hour peak period, with a thirty-minute period for the compressor to replenish the storage system
- Randomly arriving heavy-duty vehicles filling an average 10 DGE per vehicle throughout the day, with the storage system replenished periodically as needed

#### **Fast-Fill Station II may fuel:**

- The same vehicles as Fast-Fill Station I, with a redundant compressor to act as backup if the primary compressor fails. A redundant compression system is needed in situations where there is not another CNG fueling station in close proximity (within three to five miles).

#### **Time-Fill Station may fuel:**

- Forty vehicles with 38 GGE per vehicle in a ten-hour period. This same time-fill fueling station could fuel forty vehicles with 33 DGE per vehicle in a ten-hour period.

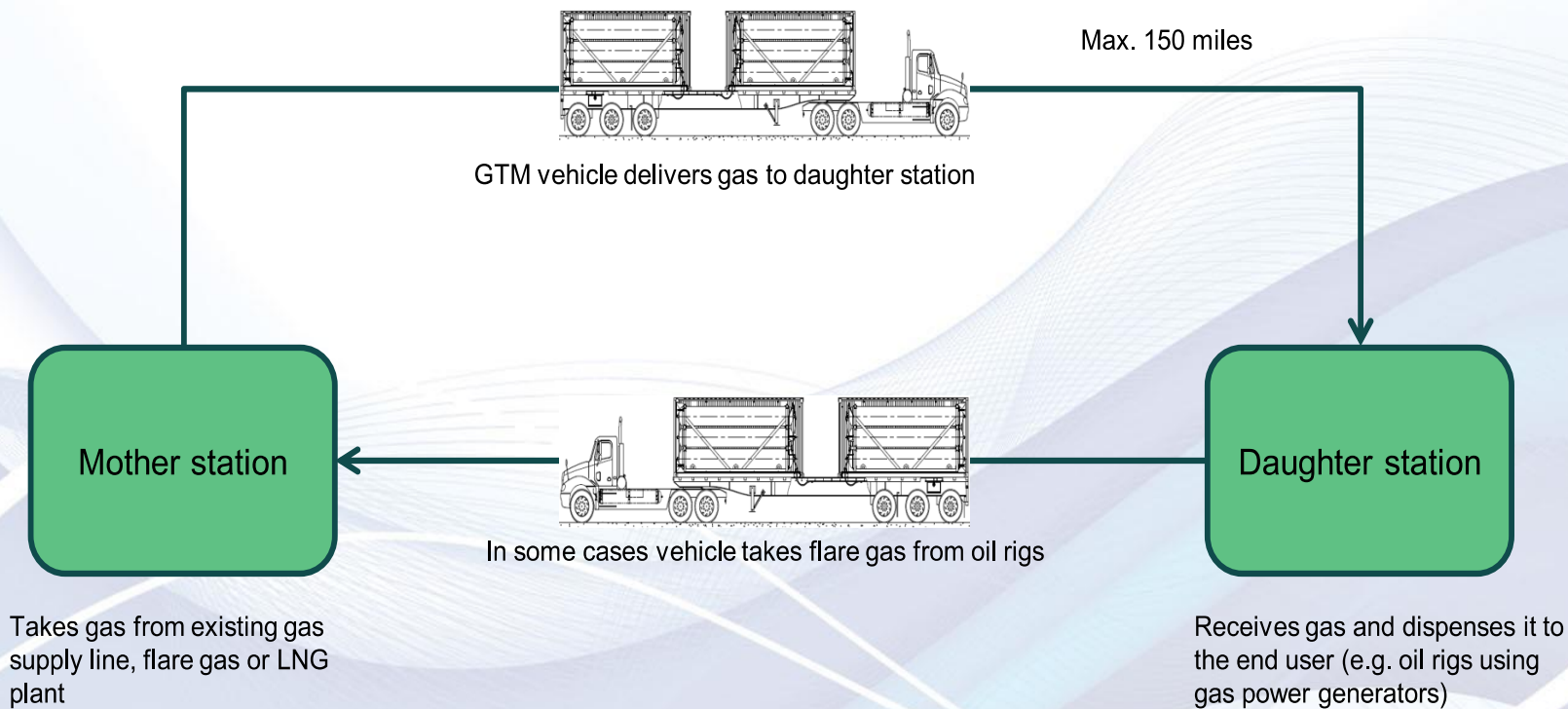
Table 3.3-1

CNG fueling stations with the same compressor flow rate have different costs and/or vehicle fueling capabilities. Combination-fill stations will incorporate cost elements from these stations.

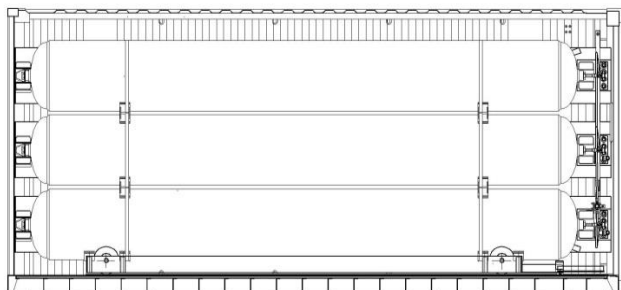
	Fast Fill Station I:	Fast Fill Station II:	Time Fill Station:
	Natural gas dryer, one 300 scfm compressor, 3 ASME vessel high-pressure storage systems, 1 two-hose fast-fill dispenser (no redundancy)	Natural gas dryer, two 300 scfm compressors, 3 ASME vessel high-pressure storage systems, 1 two-hose fast-fill dispenser (with redundancy)	Natural gas dryer, one 300 scfm compressor, 20 two-hose, time-fill dispensers (no redundancy)
Component Cost	\$500,000	\$650,000	\$375,000
Installation Cost*	\$300,000	\$350,000	\$300,000
Total Cost	\$800,000	\$1,000,000	\$675,000
Vehicle Fueling Scenarios	<p>15 light-duty/15GGE consecutively fueling in a 1-hour peak period</p> <p>or</p> <p>Randomly arriving light-duty/10 GGE</p> <p>or</p> <p>10 heavy-duty/20 DGE consecutively fueling in a 1-hour peak period</p> <p>or</p> <p>Randomly arriving heavy-duty/DGE</p>	<p>15 light-duty/15 GGE consecutively fueling in a 1-hour peak period</p> <p>or</p> <p>Randomly arriving light-duty/10 GGE</p> <p>or</p> <p>10 heavy-duty/20 DGE consecutively fueling in a 1-hour peak period</p> <p>or</p> <p>Randomly arriving heavy-duty/10 DGE</p>	<p>40 vehicles/38 GGE in a 10-hour period</p> <p>or</p> <p>40 vehicles/33 DGE in each vehicle in a 10-hour period</p>

\*Note that installation costs vary by region and permitting bureau

## GTM Mother-Daughter CNG Transport Industry Model



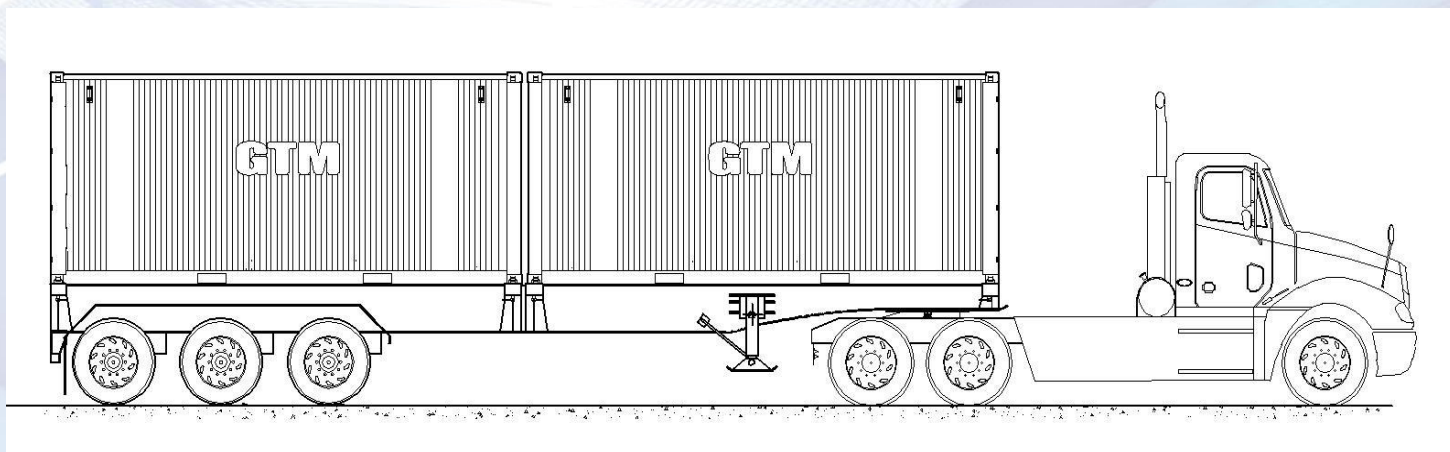
**GTM Module for CNG Storage of  
123,606 SCF (3,500 m<sup>3</sup>) of CNG at  
3,250 PSIG (224 bar)**



**Single GTM Solution for delivery of  
123,606 SCF (3,500 m<sup>3</sup>) of CNG at 3,250  
PSIG (224 bar)**




**Dual GTM Solution for delivery of 247,212 SCF (7,000 m<sup>3</sup>) of CNG at 3,250 PSIG (224 bar)**



**Virtual Pipeline / Mobile Fueling Solution**




### Features



- Easy operation
- Installed Indoors or Outdoor
- Integrated Gas Dryer
- Integrated Ventilation Fan
- Integrated Gas leak detection
- NGV1 Standard Nozzle
- Quiet operation

7


### Specifications



- Maximum Discharge Pressure: 3600 psig @ 70° F and higher
- Maximum Fill Pressure is Temperature Compensated
- Inlet Pressure: 0.25 - 0.50 psig (7" - 14" W.C.)
- Nominal GGE Flow Rate: 0.8 scfm / 0.42 gge/hr
- Nominal gas load 50,000 BTU/hr

8

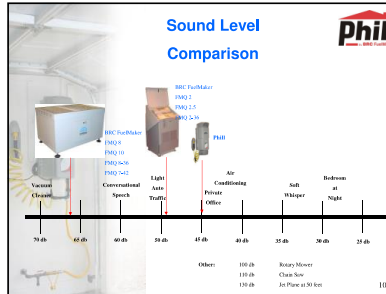
### Specifications



- Electrical Supply: 240 VAC, 60 Hz (1Φ)
- Circuit Ampacity: 15 Amps maximum
- Full Load Amperage: 5.5 amps
- Average Power Consumption: 800 Watts
- Dimensions (H x W x D): 30" x 14" x 13"
- Weight: 95 lbs
- Noise Level: 45dBA @ 16.5' open field
- Ambient Temperature Rating: - 40°F to +115°F

9

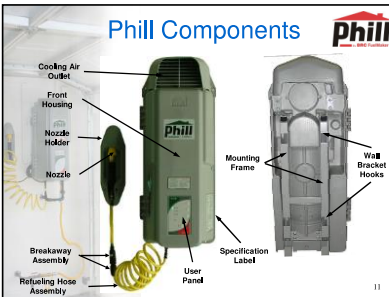
### Sound Level Comparison



Appliance	Sound Level (dBA)
Variable Speed Compressor	70 dBA
Refrigerator	60 dBA
Freezer	55 dBA
Light	50 dBA
Refrigerator	45 dBA
Refrigerator	40 dBA
Refrigerator	35 dBA
Refrigerator	30 dBA
Refrigerator	25 dBA

10

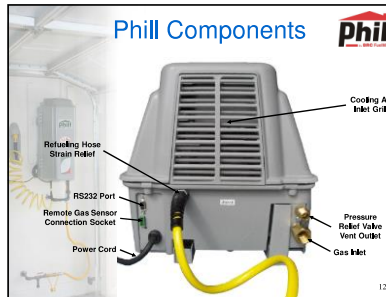
### Phill Components



Labels: Cooling Air Outlet, Front Housing, Nozzle Holder, Nozzle, Breakaway Assembly, Refueling Hose Assembly, Mounting Frame, User Panel, Specification Label, Wall Bracket Hooks.

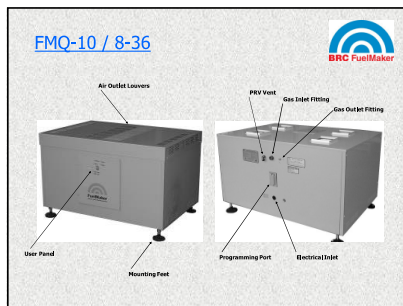
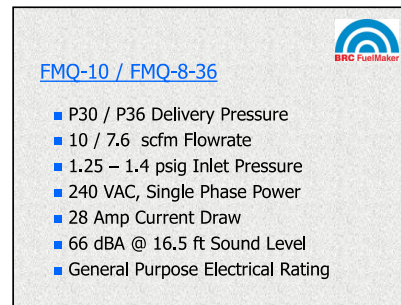
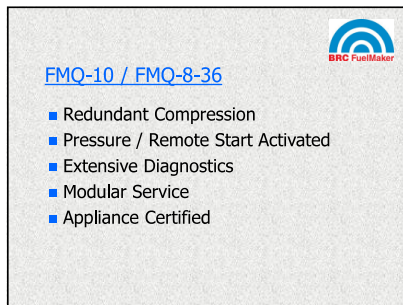
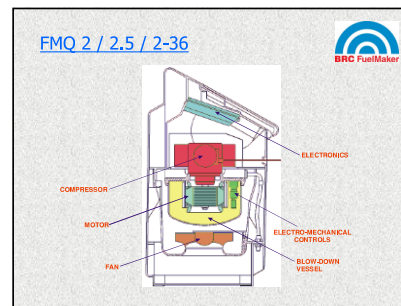
11

### Phill Components



Labels: Refueling Hose Strain Relief, RS232 Port, Remote Gas Sensor Connection Socket, Power Cord, Cooling Air Inlet Grill, Pressure Relief Valve Vent Output, Gas Inlet.

12



### Dispensing Systems



AFP  
Auxiliary Fueling Panel



R410  
Remote Fueling Panel

### AFP and R410

- Compact Enclosure
- One or Two Hose Configuration
- Optional Vent Valve
- Optional Remote Venting
- Optional Post Mounting Kit
- Integrated Breakaway
- Powder Coat Finish

### AFP and R410

- P30 / P36 Delivery Pressure
- 50 scfm Flowrate
- 1/4" Compression Inlet Fitting
- General Purpose Electrical Rating

### AFP and R410



### R410

- Automatic Temperature Compensation
- Gas Detector Interlock
- Interface Cable
- Gas Detector / Fan Interlock

### R410

- P30 / P36 Delivery Pressure
- 50 scfm Flowrate
- 1/4" Compression Inlet Fitting
- Interface Cable
- Gas Detector / Fan Interlock
- General Purpose Electrical Rating





09/14/2012































































**Harriton High School**  
Villanova, Pennsylvania

Fleet, CNG Fast-Fill Station













**Harriton High School**  
Villanova, Pennsylvania

Fleet, CNG Fast-Fill Station





















**New Jersey Natural Gas**  
Lakewood, New Jersey

Fleet/Retail, CNG Fast-Fill/Time-Fill Station





**New Jersey Natural Gas**  
Lakewood, New Jersey

Fleet/Retail, CNG Fast-Fill/Time-Fill Station









**New Jersey Natural Gas**  
Lakewood, New Jersey

Fleet/Retail, CNG Fast-Fill/Time-Fill Station





**New Jersey Natural Gas**  
Lakewood, New Jersey

Fleet/Retail, CNG Fast-Fill/Time-Fill Station





**New Jersey Natural Gas**  
Lakewood, New Jersey

Fleet/Retail, CNG Fast-Fill/Time-Fill Station





**South Jersey Gas**  
Millville, New Jersey

Fleet/Retail, CNG Fast-Fill Station













**South Jersey Gas**  
Millville, New Jersey

Fleet/Retail, CNG Fast-Fill Station





















**Elizabethtown Gas**  
Union, New Jersey

Fleet/Retail, CNG Fast-Fill Station





**Wawa, Inc.**  
Paulsboro, New Jersey

Retail, CNG Fast-Fill Station











**Wawa, Inc.**  
Paulsboro, New Jersey

Retail, CNG Fast-Fill Station





Virtual Pipeline / Mobile Fueling Solution



# *The Right Natural Gas Vehicle for the Job*

Sponsored By:  
Eastern Pennsylvania  
Alliance for Clean  
Transportation



U. S. Department of Energy



Eastern Pennsylvania Alliance for Clean Transportation



**March 29, 2017**



# Why the NGV Market Will Grow

## ✧ ***We Have the Fuel – And It's Ours***

- ✧ Substantial Air Quality: Urban Pollution
- ✧ Substantial Air Quality: GHGs
- ✧ Biomethane Makes GHG Case Stronger
- ✧ Only Natural Gas Can Displace Diesel
- ✧ NGVs are a Here-and-Now Technology
- ✧ Government Policymakers are (Finally) Recognizing the Value of NGVs
- ✧ Money – Economic Advantages: **VW Settlement Opportunities in Pennsylvania**



# Volkswagen Clean Air Act Summary

- ✧ Diesel engines were equipped with defeat devices, and they got caught by the EPA
- ✧ Three Elements of the Settlement:
  - ✧ Buyback or Repair (\$10 Billion)
  - ✧ Zero Emission Vehicles (“ZEVs”) Technology - Volkswagen must invest \$2 billion to promote the use of ZEVs.
  - ✧ Fund a \$2.925 billion mitigation trust fund to reduce NOx to be implemented over a 10-year period



# Eligible NOx Mitigation Projects

1. Class 8 Local Freight Trucks and Port Drayage Trucks
2. Class 4-8 School Bus, Shuttle Bus, or Transit Bus
3. Freight Switchers (Locomotives)
4. Ferries/Tugs
5. Ocean Going Vessels (OGV) Shorepower
6. Class 4-7 Local Freight Trucks (Medium Trucks)
7. Airport Ground Support Equipment
8. Forklifts and Port Cargo Handling Equipment
9. Light Duty Zero Emission Vehicle Supply Equipment
10. Diesel Emission Reduction Act (DERA) Option

Trust will pay a portion (25 to 100%) of the replacement/repower costs; recipient organization is responsible for providing applicable cost share

# CNG Target Markets

- ✧ Heavy-duty freight trucks:
  - ✧ Water ports and rail
  - ✧ “Less-than-Truck Load” (e.g., Yellow-Roadway, Forward Air, Swift)
- ✧ Transit buses/shuttle buses/school buses
- ✧ Major metro fleet management and public works departments
- ✧ Trash, recycling, cement and other vocational work trucks
- ✧ Medium-duty & Heavy-duty delivery and commercial service trucks:
  - ✧ Telecom — food — beverage — snack food — newspapers
  - ✧ linen/laundry — grocery — furnishings/appliances — office products
- ✧ Taxis and light-duty service vehicles



# Vehicles – Medium/Heavy Duty OEMs



A **PACCAR** COMPANY



**NAVISTAR**



# Cummins Westport, Inc. (CWI)

## ✧ Primary supplier to OEMs in

### ✧ Refuse collection trucks

(Crane Carrier LET, Autocar Xpeditor, Int'l Condor, Peterbilt LCF 320 and Mack TerraPro; many 2nd stage upfitters e.g. Heil, McNeilus, Amrep, Labrie, PennFlex)

### ✧ Buses, shuttles, trolleys

(NABI, New Flyer, Orion, Thomas, ElDorado, Blue Bird, Optima, variety of shuttle/trolley 2nd stage upfitters using FCC MB55 chassis)

### ✧ Sweepers

(Elgin, Tymco, Schwarze, Allianz-Johnston)

### ✧ Work / Vocational Trucks

(Freightliner M2 tractor and straight truck; Freightliner Custom Chassis MT45/55 walk-in/step vans; Ottawa; Capacity yard hostlers; Kenworth T800, T470, Peterbilt 384 and 365)



# CWI Natural Gas Engine Line-up

## ISB6.7 G



2016

Displ: 6.7 L  
Power: ~260 hp  
Torque: 660 lb-ft  
Cert: EPA 13  
Euro 6

## ISL G



8.9 L  
320 hp  
1000 lb-ft  
EPA 13  
Euro 6

## ISX12 G



12 L  
400 hp  
1450 lb-ft  
EPA 13

## ISX 15 G



2018

15 L  
450 hp  
1750 Lb-ft



# CNG Tank Configurations



Behind the Cab



Roof Mounted on Body



Chassis Mounted – Frame Rail

# OEM: Mack

## Mack TerraPro

- ✧ Cab Over
- ✧ Low Entry available
- ✧ ISL G Engine
- ✧ ISX12 G Engine – Mack announced expanding its CNG offerings with Pinnacle and Granite models
  - ✧ Pinnacle – Tractor
  - ✧ Granite – Roll Off, Dump, Concrete Mixer



# OEM: Crane Carrier Company

## Low Entry Tilt (LET2) Rear Loaders

- ✧ Tilt Cab
- ✧ Low Entry 18" height
- ✧ LH, RH, Dual Steer
- ✧ ISL G Engine
- ✧ ISX12 G Engine



Rooftop Mounted CNG Storage





# OEM: Autocar

## Autocar Bridgeport Split Body



Casella Waste Systems – Geneva, NY

# Refuse Truck Body Manufacturers

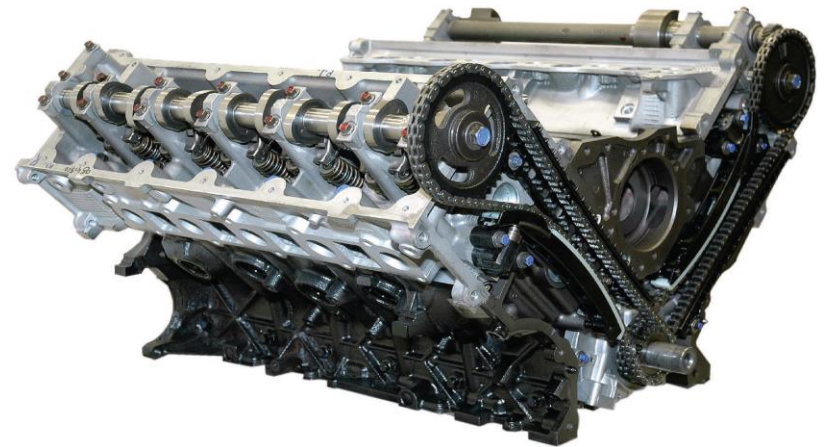
Additional manufacturers supporting CNG refuse trucks by incorporating CNG tanks into refuse body designs:

- ✧ **Amrep:** roof or chassis mounts
- ✧ **F.F. Gomez:** roof or chassis mounts
- ✧ **Heil:** behind the cab, roof, or chassis mounts
- ✧ **Labrie:** behind the cab mount
- ✧ **Leach:** behind the cab, roof, or chassis mounts
- ✧ **McNeilus:** behind the cab, roof, or chassis mounts
- ✧ **New Way:** roof mount
- ✧ **Wittke:** roof mount

# Medium Duty Dedicated Engines

## Ford 6.8L Triton 3V V10 compressed natural gas-prepped engine

- ✧ Order code 98G
- ✧ 355 HP
- ✧ 455 lb/ft torque
- ✧ up to 20,000 GVWR
- ✧ Ford F-450, F-550, F-650, and the F-59 Commercial Stripped Chassis.
- ✧ QVM Upfitters
- ✧ Available as Bi-Fuel as Well





# Medium Duty Dedicated Engines

## GM Vortec 6.0L V-8 compressed natural gas-prepped engine

- ✧ Order code LC8
- ✧ 322 – 360 HP
- ✧ 373 – 382 lb/ft torque
- ✧ Isuzu NPR, Workhorse (Navistar) W42 & W62, Chevy Express/GMC Savana Cutaway 4500
- ✧ SVM Upfitters



Chevrolet Silverado HD (Classic)

Vortec 6.0L V8  
2007 (LQ4)

# Dedicated NGVs

Ford QVM F- 450/550/650/750

- ✧ F-450/550 6.8L V10
- ✧ F-650/750 gaseous prep package ; EPA/CARB Certified
- ✧ Order Code 98G
- ✧ 60+ GGE



# Example: CNG Economics – Refuse



GVWR: >26,000 lbs.

Crane Carrier LET, Autocar Xpeditor, Peterbilt LCF 320 , ALF – Condor & Mack TerraPro (all with CWI ISL-G engine);

MPG: 2.5 – 3.0 (lots of idle and PTO time)

Fuel Use: 35-40 DGE/day; 8500-10,500 DGE/yr

CNG Premium: \$30,000 (assuming no offset from grants)

Simple Payback: 1.75 – 2.0 years (based on \$1.00/DGE savings)

Life-cycle cost savings: \$93.8 - \$123.4+!! (based on 8-yr life)

**NOTES: Calculations do not factor in any incentives.**

**Savings are exclusive of any avoided costs of diesel emission equipment and service.**



# Project Implementation

- ✦ Connect/Join your local Clean Cities Coalition, make contact with regional DOE/EPA offices, along with your state and local energy offices
- ✦ Prepare a fleet inventory and replacement spreadsheet, consider utilizing an approved consultant to assist
- ✦ Communicate with our local utility, infrastructure companies, and vehicle providers
- ✦ Do NOT over-analyze, take action!

# CNG Resources

Natural Gas Vehicle for America (NGVA)

202.824-7360 [www.NGVAmerica.org](http://www.NGVAmerica.org)

For the latest CNG vehicle availability visit:

[http://www.ngvamerica.org/pdfs/Available\\_Vehicles\\_and\\_Engines.pdf](http://www.ngvamerica.org/pdfs/Available_Vehicles_and_Engines.pdf)

Eastern PA Alliance for Clean Transportation

215.990.8200 [www.ep-act.org](http://www.ep-act.org)

Alternative Fuels Data Center

Advance Vehicle Search

<http://www.afdc.energy.gov/vehicles/search/>

American Gas Association (AGA)

202.824-7000 [www.aga.org](http://www.aga.org)

# Questions?



Caroline McCallum, PGW  
[Caroline.mccallum@pgworks.com](mailto:Caroline.mccallum@pgworks.com)  
(215) 684-6701

Barry Carr, Clean Communities of CNY  
[Coordinator@ccoofcny.com](mailto:Coordinator@ccoofcny.com)  
(315) 278-2061



# 10 Minute Break



**LCSWMA**

LANCASTER COUNTY SOLID WASTE MANAGEMENT AUTHORITY

**Rethink. Recover. Renew.**

Cummins Westport  
The Natural Choice



## Natural Gas and Near Zero Engine Technology

March 29, 2017

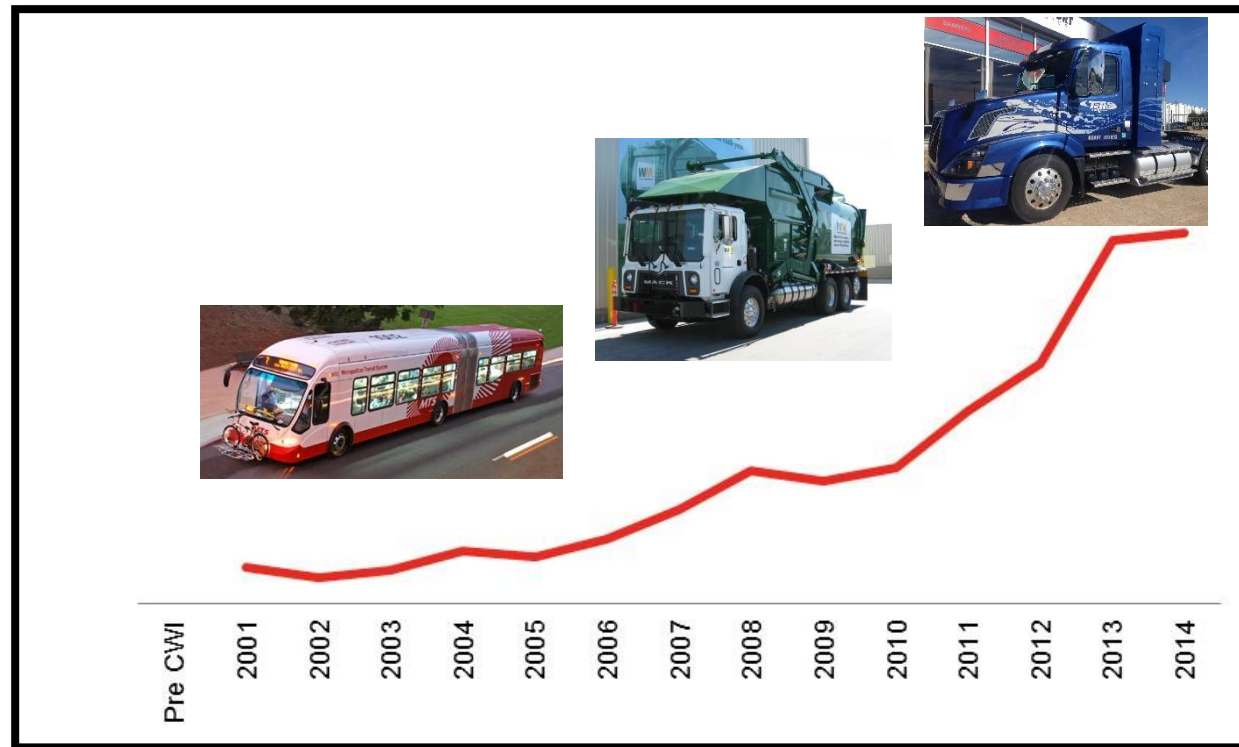


# Cummins Westport Inc. (CWI)

- Cummins Westport is a joint venture company established in 2001
  - 50% - Cummins Inc. - world's largest builder of commercial diesels,
  - 50% - Westport Innovations Inc. - world leader in gaseous fuel engine technology
- CWI offers 6 to 12 litre alternative fuel automotive engines. (CNG, LNG, RNG)
- Engines are manufactured by Cummins.
- Parts, service and training support through the Cummins Sales and Service network.



Natural gas use in vehicles has grown and evolved over the past decade



# Cummins Westport Natural Gas Engines

65,000 engines delivered worldwide



**ISB6.7G**

**6.7 Litre**

Spark Ignited  
SEGR

Three Way Catalyst  
33,000 lb. GVW

School Bus/MD Truck/Shuttle  
Sweeper/Yard spotter



**ISL G** NEAR  
ZERO  
**ISL G**

**8.9 Litre**

Spark Ignited  
SEGR

Three Way Catalyst  
66,000 lb. GVW

Refuse/Transit/Regional  
P&D Truck/Mixers



**ISX12 G**

**11.9 Litre**

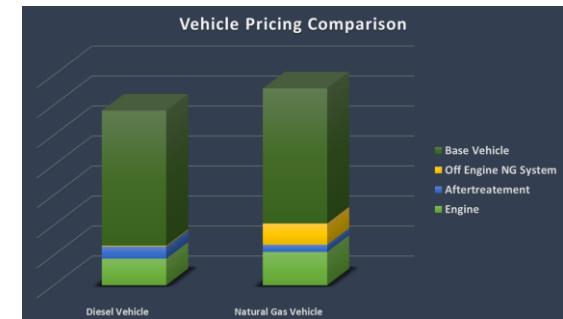
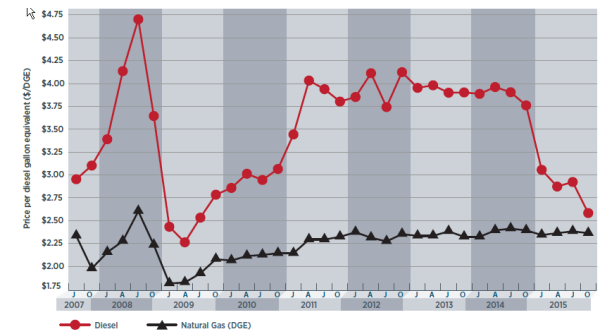
Spark Ignited  
SEGR

Three Way Catalyst  
Up to 80,000 lb. GVW

Regional Haul  
Truck/Tractor/Refuse

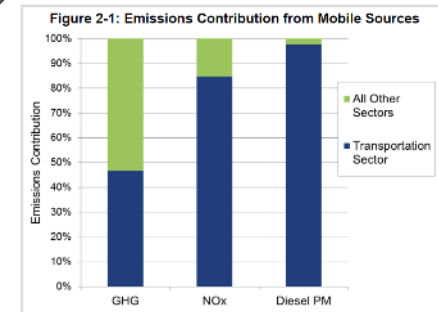
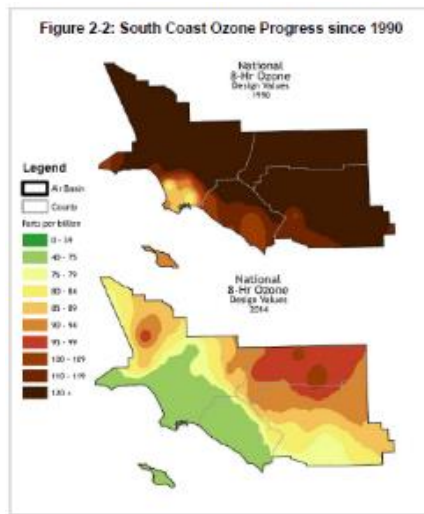
# Do NGV's make sense for me? - Economics

Cost Areas	Natural Gas Comparison to Diesel	Factors to increase NG benefit
Fuel Cost	Historically lower price and more stable	<ul style="list-style-type: none"> <li>Higher annual mileage = larger fuel savings</li> <li>No need for DEF fuel. CWI technology uses passive TWC</li> </ul>
Vehicle Purchase Price	Incremental price of NG vehicle largely dependent on off engine NG storage system	<ul style="list-style-type: none"> <li>Optimize fuel storage size for desired range</li> <li>Incentive programs available to cover incremental cost of vehicle</li> </ul>
Maintenance	Minor additional maintenance of NG engine ~\$0.01/mile	<ul style="list-style-type: none"> <li>Follow CMI maintenance intervals and procedures</li> <li>Use CMI authorized parts</li> <li>Set oil drain / service intervals based on average fleet speed.</li> <li>Check / drain fuel filter daily</li> </ul>





# What's Driving Cleaner Emission Engines?



2030: At the same time, we must continue efforts to minimize near-source risk and exposure to toxic air contaminants. As illustrated in Figure 2-1, mobile sources and the fuels that power them contribute over 80 percent of smog forming NOx emissions, 95 percent of the diesel PM emissions, and nearly 50 percent of Statewide GHG emissions. Efforts to reduce pollution and fossil fuel use in mobile sources will therefore be essential in creating a future transportation system that provides the foundation for meeting California's goals.

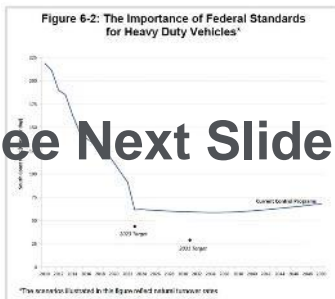
## 6. On-Road Heavy-Duty Sector

In order to meet our air quality goals and GHG emission and petroleum use reduction targets, the on-road heavy-duty sector must transition to near-zero emission technology coupled with advanced renewable fuels, and zero emission vehicles and equipment where available.

For heavy-duty vehicles, combustion technology will continue to dominate over the next 15 years. The strategy therefore calls for engine technology that is effectively 90 percent cleaner than today's current standards, with clean, renewable fuels comprising half the fuels burned. To position the heavy-duty sector for longer-term

<sup>1</sup> Vision Scenario Planning <http://www.arb.ca.gov/planning/vision/vision.htm>

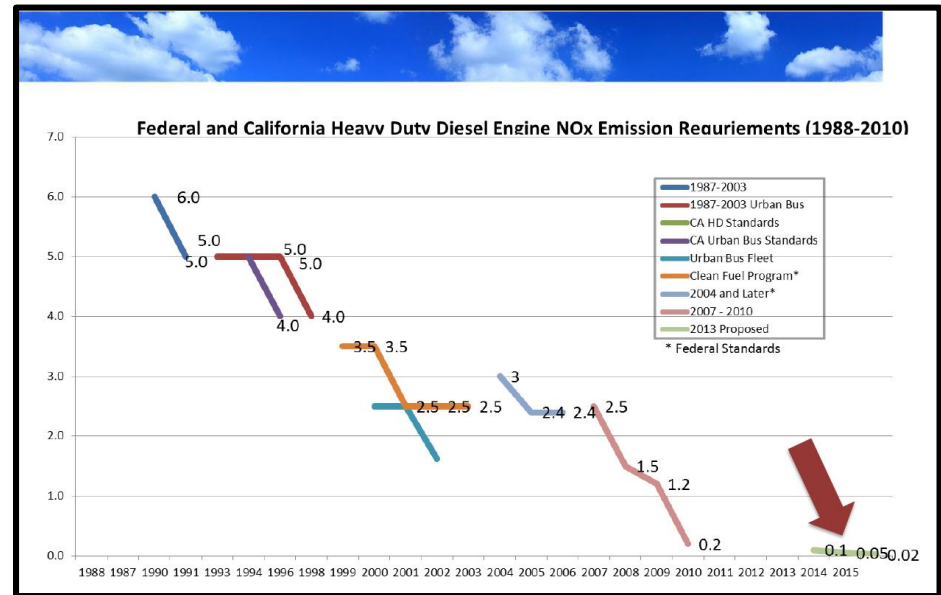
See Next Slide



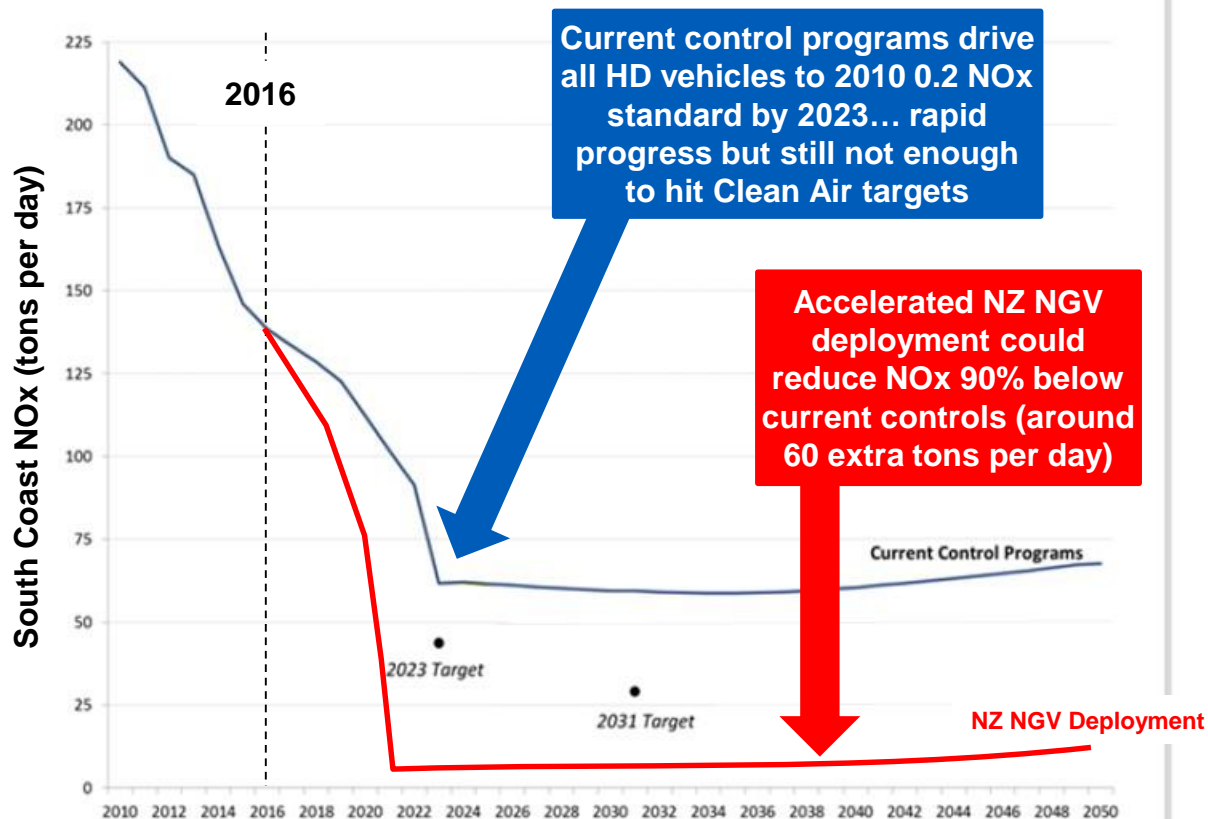
# California (ARB) Has Plans to Lower NOx

- CARB/EPA current standards for engine manufacturers have achieved 96.7% NOx reduction since 1990!
- Not enough to meet air quality targets
- Moving forward ARB has established **three optional low NOx emissions standards**
  - 0.02 g/bhp-hr is called “Near Zero” NOx emissions,
  - This is a 90% reduction in NOx from current EPA standards!
  - Funding Available!!!

0.2 g/bhp-hr	Current EPA NOx standard
0.1 g/bhp-hr	ARB optional low NOx standards
0.05 g/bhp-hr	
0.02 g/bhp-hr	



**Figure 6-2: The Importance of Federal Standards for Heavy Duty Vehicles\***



\*The scenarios illustrated in this figure reflect natural turnover rates.

		NMHC		NOx		CO		PM	
		FTP	EURO	FTP	EURO	FTP	EURO	FTP	EURO
STD		0.14	0.14	0.02	0.02	15.5	15.5	0.01	0.01
CERT		0.01	0.000	0.01	0.004	1.5	0.3	0.001	0.000

- NOx is 90% below STD
- PM is 90% below STD
- CO2 is 16% below STD
- RNG compatibility enables GHG emission reduction to near zero levels as well (landfills, dairies, waste water streams, etc.)
- ISL G NZ is ready now... how clean do you want to be and how fast?





# EPA and California ARB Certifications



## ISL G

### Current ISL G certification

- PM is 80% below the EPA standard
- NOx is 35% below the standard

	NMHC		NOx		CO		PM	
	FTP	EURO	FTP	EURO	FTP	EURO	FTP	EURO
STD	0.14	0.14	0.20	0.20	15.5	15.5	0.01	0.01
CERT	0.06	0.06	0.13	0.01	9.8	8.00	0.002	0.001

### ISL G Near Zero certification

- PM is 90% below the EPA standard
- NOx is 90% below the NZ standard!
- CO2 is 16% below NZ Standard!

## ISL G NEAR ZERO

	NMHC		NOx		CO		PM	
	FTP	EURO	FTP	EURO	FTP	EURO	FTP	EURO
STD	0.14	0.14	0.02	0.02	15.5	15.5	0.01	0.01
CERT	0.01	0.000	0.01	0.004	1.5	0.3	0.001	0.000

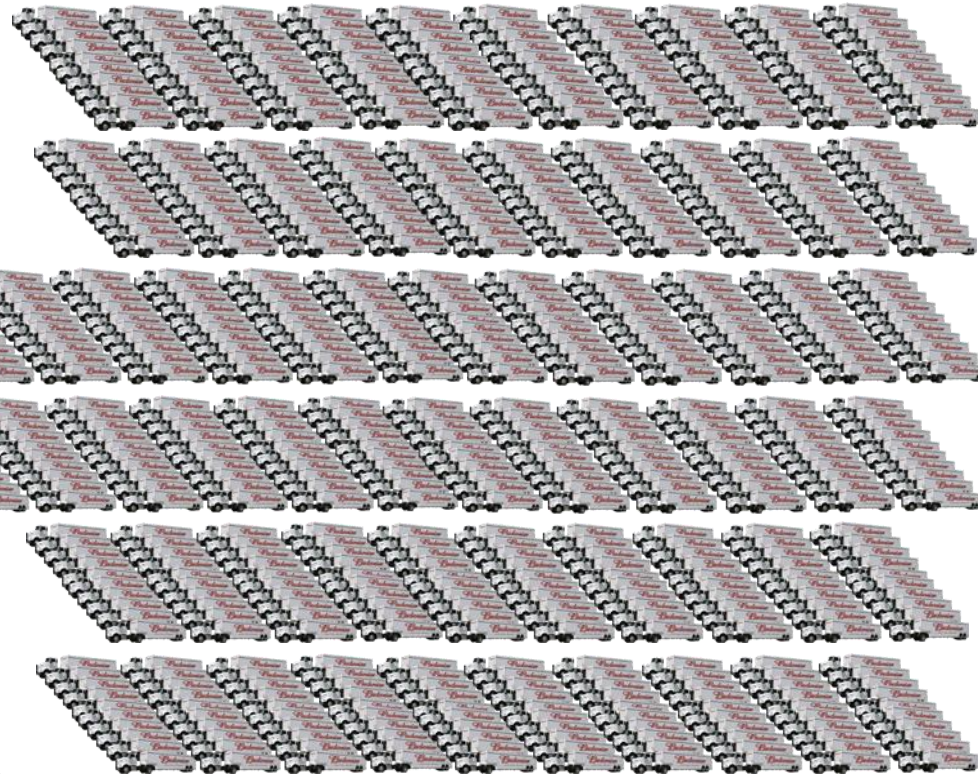
in g/bhp-hr	EPA CERTIFICATE OF CONFORMITY			PRIMARY INTENDED SERVICE CLASS	
	* CO <sub>2</sub>			VOCATIONAL	
	FTP	SET		CH <sub>4</sub>	N <sub>2</sub> O
STD	555	*		0.10	0.10
FCL	476	*		*	*
FEL	490	*		0.65	*
CERT	465	*		0.56	0.02

\* g/bhp-hr (grams per brake horsepower-hour); FTP=Federal Test Procedure; SET=Supplemental emissions testing; STD = standard or emission test cap; FEL=family emission limit; FCL=family certification level; CERT=certification level; CO<sub>2</sub>=carbon dioxide; CH<sub>4</sub>=methane; N<sub>2</sub>O=nitrous oxide; VOCATIONAL=vocational engine; TRACTOR=tractor engine

# Heavy Duty Truck/Bus Emissions Reduction Impact - NOx



=

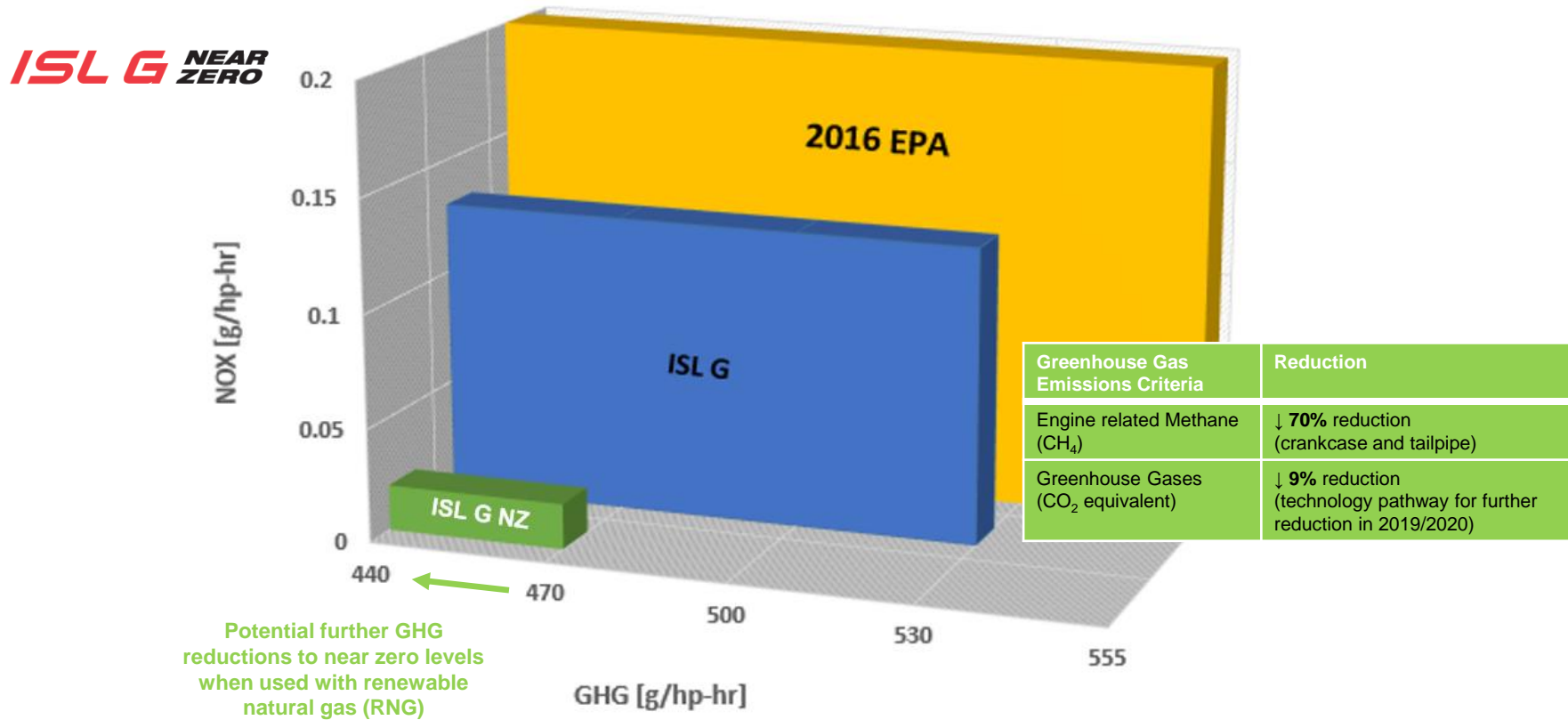


	1985	1990	1991	2000	2010
<b>NOx (g/hp-hr)</b>	10.8	6	5	4	0.2
<b>PM (g/hp-hr)</b>	0.59	0.59	0.25	0.05	0.01

0.01

54 1500

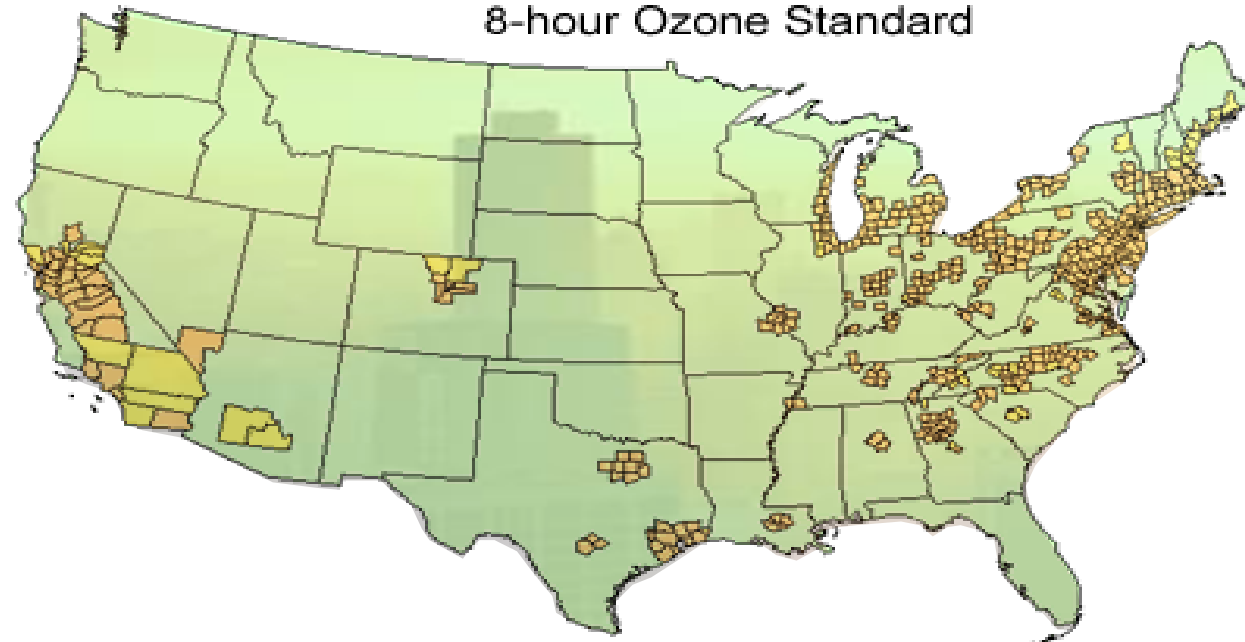
# Greenhouse Gas Reduction





# Near Zero - Not just California

Attainment and Nonattainment Areas in the U.S.  
8-hour Ozone Standard



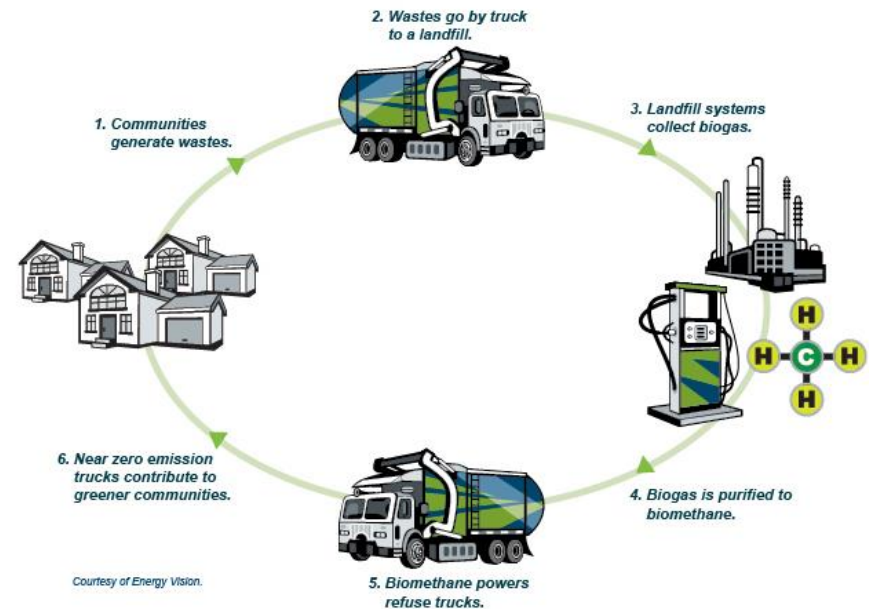
- Attainment (or Unclassifiable) Areas (2668 counties)
- Nonattainment Areas (432 entire counties)
- Nonattainment Areas (42 partial counties)

- Even with 2010 emissions standards fully adopted, further reductions will be needed to meet National Air Quality ground level ozone standards
- Many “non-attainment zones” across USA
- NZ technology can help and is ready now

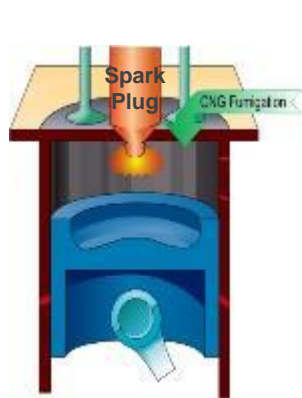
# Use Renewable Natural Gas

- Converting the methane that leaks from landfills or other sources to **RNG** fuel has **significant greenhouse gas emissions reduction benefits**.
- Use of **RNG** with ISL G Near Zero provides a GHG reduction over 80%
- In addition, there's a 100% displacement of fossil fuels as RNG is a renewable resource.

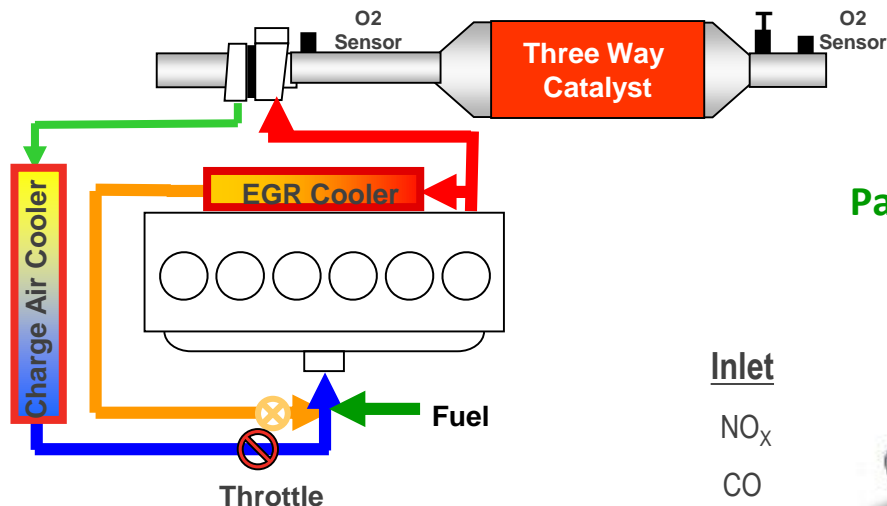
## RENEWABLE NATURAL GAS CYCLE



# What is NZ technology?



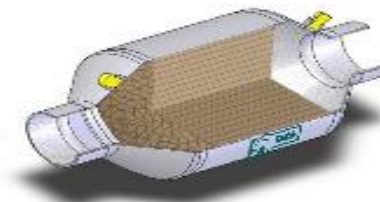
Spark Ignited



## Passive Aftertreatment

### Inlet

NO<sub>x</sub>  
CO  
HC



### Outlet

N<sub>2</sub>  
CO<sub>2</sub>  
H<sub>2</sub>O

Low Carbon Clean Burning Natural Gas

Natural Gas  
Methane  
CH<sub>4</sub>

CNG

LNG

RNG

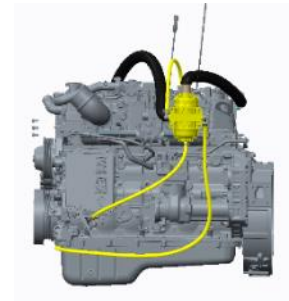
Dedicated natural gas engine requires methane at 60-150 psi... agnostic to source

- Spark-ignited
- **Stoichiometric combustion** with CEGR (SEGR)
- Maintenance Free Three Way Catalyst (TWC) aftertreatment
- This technology was first introduced in 2007 with our ISL G engine... first HD engine to meet EPA 2010 standard



# ISL G **NEAR ZERO**

- Base ISL G engine design is the same
  - Engine will be factory built at Cummins Rocky Mount Engine Plant
  - Ratings, warranty and operational / maintenance procedures will be the same
  - No change in technician service certification requirements
- Closed Crankcase Ventilation (CCV) will be added to engine
  - CCV system reduces engine related methane emissions by 70%
  - CCV filter change required at 2,000 hours
- Three Way Catalyst will change to meet next level emissions
  - Remains maintenance free
  - Larger size catalyst with addition sensor added
  - New substrate composition for durability and emission performance



# Commercialization

- Great momentum for NZ NGVs in North America
  - Product quality up, costs down, infrastructure growing, vehicle range up
  - NG is abundant, stable, clean, domestic fuel
  - Broad vehicle availability across OEMs and vehicles including transit buses, school buses, refuse, vocational and on-highway trucks
- Near Zero technology designed to be easy to install on existing NGVs... Repowers and OEM first fit ramping up
- Small incremental NGV cost increase
  - Lower cost option other near zero emission technologies under development (e.g.. EV, Hybrid, H2)
- Need states/regions to advocate... technology is ready now



# Near Zero Product Plan

(Certified to ARB Near Zero NOx standard - 0.02 gm/bhp.hr.)

Engine	2016	2017	OBD	2018	2019
<b>ISB6.7 G *</b>					
<b>ISB6.7 G NEAR ZERO</b>				Development Program Not Funded	
<b>ISL G</b>					
<b>ISL G NEAR ZERO</b>					
<b>ISX12 G</b>					
<b>ISX12 G NEAR ZERO</b>					

## Legend

Available

Not Available

- \* ISB6.7 G will be certified at launch to California ARB optional Low NOx (0.1 gm/bhp-hr.)
- Near Zero development funding for the ISB6.7 G has not be secured – no ISB6.7 G NZ in plan without funding
- ISX12 G NZ will be available in 2018
- Base ISL G and ISX12 G engines are not available post 2017 (not OBD compliant)



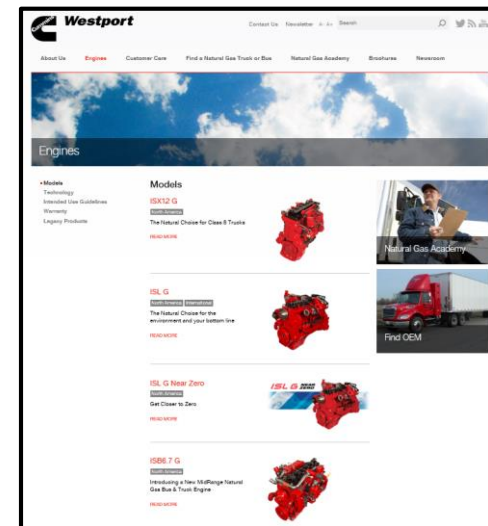
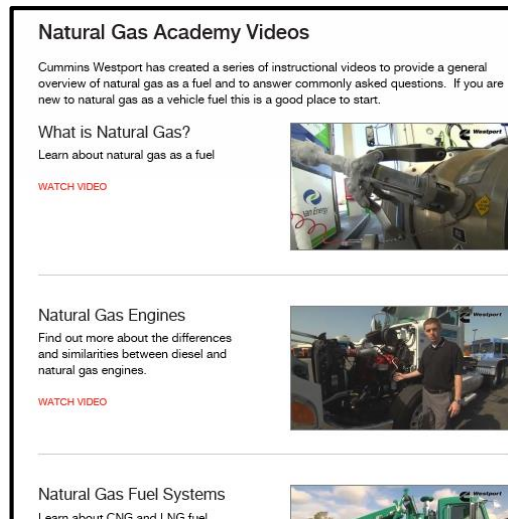
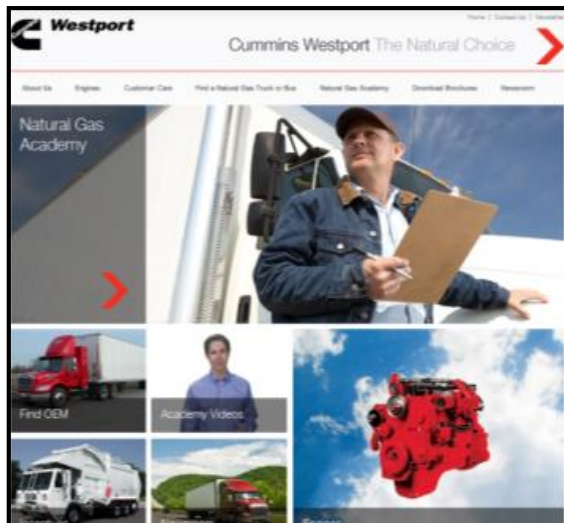
# OEM Availability

	OEM	ISL G	ISX12 G
Conventional Truck	Freightliner	Yes	Yes
	International	Yes	-
	Kenworth	Yes	Yes
	Mack	-	Yes
	Peterbilt	Yes	Yes
	Volvo	Yes	Yes
	Western Star	-	-
Refuse Truck	Autocar	Yes	Yes
	Crane Carrier	Yes	-
	Mack	Yes	-
	Peterbilt	Yes	Yes
Coach	MCI		Yes

	OEM	ISL G	ISB6.7 G
Transit Bus	El Dorado	Yes	Pending
	Gillig	Yes	
	New Flyer	Yes	
	Nova	Yes	
School Bus	Blue Bird	Yes	
	IC Bus	-	
	Thomas Built	Yes	Yes

**ISL G NZ Availability  
Pending OEM orders**

More information... [www.cumminswestport.com](http://www.cumminswestport.com)



- Natural Gas Academy: great source of information about NG, technology, vehicles
- Series of instructional videos, including engine walk-arounds and service & driver training videos
- Engine information – specs, features, maintenance intervals
- Product Brochures & Bulletins available for download



# Thank You!

- For more information:  
Bill Boyce  
East Regional Manager  
(330) 720-9785  
or  
[bill.boyce@cummins.com](mailto:bill.boyce@cummins.com)
- Or visit  
[www.cumminswestport.com](http://www.cumminswestport.com)





# UGI CNG Fleet

# UGI CNG Fleet

- Lancaster - 5 Ford Transit 250 Cargo Vans
- Wilkes Barre - 8 Ford Transit 250 Cargo Vans
- Williamsport
  - 3 Ford Transit 250 Cargo Vans
  - 1 Ford F250 Utility Body Truck
  - 1 Ford Transit Connect Van

## 28 NGVs currently on order for 2017

- Lancaster - 6 Ford F-250 Utility Body Trucks
  - 5 Ford F-150 Pickups
  - 3 Freightliner 5 Yard Dump Trucks - (Dedicated CNG)
  - 2 Ford Transit Connect Vans
- Lehigh - 8 Ford 150 Pickups
  - 4 Ford Transit 250 Cargo Vans



# UGI CNG Success Stories

# What Fleet Applications are a “Good Fit” for NGVs?

- Refuse - Trash Trucks, Recycling Trucks
- Transit - Buses
- “Short-Haul” Delivery - Food & Beverage, Linen & Textile, Package, Trades, Newspapers, Box Trucks
- Transportation - Shuttles, Taxis
- Government - All Departments
- School Districts - Buses, Maintenance
- Utilities

## Pennsylvania Natural Gas For Vehicles



### Increasing in popularity

Natural gas vehicles (NGVs) are increasing in popularity with approximately 50 U.S. manufacturers producing close to 100 models of engines for use in light-, medium- and heavy-duty vehicles. There are 150,000 NGVs operating in the U.S. and that number, along with the number of public fueling stations, is growing.

NGVs can use either CNG (compressed natural gas) or LNG (liquefied natural gas); the fuel is stored in onboard vehicle cylinders. NGVs have a higher octane rating, are more fuel efficient, have lower operating costs and produce fewer emissions than gasoline or diesel engines.

Federal and state incentives, including grants for public transportation vehicles, are helping to make NGVs a more affordable and eco-friendly option.

### NGVs can operate in three modes:

- **Dedicated** (all vehicles), run only on natural gas
- **Bi-fuel** (light or medium duty vehicles), run on either natural gas or gasoline
- **Dual fuel** (heavy duty vehicles), use diesel to start the NGV and then CNG is injected when the engine is hot.

### Natural gas vehicles at work

A variety of fleets can be powered by natural gas, including municipality equipment (snow plows, sewer and refuse trucks, and courier vehicles), school and transit buses, and airport shuttles.



### Natural gas vehicle benefits

- **Cost savings:** natural gas costs about 50 percent less than gasoline and about 60 percent less than diesel. On average a price advantage is expected to remain stable for some time due to our nation's abundant supply of natural gas.
- **Abundant natural gas supply:** using a gallon equivalent of domestic natural gas means one less gallon of imported oil, which reduces dependency on foreign oil.
- **Cleaner environment:** natural gas produces less exhaust emissions, and also less carbon than any other fossil fuel.
- **Safety:** natural gas is lighter than air, so it dissipates when released. The ignition temperature is high at 1000 - 1100°F. Comprehensive standards for fuel tank, vehicle and station design ensure safe operations.

### What is needed for growth

- **Government support:** reliable, long-term government support and emphasis on CNG to encourage conversions.
- **Market needs:** requirements and commitments to convert fleets to CNG, public fueling stations and financial incentives.
- **Expansion of the Alternative Fuels Incentive Grant (AFIG):** PA AFIG funds need to target NGV projects.

Visit [www.ugi.com/ngv](http://www.ugi.com/ngv) for more information about natural gas vehicles, incentives, grants and legislative updates.



# PENNSYLVANIA FIRSTLINE

JULY 2015

## At P&G, Natural Gas-fueled Vehicle Fleet Grows

UGI worked with Procter & Gamble (P&G) Paper Products Co. in Wyoming County to add a second fast-fill compressed natural gas (CNG) fueling station at the company's expansive northeastern Pennsylvania facility. P&G opened its first CNG fueling station in 2012 and has converted 74 of its yard and heavy-duty freight trucks to run on natural gas. The second station will allow P&G to double its CNG fleet to 150, making it one of the largest CNG fleet conversions in the United States.

P&G's CNG vehicles are running on locally produced Marcellus Shale gas, extracted from wells on P&G's 1,400-acre property and from neighboring properties within a 5-mile radius. The gas is delivered and monitored for quality, pressure and safety through a pipeline built and managed by UGI.

"Natural gas is much cheaper than diesel fuel," said Alex Fried, P&G public relations/energy affairs manager. "For local and over-the-road trucks operating within a 200-mile radius of a facility, CNG absolutely makes sense."

Fried said the project will generate annual fuel cost savings of more than \$1 million. The environmental benefits will be equivalent to removing emissions from 550 cars.

In addition to P&G's vehicle fleet, UGI-supplied natural gas fuels large boilers and furnaces for steam and hot air used in the papermaking process, and it fuels two gas turbines that generate all of P&G's electricity. As a bonus, the turbines produce excess electricity which is sold to the local power grid, enough to serve about 10,000 homes, Fried said.



The conversion of P&G's vehicle service fleet and installation of two fast-fill compressed natural gas (CNG) stations is expected to save the company approximately \$1 million annually in fuel costs.

## UGI Fuels Bakery's new CNG Station on Wheels

A trailer-mounted, 150-horsepower mobile CNG station, carrying natural gas supplied by UGI, will fuel 10 new natural gas-powered delivery trucks at the Bimbo Bakeries USA plant in Pittston Township, Luzerne County, for the next year.

UGI Key Accounts Project Leader Joe Bauman says the project is UGI's first to support modular CNG fueling equipment. "We are expanding our involvement in this technology and this project clearly illustrates that," he says.

Bimbo Bakeries will use the CNG facility until Clean Energy, the owner of the station, finishes construction of a permanent station late in 2016. The Pittston project is a pilot expected to lead to three other CNG stations at bakery sites throughout Pennsylvania.



Bimbo Bakeries added 10 new CNG-powered delivery trucks to their fleet.

"Natural gas is the simplest, most cost-effective and environmentally cleanest method for vehicle fueling," says Leo Cortizo, Clean Energy's business development manager. He adds that price stability is another major advantage. "There are no wild fluctuations like with oil or gasoline. If you want to know what you'll be paying for the next five years, natural gas is your best bet."

Bimbo Bakeries USA, the largest bakery company in the United States, is a manufacturer, distributor and marketer of bread, cakes and cookies. The Pittston operation, a UGI natural gas customer, is Bimbo's cake location and provides baked goods for major outlets including Entenmann's, Thomas', Strohmann's and Maier's.



BRINGING ENERGY TO YOU



Energy to do more®

## UGI's First CNG Filling Station Opens in the Lehigh Valley

UGI-supplied natural gas is now available at the pump for commercial vehicle fleets at an Exxon service facility along Route 309 in Whitehall. The new fast-fill station, the first public fueling station in UGI's service territory to offer compressed natural gas (CNG), will allow commercial vehicles to fill up quickly, in about 8 to 12 minutes.

Lehigh Gas Partners, an Allentown-based CNG fueling station provider, and UGI have been working together on opening a public CNG filling station since 2007. Sil Lutkewitte of Lehigh Gas Partners says the station has a capacity the equivalent of approximately 300,000 gallons. He estimates between 50 to 125 vehicles will stop to use the facility.

The station has both CNG and gasoline pumps. The savings from using CNG are significant: CNG currently costs \$2.19 per gasoline

gallon equivalent (GGE), about \$1.50 less than the average cost for a gallon of gasoline.

Barry Wentzel, UGI technical advisor, says this is an "enormous step" for CNG technology. "UGI is proud to be a partner in promoting how consumers, particularly those with large commercial fleets, can save money and help improve the environment by using clean-burning natural gas for their transportation needs," says Wentzel. "Natural gas is not only a domestic fuel but is being produced right here in Pennsylvania," he adds.

Surely this is just the first of many public CNG filling stations to come to UGI's service area. According to Lutkewitte, Lehigh Gas Partners has identified several additional locations within UGI's service territory for development of CNG over the next few years.



Commercial vehicles using natural gas refuel on the road at UGI's first public fueling station, located on Route 309 in Whitehall.

"We still have a lot of work to do, but this a great start," says Lutkewitte. "We expect to see more natural gas passenger vehicles on the market as soon as consumers demand the benefits CNG offers."





BRINGING ENERGY TO YOU



Energy to do more®

## New CNG Fueling Station Opens in Schuylkill Near I-81



UGI's project team checks the CNG meter at Trillium's new fueling station.

A new compressed natural gas (CNG) fueling station for heavy-duty vehicles is now available in Schuylkill County, thanks to a 1.7-mile pipeline extension completed by UGI in January. Crews overcame complex construction challenges and unpredictable winter weather to bring UGI natural gas from an existing line in nearby Gordon to the fast-fill station at the Highridge Business Park plaza off Interstate 81 near Minersville.

The service station and natural gas compressor equipment on site is owned and operated by Trillium CNG, an Integrys Energy Group business that provides compressed natural gas fueling solutions and equipment. While it is open to the public, the facility is designed to serve fleet vehicles based at nearby business operations.

Frank Zukas, president of the Schuylkill Economic Development Corporation, says three Highridge businesses – Lowe's Distribution Center, Wegman's Food Markets and Penske Truck Rental – have committed to using the CNG station for their truck fleets, which will be converted from diesel fuel. "We do believe that the entire logistics industry will begin to move to (this) more efficient form of fuel," he says.

CNG burns cleaner than diesel, making it more beneficial to the environment and the operation of vehicles. In addition, a gasoline gallon equivalent of CNG costs significantly less than a gallon of diesel fuel.

"With this new Trillium station, natural gas is one step closer to becoming a mainstream U.S. transportation fuel," says Becky Eshbach, UGI's east region business development director.





GETTING THE MOST OUT OF NATURAL GAS



Energy to do more®

## Lock Haven Transports Students with CNG Power

UGI is supplying compressed natural gas (CNG) to a brand-new CNG filling station at the Wayne Township Landfill in Clinton County. The new facility, which opened in September, is available for use by the general public, and already it has attracted an enthusiastic regular customer.

Lock Haven University, located just four miles away, is one of the first Pennsylvania institutions of higher learning to adopt natural gas as a transportation fuel.

It is using the landfill's new CNG pumps to regularly refuel the newest of its three student commuter trolleys shuttling students to and from locations on and near the Lock Haven campus.

University officials are seeing significant savings on fuel costs. Rodney Jenkins, executive assistant to the president, says the university thinks the savings will pay back the



Left to right, Don Smith, UGI; Tim Egler, UGI; Ken Pittenger, Lock Haven University student commuter trolley driver.

purchase cost for the new student commuter trolley in one year.

Typically it takes about five years for a CNG-powered vehicle to pay for itself, but proposed incentives in federal legislation would significantly reduce that time.

Jenkins says the university is strongly considering purchasing other CNG commuter trolleys or converting their existing vehicles to natural gas. The university is "very excited to be using this environmentally safe technology," he adds.





ENHANCING ECONOMY, EFFICIENCY & ENVIRONMENT



Energy to do more®

## Waste Management Converts Dunmore Fleet to CNG Fuel

Waste Management, a leading provider of comprehensive environmental solutions services in North America, is working with UGI to complete a two-year project to convert its truck fleet in Dunmore, Lackawanna County, to natural gas. The project includes installation of an on-site compressed natural gas (CNG) filling station.

Sixty packer trucks will be operating with CNG tanks mounted behind as well as over the cab. The truck pictured below is equipped with a 12-litre Cummins Westport spark-ignited engine and an Allison transmission. The company proudly parked this truck on site next to I-81 Northbound to show all passersby that it is serious about using proven, environmentally friendly technology to run its fleet.



CNG burns more cleanly than gasoline or diesel fuel. Natural gas vehicles are a game-changing sustainability solution, reducing CO<sub>2</sub>, CO, NOx and VOC emissions by as much as 90 percent. CNG vehicles also offer the additional benefit of reduced engine maintenance requirements. As a cleaner burning fuel, CNG vehicles experience less engine wear and require fewer oil changes.

UGI Key Accounts Project Leader Joe Bauman said, "UGI is committed to encouraging customers with diesel-fueled vehicle fleets to convert to CNG fueling equipment. We are expanding our involvement in this technology, and this is another project that clearly illustrates progress."

A number of organizations have switched their vehicle fleets to CNG and have installed on-site CNG fueling stations. In addition, the number of public CNG fueling stations continues to grow, providing the opportunity for small businesses and residents to benefit from natural gas vehicles. There are currently 18 CNG filling stations within the UGI service territory, 15 of which have been installed in the past two years.





Energy to do more®

# PENNSYLVANIA FIRSTLINE

JULY 2016

## UGI Adds CNG Vehicles to its Utility Fleet

UGI's utility fleets in Lancaster, Wilkes-Barre and Williamsport now include vehicles fueled with compressed natural gas (CNG). The 18 new vehicles include cargo vans, connect vans and utility body pickup trucks.

CNG vehicles offer a number of advantages over traditional gasoline-burning cars, trucks and vans. Natural gas vehicles reduce as much as 90 percent of the emissions of carbon dioxide (CO<sub>2</sub>), carbon monoxide (CO), nitrogen oxide (NO<sub>x</sub>) and volatile organic compounds (VOCs) compared with vehicles burning gasoline or diesel. CNG vehicles also offer the additional benefit of reduced engine maintenance requirements. As a cleaner burning fuel, CNG vehicles experience less engine wear and require fewer oil changes.

A number of organizations have switched their vehicle fleets to CNG to realize these benefits. At the same time, public CNG fueling stations continue to grow in number, providing greater access to small businesses and private vehicle

owners wishing to invest in natural gas vehicles. There are currently 18 CNG filling stations within the UGI service territory, 15 of which have been installed in the past two years.

UGI vehicles will fuel at both company-owned and privately owned CNG stations. Lancaster-based vehicles are refueling at CNG stations operated by the Lancaster County Waste Authority and at a facility near New Holland. Wilkes-Barre vehicles use stations on UGI's property or at USAgain, a textile recycling company with facilities in the city. Williamsport vehicles are stopping at River Valley Transit for their CNG fueling.



Thank You!!

Any Questions??



# LCSWMA

LANCASTER COUNTY SOLID WASTE MANAGEMENT AUTHORITY

Rethink. Recover. Renew.

# Compressed Natural Gas

## Lancaster County Solid Waste Management Authority





# Integrated Waste Management System



# Compressed Natural Gas (CNG)

LCSWMA installed **Time-Fill and Fast-Fill** CNG fueling infrastructure at its Transfer Station Complex

## REASONS FOR MAKING THE SWITCH

- ✓ Immediate fuel expense savings
- ✓ Closed-loop daily transfer route
- ✓ Aging fleet
- ✓ Proximity of NG infrastructure
- ✓ CNG is well proven in waste industry (customers)
- ✓ Lancaster is a non-attainment area for air quality



# Fleet Basics

## CNG Waste Transfer Trucks

- ✓ 14 truck tractors
- ✓ Peterbilt truck body
- ✓ 12L ISXG Cummins engine
- ✓ 80 DGE Agility fuel system



## CNG Triaxle Ash Trucks

- ✓ 2 truck tractors
- ✓ Kenworth truck body
- ✓ 12L ISXG Cummins engine
- ✓ 80 DGE Agility fuel system



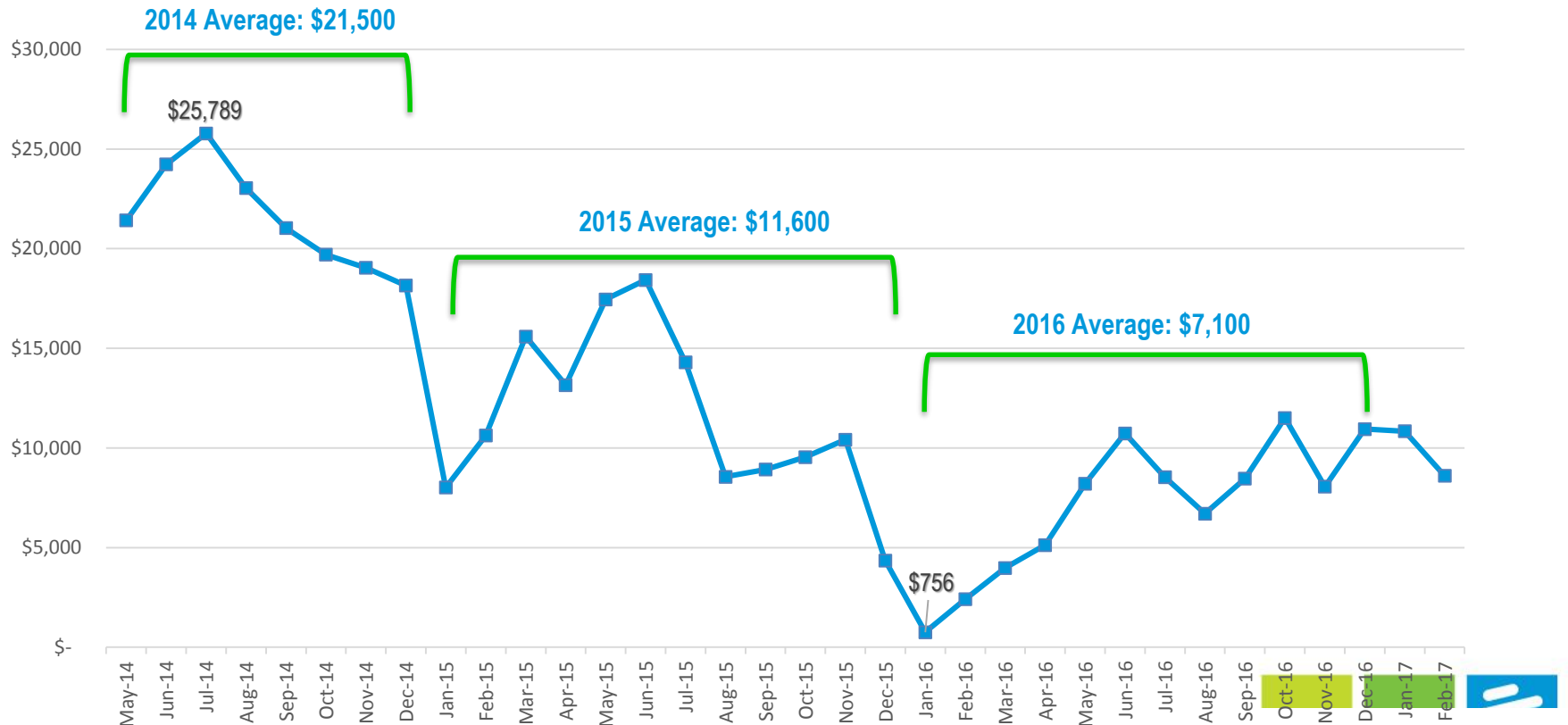


# Fueling Infrastructure

- Clean Energy built time-fill and fast-fill station
  - ✓ O&M and Retail agreements
- 18 time-fill posts (LCSWMA use)
- Two dual fast-fill pumps (retail)
- Two 250 HP compressors with 7 GGE per minute



# Monthly Savings: CNG vs. Diesel\*



\*Excludes excise tax credit and retail revenue

# Contact Information

Michelle Marsh  
Director of Business Solutions  
LCSWMA  
1299 Harrisburg Pike  
Lancaster, PA 17603  
[mmarsh@lcswma.org](mailto:mmarsh@lcswma.org)  
(717) 735 - 0178



**LCSWMA**

LANCASTER COUNTY SOLID WASTE MANAGEMENT AUTHORITY

**Rethink. Recover. Renew.**



# Questions?