

Green Fleet efforts

City of
SACRAMENTO
Department of General Services

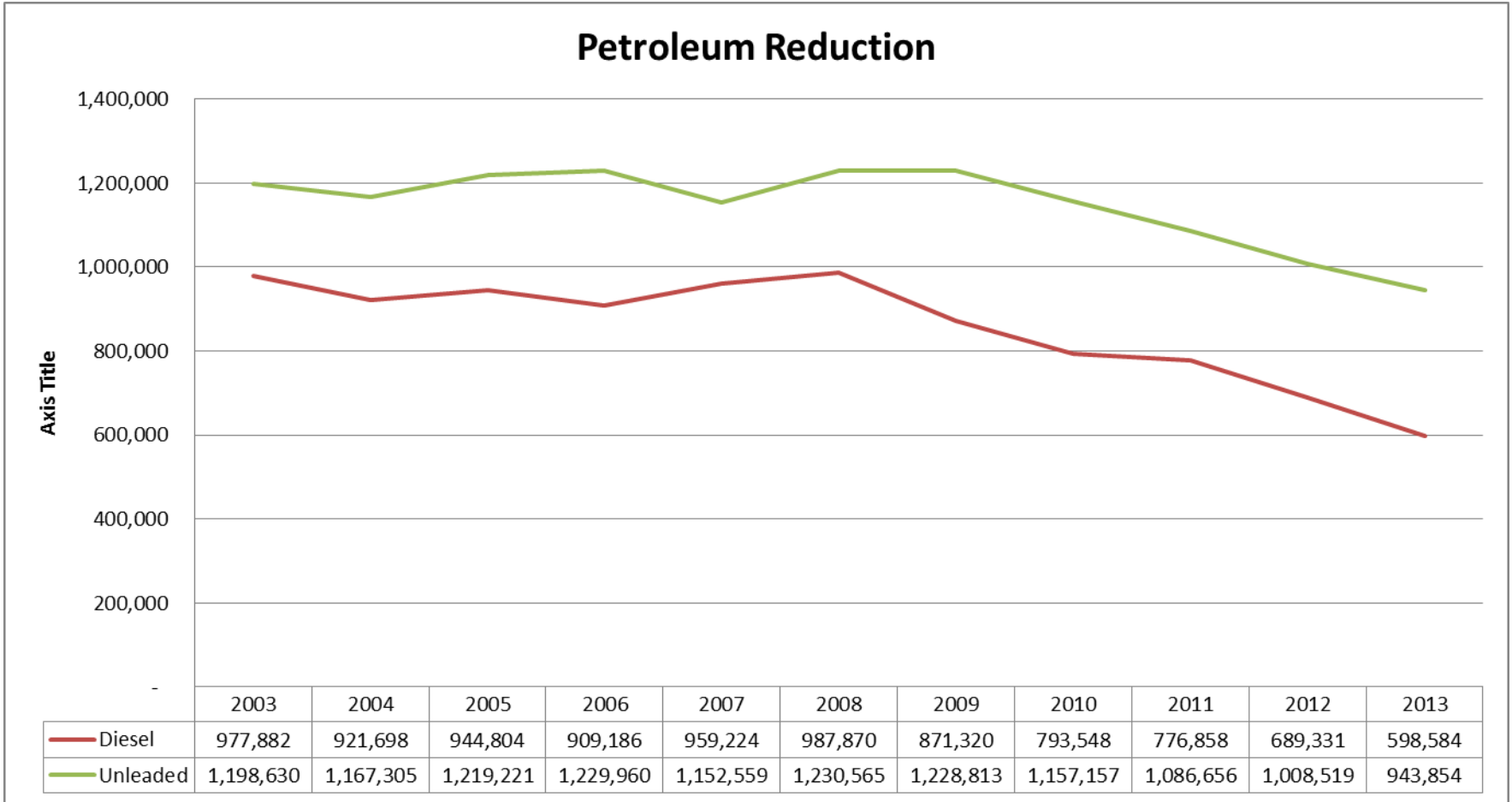
City of Sacramento



Alt Fuel/Plug In & Hybrid Vehicles

□ Renewable LNG & CNG	120
□ E85 Flex Fuel	272
□ Propane	27
□ Hybrid	46
□ Electric	17


Petroleum Reduction



From year 2003 to 2013 total overall petroleum consumption dropped by 34% (Reduction in unleaded by 24% and Diesel by 48%)

Making Sustainable Choices



	Diesel	CNG	Diesel	CNG
Price	\$ 312,165.00	\$ 369,165.00	\$ 165,951.00	\$ 222,591.00
Incentives 	\$ -	\$ (10,917.00)	\$ -	\$ (19,839.00)
Price after incentive	\$ 312,165.00	\$ 358,248.00	\$ 165,951.00	\$ 202,752.00
*Total Diesel SCR vs. CNG system maintenance cost including fuel based on City 10 year lifecycle	\$ 109,170.00	\$ 29,418.00	\$ 115,450.00	\$ 31,188.00
10 year Total Cost for this comparison	\$ 421,335.00	\$ 387,666.00	\$ 281,401.00	\$ 233,940.00
Projected Savings	\$ -	\$ 33,669.00	\$ -	\$ 47,461.00

Total Projected Savings

\$ 81,130.00

- **Greening the Fleet has a direct impact on reducing costs**
- **Cost-effectively meets city sustainability policy**



*This cost comparison is based on manufacturers recommended diesel Selective Catalytic Reduction (SCR) vs. CNG system maintenance only plus historical fuel use . The cost of Diesel is based on an avg. price of \$3.63 vs. the contract cost of CNG projected to be stable for the next three years at 86 cents per gallon assuming vehicles will be fueled at RT stations. A fuel conversion factor of 1 gallon diesel = 1.19 CNG was used in this table

Taking the Green Leap

CNG CYLINDERS

would warrant further, more detailed inspection.

- Look for damage or deterioration, such as impact damage from a collision, cuts and abrasions, corrosion from deicing salts, exposure to fire, and/or over-pressurization by a defective station.
- If there is any damage to the cylinder, one should refer to the tank manufacturer's cylinder inspection manual in order to

determine which level of damage the tank has sustained," Wollgiehn recommended. "The level of damage will determine whether a minor repair can be performed by the customer, whether the cylinder will need to be returned to the manufacturer for repair, or whether the cylinder needs to be condemned and removed from service."

SPECIAL CONSIDERATIONS FOR CNG TANKS

When looking to install and utilize a compressed natural gas (CNG) tank, fleet managers should take the following factors into special consideration:

- CNG cylinders are pressure vessels, operating at 3,600 psi (250 bar) in the U.S. market. That means a structural failure of the tank produces hazards beyond the release of a flammable fuel. Regular fuel tanks hold no pressure.
- Because CNG tanks are pressurized, more comprehensive performance tests are required.
- CNG cylinders need to be protected from impact damage, road debris, and UV exposure from sunlight.
- CNG cylinders are more expensive to replace.

WHAT HAPPENS TO A CNG CYLINDER WHEN IT'S REPLACED?

After a compressed natural gas (CNG) tank has passed its useful life, several steps must be followed for proper disposal; they must be depressurized, removed, destroyed, and disposed of.

A critical step in the process is venting all CNG from the cylinder. "There have been a number of serious and fatal accidents when technicians mistakenly thought they had released all of the pressure from a CNG cylinder but had not," said John Dimmick, director of technology, Clean Vehicle Education Foundation. "The various cylinder valves used in CNG cylinders require different procedures to make sure the pressure in the cylinder is fully released. No attempt to remove a cylinder valve should be made without following the service procedures of either the natural gas vehicle (NGV) OEM or the manufacturer of the valve."

After the cylinder is completely vented, the valve must be removed. "This is the best indicator that the cylinder is really empty," Dimmick said.

Once cylinders are purged of all residual natural gas, Randolph Wollgiehn, marketing manager for CNG Cylinders International, said there are a few final precautions before they're finally recycled. "Cylinders should be destroyed by drilling or cutting before they are sent to a recycling facility," he said. "This ensures a third party is not able to fill the cylinder by accident."



This International WorkStar 7600 is fitted with a CNG tank. Its CNG cylinders need to be protected from impact damage, road debris, and UV exposure from sunlight.

The Consequences of Waiting

Guidelines for the proper replacement times of CNG cylinders are in place for a reason: keeping cylinders in use after the expiration date or operating damaged tanks can have serious safety consequences.

"Under no circumstances should an expired cylinder be used on a CNG vehicle as the manufacturer is not able to guarantee the cylinder will be able to safely withstand the pressure and stress put on the cylinder during the fueling and de-fueling process," Wollgiehn said. "CNG cylinders in the U.S. market have a service pressure of 3,600 psi (250 bar). Needless to say, when dealing with these kinds of pressures, one should not gamble with safety."

Dimmick said the Clean Vehicle Education Foundation has seen CNG tanks fail. And, while these incidents are few, they are serious in nature.

"CVEF believes that it is very important to comply with the safety standards and codes for CNG cylinders. The failure modes that drive the tests in FMVSS 304 and NGV2 are a CNG leak and a cylinder rupture and these tests are predicated on a finite design life," he said. "The Clean Vehicle Education Foundation assists in the investigation of serious incidents involving NGVs and these include a number of ruptures. In some cases, the cylinder had exceeded its labeled life but it has not been definitively possible to state that this was the cause of the rupture. From a statistical standpoint, relatively few CNG cylinders have been in service long enough to exhaust their design life."

"We strongly discourage fleets from purchasing used CNG cylinders, since it is very difficult to determine their history, such as whether or not they were involved in an accident. Damage is easily disguised but can have detrimental consequences," Wollgiehn said. "Pricing can also be an indicator. If it sounds too good to be true, it usually is."

When in doubt, Horne of the Clean Vehicle Education Foundation said the best rule of thumb is to never deviate from code and manufacturer guidelines.

"As long as the CNG cylinder owners follow the code requirements and manufacturers' instructions concerning the inspection programs and the end of life date noted on the cylinder labels, we will continue to have safe and reliable CNG storage systems," he said. "As we move toward more OEM products these issues will be part of the OEM maintenance programs and notices for the end of life removal, decommissioning and proper disposal of cylinders." #



The City of Sacramento's fleet department (inset) has reduced gasoline consumption by 10 percent since 2011 and increased the use of compressed natural gas (CNG), due to the Sacramento BioDigester (above), an anaerobic digestion system that converts 25 tons of food waste into different forms of renewable energy.

Taking the Green Leap

The City of Sacramento has taken its "going green" goals to a new level, and it's been able to prove the benefits along the way. By **Stephane Babcock**

In the capital of alt-fuel friendly California, the City of Sacramento's Fleet Manager, Keith Leech, has not only invested in going green, he's converted more than 20 percent of the City's fleet to alternative-fuel vehicles, including liquefied natural gas (LNG) and compressed natural gas (CNG) refuse trucks, flex-fuel light-duty sedans and pickup trucks, propane autogas vans and trucks, and plug-in battery electric and hybrid motor pool vehicles.

"Fleet management decided to make the change to reduce the fleet's reliance on petroleum and also reduce emissions," said Leech, a 2013 *Green Fleet Sustainability All-Star*. He has measured the effectiveness of different alternative fuels based on the reduction of emissions, as well as their cost effectiveness and total cost of alt-fuel vehicle ownership (TCO).

Leech is able to justify the cost difference of alt-fuel vehicles by recovering the added initial cost through the lifecycle of the vehicle due to their lower fuel and maintenance costs. "Additionally, we are reducing the carbon footprint, which is in alignment with the City of Sacramento Sustainability Master Plan," Leech added.

Paving the Way

Over the past few years, the City of Sacramento has pioneered a number of alternative-fuel programs, including the

use of renewable natural gas produced by food waste. The Sacramento BioDigester, manufactured by CleanWorld, is the largest closed-loop anaerobic digestion system in North America, according to the City. It converts 25 tons of food waste per day — and will soon be upgraded to 100 tons per day — into a number of different forms of renewable energy, including heat, electricity, and CNG, which is dispensed at an adjacent fueling station that is owned by Atlas Disposal and operated by Clean Energy Fuels.

"The City of Sacramento is the first government fleet in the country to use renewable CNG produced locally from food waste from an anaerobic digester to power their trucks," Leech said. "The City also uses more than 1 million gallons of LNG per year to power its refuse trucks, which saves Sacramento more than \$1 million versus diesel trucks."

According to Leech, the City has a sourcing agreement in place for up to 2,500 gallons of CNG per week. This includes at least 30-percent renewable CNG at the fueling station, which will fuel 20 new heavy-duty CNG-powered trucks, 11 Autocar rear loaders, three Freightliner Elgin Broom Bear sweepers, two Vaccon sewer truck, a pavement patch truck, and three Freightliner M2 Utility Service trucks.

Reporting on Sustainability

Sacramento's fleet management department

was provided a report containing the results of two separate analyses based on data provided by Ullimaker, a fleet consulting and technology solutions firm. These analyses included fuel consumption by type as a percentage of fleet and greenhouse gas emissions (GHG) analysis.

According to Leech, "the report quantifies the City's reduction in petroleum consumption and increases in alternative-fuel usage with the associated emissions benefits. This information has been extremely effective in further educating and influencing the city council and our fleet customer departments resulting in the adoption of our enhanced Fleet Sustainability Policy."

Among the fleet's sustainability achievements due to its alternative-fuel fleet between 2011 and 2013:

- Gasoline consumption was reduced by 10 percent.
- LNG fuel consumption was increased by 87 percent.
- Diesel consumption was reduced by 34 percent.
- The City fleet consumed 703,419 fewer gallons of gasoline and diesel fuel in 2013, compared to 2009.
- Fleet had a decrease of 33.5 percent in total fuel consumption, compared to 2009.
- GHG gas emissions decreased by 3,040 metric tons from 2009 to 2013, an 11-percent decrease from 2009 to 2013. #

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