

# Compressed Natural Gas (CNG) Safety Assurance



## CNG Safety Assurance Project Webinar

April 11, 2017

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Supporting the U.S. DOE Clean Cities Program

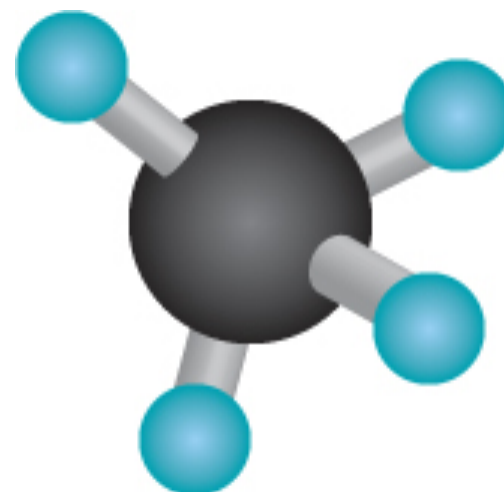
# AGENDA



Topic
CNG Basics
Safety Assurance Project Background
CNG Maintenance Requirements
Fuel Tank Code & End of Life Requirements
Defueling, Decommissioning and Disposal Video
Additional CNG Safety Assurance Efforts Underway
Q&A

## Natural Gas

- Hydrocarbons, predominantly methane ( $\text{CH}_4$ )
- High octane rating
- Nontoxic, noncorrosive, and noncarcinogenic
- Not a threat to soil, surface water, or groundwater
- Conventional natural gas is extracted from gas and oil wells
- Renewable natural gas can be produced from landfills and livestock operations
- Existing pipeline distribution system

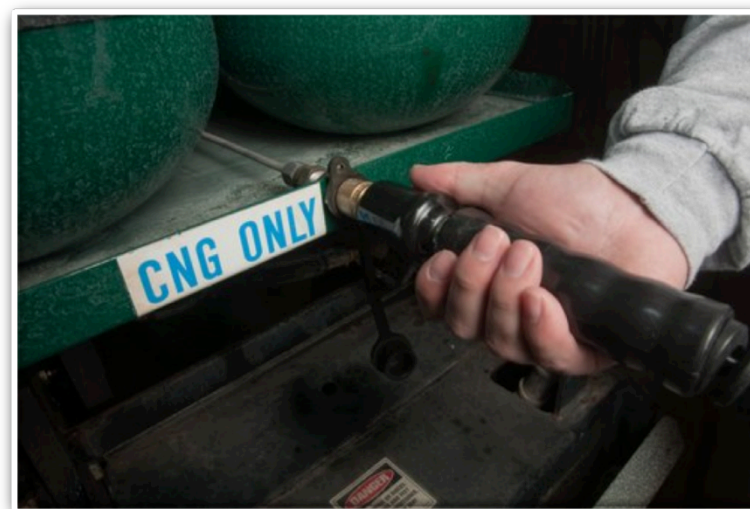


## Compressed Natural Gas (CNG)

- Stored in onboard tanks under high pressure
- Fuel economy similar to gasoline
- 1 GGE = 5.7 lb CNG

## Liquefied Natural Gas (LNG)

- Kept at cold temperatures
- Stored in double-wall, vacuum-insulated pressure vessels
- Heavy-duty vehicles
- 1 GGE = 1.5 gal LNG



# Vehicles: Applications



## Light-Duty

- Passenger cars and light-duty trucks in private and government fleets
- Personal vehicles



## Medium-Duty

- Vans and shuttles
- Airports and taxi fleets



## Heavy-Duty

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

# CNG Safety Assurance Project Background



- NGV Industry stakeholders meet regularly to discuss and address technical concerns, including those related to CNG fuel tank safety standards, periodic inspections and end-of-life disposal requirements
- A Transit Authority contacted DOE to look for assistance/direction on 160+ CNG buses with tanks that were approaching their expiration date and this experience was the catalyst to develop additional information for fleets with aging CNG fuel tanks
- To ensure safe operation and decommissioning of these fuel tanks, a government-industry partnership began to develop resources related to training, best practices, case studies, and general outreach/awareness.

# CNG Tanks and Safety



## Helpful Resource:

When properly operated and maintained, natural gas infrastructure and vehicles are unlikely to present any danger to drivers or passengers. **NFPA 52, the Vehicular Gaseous Fuel Systems Code**, spells out specific safety requirements for natural gas vehicles (NGVs) and their fueling facilities.

# CNG Code Requirements: Periodic Inspections



- CNG Fuel Tanks (Cylinders) **shall be manufactured, inspected, marked, tested, equipped and used** in accordance with ANSI NGV 2 or FMVSS 49 CFR 571.304. NFPA 52 allows either standard.
- Fuel Tanks **should be visually inspected** at least every 36 months or 36,000 miles, whichever comes first, and;
  - After a motor vehicle accident or fire and;
  - After a dispenser malfunction that results in pressure greater than 125% service pressure.



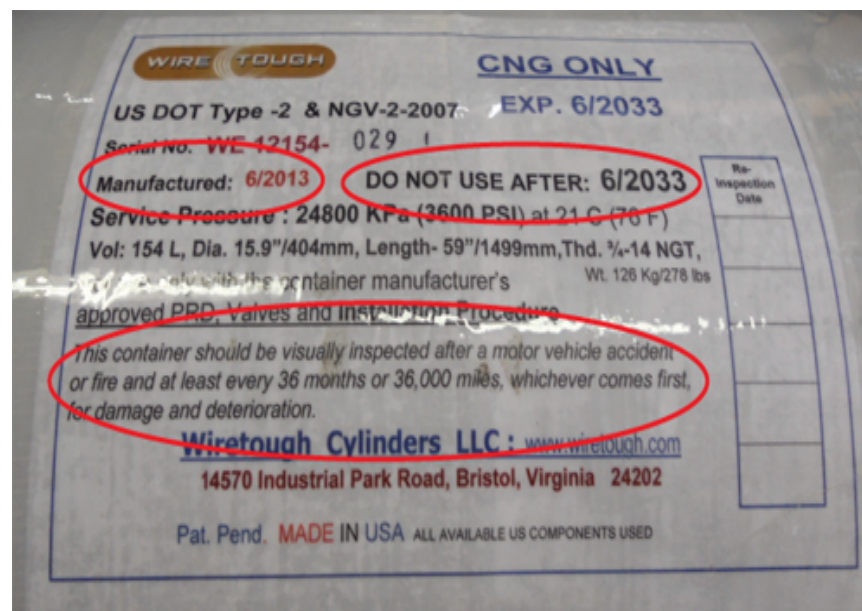
# Importance of Inspections After Accidents/Incidents



# CNG Code Requirements: End of Life



- Fuel Tanks that have reached their labeled expiration date (EOL) or been condemned by inspection **shall be removed from service (and destroyed)**.
- All CNG fuel tanks carry a label that says "DO NOT USE AFTER (EXPIRATION DATE)."
- CNG fuel tanks have a useful life of 15, 20, or 25 years, depending on their construction and how they were certified by the original manufacturer.



# LA Metro Site Visit



- In December 2015, LAMTA hosted a Clean Cities technical assistance team to observe their CNG fuel tank defueling, decommissioning, disposal and replacement process.
- The team included representatives from NREL, CSA Group, Agility Fuel Systems, Gladstein, Neandross & Associates (GNA), and U.S. Department of Transportation-Volpe Center.
- The process used by LA Metro was videotaped and is the basis of a training video developed by NREL for transit agencies and other CNG fleets.



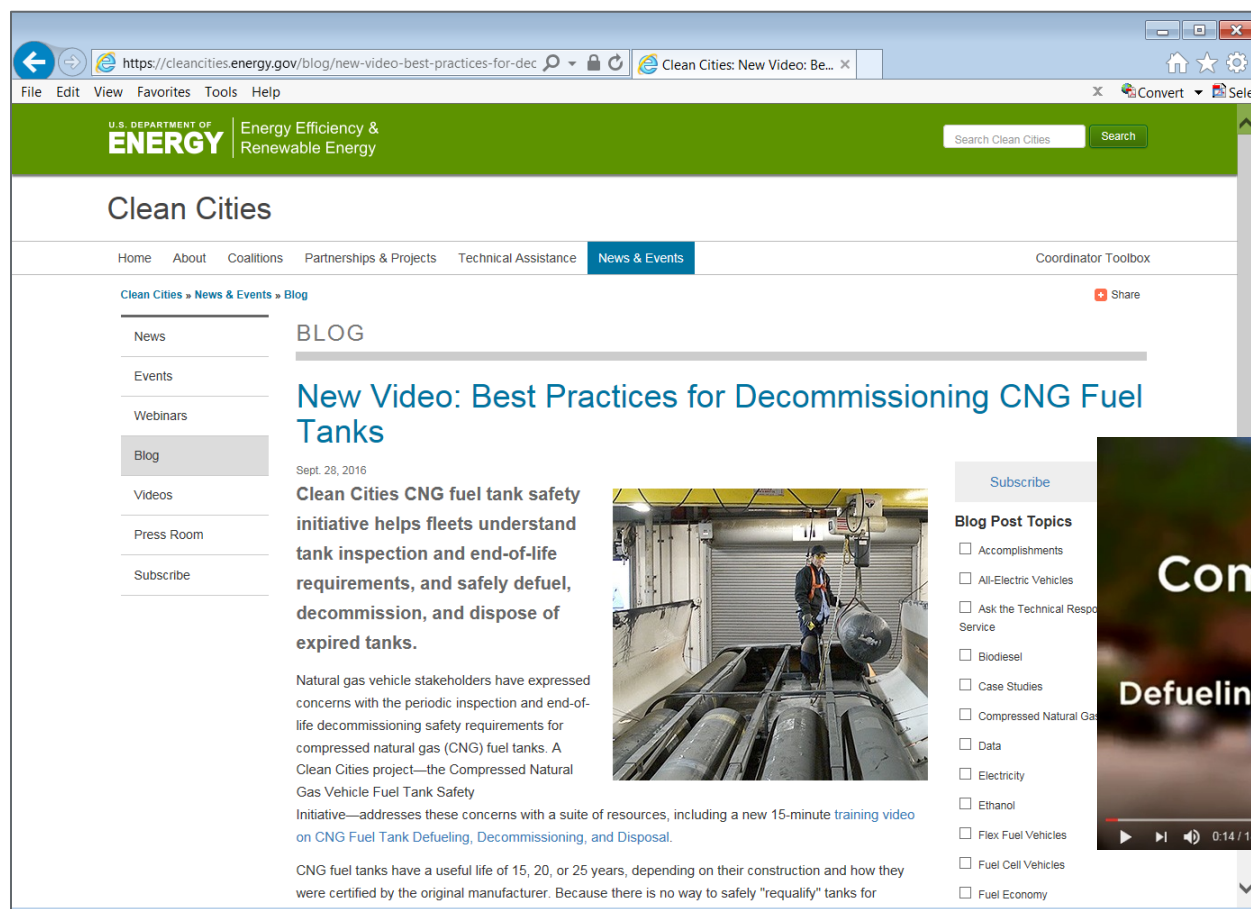
# CNG Defueling, Decommissioning and Disposal Video



[www.cleancities.energy.gov](http://www.cleancities.energy.gov)

## Chapters

- Introduction
- Defueling
- Decommissioning
- Disposal



<https://youtu.be/vTxQPfsm8n0>

## 1. Inspection of Fuel System

- Wear personal protective equipment
- Follow manufacturer guidelines
- Use properly trained technicians
- Inspect tank, valves, fittings and mounting hardware for damage/leaks



## 2. Defueling Tank

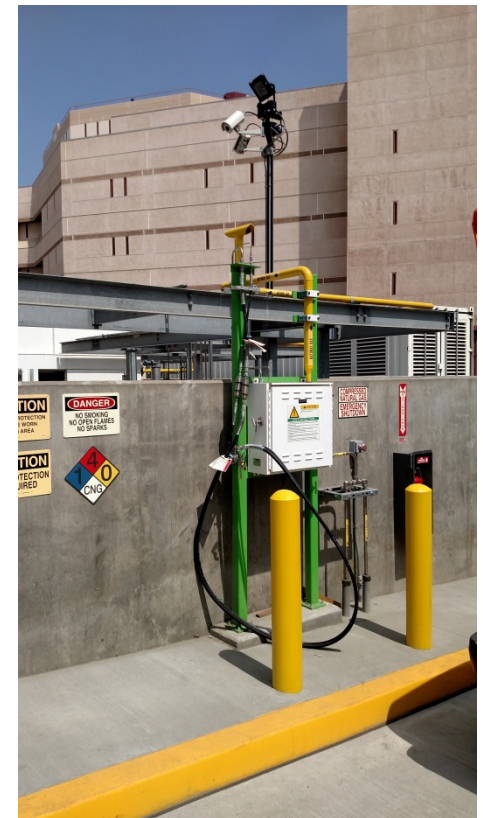
- Defuel while tank is still secured on the vehicle
- Earth ground the vehicle
- Ensure a proper connection between vehicle and fuel panel
  - Defueling time ranges from 1-12 hours depending on tank size/configuration
- Use gauge to check pressure
- Vent any residual gas remaining in tank

## 3. Verify and Document Completed Defueling

# Defueling Options



- Defuel to Another Vehicle
- Defuel to Storage
- Vent Stacks
- Flare Stacks



# Decommissioning



1. Verify Completed Defueling
2. Remove Valve from Tank
  - Wear personal protective equipment
  - Follow manufacturer recommended procedures
  - Disconnect lines & fittings before removing valve
  - Ensure technician is not in direct line with the valve as it is removed
3. Remove Tank from Vehicle
  - Remove tank mounts
  - Remove tanks individually or as an assembly
4. Purge, Destroy and Decommission Tank
  - Purge with Nitrogen to drive out any residual natural gas
  - Drill ½” holes to prevent re-use
  - Mark tank label to indicate that it is decommissioned
5. Verify and Document Completed Decommissioning



# Disposal



1. Verify Completed Decommissioning
2. Properly Dispose of Tanks
  - Follow manufacturer recommendation
  - Some tank materials can be recycled
3. Document Completed Disposal



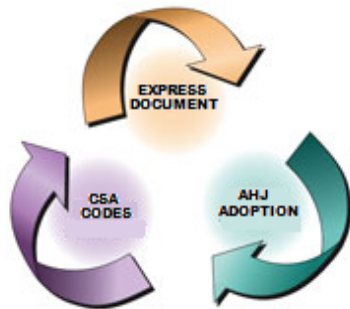
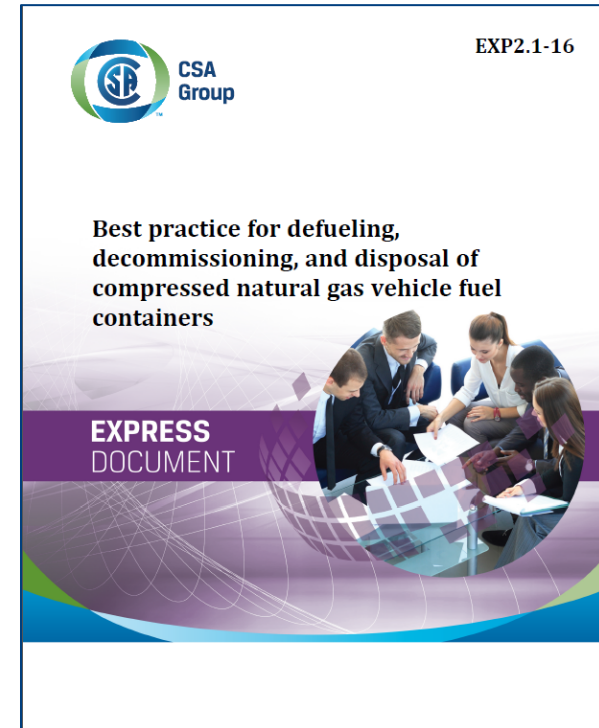
## EXP2.1, Defueling, Decommissioning and Disposal of Containers



*Key industry stakeholders have developed a CSA Express Document that will serve as a bi-national publication for the safe decommissioning, defueling and disposal of CNG storage vessels.*

The Express Document is intended to;

- increase awareness of safe practices pertaining to the decommissioning, defueling and disposal of CNG and LNG storage vessels.
- alert technicians, owners and recyclers to the potential hazards and safe practices



The Express Document will be referenced in existing Codes and Standards and is available for purchase at [www.csagroup.org](http://www.csagroup.org)

*Target users include the general public, CNG and LNG fleets, emergency responders, disposal centres and Authorities Having Jurisdiction (AHJ's).*

# Additional CNG Safety Assurance Efforts



- End of Life CNG Tank Testing Effort
  - NREL is evaluating a cross-section of CNG fuel tanks that are leaving service at end of life based on existing tank standards
  - Results of this testing will be shared with industry to continue to validate and improve tank safety standards
- CNG Incident Investigation Process Improvements
  - Collaboration between the U.S. Department of Transportation National Highway Traffic Safety Administration (NHTSA), Natural Gas Vehicles for America (NGVA) and Clean Cities Tiger Team technical experts
  - Evaluate CNG incidents to determine root cause and recommend best practices that will prevent future incidents
- CNG Maintenance Facility Modifications
  - Handbook for fleet managers in development, anticipated publication – summer 2017
  - Development of risk-informed guidelines for maintenance facility design and operation

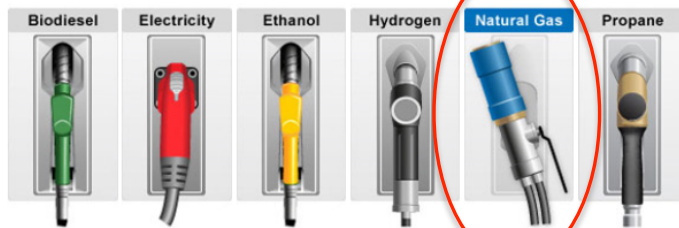
# Alternative Fuels Data Center (AFDC) CNG Resources



1 [www.afdc.energy.gov](http://www.afdc.energy.gov)

2

## Fuels & Vehicles >



3

U.S. DEPARTMENT OF  
**ENERGY**

Energy Efficiency &  
Renewable Energy

## Alternative Fuels Data Center

FUELS &  
VEHICLES

CONSERVE  
FUEL

LOCATE  
STATIONS

LAWS &  
INCENTIVES

Maps & Data

Case Studies

[EERE](#) > [AFDC](#) > [Fuels & Vehicles](#) > [Natural Gas](#)

Natural Gas Basics

Benefits & Considerations

Stations

Vehicles

Availability

Conversions

Emissions

Maintenance & Safety

- Fuel System & Tank Maintenance
- Fuel Safety
- Traffic Accident
- Filling CNG Tanks

LAWS & INCENTIVES

### Natural Gas Vehicle Maintenance and Safety

Natural gas is a clean-burning, safe fuel that can save you money at the pump while benefitting the environment and reducing U.S. dependence on petroleum. Natural gas is primarily methane and is the same gas we can use to heat our homes and cook our food, but it is also suitable as a transportation fuel in many applications.

Natural gas vehicles (NGVs) use a spark ignited engine, similar to conventional gasoline-fueled vehicles, but use a natural gas fuel storage and delivery system. Typical engine modifications for NGVs include hardened exhaust valves and valve seats, but these modifications do not change the visual appearance of the engine, nor do they change the engine's maintenance and service requirements.

### CNG Cylinders and Fuel System >

Modern vehicles have sophisticated fuel systems designed to store and deliver precise amounts of fuel to the engine to maximize performance and minimize harmful emissions. NGVs are no different—but the fuel storage and delivery system may look and operate differently than those of conventionally-fueled vehicles. NGV system maintenance differs, too. The most important added maintenance requirement for NGVs is to have the fuel storage tanks inspected at regular intervals, after accidents, or when there is suspected damage. It is also critical to know the end-of-life date of the tank so it is properly decommissioned at the end of its useful life.

More Information

- > [CNG Cylinder and Fuel System Maintenance](#)
- > [Natural Gas Safety](#)
- > [After a Traffic Accident](#)
- > [Filling a CNG Tank](#)

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Clean Cities Website: [www.cleancities.energy.gov](http://www.cleancities.energy.gov)

Alternative Fuels and Advanced Vehicles Data Center: [www.afdc.energy.gov](http://www.afdc.energy.gov)

Fuel Economy: [www.fueleconomy.gov](http://www.fueleconomy.gov)

Clean Cities Coordinator Contact Information and Coalition Web Sites:  
[www.afdc.energy.gov/cleancities/progs/coordinators.php](http://www.afdc.energy.gov/cleancities/progs/coordinators.php)

Clean Cities Technical Response Service: [technicalresponse@icfi.com](mailto:technicalresponse@icfi.com),  
800-254-6735



U.S. Department of Energy

## Question and Answer Session

Please type your questions  
into the question pane on the control panel