



# Implementing a Natural Gas Vehicle Program: Getting the Fuel

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- **VSE Federal Group**
  - Engineering, technical, management, and integrated logistics support services to U.S. military, government agencies, others
- **VSE International Group**
  - Engineering, industrial, logistics, maintenance, fleet-wide ship and aircraft support, and foreign military sales services to U.S. military, government agencies, and commercial customers
- **Akimeka, LLC\* / G&B Solutions, Inc.\***
  - Information technology provider and consulting
- **Energetics Incorporated\***
  - Technology and management consulting firm
- **Wheeler Bros., Inc.\***
  - Design and distribution of fleet vehicle maintenance and defense components

Highly-qualified staff of 150 with diverse skills and depth of experience

## ● Services

- Studies and Analysis
- Strategic Planning
- Roadmapping
- Program/Project Management
- Metrics and Evaluation
- Communications and Outreach

## ● Technical Expertise

- Climate Change and Natural Resources
- Energy Supply and Delivery
- Energy Efficiency
- Public Health
- Critical Infrastructure
- Industries

Headquartered in Columbia, MD with additional offices in Arlington, VA, Washington, DC, and Albany, NY

- **Program Management and Technical Support**
  - U.S. Department of Energy Vehicle Technologies Program
    - 21<sup>st</sup> Century Truck Partnership
    - Deployment – Clean Cities Program
- **Technology Assessments and Market Evaluation**
  - Electric Trailer Refrigerated Units (eTRU) for long haul trucks
  - Hydraulic hybrid series technology for taxis, shuttle buses, delivery
  - Propane heaters for northern climate school bus applications
- **Technology Demonstration and Testing**
  - Hydrostatic Regenerative Braking (HRB) for refuse trucks
  - Hybrid Electric Vehicle (HEV) technology for delivery trucks
- **Technical and Outreach Assistance for Deployment**
  - NYS Electric Vehicle Supply Equipment Support
  - NYS CNG Outreach and Education
  - NYSDOT Idle Reduction Technology Assessment

- ✓ Learn about natural gas
- ✓ Understand the benefits of natural gas
- ✓ Assess your vehicle fleet
- ✓ Identify suitable natural gas vehicles
- ✓ Determine economic payback on vehicles

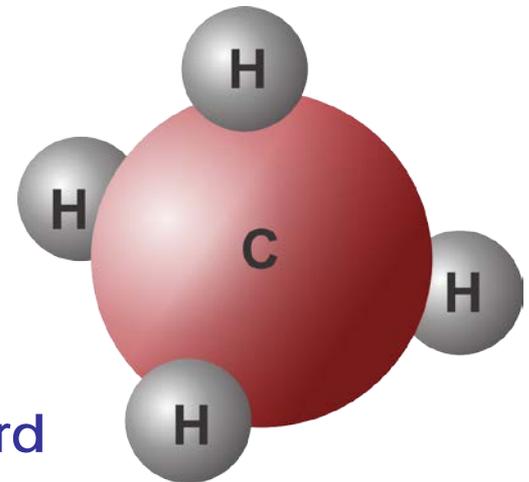
Where, How, and with What do I fuel these vehicles?

## ● Source

- Fossil fuel (petroleum by-product, shale gas, etc.)
- Biomethane (renewable: landfill gas, animal/crop waste)

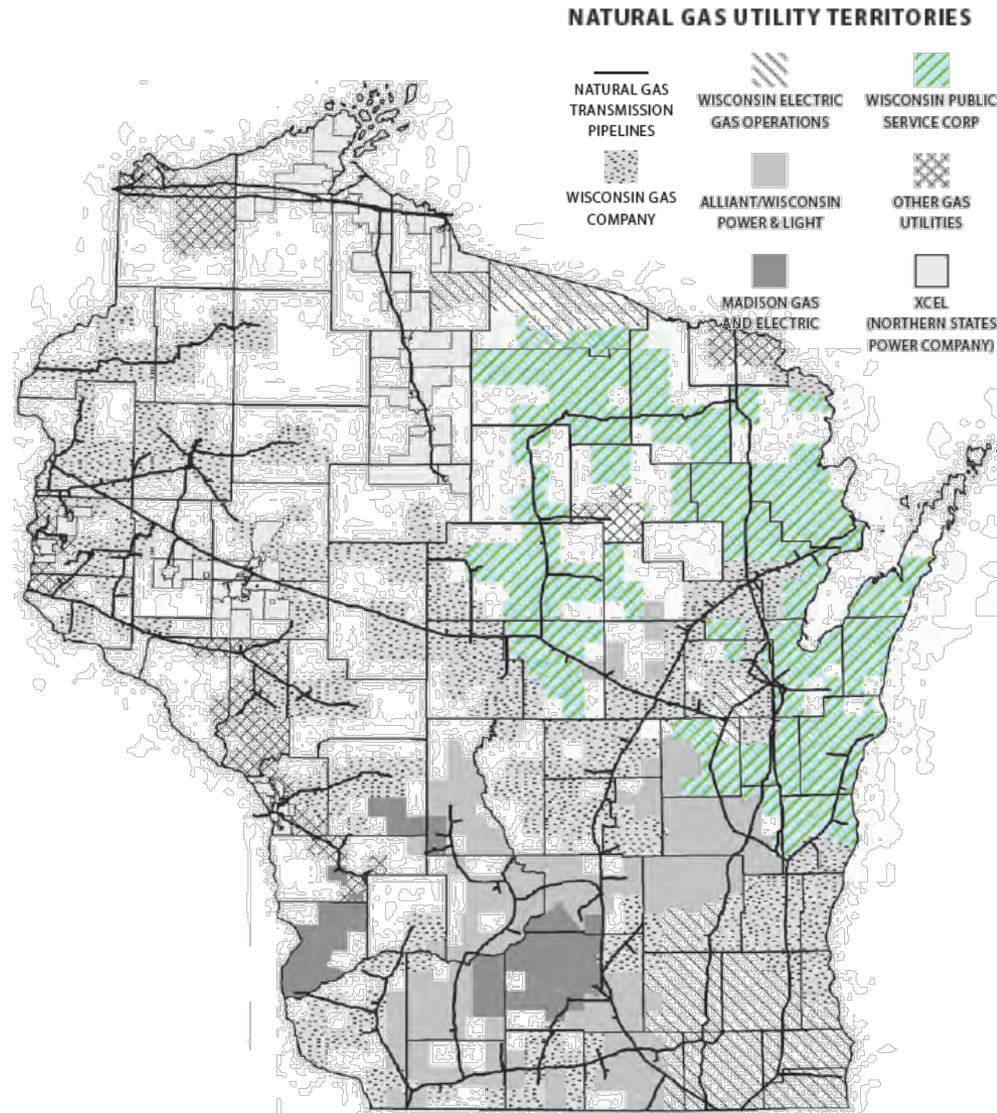
## ● Vehicle fuel types

- Compressed natural gas (CNG)
  - 3,000-3,600 psi
  - SAE J1616 recommended practice
- Liquefied natural gas (LNG)
  - $-162^{\circ}\text{C}$  /  $-260^{\circ}\text{F}$
  - SAE J2699 recommended fuel standard

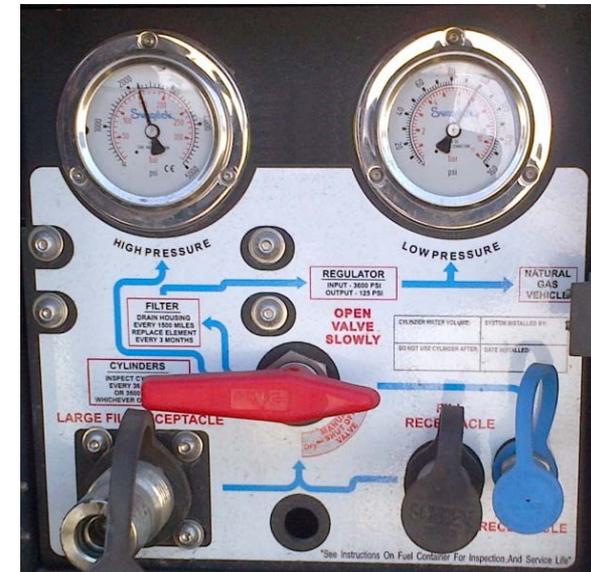


# Natural Gas Supply

- 95%+ Domestic
- Significant existing distribution network
  - More than 1,900,000 miles of distribution pipelines
  - Heat commercial and residential buildings
  - Generate electricity



- American National Standards Institute (ANSI) NGV1: sets requirements for CNG fueling connection devices
  - P36 (3,600 psi): yellow, P30 (3,000 psi): blue
  - Type 1: venting, Type 2/Type 3: non-venting
  - CT1000: light-/medium-duty, CT5000: heavy-duty



- Gasoline gallon equivalent (GGE) = therms/1.25
- Diesel gallon equivalent (DGE) = therms/1.37



- Automatic temperature compensation
  - Gas Technology Institute: full fill algorithm
  - Fast-fill fueling may not result in a completely full tank

# Existing Infrastructure

- CNG: 26 public (14 commissioned in 2012), 6 private, and 1 planned / LNG: 1 public
  - We-Energies (6), Kwik Trip (6/1), Probe (4), Trillium (3)

*U.S. Department of Energy Alternative Fuels Data Center: Alternative Fueling Station Locator*

The screenshot shows the 'Find Stations' interface for Wisconsin. The search criteria are set to 'Wisconsin' and 'Compressed Natural Gas'. The results show 23 CNG stations in Wisconsin, excluding private stations. The map displays the state of Wisconsin with various cities and towns marked, including Eau Claire, Wausau, Green Bay, Appleton, Neenah, Manitowoc, Oshkosh, Fond du Lac, Sheboygan, Madison, Germantown, Mequon, Milwaukee, Waukesha, Janesville, Racine, Kenosha, and Dubuque. The map also shows major highways like 53, 141, 43, 18, and 151.

- Case study: fleet using existing public stations

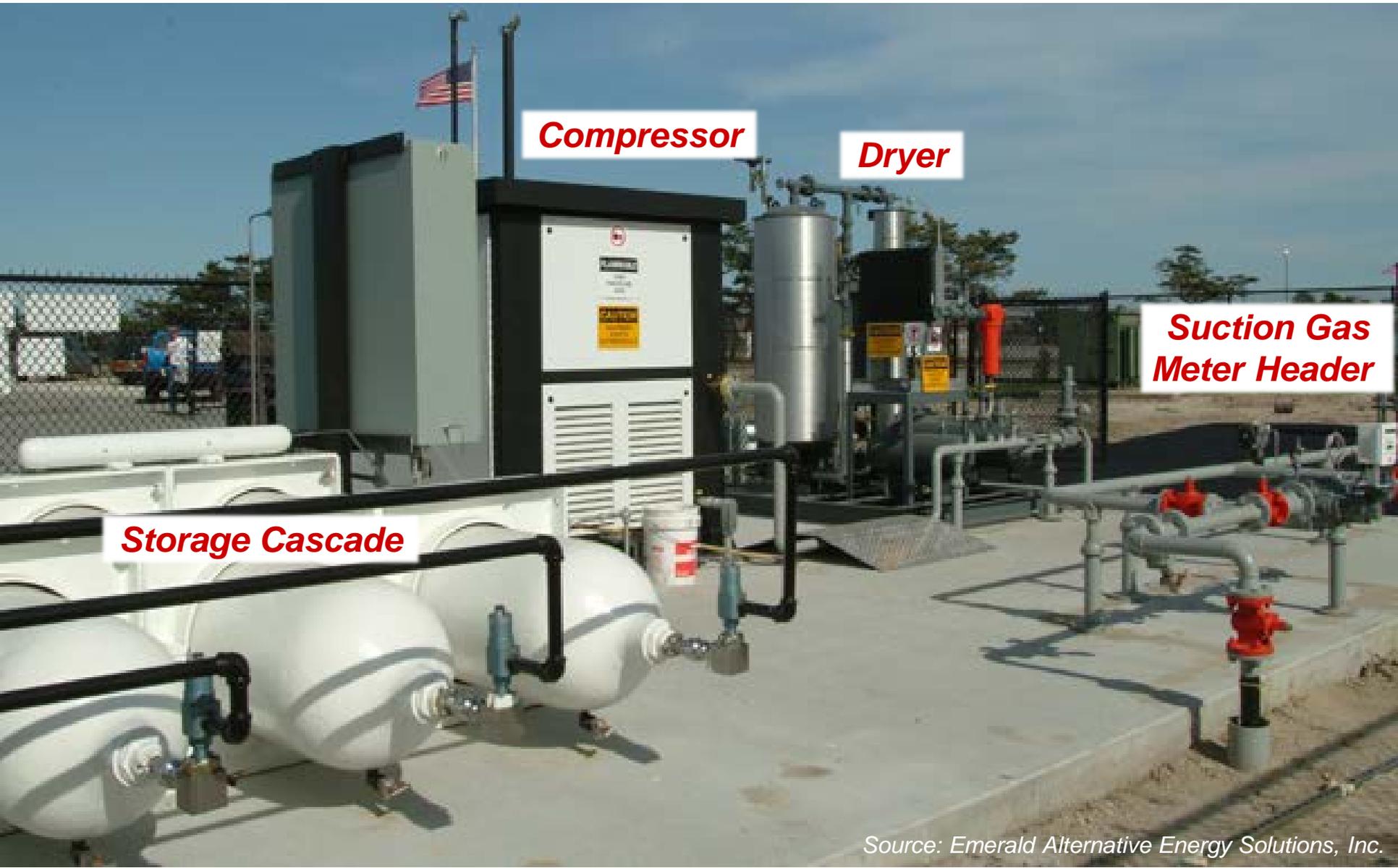


## ● Case study: fleet using existing public stations



- **Dryers: single- or twin-tower designs**
  - Desiccant drying bed that must be “regenerated”
- **Compressors: typically reciprocating or rotary**
  - Rated by standard cubic feet per minute (SCFM) discharge
    - GGE/hr is approximately equal to the SCFM x 0.5
  - Multiple compressors provide redundancy
- **Storage tanks: spheres or cylinders**
  - Designed to handle peak fueling, can be increased as needed
- **Dispensers and fuel management controls**
  - Metering, payments, vehicle data capture

# Long Beach Schools



**Compressor**

**Dryer**

**Suction Gas  
Meter Header**

**Storage Cascade**

## ● Time-fill

- Dedicated parking of multiple vehicles for a long period
- No storage, constant compressor use, most complete fill

## ● Cascade fast-fill

- Irregular fueling of few vehicles, primarily light-duty
- Smaller compressor, 3 bank storage (low, med, high)

## ● Buffer fast-fill

- Continuous fueling of vehicles, large vehicles
- Larger compressor, single pressure storage for “dwell” time

## ● Combination

- Time-fill and cascade/buffer fast-fill

- Case study: fleet using a time fill solution



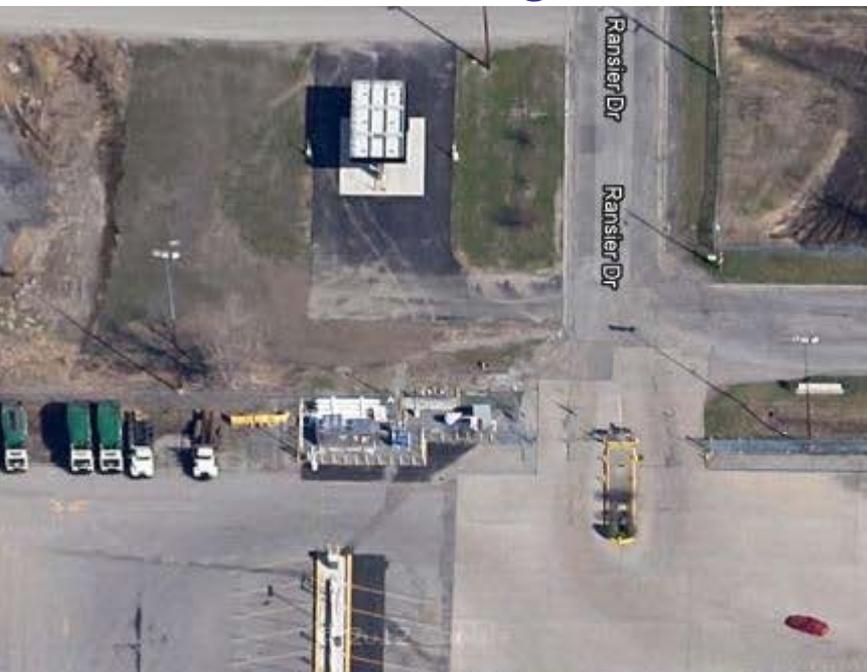
## Case study: fleet using a time fill solution



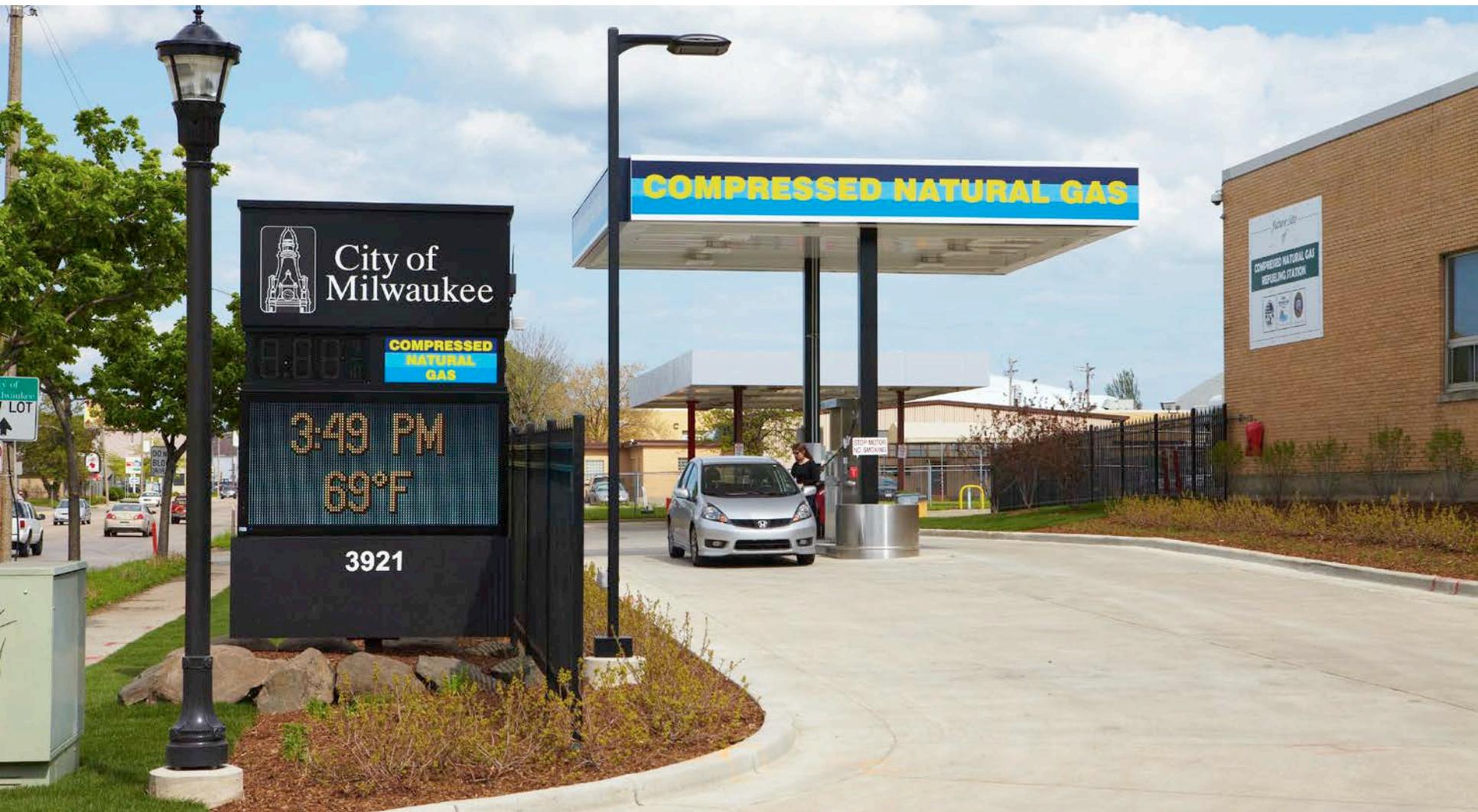
- Vehicle number and type that will be fueling
- Max amount of fuel dispensed daily and hourly
  - Determines compressor and storage sizes
- Fueling pattern (at once or spread throughout)
  - Determines station configurations
- Nearest location of a back-up option
  - Determines importance of redundant equipment
- Facility location and property
  - Equipment footprint, natural gas availability, traffic flow
  - Proximity to other fleets or general traffic (public access?)

# Waste Management

- Case study: combination (inside/outside fence)



- Case study: combination (inside/outside fence)



- **Initial station equipment onsite**
  - Own: access to capital, time-fill, small/medium fleets
  - Outsource: long-term fuel agreement, royalty for other sales
- **Station service and maintenance**
  - Own: requires expertise and knowledge, inventory of parts
  - Outsource: included with construction bid or contracted separately, may be more costly but provides Peace of Mind
- **Public access**
  - Facility security, management of payments
- **Outsource station construction and operation offsite**
  - “Pool” fuel demand, better fleet location, C-stores (Kwik Trip)

- Case study: CNG bid for services, outsourcing



## ● Time-fill

- Dryer, 300 scfm compressor, 20 2-hose time-fill dispensers
- 40 heavy-duty vehicles (up to 38 GGE) in a 10-hour period
- Total cost: ≈\$675,000 (≈\$375,000 for components)

## ● Fast-fill

- Dryer, 300 scfm compressor, 3 vessel storage, 2-hose dispenser
- 15 light-duty or 10 medium-duty vehicles during 1-hour peak
- Total cost: ≈\$800,000 (≈\$500,000 for components)
- Add ≈\$200,000 for a second redundant compressor

Source: America's Natural Gas Alliance TIAX Study "U.S. Canadian natural Gas Vehicle Market Analysis: Compressed Natural Gas Infrastructure – Final Report"

[www.anga.us/media/content/F7D3861D-9ADE-7964-0C27B6F29D0A662B/files/11\\_1803\\_anga\\_module5\\_cng\\_dd10.pdf](http://www.anga.us/media/content/F7D3861D-9ADE-7964-0C27B6F29D0A662B/files/11_1803_anga_module5_cng_dd10.pdf)

## • Case study: Private fast-fill station



- No ignition source within 18" of ceiling
  - Except with 4 air changes per hour (ACH)
- Ventilation
- Non-spark heating system and lights
- Methane detection, emergency safety system
- Emergency push buttons
- Defueling capability
- NFPA 88B – Standard for Repair Garages; NFPA 30A – Motor Fuel Dispensing Facilities and Repair Garages
  - Check and work with your local permitting authority
  - Early Fire Marshal involvement

- Talk to fleets that have gone through the process
- See if other nearby fleets have interest to pool demand (work with Clean Cities, fuel providers, etc.)
- Natural gas supply capacity test
- Availability of incentives and outside funding
- Assistance from consultants for engineering design, construction, etc
- Final economic evaluation and business case
- Develop Implementation Plan
- TAKE ACTION!



# ? Questions ?

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