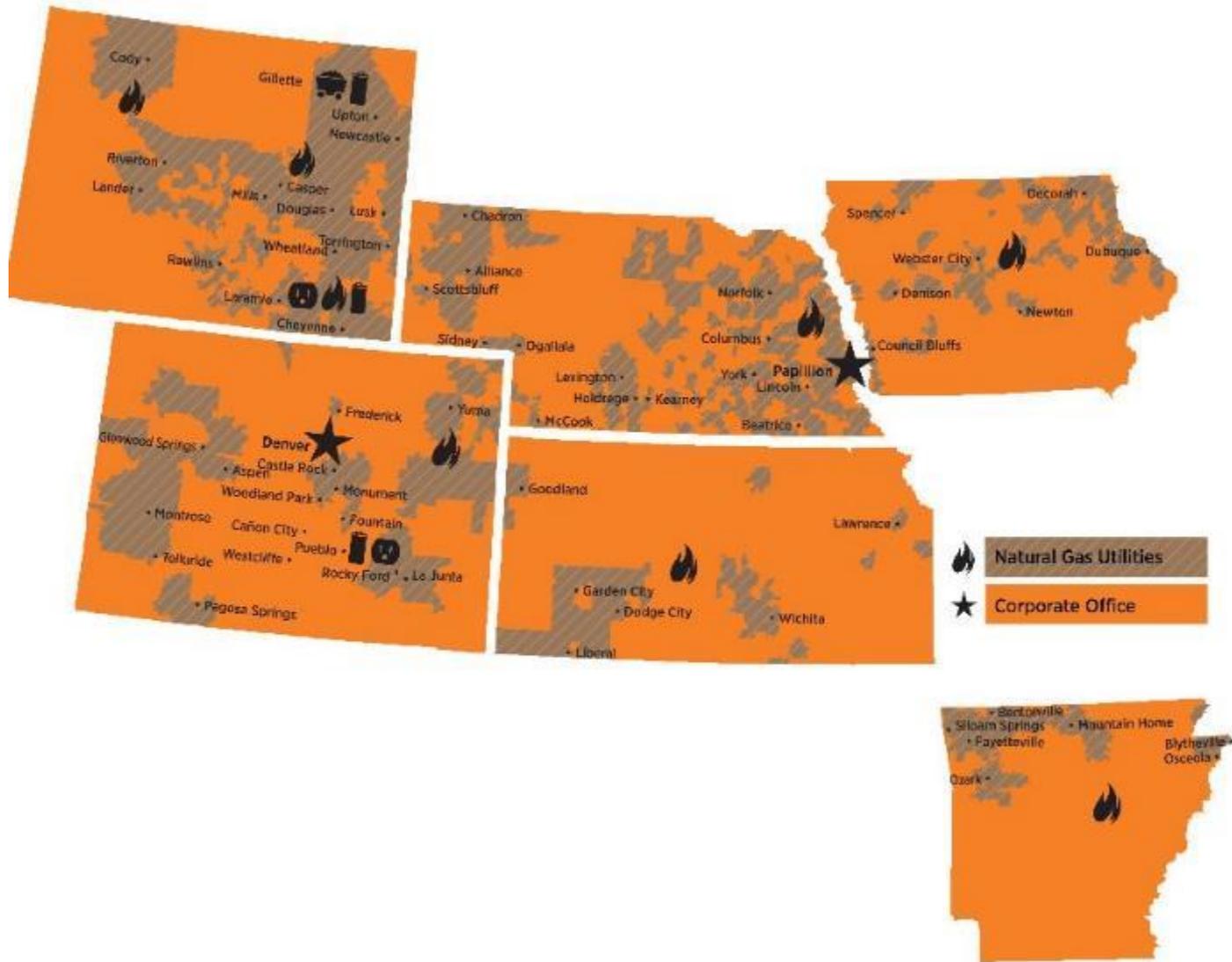




# **NATURAL GAS VEHICLES – 2016**

**Colorado Association of School  
District Energy Managers  
Thompson School District  
800 S. Taft Avenue  
Loveland, CO  
November 3, 2016**

# BHE Natural Gas Service Areas



# Today's Discussion

- **NGV Industry Related Definitions**
- **Fast Facts About Natural Gas Vehicles**
- **Common Industry Measurements**
- **Common Industry Standards**
- **Why Nat. Gas as a Transportation Fuel**
- **What Benefits Do NGVs Offer**
- **Energy Forecasts**
- **Today's Challenges**
- **Where Can You Fill Up**
- **Fuel Analysis**

# NGV Definitions

- **CNG – Compressed Natural Gas**
- **LNG – Liquefied Natural Gas (-260 degrees)**
- **NGV – Natural Gas Vehicle**
- **GGE – Gasoline Gallon Equivalent**
- **DGE – Diesel Gallon Equivalent**
- **Slow Fill – Compressor directly fills NGV tank over time**
- **Fast Fill – High pressure storage fills NGV tank**
- **Dedicated = CNG powered only**
- **Bi-Fuel = Traditional Fuel or CNG (one fuel or the other)**
- **Dual-Fuel = Diesel Fuel & CNG (blended fuel stream)**
- **Repower = Replacing Diesel Fueled Engine w/ CNG Fueled Engine**
- **Conversion = Added after market CNG kit**
- **OEM = Factory Built NGV (Ford, GM, Dodge, Freightliner, Kenworth)**

# **Fast Facts About “Natural Gas Vehicles”?**

- 1. ~ 153,000 NGVs on U.S. Roads**
- 2. ~ 15.2 million worldwide**
- 3. ~ 1,564 CNG fueling stations in the U.S.**
- 4. 50 manufacturers producing 100 NGV vehicle models**
- 5. CNG retail prices range from \$0.99 to \$2.35 per GGE**
- 6. U.S. NGVs use about 500 million gallons of CNG Annually**
- 7. NGVs meet the strictest emission standards, including CA’s AT-PZEV standards (Advanced Technology-Partial Zero Emissions Vehicle)**
- 8. NGVs are as safe or safer than traditional gasoline or diesel vehicles**

# Common Industry Measurements

sourced from NGVSolutions

1 cubic foot (cf) = 1,000 Btu

100 cubic feet (1 ccf) = 1 therm (approximate)

1,000 cubic feet (1 Mcf) = 1,000,000 Btu (1 MMBtu)

1,000 cubic feet (1 Mcf) = 1 dekatherm (10 therms)

1 million (1,000,000) cubic feet (1 Mmcf) = 1,000,000,000 Btu

1 billion (1,000,000,000) cubic feet (1 bcf) = 1 trillion Btu

1 trillion (1,000,000,000,000) cubic feet (1Tcf) = 1 quadrillion Btu

So

1ccf = Therm

1Mcf = Dekatherm

1Tcf = Quad

# Common NGV Industry Standards

- 1. 1 GGE = 126.67 Standard Cubic Feet of Nat. Gas (scf)**
- 2. 1 GGE = 5.66 lbs of Nat. Gas @ 70 degrees**
- 3. 1 GGE = ~ 125,000 btu**
  
- 4. 1 DGE = 139.20 scf**
- 5. 1 DGE = 6.39 lbs**
- 6. 1 DGE = ~ 140,000 btu**
  
- 7. GGE/DGE Per Hour – rating for time-fill system**
- 8. GGE/DGE Per Minute – rating for fast-fill system**
  
- 9. 3600 psi = complete tank fill for NGV @ 70 degrees**

# Why Natural Gas as a Transportation Fuel?

- **Burns Cleaner than Gasoline or Diesel Fuel**
- **Safer than Gasoline or Diesel Fuel**
- **Delivers Same Fuel Mileage & Performance**
- **Natural Gas Requires Considerably Less Refining**
- **Pump Price for Natural Gas Projected to Stay in the \$2.00/GGE Range VS Gasoline & Diesel Fuel are Projected to Return to \$3.50 to \$4.00/gallon**
- **Mature Technology for Vehicles & Fueling Infrastructure**

# What Benefits Do NGVs Offer?

- **Significantly Lower Tail Pipe Emissions**
- **Reduction in Maintenance Costs & Extends Engine Life**
- **Fuel Cost Savings**
- **Uses a Domestically Produced Energy** (reduces dependence on crude oil imports)
- **Supply Chain Taxes & Profits Stay Within the U.S.**

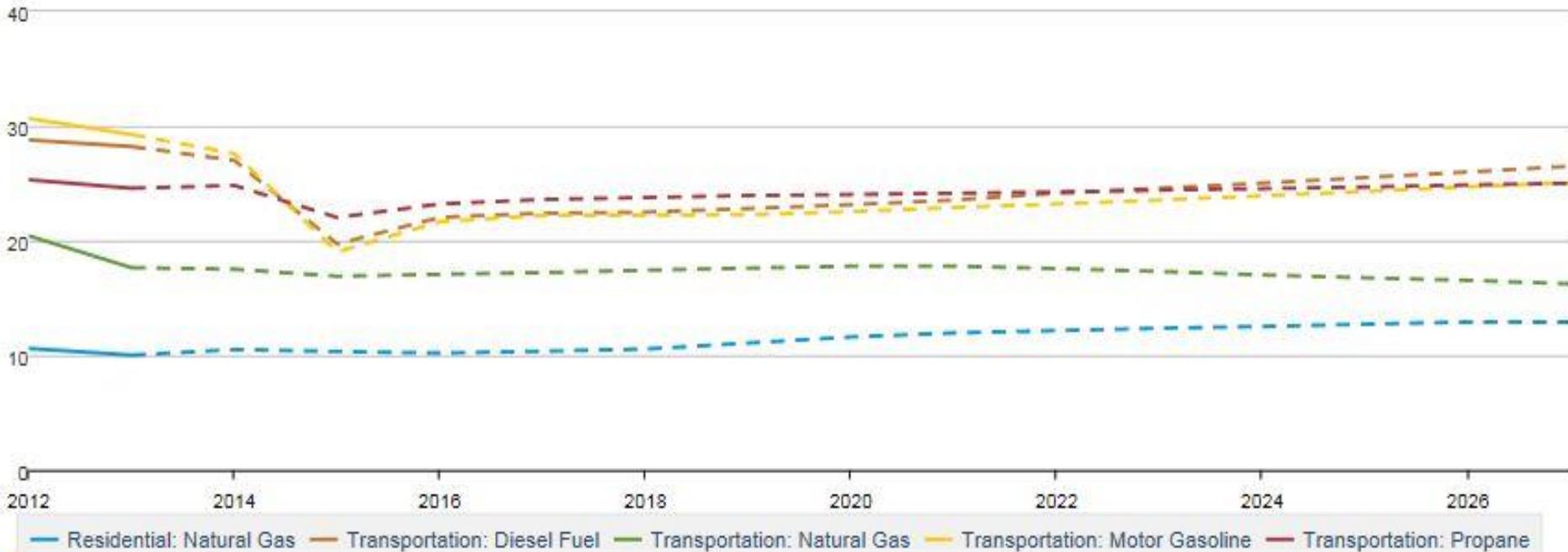
# Energy Forecasts

## Energy Prices

 [DOWNLOAD](#)

Case: Reference case | Region: United States

2013 \$/MMBtu



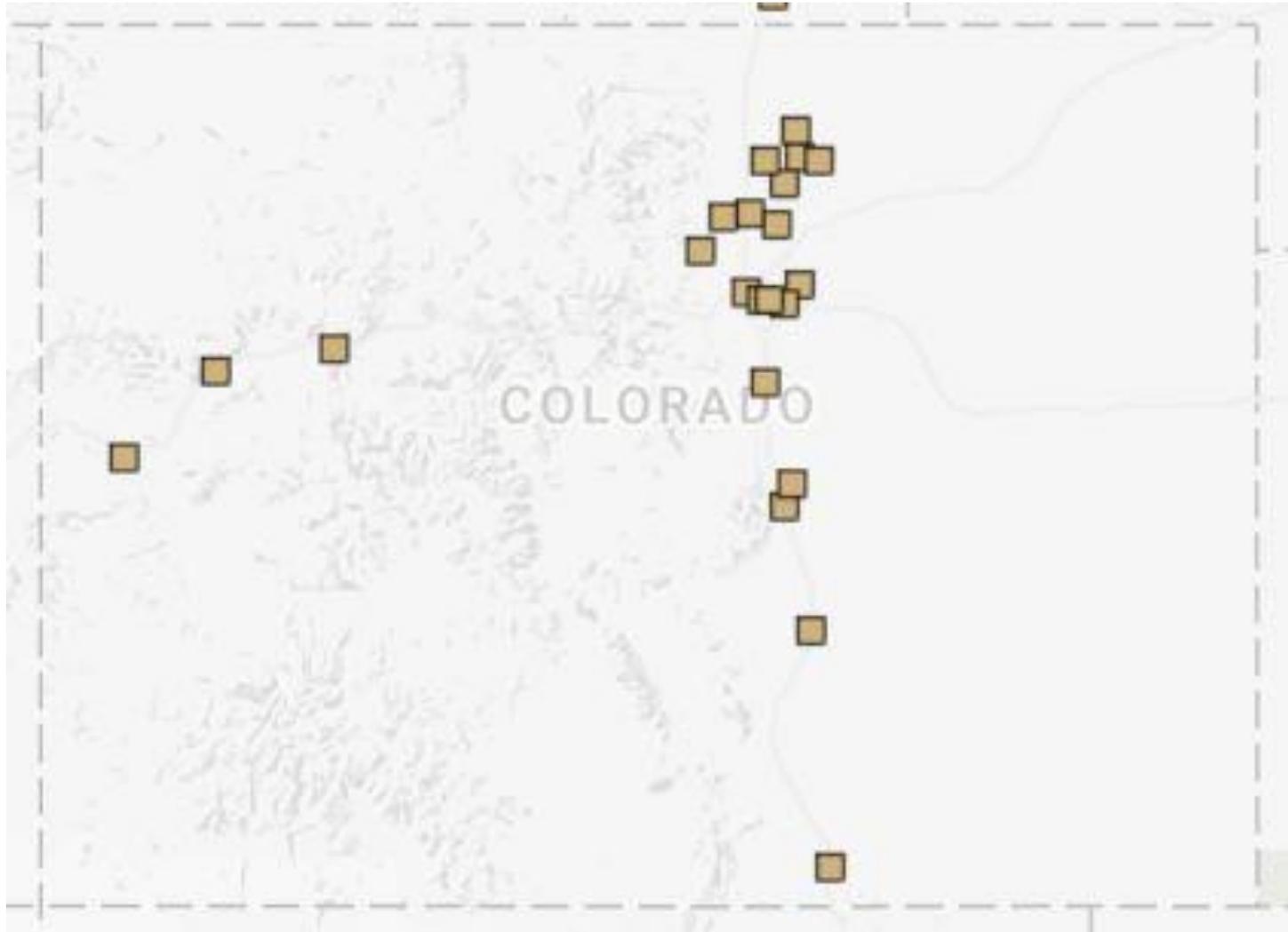
Source: U.S. Energy Information Administration

# Today's Challenges

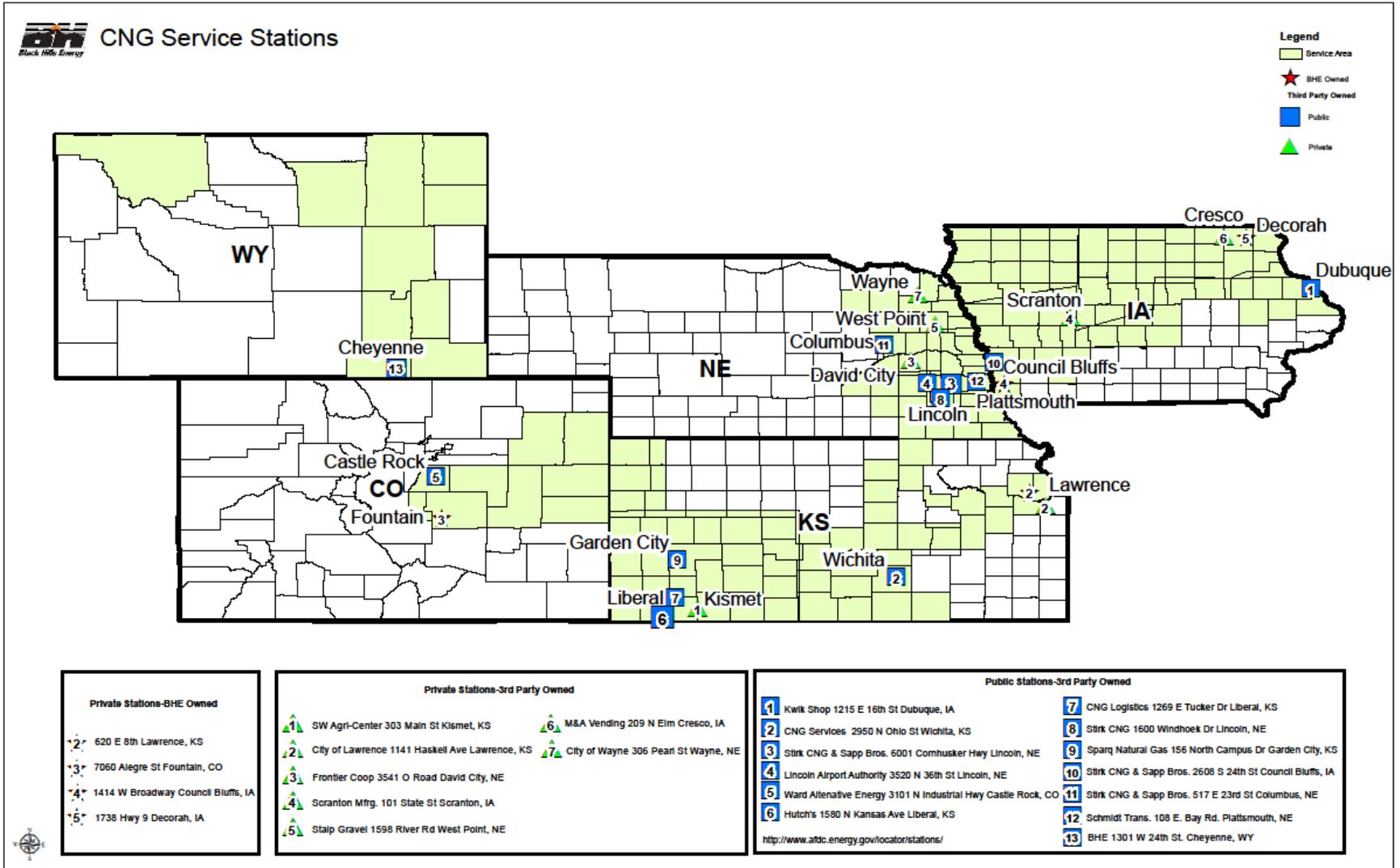
- **Not Enough CNG Fueling Stations**
- **Not Enough Natural Gas Fueled Vehicles**
- **Lack of Education & Knowledge @ NGV Industry**
- **High Entry Cost for Fleet Conversions**
- **High Entry Cost for Construction of New CNG Fueling Infrastructure**
- **More Financial Incentives Needed To Spur Industry.**

# Where Can You Fill Up?

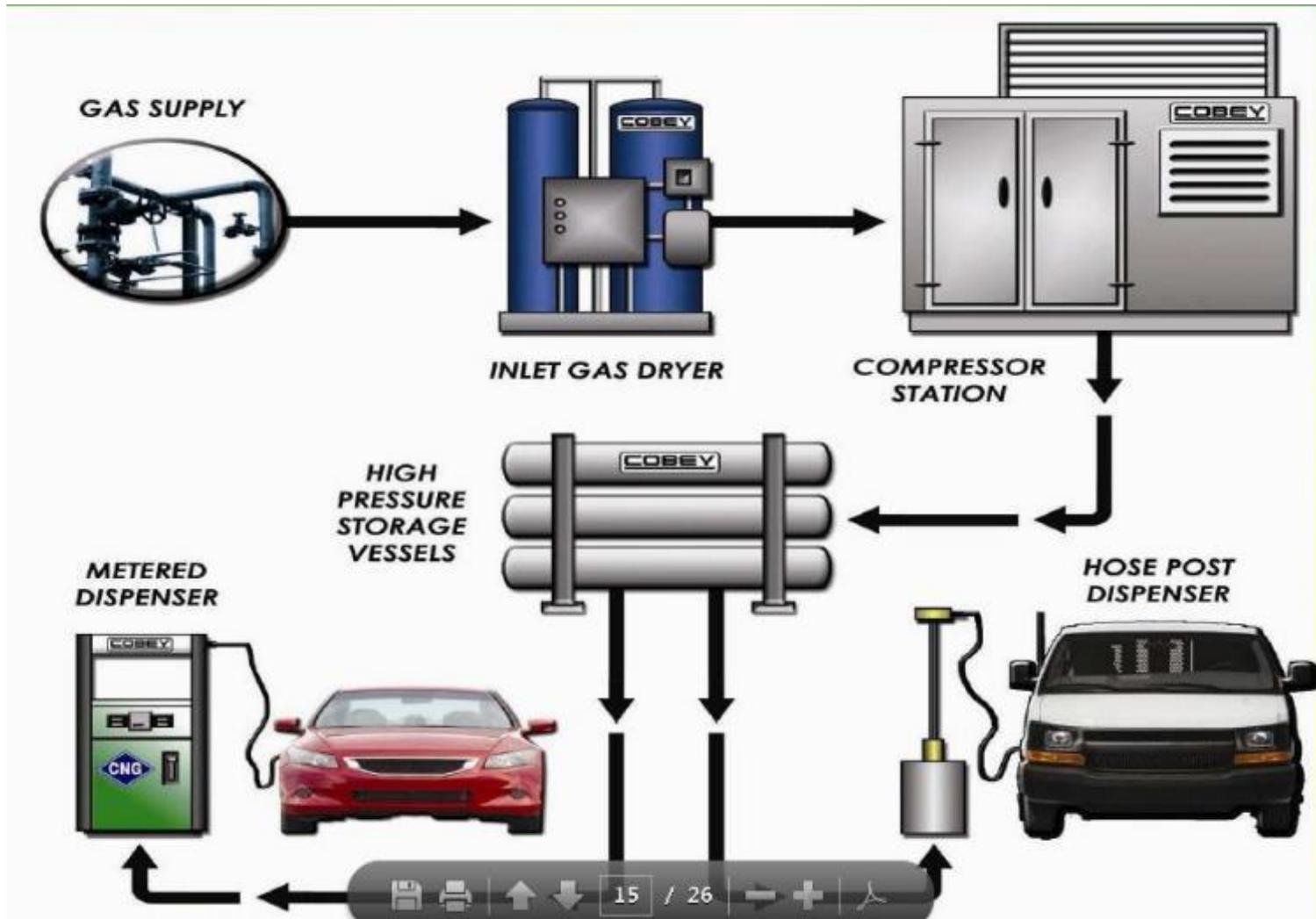
<http://www.afdc.energy.gov/locator/stations/>



# CNG Stations Served By BHE



# What's Next?



# Typical School Bus Fuel Analysis



## Vehicle Conversion Details

Description	Class C School Bus
Number of Vehicles	1
Fuel Type	Diesel
Average MPG	7
Yearly Miles Driven	15,000
Cost per Conversion	\$35,000
Annual Fuel Gallons / Vehicle	2,143

## Fuel Assumptions

	Diesel	Gasoline	
Average Fuel Price	\$2.75	\$ 2.35	Estimated diesel and gas costs per gallon over project life, displaced fuels.
	Building Station	Public Station	
Average GGE of CNG	\$2.50	\$ 2.15	Estimated CNG cost over project life

# Typical School Bus Fuel Analysis



Black Hills Energy proudly presents financial and fuel analysis for :

CASDEM Audience

Date: **11/3/2016** Prepared For: **Craig Wright**

## Project Description

Project Summary	Year 1	Year 5	Year 10	Year 15
Current Cumulative Fuel Cost	\$5,893	\$29,464	\$58,929	\$ 88,393
Estimated Fuel Cost Savings	\$3,650	\$18,249	\$36,499	\$ 54,748
Fleet Conversion Investment	\$35,000			
CNG Station Investment	\$0			
RAQC Incentives	\$ 26,000			
Estimated Payback Time	1.81 Years			

Note: This financial analysis and proposed incentives are based on current prices and economic conditions.

## Vehicle Conversion Financial Summary

Total Investment CNG Equipped:	(\$35,000)	Maintenance Facility Investment	\$0
Avg. Annual Net Fuel Savings	\$3,650	BHE Incentives or Rebates	\$26,000
<i>For full fleet conversion</i>			

Vehicle Investment by Year	Year 1	Year 2	Year 3	Year 4	Year 5
	(\$35,000)	\$0	\$0	\$0	\$0

## CNG Fill Station Financial Summary

Capital Investment	\$0	Year 1 O&M Costs	(723)
Avg Annual Station Throughput (GGE)	2,443	Payback	1.81 Years
5 Year IRR	39.5%		

Inflation factors have differing long term effects on cost of ng vs petroleum based fuels. Spreads widen resulting in better/improved financials for