The Compelling Case For NGVs in Public and Private Fleets






Stephe Yborra

Director of Market Analysis, Education & Communications

Clean Vehicle Education Foundation

Director of Market Development

NGVAmerica

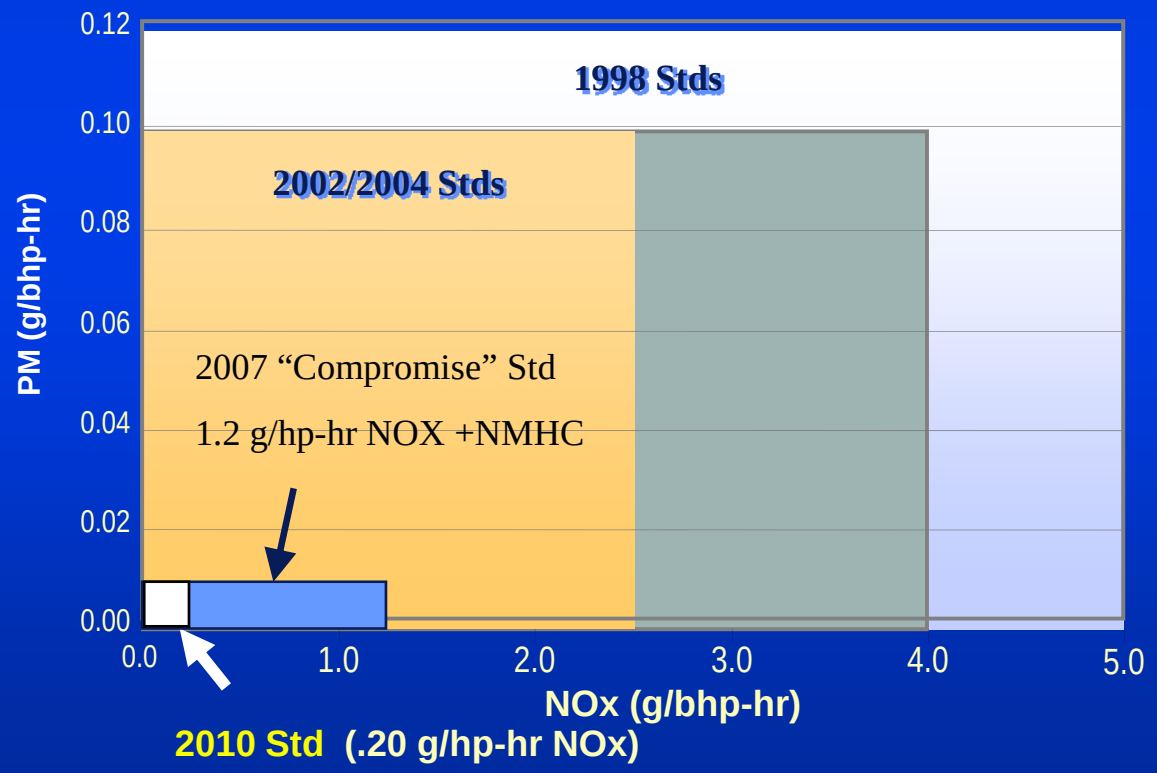
Compelling Case for Natural Gas Vehicles

- Natural gas is America's fuel: America's resource, America's jobs. Reduced reliance on volatile foreign oil supplies – Energy Security.
- Natural gas engines emit far less emissions than diesel or gasoline
- Significantly lower fuel / O&M costs provide fast payback of initial purchase premium, then generate substantial life-cycle savings. (Price differential is shrinking each year)
- Natural gas engines' performance now match/exceed diesel, gasoline
- Wide variety of NGVs available from OEMs and SVMs
- Vigorous NGV fueling industry emerging, expanding options

Market Drivers of Change

Emissions/Improvement in AQ

- AQ Goals, NAAQS and EPA Vehicle Emissions Requirements
  - CAAA drive local/regional govts to reduce criteria emissions (NOx, PM)
  - EPA and CARB vehicle/engine emissions requirements and their impact on OEMs' product offerings, vehicle performance and fuel economy



•To achieve 2004 and 2007 emissions benchmarks, fuel economy and performance took a hit.

•Diesel exhaust after-treatment technologies have increased truck purchase and O&M costs

•2010 NOx requirement: SCR or EGR strategies – add'l complexity and cost (and weight)

The Price of Progress: OUCH!

Complexity, Confusion and Cost

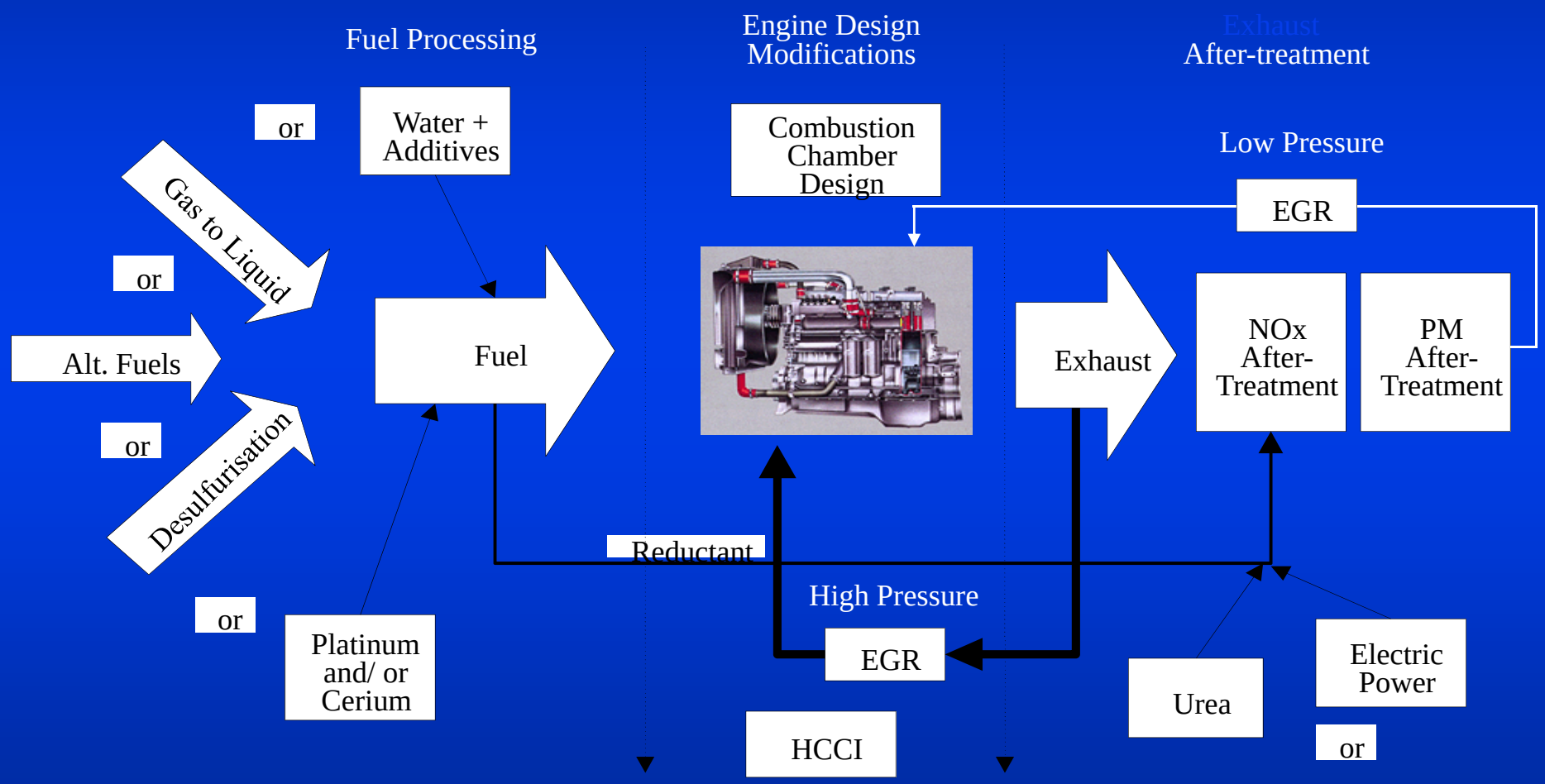


Diagram Courtesy of TIAX LLC

The Emissions Hurdles for Fleet Operators

Impact of EPA's 2004, 2007 and 2010 Requirements

- Diesel performance trade-offs were required to achieve 2004 emissions benchmarks and again in 2007
  - 2004 diesels: decreased fuel economy (3-6%), decreased power/performance; further declines in 2007.
  - Complex exhaust after-treatment technologies are expensive and maintenance intensive
- Achieving 2010 NOx requirement
  - Most have elected to use SCR w urea + ionized water -"DEF"
  - Ratio of DEF to diesel will vary from 1:50 to 1:25 based on duty cycle
  - Added complexity; compliance strategies when vehicle runs out of DEF
  - DEF system adds weight as well.
  - Concern about "slippage" – unreacted by-product is ammonia

Market Drivers of Change

Greenhouse Gases (GHG) -- Global Warming

- The Environmental, Economic and Political Realities of Global Warming and Greenhouse Gases
  - Issue is quickly gaining traction internationally and here in US
  - California Adopts Low-Carbon Fuel Standard (LCFS)
  - Additional states are likely to follow as they have done with vehicle emissions standards. NESCAUM (northeast states) undertaking GHG initiative with potential for LCFS.
  - Obama Administration has signaled willingness to tackle GHG

- **Natural gas vehicles reduce GHGs between 20-29%**
  - For HDVs, about 20-23%; for LDVs, 26-29%
  - Depends on comparative vehicles and duty cycles

Market Driver For NGVs

Energy Security and Economics

- Global oil supply-demand imbalance getting worse, which pushes fuel prices up
  - US = <5% of world pop but 25% of oil use
  - Asian economies compete for oil supply; demand outpacing supply; New oil discoveries lag growth; existing refinery capacity is at/or near peak – new capacity is lengthy process
  - Barrel of oil topped $145 in late spring 2008! Slump in world economy pushed prices down but higher prices will return. Are you prepared?
  - Traditionally ratio between MCF and barrel was 6/7-to-1. Now @ 20-to-1 Was 22/1 several months ago!

- **CNG savings compared to diesel are currently 1.00-1.50 less per DGE depending on location, size of station, ownership/O&M arrangements**
  - **<u>Differential was as high as $2.50 in Spring '08</u>**

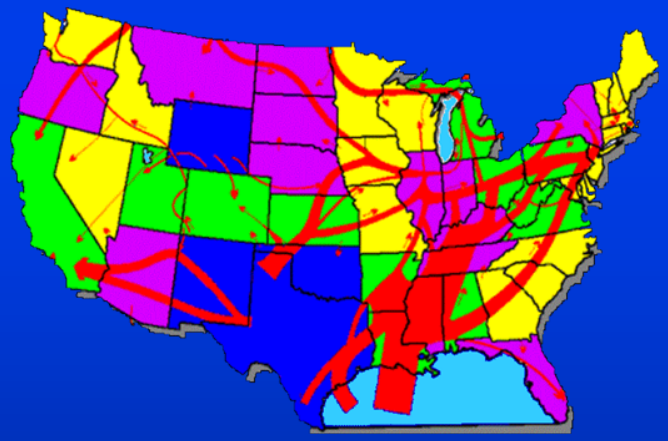
Traffic in Shanghai China: Chinese vehicle ownership per capita is equal to where US was in 1919!

Diversifying America's Transportation Fuel Portfolio

- Many Alternative Fuels and Vehicles Needed
  - Electricity
    - All-electric
    - Hybrids, PHEVs
  - Bio-diesel (B100) and blends
  - Ethanol
    - E85 (limited production/distribution – majority is in midwest market)
    - Oxidant additive to gasoline (e.g. E10 gasoline – perhaps to be increased)
  - Propane
  - Natural Gas
    - CNG and LNG
  - Hydrogen
    - Internal combustion engines (H/CNG blends like Hythane)
    - Fuel cells (eventually)

Facts About Natural Gas

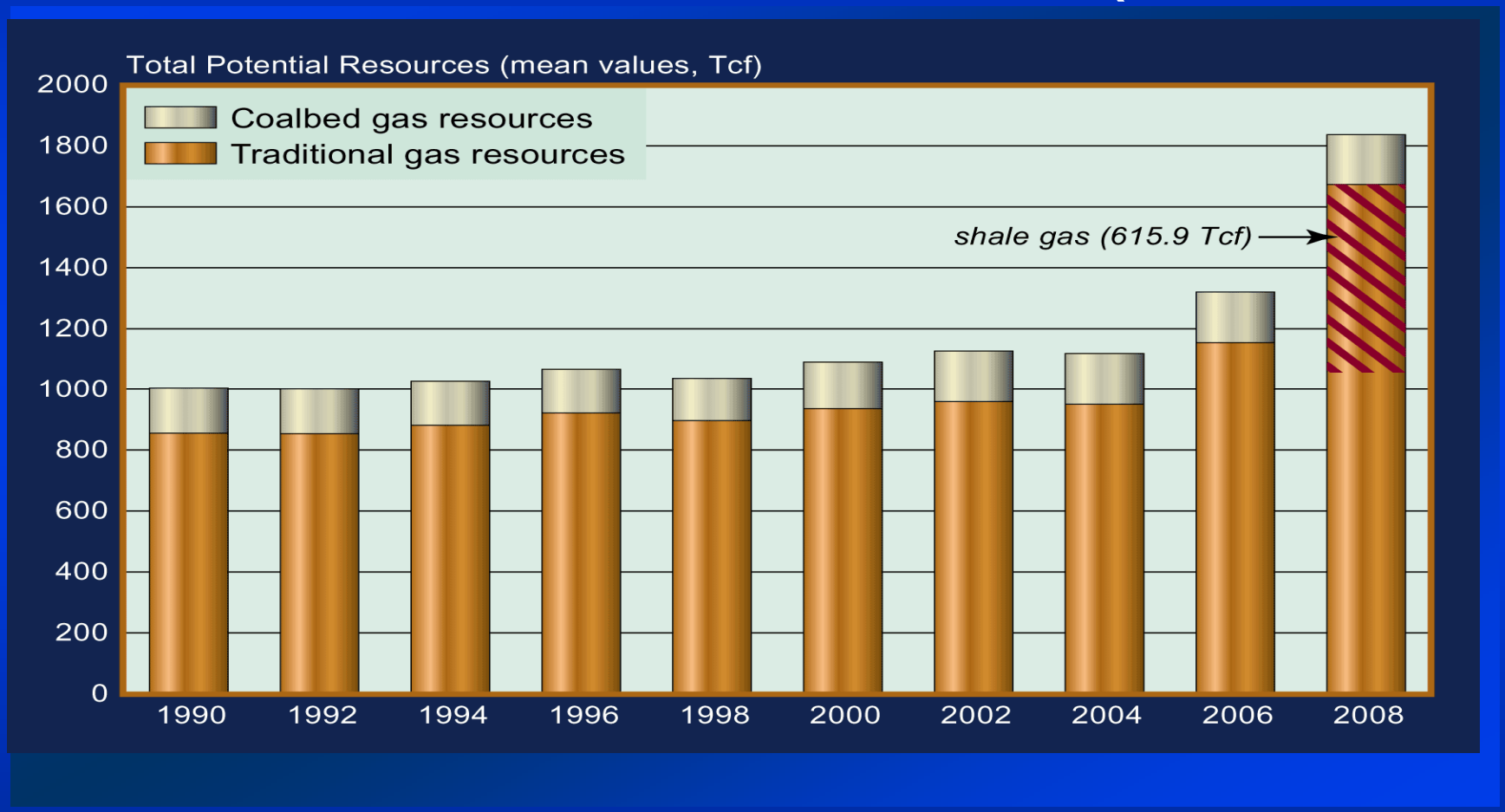
- Natural gas is abundant domestic fuel
  - 98+% from North America
    (~87% US, ~12% Canada, ~1-2% imported LNG)
  - Well-developed distribution infrastructure
    (290K miles of interstate pipeline provides gas to 1.2 million miles of LDC distribution lines)
  - American fuel = American jobs
  - Consistent buffer of supply in proved reserves, technology improvements keep expanding recoverable base.



  - Improved technologies have made shale gas economically viable and significantly bumped our supply base. Supply now estimated @ 115+yrs!

PGC Resource Assessments, 1990-2008

Total Potential Gas Resources (mean values)



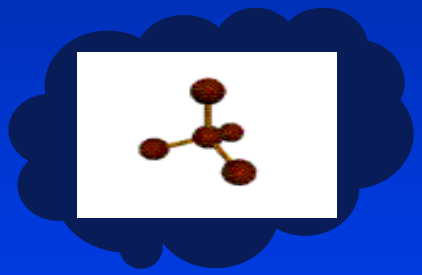
Data source: Potential Gas Committee (2009)

Shale Basins and the U.S. Pipeline Grid

Source: American Clean Skies Foundation.

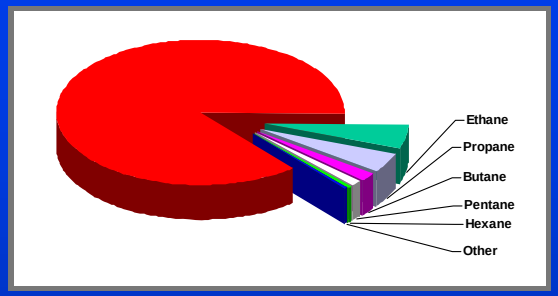
Facts About Natural Gas

- Natural gas is an inherently clean fuel
  - Natural gas is mostly methane: one carbon atom
  - (Diesel – C14H30; Gasoline – C8H18; Propane – C3H8)
  - Less NOx, soot and greenhouse gases than petroleum fuels



Methane Molecule

- Natural gas is very safe
  - Lighter than air… dissipates when released
  - High ignition temperature: 1000-1100F
  - Limited range of air/fuel combustion ratio (5-15%)
  - Colorless, odorless, non-toxic substance
  - Doesn't leak into groundwater
  - Comprehensive fuel tank, vehicle and station design/mfg codes & standards



Facts About Natural Gas

- Liquefied Natural Gas (LNG)
  - Cryogenically cooled to liquid @ ~(260)F, stored in liquid form onboard vehicle and vaporized before it enters engine cylinder
  - Preferred by many heavy-duty fleets due to its energy density, space requirements
  - Most vehicular LNG used today is produced at limited number of plants and trucked to fleets' onsite storage vessels.
  - Transport distance/costs are major determinant of economic feasibility
  - Growing interest in small- and medium-scale liquefaction plants located nearer to point of end-use; likely higher production cost/gallon but lower transportation cost.
  - Gas supply from pipeline, landfills, sewage/agri-waste digesters

Facts About Natural Gas

- Compressed Natural Gas (CNG)
  - Gas delivered to site by local gas utility and compressed and stored onsite and/or distributed directly to vehicles….or
  - L/CNG - LNG made on-site or delivered to site, then compressed to higher pressure and passed thru evaporator/heater to turn to vapor stage, then dispensed into onboard storage
  - Onboard 3600psi vehicle cylinders; 4 types of onboard cylinders; all meet same safety standard.
    - Type I (all metal)
    - Type II (metal liner, partial wrap)
    - Type III (metal liner, full wrap)
    - Type IV (plastic liner, full wrap)

Benefits of NGVs

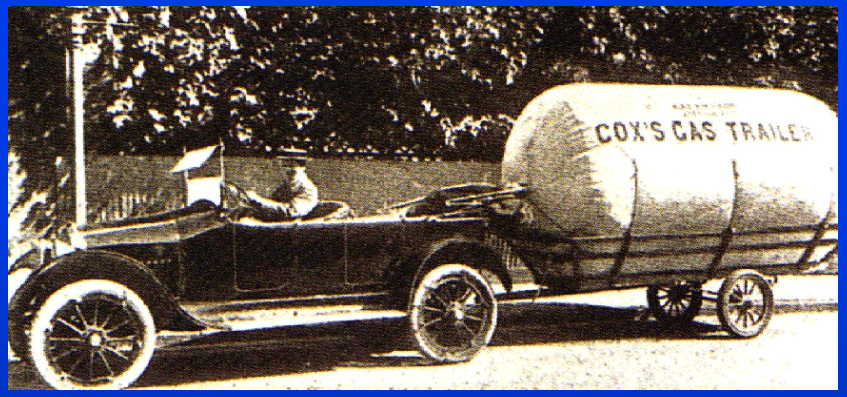
- NGVs are proven and reliable
  - ~11 million NGVs in use worldwide; ~110K operating on US roads
  - Fleets are best **(high fuel use, central fueling, local routes/op. areas)**
    - 11,000+ transit buses (1 in 5 on order),
    - Nearly 4000 refuse trucks – new fleets transitioning, existing fleets expanding
    - 3000 + school buses
    - 15-17,000 MDVs in shuttle and wide variety of work truck applications,
    - 25,000+ LDVs in federal, state local government fleets; private fleets
- NGVs are quiet
  - HD NGVs are 80-90% lower db level than comparable diesel
- NGV life-cycle costs are lower
  - Fuel costs are far lower! Maintenance costs are =/< than gas or diesel
  - **<u>Life-cycle cost advantage improves with new federal tax credits</u>**

NGVs Are a “Good Fit” for Many Fleet Applications

- Local/State Government
  - All Depts.
- Airports
  - Terminal Buses, Hotel/Parking Shuttles, Taxis, Door-to-Door
- Refuse
  - Collection/Transfer
- Transit
  - Buses, Maintenance, Supervisors
- School Districts
  - Buses, District personnel, Maint.
- “Short-Haul” Delivery
  - Food & Bev., Port-Rail, Linen Svc,
- Utilities
  - Gas/Electric/Water, Communications

Wheels

Available Natural Gas Vehicles and Engines and the Sales /Service Channels that Support Them



(“We’ve come a long way baby”)

Growing Selection of Vehicles from OEMs, SVMs and 2nd Stage Upfitters

OEMs

- American Honda
- General Motors
- Thomas Built Bus
- Blue Bird Bus
- Optima/NABI
- El Dorado
- New Flyer
- Daimler/Orion
- Gillig
- Elgin
- Allianz/Johnston
- Schwarze
- Tymco
- Daimler/Freightliner
- Kenworth

OEMs

- Peterbilt
- Mack
- American LaFrance/ Condor
- Crane Carrier
- Autocar Truck
- Capacity

OEM Engines

- Cummins Westport
- Westport Innovations

Repower Engines

- Cummins Westport
- Emission Solutions Inc
- Doosan America

SVMs (LDVs)

- Altech-Eco
- BAF Technologies
- Landi Renzo/Baytech Corp
- IMPCO Technologies
- Natural Drive
- NGV Conversions/Motori

SVMs (M/HDVs)

- BAF Technologies
  - Ford
- Landi Renzo/Baytech
  - Workhorse Chassis
  - Isuzu
  - GMC

1.8L Dedicated Honda Civic GX (OEM @ factory).

3.5L and 3.9L BiFuel and Dedicated Impala, Malibu, Lucerne and G6

2.0L BiFuel and Dedicated Ford Focus

4.6L Dedicated Ford Crown Vic, Lincoln Town Car and Mercury Grand Marquis

2.3L and 2.5L BiFuel and Dedicated Ford Fusion and Mercury Milan

5.3L and 6.0L BiFuel and Dedicated GMC Sierra + Chevy Silverado 15/25/35

5.4L BiFuel and Dedicated Ford F150, F250, F350 6.2L Super Duty soon

5.4L Dedicated Ford Expedition and Lincoln Navigator.

4.8L and 5.3L BiFuel and Dedicated Chevy Tahoe

5.3L Dedicated Chevy Colorado and GMC Canyon

5.3L Chevy BiFuel and Dedicated Suburban, GMC Yukon/Yukon XL

6.0L BiFuel and Dedicated Chevy or GMC 2500HD, 3500 Series Cab & Chassis

5.3L BiFuel and Dedicated Chevy Avalanche

2.0L BiFuel and Dedicated Ford Transit Connect

4.8L, 5.3L and 6.0L BiFuel and Dedicated Chevy Express and GMC Savana vans

5.4L Dedicated Ford E250, E350 cargo and passenger van

6.0L Chevy or GMC G3500 Series Cab & Chassis and Van Cutaway

6.8L Dedicated Ford E450 cutaway.

6.0L GMC and Chevy G4500 Cutaway

GMC W3500 and W4500 (GM discontinued chassis) / Isuzu NPR and NPR HD cab-over chassis w GM 6.0L engine **(retrofits of existing inventory only)**

Workhorse W42 Chassis step-van chassis w GM 6.0L engine, and **Workhorse W62 w GM 8.1L engine (retrofits of existing stock only until 12/31/2010)**

GMC C 6500/7500/ 8500 Topkick Series with 8.1L GM engine (**retrofits of existing stock only until 12/31/10)**

GMC C4500/5500 Series Cutaway w 8.1L GM engine **(retrofits of existing stock only until 12/31/10)**

Ford F450 and F550 with 6.8L engine

Ford F59 strip chassis with 6.8L engine

- Refuse collection trucks

(Crane Carrier LET, Autocar Xpeditor, ALF-Condor, Peterbilt LCF 320 and Mack TerraPro; many 2nd stage upfitters e.g. Heil, McNeilus, Amrep, Labrie, PennFlex, E- Pak, others)

- Buses, shuttles, trolleys

(NABI, New Flyer, Orion, Thomas, ElDorado, Blue Bird, Optima, Gillig, variety of shuttle 2nd stage up-fitters)

- Sweepers

(Elgin, Tymco, Schwarze, Allianz-Johnston)

- Work /Vocational Trucks

(Freightliner M2 tractor and straight truck; Autocar and Capacity yard hostlers; Kenworth T8SH, T440, T470, Peterbilt 384 and 365; International DT466/MaxxForce DT-equipped trucks)

- Heavy-Haul Trucks

(Kenworth T800, Peterbilt 386)








Filler' Up:
Addressing the "Chicken & Egg" Conundrum

Natural Gas Fuel Station Types
Development, Ownership and Operations Options
Sizing/Design Considerations

Natural Gas Fuel Station Options

- Offsite – use existing public access station
  - Station may be operated by independent retailer, utility or another fleet
  - Development usually driven by anchor fleet and/or the ability to "pool" fleets to achieve fuel use needed to warrant investment

- Onsite - private access (e.g., only for the fleet operator)
  - Many existing large fleets (e.g., transit, refuse) or fleets with restricted access sites (e.g., federal property such as military bases) still operate private-access-only stations. Time-fill-only stations are always private access.

- Onsite - public access (often "outside the fence" pump)
  - Growing trend: public access pump installed at fleet location - located adjacent to or "outside the fence" of fleet's secure fueling area. Takes advantage of economies of scale, promotes greater public network

NGV Station Cost Considerations

- Myth: NGV stations cost $1 million
  - Station costs can range from $15K – $6 million
- Natural gas volume/throughput over time is amortized against capital investment
  - Ownership type, depreciation period affect $/GGE
- Anchor fleets or ‘pooled loads’ create economies that eliminate chicken & egg challenge.
  - Outside-the-fence access adds load and strengthens infrastructure network.
- Station O&M expenses need to be factored into GGE cost

Natural Gas Station Development and Ownership-Operations Options: #1

- Fleet owns & operates station
  - Fleet takes responsibility for building and then operating its own station. Fleet works with vendors or design consultant, manages build-out and takes responsibility for PM (parts, etc).
  - Applies to small-to-mid sized fleets that do not have offsite options nearby, b/c their fuel use does not meet the threshold required by independent developers to invest in developing, owning and operating station for them.
  - Some large fleets also opt for this but many do not have experience nor want responsibility for station operations and maintenance

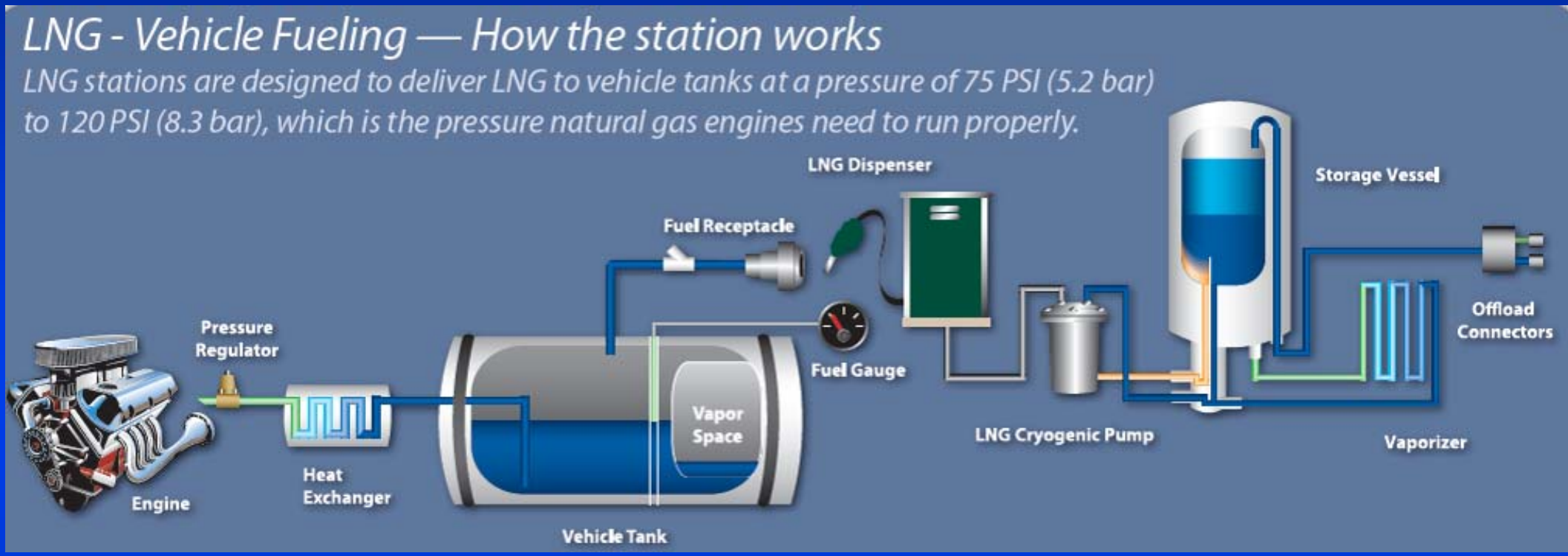
Natural Gas Station Development and Ownership-Operations Options: #2

- Outsource station development, ownership, O&M to independent fuel provider
  - Fleet serves as anchor for independent operator's station, contracts long term fuel agreement with set price(s) and expected throughput for duration.
  - One stop shop. All capital investment and O&M risks are borne by independent fuel provider while fleet focuses on core competencies.
  - Fleet usually provides low-cost lease for property – important to making deal work - land is costly!
  - Often allows fuel provider option to create public access as well – sometimes a "royalty" paid back to fleet for retail sales from premises

Natural Gas Station Development and Ownership-Operations Options: #3

- Fleet owns/leases station but contracts out operations for a fee (e.g., monthly fee or GGE basis)
  - Option used by many large fleets that need/desire ownership of their own station equipment but want to reduce risk, assure best O&M practices, etc
  - Contract is often (but not always) awarded to the firm that builds station; usually a 5-7yr contract.
  - Some fleets that initially Own & Operate their own stations decide that they want to delegate to others – put out RFP for O&M contract
  - Decision weighs pros/cons of “leaving $ on table” versus potential downtime risks, maintaining parts inventories, updated training of techs, etc

LNG Fuel Station – How it Works



LNG Fuel Station Types

- Mobile: LNG ORCA
  - 3500 gal tank with dispensing/metering system on a truck.

- Starter/Containerized System:
  - Complete fueling station in a box. Includes storage tank, dispensing and metering and required containment.

- Custom Large Stations
  - Larger bulk tank(s), multiple traditional dispensers, LNG and/or CNG dispensing

CNG Fuel Station Types

- **Time-fill capability**
  CNG is dispensed slowly directly to vehicles' onboard storage tanks. Lower cost station investment. Best for fleets that return to central lot and sit idle overnight or for extended periods and do not need fast fill capability.

- **Fast-fill capability**
  Similar to liquid fueling station, same fill rates and times. A MUST for public access. Also good for larger fleets where fueling turn-around time is short.

- **Combo-fill capability**
  Comprises both time-fill and fast-fill. Often good for fleets that can fuel on time-fill but need occasional "top off" or want/need ability to provide public access

LNG/CNG Station Design Considerations

How Much Fuel in How Much Time?

- What is the projected number of vehicles per day and what is the required fuel per vehicle?
- What are the fueling patterns?
  - Are all fueled at once?
  - Can they be staggered throughout the day?
- What is the maximum *daily* flow and maximum *hourly* flow
  - This affects equipment selection and/or storage amount, especially when designing CNG station
- If CNG station, is backup fueling available nearby (even if only on an emergency basis) or is design redundancy required?

LNG/CNG Station Design/Cost Considerations

Station Design/Cost Factors *other than* Fuel vs Time

- Real estate
  - Location:
    - Urban/Suburban/Rural and cost of land
    - Competition with other commercial businesses for prime locations
    - Traffic access
  - Size of property
    - Required space for equipment footprint
    - Required space for vehicle traffic (including # of islands, vehicle entry/exit)
  - Site Development
    - Remediation of existing fueling site
    - Permits, Codes & Regulations

CNG Station Design/Cost Considerations

Station Design/Cost Factors Impacted by Fuel vs. Time

- Fueling equipment needs/costs
  - Compression:
    - Electric drive or gas engine drive
      - Size of electric service?
      - Inlet gas psi and peak flow rates
    - Sizing (HP and SCFM rating) is critical
    - Enclosures for sound attenuation
    - Sophistication of controls
  - GGE/hr = 0.5 x SCFM (@ rated inlet psi)
    - Ex: 200 SCFM compressor = ~100 GGE/hr
    - Ex: 75 SCFM compressor = ~35-37 GGE/hr

CNG Station Design/Cost Considerations

Station Design/Cost Factors Impacted by Fuel vs Time

- Fueling equipment needs/costs
  - CNG Storage:
    - Is it needed? If so, what is balance between compression capacity and storage needs
    - Peak storage requirements and dispensing projections
    - Cascade vs buffer system
    - Type of storage containers (Spheres or cylinders)
    - Available space

CNG Station Design/Cost Considerations

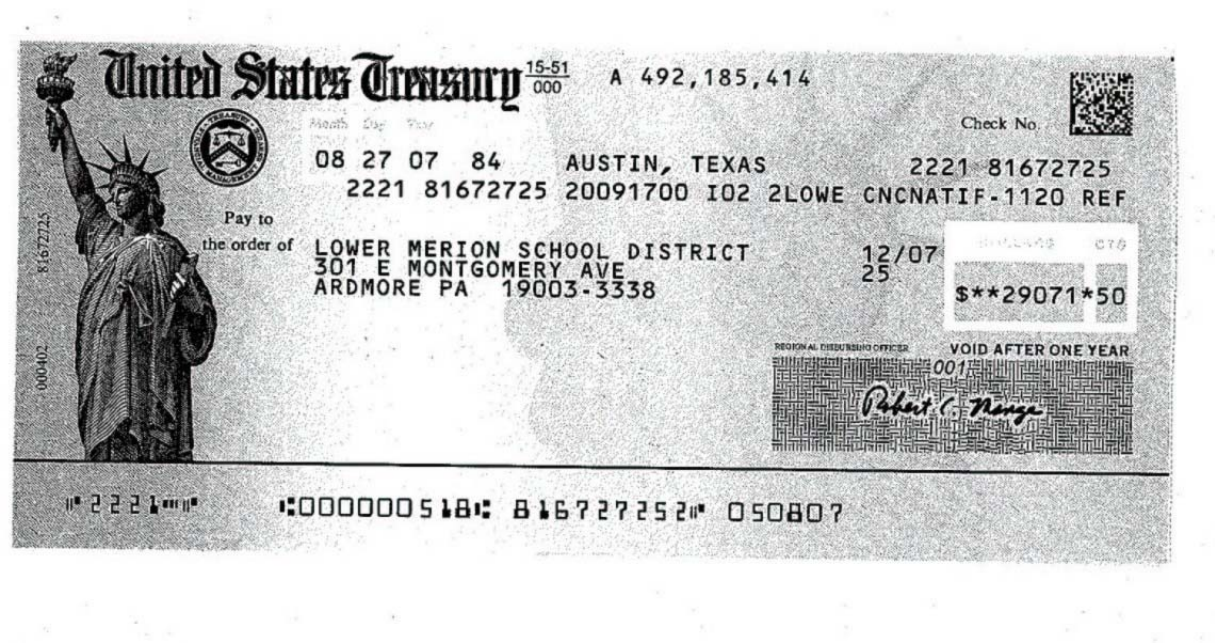
Station Design/Cost Factors Impacted by Fuel vs Time

- Fueling equipment needs/costs
  - Natural gas dryers:
    - Projected volume and flow rates
    - Inlet gas pressure and potential variance from spec
    - Moisture content (gas analysis) and historical variances from spec
    - Manual vs automated regeneration
    - Single tower versus dual towers

CNG Station Design/Cost Considerations

- Fueling Equipment Needs/Costs
  - Dispensers and Fuel Management:
    - Time fill posts? Or Fast Fill dispensers? Both?
    - Number and type to meet expected vehicle types/counts
    - Fuel metering/data capture, payment system?
    - CCs/pmt cards, training video (e.g. in CA)?

NGV Tax Incentives and Grants for Vehicles, Stations and Fuel


United States Treasury 15-51/000 A 492,185,414

Check No.

08 27 07 84 AUSTIN, TEXAS 2221 81672725

2221 81672725 20091700 I02 2LOWE CNCNATIF-1120 REF

Pay to the order of LOWER MERION SCHOOL DISTRICT
301 E MONTGOMERY AVE
ARDMORE PA 19003-3338

12/07 25

$**29071*50

REGIONAL DISBURSING OFFICER

VOID AFTER ONE YEAR

001

Robert C. Nunge

⑈2221⑈ ⑆000000518⑆ 816727252⑈ 050807

Federal Tax Credits for Vehicles, Stations and Fuel

- Vehicle income tax credit *(for buyer)* covers 50-80% of incremental cost or conversion cost. Applies to dedicated vehicles only. Expires 12/31/10.

Gross Vehicle Weight Rating	Incremental Cost Cap (ICC)	50% Credit At ICC	80% Credit at ICC
Less than 8500 lbs.	$5000	$2500	$4000
8501 to 14,000 lbs.	$10,000	$5000	$8000
14,001 to 26,000 lb.	$25,000	$12,500	$20,000
More than 26,000	$40,000	$20,000	$32,000

- Station income tax credit (*for buyer*) equal to 50% of the cost of new CNG and LNG refueling equipment, up to $50,000 per year per location. Expires 12/31/10

- Motor fuels excise tax credit (*for fuel seller)* equal to $.50/GGE or LNG gallon. IRS guidance: owner of fuel as it is dispensed into vehicle gets credit, regardless of who owns equipment or compresses fuel. Expired 12/31/09 but due to be renewed very shortly and be retroactive to 1/1/10.

NAT GAS Act of 2009

(House Bill H.R. 1835; Senate Bill S. 1408)

- Vehicle Purchase Income Tax Credit
  - Extends the income tax credit significantly (House: 2027 /Senate: 2019)
  - Automatically qualifies dedicated NGVs for 80% tax credit
  - Qualifies bi-fuel vehicles for 50% tax credit (NEW!)
  - Increases the incremental cost cap limits for NGVs
    - LDV (under 8500# GVWR) ICC cap bumped 150% to $12,500
    - MDV and HDV ICCs doubled to $20K, $50K and $80K
- Station income tax credit
  - Extends the income tax credit significantly (House: 2027 /Senate: 2019)
  - Increases the income tax credit to 50% up to $100,000
- Alternative Fuels Excise Tax Credit
  - Extends the credit significantly (House: 2027 /Senate: 2019)

Natural Gas Vehicle Incentives

In addition to tax credits, go after Federal Grants:

- DOT Congestion Mitigation & Air Quality (CMAQ) grants
- FAA VALE Grants for airports
- FTA Grants for transit
- DOE Clean Cities grants
  - **2009 stimulus bill provided $300 million for 30 projects @ $5-15 million)**
- EPA Diesel Emission Reduction Program grants
  - **Referred to as "Nat'l Clean Diesel Campaign," two types of NGV projects qualify….repowers and early replacements**
  - **2009 stimulus bill provided $300 million**
- Also – Many states offer incentives (credits, grants)
  - **2009 stimulus bill included $3+ billion in block grants**
  - Join/work with your Clean Cities Coalition, MPO and Regional EPA Collaborative

Components of CNG Cost

- Gas Bill:
  - Gas Commodity
  - Pipeline transportation to utility's city gate + Local gas distribution company service
- Compression
  - Electric motor KWH and KW …OR engine driven unit's natural gas use
- Station Maintenance
  - Normal PM, scheduled replacement of parts, compressor rebuilds
- Capital /equipment amortization
  - Actual cost of equipment or cost of capital factored into each GGE over life of station equipment

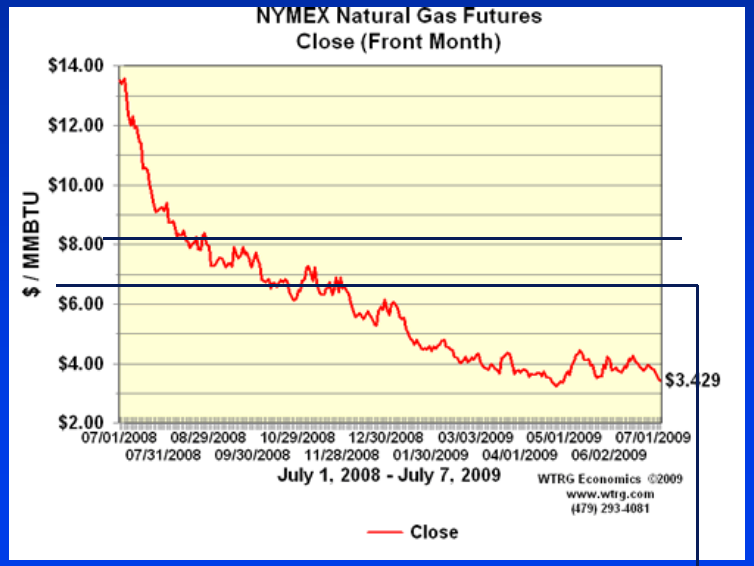
Components of CNG Cost

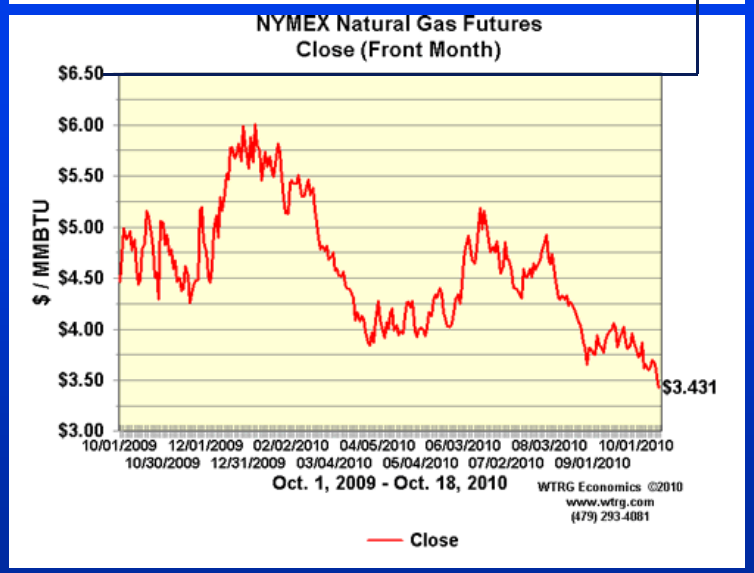
- Gas Bill:
  - Gas Commodity:

    Gas is drawn from wells, gathered/ pooled, stripped of impurities and "heavy" gases, then transported to "hubs" where it is available on the commodities market. Henry Hub (Louisiana) is used for NYMEX pricing.

    US DOE and industry long term price forecasts (prior to the economic collapse) pegged NYMEX natural gas at $6.50-8.00/MCF.

    Future market projections for gas are still up in the air now that shale gas has changed the equation





Components of CNG Cost

Gas Bill - Gas Commodity:

- One cubic foot = ~1000 BTUs (Note: cf = volume, BTU = energy)
- One Mcf = 1000 cubic feet
- One Mcf = 1000x1000 = ~1,000,000 Btus (MMBtu or decatherm)
- US Gov't says 124,800Btu/GGE …therefore….
- **One Mcf = roughly 8.0 GGE of (uncompressed) natural gas**
- **One MCF = roughly 7.2 DGE of (uncompressed) natural gas**.

- When NYMEX Mcf was $12.00, commodity portion of CNG was $1.50/ GGE
- When NYMEX Mcf was $8.00, commodity portion of CNG was $1.00/GGE
- When NYMEX Mcf was 3.20, commodity portion of CNG was $.40/GGE
- Currently NYMEX Mcf is ~$3.43; commodity portion of CNG is $.43/GGE
- Your local gas company buys gas at various prices and uses weighted formula to pass along commodity at cost….purchased gas cost adjustment (this helps eliminate extreme swings in market price)

Components of CNG Cost

- Gas Bill:
  - Gas Commodity
  - Pipeline services/gas acquisition/marketer services to utility's city gate plus distribution/delivery service (regulated tariff)

    The LDC contracts with the producers and pipelines for short-term and long-term gas supplies, related storage and balancing services and delivery to the city gate. The LDC then delivers gas to you (customer) and charges regulated tariff for this service (pipe system investment and depreciation, maintenance, meter set, customer services, invoicing, etc). Varies quite a bit from one state to the next, one utility to the next

Components of CNG Cost

- Gas Bill: $.78-.86/GGE
  - Gas Commodity: ~$.66/GGE
    (based on estimated average purchase price of $5.28/MCF
    check with your utility representative for actual tariffs in effect)
  - Pipeline/gas acquisition/marketer services + local gas company city-gate-to-meter service : ~$0.12-.20/GGE

Components of CNG Cost

- Gas Bill: $.78-.86GGE (based on avg Mcf cost of $5.28)
- Electric compression costs
  - Gas delivered to the customer has to be compressed.
  - Most stations use electric motors although many larger stations use natural gas engine-drive compressors (depends on local regs).
  - Be sure to factor in both KWH consumption and KW demand
  - Estimated @ 1 fully-loaded KWh/GGE – a bit less for larger stations and more for small stations
  - Varies significantly from one utility area to the next
  - Nat'l range:$.04 -.30/KWH – **Rates vary: ~$.10/GGE**

Components of CNG Cost

- Gas Bill: $.78-.86GGE (based on avg Mcf cost of $5.28)
- Electric compression costs:$.10/GGE
- Maintenance/Repair/Service: $.30-.65/GGE.: **$.40/GGE***
- Like any compressor equipment, CNG stations require regular preventative maintenance/service and occasional rebuilds of compressors and replacement of other parts. Cost per GGE will vary based on total throughput (generally, larger throughput = less cost/GGE)
- ***Cost** /GGE range noted above assumes these services are provided using in-house capabilities . Assume higher cost/GGE when using PM service contractor. **Price**/GGE quoted by independent retailer providing fully-loaded **O&M** services will be higher as risk/liability is shifted to them and they should be compensated for on-call technician, parts inventory, 24-hr remote monitoring, emergency back-up provisions, etc. Est: $.40-.75/GGE

Components of CNG Cost

- Gas Bill: $.78-.86/GGE (based on avg Mcf cost of $5.28)
- Electric compression costs: $.10/GGE
- Maintenance/Repair/Service: Assume average of $.40/GGE

- **Capital amortization of equipment: $.35-.65/GGE (simple calc)**
  - Station cost divided by total GGE over life of equipment
  - Depreciation term will affect this cost (10 yrs; 7 yrs; 5 yrs)
  - Utilization factor is important (how much of the capacity of the station is actually utilized)

  - Ex: 20 veh. x 15 GGE/day x 5 days/wk = 1500 GGE/wk =~80,000 GGE/yr
  - 80,000 GGE/year x 10 yrs = 800,000 GGE
  - If station cost is $400K, then $.50/GGE

Components of CNG Cost

- Gas Bill: $.78-.86/GGE (based on avg Mcf cost of $5.28)
- Electric compression costs: $.10/GGE
- Maintenance/Repair/Service: $.40/GGE
- Capital amortization of equipment: $.35-.65/GGE

SUB-TOTAL: $1.63 – 2.01

- **SUBTRACT federal motor fuels excise tax <u>net credit</u>**
  - Tax exempt fuel sales reap full benefit of $.50/GGE
  - Taxable fuel sales: Pay $.183 fed tax, apply $.50/GGE credit; net $.317/GGE credit

Components of CNG Cost

- Gas Bill: $.78-.86/GGE
- Electric compression costs: $.10/GGE
- Maintenance/Repair/Service: $.40/GGE
- Capital amortization of equipment: $.35 -.65/GGE
- Net federal excise tax credit of either $.317 or $.50/GGE

- **Tax exempt makes and uses their own fuel for net $1.13-1.51/GGE**

- **Taxable entity makes and uses fuel for net $1.32-1.70 + state motor fuels excise tax**
  (includes $.183 fed excise tax, state excise tax varies widely and not included here.)

Caveat Regarding CNG Component Costs

- GGE costs presented here include following assumptions:
  - No grants for equipment
  - 10 year depreciation of equipment
  - No embedded cost of capital
  - Station is developed, owned and operated by the end-user and therefore assumes all risks/responsibilities associated monitoring station performance, maintenance, parts inventory, training staff.
- An independent retailer's price will be higher because:
  - Retailer carries risk/responsibility/liability for down-time
  - Shorter depreciation period (likely 5-7 years max)
  - Operations fee (e.g., 24-hr real-time remote monitoring, on-call technician for PM and emergencies, maintaining parts inventory)
  - Cost of capital
  - Profit margin

Cargo van for contractor

- GVWR: >8500 and < 14,000 lbs.
  - Ford E-350 cargo van
  - Chevy/GMC 3500 cargo
- MPG: 13/15 City/Hwy, 35K miles/year
- Fuel Use: 8-10 GGE/day; 2700-3100GGE/yr
- CNG Premium: $15,500-16,000
  (before fed tax credit)
- Fed Tax Credit: $ 8000 (> 8500 < 14000 #)
- Remaining premium (assuming no grant): $7500
- Simple Payback: 1.9-2.2 years
- Life-cycle cost advantage: $9,450-$12,000
  (based on 5 yr life and $ 1.25/GGE savings at "retail" station)

Passenger van for Limo

- GVWR: > 8500 and < 14,000 lbs.
  - Ford E-350 passenger van
  - Chevy/GMC 3500 passenger van
- MPG: 13/15 City/Hwy, 75K miles/year
- Fuel Use: 16-19 GGE/day; 4700-5800gge/yr
- CNG Premium: $15,500-16,000
  (before fed tax credit)
- Fed Tax Credit: $ 8000 (> 8500 < 14000 #)
- Remaining premium (assuming no grant): $7500
- Simple Payback: 1.0-1.25yrs
- Life-cycle cost advantage: $16.2K – 22K
  (based on 4yr life and $ 1.25/GGE savings at “retail” station)
  (Most shuttle services run their vehicles up to 500K+ miles!!)

Medical Lab Courier Service

- GVWR: <8500 lbs.
  - Honda Civic GX
- MPG: 19/30 City/Hwy, 30K miles/year
- Fuel Use: 4-6 GGE/day; 1000-1575GGE/yr
- CNG Premium: $6500 (before tax credits)
- Fed Tax Credit: $ 4000 (<8500 #)
- Remaining premium: $2500
- Simple Payback: 1.3 - 2.0 yrs
  (based on $1.25/GGE savings at retail station)
- Life-cycle cost advantage: $3750 – $7250
  (based on 5yr life)

Step Van

- Sample Applications (Linen Service)
- GVWR -14,000-19,500lbs.
  - Freightliner Custom Chassis MT45 w CWI 5.9 B Gas+
- MPG: 5.0 – 6.5, 75-90mpd x6 dys/wk, 26-28K/yr
- Fuel Use: 13-16DGE/day; 4200-5000GGE/yr
- CNG Premium: $28-30,000 (before tax credits)
- Fed Tax Credit: $20,000 (> 14,000#, < 26,000 #)
- Remaining premium (assuming no grant): $9000
- Simple Payback: 1.2 - 1.4 yrs
- Life-cycle cost savings: $54-66K !!!
  (based on 10 yr life and 1.50 savings/DGE at O&O station)

Utility Crew Cab/Work Truck

- GVW – > 26,000# lbs.
  - Int'l 4000 Series with ESI 7.6L NG,
- MPG: 3.5 – 4.75 (Lots of PTO time)
- Fuel Use: 15-20 DGE/day; 4600-5200 DGE/yr
- CNG Premium: $52,000 (before tax credits)
- Fed Tax Credit: $ 32,000
- Remaining premium (assuming no grant): $20K
- Simple Payback: 1.2 - 2.9 yrs
- Life-cycle cost savings: $49-68K!!!
  (based on 10 yr life $ 1.50 /DGE savings for O&O station)

School Bus – Contract Provider O&O

- GVWR: >26,000 lbs.
  - Blue Bird All American RE or Thomas Built Saf-T-Liner (both factory-built with CWI ISL-G engine);
- MPG: 6.0.- 7.0 / DGE (avg 18,000 miles per year)
- Fuel Use: 2650DGE/yr
- CNG Premium: $40,000 (before tax credits)
- Fed Tax Credit: $29,000 (assume dealer keeps %)
- Remaining premium (assuming no grant): $11,000
- Simple Payback: 2.8 yrs
- Life-cycle savings: $40,500
  (based on 13 yr life @ 1.50/DGE savings)

Refuse Truck

- GVW - 26,000+ lbs. (qualifies for highest tax credit)
  - LCF/LCOE models: Crane Carrier LET, Autocar Xpeditor, Peterbilt LCF 320 , Condor , Mack TerraPro)
  - Conventional: Freightliner M2, Kenworth T8SH/T440
  - All with 2010-compliant CWI ISL-G 8.9L 320hp engine
- MPG: 2.5 – 3.0 (lots of idle and PTO time)
- Fuel Use: 35-40gge/day; 8500-10,000dge/yr
- Natural Gas Premium: $45,000 (before fed tax credit)
- Federal Tax Credit: $32,000
- Simple Payback: 1.0-1.3 years (assumes no grants)
  (based on 1.25 savings /DGE --- conservative)
- Life-cycle cost savings: $60,000 - $70,000
- (based on 8-year life)

If no tax credit passed thru, payback is 4 – 4.5 years. Grants reduce this payback period

Specific Next Steps

- **Join your local Clean Cities Coalition, get connected to your EPA Regional Collaborative and state environmental and energy offices**
- **Prepare fleet inventory and replacement spreadsheet**
- **Ask your vehicle vendors about natural gas options**
- **Start communicating with your LDC, station developers and equipment vendors about their products and services**
- **Don't "study it to death" – take action!**

Summary

- Environmental, energy security and economic market drivers are very favorable to fleets' use of NGVs. Developing fleet market will spur eventual consumer market….walk before running.
- Many light-, medium- and heavy-duty NGVs are available from a growing number of OEMs and SVMs
- Variety of fueling options available depending on your willingness to assume or assign station O/O&M
- Federal tax credits and grants further improve NGVs' already favorable life-cycle advantages

For more information please contact:

Stephe Yborra - Director of Market Development
syborra@ngvamerica.org / syborra@cleanvehicle.org
(301) 829-2520

NGVAmerica
400 N. Capitol Street, NW - Suite 450 - Washington, DC 20001
www.ngvamerica.org

Clean Vehicle Education Foundation
6011 Fords Lake Court - Acworth, GA 30101
www.cleanvehicle.org