Natural Gas Vehicles

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Agenda

- Why natural gas?
- Types of Natural Gas Vehicles (NGVs)
- How do you fuel with Compressed Natural Gas (CNG)?
- Current activity
- Future
- Challenges
- Questions?
Black Hills Corporation
Based in Rapid City, SD, with corporate offices in Denver, CO, & Papillion, NE, the company serves 750,000 utility customers in Colorado, Iowa, Kansas, Montana, Nebraska, South Dakota and Wyoming. The company’s non-regulated businesses generate wholesale electricity, produce natural gas, oil and coal, and provide appliance repair services.
Video

http://www.youtube.com/watch?v=Wm70bB0atf0
Natural Gas: Clean, Abundant, Affordable and American Energy Alternative

- Natural gas is the **cleanest** commercially available fuel for transportation today, reducing GHG’s between 20-29%

- Worldwide, natural gas **reserves** are greater than petroleum, with a supply now estimated @ 100+ years

- Natural gas **costs** 20-50% less per gallon equivalent than conventional gasoline at the pump, with over 1,100 CNG fueling stations in the U.S.

- 98 percent of all the natural gas consumed in America is produced in **North America**

- There are approximately **130,000** NGV’s on U.S. roads today and over **13 million** worldwide
NGVs Are a “Good Fit” for Many Fleet Applications

- Best applications:
  - High fuel use
  - Central fueling
  - Local routes/operating areas
- Federal/State/Local Government
  - 25,000+ light duty NGVs
- Refuse
  - 4,000+ trucks
- Transit
  - 11,000+ buses
  - 1 in 5 on order
- School Districts
  - 3,000+ buses
- “Short-Haul” Delivery
  - 17,000+ medium duty NGVs
Types of NGV Systems

• **Dedicated** – powered **only** by natural gas

• **Bi-fuel** – natural gas **or** gasoline

• **Dual fuel** – natural gas **and** diesel
How do you fuel with CNG?

• **Time-fill**

• **Fast-fill**
  - Cascade, Buffer or Combination

• **Gasoline Gallon Equivalents (GGEs)**
  - Amount of CNG it takes to equal the energy content (in BTUs) of one liquid gallon of gasoline
  - 1 GGE = 5.660 lbs of natural gas
  - 127 scf of natural gas per GGE = 8 GGEs per Mcf of natural gas

• **Diesel Gallon Equivalents (DGEs)**
  - Amount of CNG it takes to equal the energy content (in BTUs) of one liquid gallon of diesel fuel
  - 1 DGE = 6.360 lbs of natural gas
  - 140 scf of natural gas per DGE = 7.2 DGEs per Mcf of natural gas
Combination Fast-fill
Home Refueling Appliance (time-fill)
CNG Station & NGV Conversion Costs

- **CNG station** costs range from $5K to $2.5 million
  - Time-fill, Fast-fill, Combo-fill
  - Depends upon number of vehicles per day, vehicle fueling patterns, maximum daily flow, maximum hourly flow
  - Modular approach adds capacity as fleet grows
  - Average national pump prices < $2.00/GGE

- **NGV conversion** costs range from $10K to $50K+
  - Dedicated, bi-fuel or dual fuel
  - EPA certified or approved kits and installers
  - NFPA 52 and 30A
Future of NGVs

• Only 130K in U.S.; 13 million worldwide
• CNG & LNG fueling infrastructure
• Price of natural gas vs. diesel/gasoline
• Fracking & the EPA
• OEMs vs. conversion shops
• Over-the-road trucking industry
• Home fueling appliances
Liquefied Natural Gas

LNG

- Natural gas cooled to -260 degrees F
- 1/600th the volume of gaseous natural gas
- Vaporized to gaseous form for use
- Costly to produce (liquefy) but easy to transport
- Stored in specialized tanks with insulated walls
- Kept in liquid form by autorefrigeration
Westport Cummins 12L Dedicated CNG Engine

- 26 million trucks in U.S., including three million Class 8 OTR
- 165 million gallons of diesel fuel used daily
- 871 million metric tons of GHG emissions annually
Home Fueling Appliances

- PHILL @ $6,000
- Whirlpool @ $2,000
- GE @ $500
Challenges to NGV’s

- Initial conversions costs of $10K - $50K
- Limited availability of CNG fueling stations
- Cost of CNG fueling stations ($5K - $2.5MM)
- Lack of federal & state grants/incentives/funding
- High pressure fuel tank in vehicle
- Paradigm shift as a transportation fuel
- Crude oil & gasoline costs historic fluctuation
- NGV industry is still in its infancy
- Is natural gas really “safe”? 
- LNG issues
Why natural gas vehicles today?

“We need a bridge…to replace foreign oil with American natural gas for cars and trucks. It’s cleaner, it’s cheaper, it’s abundant and it’s ours. It buys us one thing money can’t buy: time, time to develop the renewable fuels that will break our dependency on foreign oil.”

-- T. Boone Pickens
Natural Gas – The Vehicle Fuel that’s good for America!