



Clean Cities Program Overview

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Mission

To ensure America's security and prosperity by addressing its energy, environmental, and nuclear challenges through transformative science and technology solutions

Clean Cities Mission

To advance the energy, economic, and environmental security of the U.S. by supporting local decisions to reduce petroleum use in transportation.

- Energy Policy Act of 1992 (EPAAct)
- Provides a framework for businesses and government agencies to work together
- Goal: Reduce U.S. petroleum use by 2.5 billion gallons per year

- Nearly 100 coalitions in 45 states
- 775,000 AFVs using alternative fuels
- 6,600 fueling stations

Clean Cities Coalitions

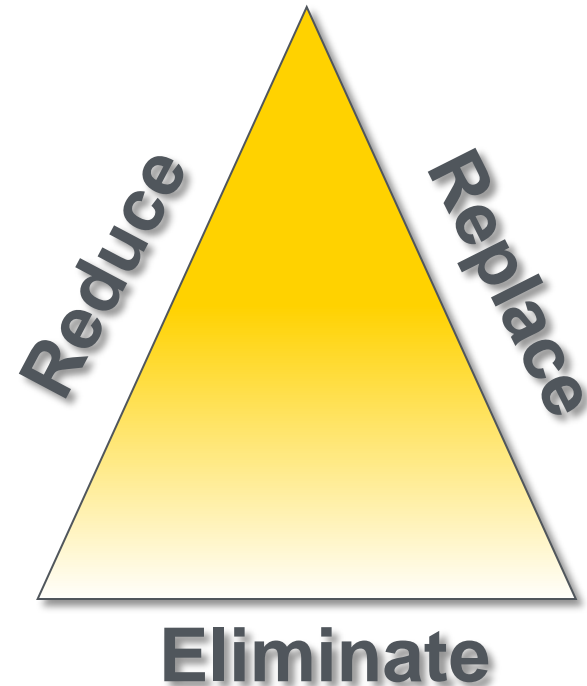


Coalitions are made up of local and national stakeholders.

- 8,400 stakeholders nationwide
- 49% private-sector stakeholders
- 51% public-sector stakeholders



- **Replace** petroleum with alternative and renewable fuels
- **Reduce** petroleum use through fuel efficiency measures, smarter driving practices, and idle reduction
- **Eliminate** petroleum use by promoting mass transit, trip elimination, and congestion mitigation



Clean Cities has saved nearly 3 billion gallons of petroleum since 1993.

- Connecting fleets with fuel providers and industry partners
- Training and information
- Technical assistance
- Funding
- Education and outreach to decision makers, fleets, and the public



Alternative and Renewable Fuels

- Biodiesel
- Electricity
- Ethanol (E85)
- Hydrogen
- Natural gas
- Propane

Fuel Economy

- Fuel efficient vehicles
- Driving habits
- Vehicle maintenance

Idle Reduction

- Technologies
- Behavioral changes

Trip Elimination

- Telecommuting
- Ridesharing



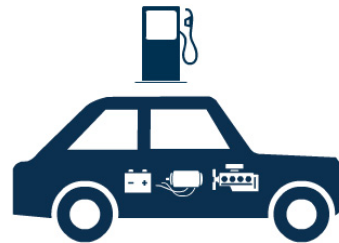
- Biodiesel can be blended with diesel in any proportion: B2, B5, B20, B100.
- B20 is the most common blend in U.S.
- Most OEMs approve up to B5 with no modifications.
- Similar payload capacity, range, horsepower, and torque as diesel.
- B20 suitable for nearly all unmodified diesel engines.



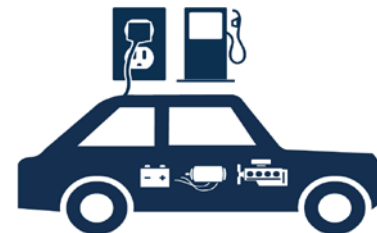
Hybrids and plug-in electric vehicles use electricity either as their primary fuel or to improve the efficiency of conventional design

Three categories of vehicles:

Hybrid Electric Vehicles (HEVs)



Plug-In Hybrid Electric Vehicles (PHEVs)



All-Electric Vehicles (EVs)



- Electric Vehicle Supply Equipment (EVSE)
- Charging times for fully depleted batteries vary based on type of battery and type of EVSE
 - **Level 1:** AC, 120V, 6-20 hours, residential
 - **Level 2:** AC, 240V, 3-8 hours, residential and public
 - **Level 3** (in development): AC, 30 minutes, public
 - **DC Fast:** DC, 208-600V, 30 minutes, public



E10

- Contains 10% ethanol, 90% gasoline
- Most common blend in U.S.

E15

- Contains 15% ethanol, 85% gasoline
- EPA approved for use in MY2001 and newer vehicles

E85

- Contains 51%-83% ethanol
- Alternative fuel under Energy Policy Act of 1992
- Used in flexible fuel vehicles (FFVs)
- Available in most states



- Currently used in modified internal combustion engines.
- Several OEMs have pre-production light-duty vehicles in demonstration projects.
- Hydrogen can be blended with natural gas to create a fuel for natural gas vehicles.



- Also known as liquefied petroleum gas (LPG)
- Colorless, odorless liquid (when stored under pressure)
- High octane rating
- Nontoxic
- By-product of natural gas processing and crude oil refining
- Less than 2% of propane used in U.S. used in transportation
- Lower GHG emissions



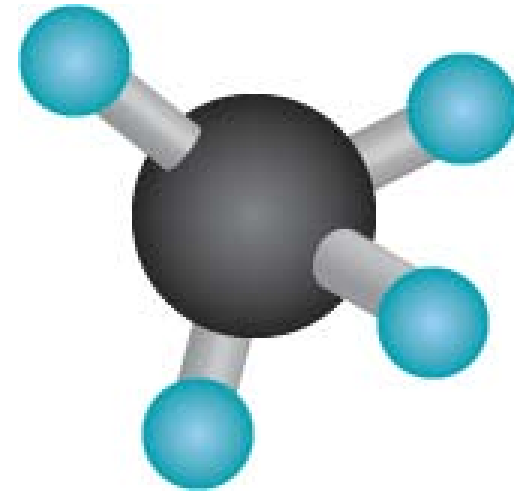
Propane Vehicle Availability

- Light-duty vehicles available
- Engines and fueling systems for heavy- and medium-duty vehicles
- Conversions



Natural Gas

- Hydrocarbons, predominantly methane (CH_4)
- High octane rating
- Nontoxic, noncorrosive, and noncarcinogenic
- Not a threat to soil, surface water, or groundwater
- Lower ozone-forming emissions than gasoline
- Extracted from gas and oil wells
- Existing pipeline distribution system



Dedicated Natural Gas Vehicles (NGV)

- Run only on natural gas
- Better performance
- Lower emissions
- Increased cargo capacity

Bi-fuel NGVs

- Two fueling systems
 - Natural gas
 - Gasoline
- Fueling flexibility

Dual-fuel NGVs

- Run on diesel and natural gas
- Heavy-duty vehicles only



- Many conventional gasoline vehicles can run on CNG.
- OEM's include Honda, BAF, Landirengo, and Cummins Westport
- 43 CNG vehicle engines are certified by EPA, available through up-fitters, carry factory

Public Health and Environment

- Lower greenhouse gas (GHG) emissions
- Lower particulate pollution
- Lower carcinogens

Energy Security

- Plentiful in U.S.
- Existing infrastructure

Driving Range

- Shorter than gasoline
- Comparable power and speed

Deployment

- Proven and established
- 114,000 natural gas vehicles in U.S. in 2008



Light-Duty NGVs

- Suitable for light-duty needs in private and government fleets
- Honda Civic GX

Medium-Duty NGVs

- Vans and shuttles
- Airports and taxi fleets

Heavy-Duty NGVs

- Refuse haulers
- Transit buses
- School buses
- Long-haul trucks
- Street sweepers
- Snowplows
- Short-haul delivery trucks



Natural Gas Vehicles for America
www.ngvamerica.org

Compare CNG Light Duty



- 2011 Honda GX (CNG)
- Combined MPG = 28
- Fuel \$/yr = \$1,071 based on CNG @ \$2.00 gge and 15K miles/yr
- Carbon Footprint 5.4 annual tons of CO₂
- Air Pollution score = 9
- Energy Impact Score = 0.1 barrels



- 2011 Honda Civic
- Combined MPG = 29
- Fuel \$/yr = \$1,810 based on reg. gas @\$3.50/gal and 15K miles/yr
- Carbon Footprint 6.3 annual tons of CO₂
- Air Pollution Score = 6
- Energy Impact Score = 11.8 barrels





Transit Connect



Ford E-Series



Ford F-Series



CNG Fuel Cost Savings – Heavy Duty - Transit Bus Example



	Fuel Use over 12 yr bus service life	Fuel Cost over 12 yrs (current price)	Fuel Savings over Diesel	Fuel Savings over Hybrid
Diesel	154,300 gal	*\$464,443	NA	NA
Hybrid (Electric/Diesel)	128,575 gal	\$387,011	\$77,432	NA
CNG	162,000 Diesel equivalent gal	**\$286,740	\$177,703	\$100,271

This chart uses pricing of \$3.01/gal for diesel (taxed)
\$1.77 Dge for CNG

Transit bus travelling 45,000 miles/year

Typical incremental cost of CNG bus over diesel is about \$50,000 (NABI 40'

Transit bus) so **Natural Gas payback from fuel savings is approx 3.3 years of typical operation.** *New England diesel price average 2-22-10

<http://tonto.eia.doe.gov/oog/info/wohdp/diesel.asp> **Based on dge=.88 gge

Viable CNG Upfit Vehicles/Engines



- Sedans, Pick-ups/SUVs, Vans/Wagons
 - American Honda
 - GMC brands through SVMs
 - Ford brands via QVMs
- Work/Vocational Trucks
 - Peterbilt, Freightliner, Crane Carrier, Condor, Isuzu, GM, Workhorse, Ottawa.....
 - Dozens of upfitters
- Bus and shuttle
 - NABI, Orion, New Flyer, Specialty El Dorado-National, Champion, Supreme, Blue Bird, Thomas Built, Optima...

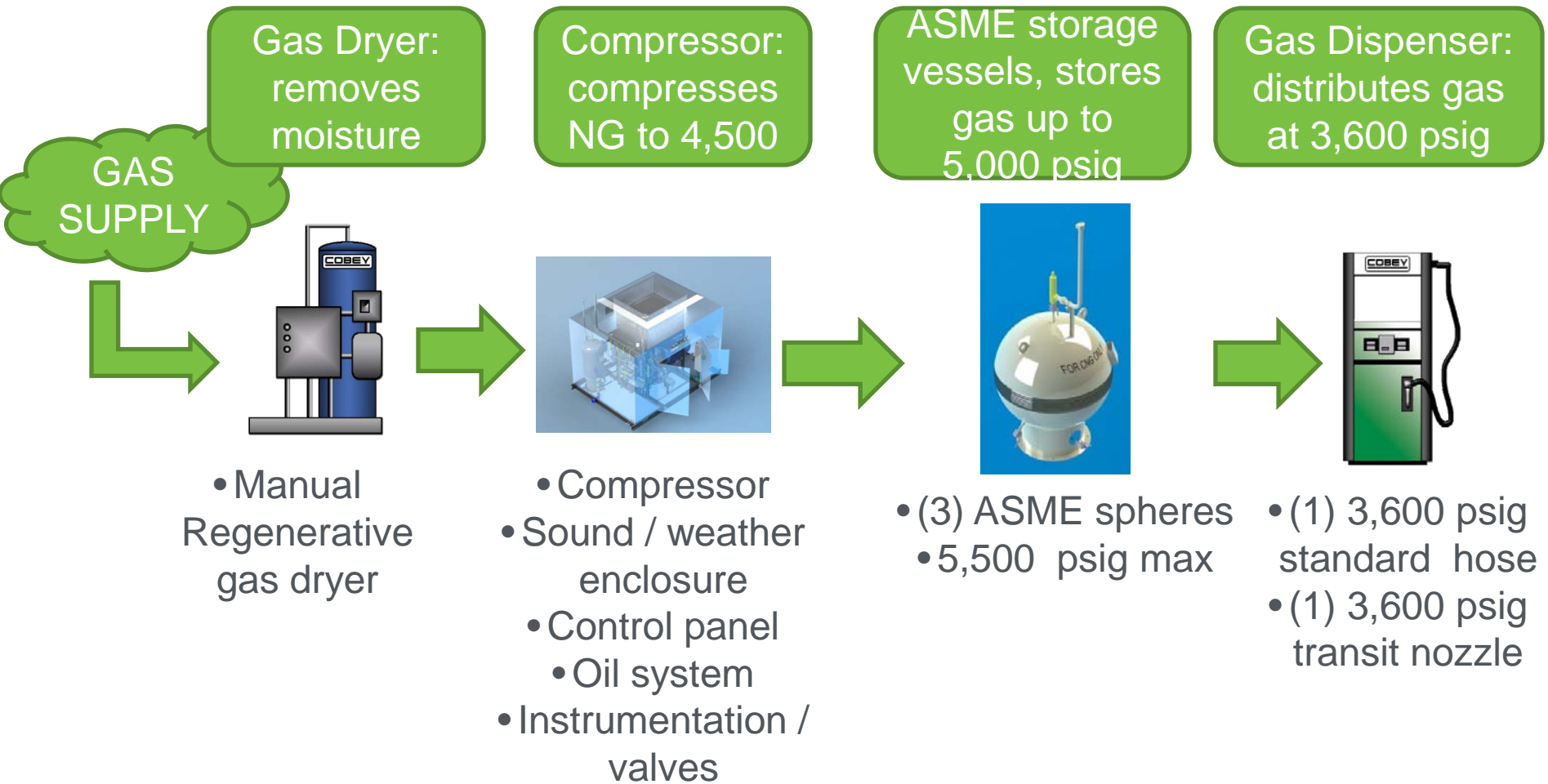


2012 Certified Natural Gas Powered Engines and Vehicles for Fleet Applications



- American Honda
 - Civic Natural Gas
- BAF Technologies
 - 5.4L (F250, E250)
 - 6.2L (E-350 cargo/passenger van – F250/350)
 - 6.8L (E-450 , F450/550/650/750)
- Baytech Corporation
 - 6.0L & 8.0 L/M/HD (GMC/Chevy, Workhorse – pick-ups, vans/stepvans,
 - Westport Innovations Inc
 - 15L GX- compression ignited – up to 475hp
- Cummins Westport
 - 8.9L “ISL-G” – 250-320hp
- Emission Solutions Inc.
 - 7.6L Phoenix NG – 175-265hp (re-power for Int’l DT466 trucks, School Bus front end)
 - Doosan Intercore America
 - 11 L GK12 290 hp for Transit, refuse, and other HD applications

CNG Filling Station Flow Diagram



CNG Fast Fill Station



Time-Fill Fueling

- Good for centrally-based fleets with consistent schedules
- CNG is dispensed slowly, often overnight
- Lower cost investment

Fast-Fill Fueling

- Fueling takes place in minutes
- Necessary for public-access stations
- Good for vehicles with little downtime

Combo-Fill Fueling

- Time-fill and fast-fill
- More flexibility in fueling



Questions to Ask

- How many vehicles will be fueled each day?
- How much fuel will each vehicle need?
- When and how often will vehicles need to be fueled?
- What are the site development requirements?



Clean Cities website

www.cleancities.energy.gov

Alternative Fuels & Advanced Vehicles Data Center website

www.afdc.energy.gov

Clean Cities Coordinator Contact Information and Coalitions

www.afdc.energy.gov/cleancities/progs/coordinators.php

Natural Gas Vehicles for America

www.ngvamerica.org

Some of the information in this presentation was provided by Natural Gas Vehicles for America, in the presentation, "The Compelling Case for NGVs in Public and Private Fleets," by Stephe Yborra, Director of Communications for the Clean Vehicle Education foundation and NGVAmerica, May 26, 2010.

For More Information



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