West Coast Partnership to Promote Alternative Fuel Corridors

Natural Gas and Propane Technologies & Infrastructure

Alternative Fuel Infrastructure Corridor Coalition (AFICC)
Washington, Oregon, and California
Webinar Session #3
Thursday, November 1, 2018
2:30 p.m. – 4:00 p.m. PT
Overview

- Overview of the Alternative Fuel Infrastructure Corridor Coalition (AFICC)
- AFICC Technical Webinar Objectives
- Discussion Leader Presentations: Natural Gas and Propane Technologies and Infrastructure
- Workgroup Discussion
West Coast MD/HD Alternative Fuel Corridors

Interstate collaboration is needed to develop west coast corridors for MD/HD AFV fueling similar the one shown here for LD ZEVs. This would help to address:

- Emission reductions
- Fuel supply diversity
- Sustainable freight, public works, refuse collection, transit & school bus
- Local job creation and economic development
Alternative Fuel Infrastructure Corridor Coalition (AFICC)

1. Convene a stakeholder coalition focused on M/HD alternative fuel infrastructure deployment.
2. Conduct stakeholder workgroups & targeted outreach to identify desired and unfunded M/HD alternative fuel stations.
3. Synthesize stakeholder input into a plan document.
4. Use the plan to support project development, leverage existing funds, and seek joint applications to US DOT and other competitive funding programs.
5. Obtain federal funding assistance to help implement infrastructure in California, Oregon and Washington (i.e. natural gas, propane, electric vehicle charging and hydrogen for public and private M/HD fleets).
AFICC Project Overview

**Needs**
- Prioritize Hot Spots (Areas of Congestion, EJ Communities, Intermodal Freight Hubs)
- ID Alt. Fuel Infrastructure Gaps
- ID Best Techs/Fuels for Vocational/Transportation Activities/Project Areas

**Facilitate Workgroup Sessions [CA, OR & WA]**
- Collect Feedback, Compile Info, & Research Q's

**Develop AFV Stakeholder Synthesis**
- Summarize Workgroup Feedback
- Respond to Questions
- Outline Critical Barriers & Challenges
- Evaluate Needs & Costs for AFV Infrastructure

**Draft Implementation Plan**
- Include Themes & Priorities
- Outline Strategy & Actions
- Provide Recommendations
- ID AFV Project Partnerships
- Estimate Project Costs & ID Funds

**Establish Framework**
- Define Workgroup Discussion Objectives
- ID Key Stakeholders
- ID Coalition-Supporting Resources
- ID Direct Outcomes

**Opportunities**
- ID partnerships with Freight Shippers, Carriers, BCOs, Ports, Railroads, Truck Associations (LMCs/IOOs) Truck Stops, Warehouses, EDCs, and Cities on Coordinated Alt. Fuel Corridor Projects

**Present Outcomes to Partners**

**Needs**

**Facilitate Workgroup Sessions [CA, OR & WA]**

**Develop AFV Stakeholder Synthesis**

**Draft Implementation Plan**

**Establish Framework**

**Opportunities**

**Needs**

**Facilitate Workgroup Sessions [CA, OR & WA]**

**Develop AFV Stakeholder Synthesis**

**Draft Implementation Plan**

**Establish Framework**

**Opportunities**
Today’s Webinar Objectives

Learn from vehicle manufacturers, fuel suppliers and fleets about the benefits, application and business case for natural gas and propane vehicle technologies.

1) Latest emerging technologies and costs;
2) Operational suitability;
3) Infrastructure considerations;
4) Fleet best practices; and
5) Opportunities for alternative fuel corridors.
Our Next Technical Webinar

Plug-In Electric and Hydrogen Fuel Cell Technologies and Infrastructure Webinar

November 6th, 2018
10:30 a.m. – 12:30 p.m. (PST)

- Tim Weaver, VP of Corporate Development, Chanje
- Brendan Riley, President, GreenPower Motor Company, Inc.
- David Peterson, Director of Fleet Solutions, ChargePoint
- Rob Del Core, Managing Director, Hydrogenics USA, Inc.
- Alan Mace, Heavy-Duty Market Manager, Ballard Power Systems

Register Here:
https://attendee.gotowebinar.com/register/926801834837034242
Today’s Discussion Leaders

Program Facilitators

• Alycia Gilde, Director, CALSTART
• John Mikulin, Environmental Protection Specialist, EPA Region 9

Presentations by:

• William Zobel, General Manager, Business Development & Marketing, Trillium CNG
• Ruan Transportation Management Systems, a Renewable Natural Gas Case Study
• Joy Alafia, Executive Director, Western Propane Gas Association
• Todd Mouw, President, ROUSH Clean Tech
• Dan Zenger, Equipment Services Superintendent, City of Vancouver, WA
• Discussant: John Gonzales, Senior Engineer, Advanced Deployment, National Renewable Energy Laboratory
West Coast Collaborative, Alternative Fuel Infrastructure Corridor Coalition Webinar

CNG Market and Technology Overview
11/1/2018
Who is Trillium

Trillium is the Alternative Fuel Brand for the Love’s Family of Companies

- Trillium provides turn-key solutions for our CNG/RNG, EV Charging and Hydrogen fueling customers
  - Design and Build Refueling Centers
  - Provide Operations & Maintenance Services
  - Provide Retail Fueling
  - Provide Renewable Natural Gas (RNG) Supply
- Own/operate over 220 fueling stations nationwide
CNG Economics for Commercial Fleets are Very Attractive

- **CNG economics are very attractive**
  - Retail fuel spread vs. diesel is $1.50 - $2.00 in the west
  - Savings of $0.05 – $0.10 cents per mile
  - Incentives up to $40,000/class 8 (OTR) truck
  - Fuel Providers are locking diesel minus value

- **CNG Trucks run reliably and clean**
  - New 12L LoNOx engine platform available
  - Cleanest commercially available HD truck
  - No DPF maintenance, No DEF

- **2,000 Lbs. weight exemption in 28 States**
US States with 2,000 lb. Weight Exemption
Sept. 2018

- 10 states approved in 2016
  (AZ, CO, IL, KS, LA, MN, NC, NM, OK, SC)

- 2 states say this is already allowed
  (WA, WY - they charge a small fee)

- 11 states approved in 2017
  (FL, IA, MI, MO, NV, NY, OR, PA, TX, VA, WI)

- 5 states approved in 2018
  (AL, CA, NE, NJ, RI)
Which Fleets make sense for CNG Conversion?

High Fuel Consuming Fleets Realize Savings with CNG

- Fleets whose trucks consume a high volume of fuel
  - Over the road trucking > 85,000/year/truck
  - Refuse and Transit
- Fleets able to utilize state level grants
  - Usage in specified states and air-sheds
- Fleets with good maintenance practices
  - On par to a few cents per mile more than diesel
- Fleets Seeking a Competitive Advantage
  - Sustainability Benefits for Shippers
  - Lower Cost per Mile
  - Low Fuel Price Volatility
  - Low Fuel Prices Long Term
Cleanest Commercially Available Engine

Further GHG reductions when used with renewable natural gas (RNG)

*Information provided by Cummins Westport*
CNG Engine Line-up

Product line

Over 60,000 engines delivered worldwide

**ISB6.7G**
6.7L
Spark Ignited, SEGR, TWC
Peak Rating: 260 hp
660 lb-ft torque
33,000 lb. GVW
School bus/Motorcoach, Truck/Shuttle bus/Sweeper/Yard spotter

**ISL G**
8.9L
Spark Ignited, SEGR, TWC
Peak Rating: 320 hp
1000 lb-ft torque
66,000 lb. GVW
Refuse/Transit/Regional P&D Truck/Mixers

**ISX12 G**
11.9L
Spark Ignited, SEGR, TWC
Peak Rating: 400 hp
1450 lb-ft torque
80,000 lb. GVW
Regional Haul Truck/Tractor/Refuse

*Information provided by Cummins Westport*
Carbon Benefits of RNG

Carbon Intensity Scores

<table>
<thead>
<tr>
<th>gCO2e per Megajoule</th>
<th>Baseline Diesel ULSD001</th>
<th>Biodiesel: N. American Midwest Soybeans</th>
<th>Fossil CNG: N. American</th>
<th>Gaseous Hydrogen (SMR w/ 33% RNG) (HYGN005)</th>
<th>Average California Electricity ELC002</th>
<th>Renewable Diesel (100%): Tallow</th>
<th>Renewable LNG Landfill Gas (90% liquefaction efficiency)</th>
<th>Renewable CNG Landfill Gas</th>
<th>Renewable CNG 020: Anaerobic Digestion (Wastewater Sludge)</th>
<th>Renewable CNG 005: High Solids Anaerobic Digestion (Food/Waste)</th>
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<td>105</td>
<td>102.0</td>
<td>83.3</td>
<td>87.1</td>
<td>46.5</td>
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<td>28.4</td>
<td>26.2</td>
<td>20.1</td>
<td>8.6</td>
<td>-25.5</td>
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</table>

Bar Graph: Data provided by Gladstein, Neandross & Associates’ “Game Changer” Report, May 2016. For more information, please go to www.gladstein.org.
CNG Refueling Infrastructure

Building CNG Refueling Infrastructure Right Pays Off

- Keys to CNG Refueling Infrastructure
  - Dependent on Fleet Operation
  - Refueling Speed
  - System Controls, Energy Mgt.
  - Reliability – Preventative Maintenance
  - 24/7 Monitoring
  - Response Time
  - Service Network
  - Utility Connections
CNG Station Development

CNG Stations Are Easy to Locate

- New CNG Development
  - Commercial Corridors
  - High Capacity Designs
  - Retail Hospitality Centers
  - Card Lock Operations
  - Incentives Factor In
- Locating CNG Stations:

  https://www.afdc.energy.gov/stations/#/find/nearest?fuel=CNG
  https://maps.cngnow.com/
  http://www.cngprices.com/
  https://www.ngvamerica.org/fuel/ngv-station-map/#/find/nearest?fuel=CNG,%20LNG
Grants and Incentives

- **Vehicles and Infrastructure**
  - State Level Programs – Ca, Co
  - Variety of market segments – HD, MD
  - Air Quality
  - Carbon Reduction (Ca)

- **VW Settlement Fund**
  - Much of the pie going to public schools and municipal government
  - Funding programs vary by state
  - [https://www.ngvamerica.org/vw-trust-action-center/](https://www.ngvamerica.org/vw-trust-action-center/)
Trillium
Bill Zobel: Vice President – Business Development & Marketing
Cell: (760) 590-3420
Email: william.zobelii@Loves.com
Class-8 CNG and RNG Experience

Natural Gas and Propane Technologies & Infrastructure Webinar

West Coast Collaborative, Alternative Fuel Infrastructure Corridor Coalition (WCC-AFICC)

Ruan Transport Corporation
Steve Larsen 11/1/18
Ruan Introduction

+ Founded 1932 (John Ruan), Headquartered in Des Moines, IA
+ Primary business offerings
  • Dedicated Contract Transportation
  • Supply Chain Solutions
  • Warehouse Management
  • Integrated Solutions
+ National footprint with 300+ Operations
+ Approximately 4,000 Class 8 tractors / 9,500 trailers
+ Sustainability
  • Multiple time Excellence Award recipient – EPA Smartway Partner
  • Member of DOE National Clean Fleets Partnership
  • Heavy Duty Trucking “Top 50 Green Fleets” award winner
  • Named annually to Food Logistics’ “Top Green Provider” list
  • Named annually to Inbound Logistics’ “Green Supply Chain Partner” list
Compressed Natural Gas Fleet (CNG and RNG)

+ Over 90 million miles run on CNG equipment to date
+ Fleet at a glance
  • 120+ CNG 12L tractors in service
+ Fleet domiciles: IA, IN, MN, TX, WI
CNG vs. Diesel Decision Making Process – ROI Model

+ Generic assumptions (# of trucks, miles/yr, contract term)
+ Fuel Assumptions
  • MPG
  • Price per gallon
  • DEF usage rate and cost (diesel only)
  • Fuel credits or incentives (LCFS, RIN, VETC, IFTA discounted rates)
+ Equipment
  • Costs
  • Grants (if applicable)
  • Residual assumptions (to calculate depreciation)
  • Interest
  • Maintenance costs per mile
+ Other State-level impacts
  • Excise or Sales tax on purchase
  • Personal property tax
+ Calculation of total cost of ownership and resulting cost per mile
+ Decision based on costs, emissions benefits and customer needs
CNG – Ruan Experience

+ Equipment
  • Various fuel system/tank suppliers
  • Vehicle cost
    – Significant upcharge vs. diesel
    – Largest factor is the CNG tank selection
  • Don’t over-spec, but need to be comfortable with operating range/weight
  • Depressed resale market led to decision to refurbish and run equipment for second life

+ Maintenance
  • Many of Ruan’s Fair Oaks, IN vehicles have over 1 million life-to-date miles (after refurbishment)
  • Shorter maintenance intervals (oil changes)
  • Spark plugs (n/a on HPDI diesel engines)
  • Tank inspections every 36,000 miles
  • Overall CNG equipment maintenance generally expected to be a little higher than diesel
    – Approximately $0.02 per mile higher including inspection costs
CNG/RNG Station Considerations – Fleet

+ Ensure station specs are adequate for fleet operations

- Class 8 accessible
  - Accessible location (controlled intersections, road type/condition, proximity to interstates)
- Fleet cards accepted (i.e. Comdata)
  - Alphanumeric keypad (similar to National truck stop chains)
- Redundant compressors
- Fill rates (should be ~ 10 to 14 GGE per minute)
- Card lock vs full service truck stop
- Customer service phones available for drivers
- Public vs. “behind the fence”
- Multiple pumps/lanes
Renewable Natural Gas (RNG) – Ruan / Fair Oaks Farms

+ Anaerobic digestion – 32,000 dairy cows
  • ampCNG produces 2 million DGE/yr of RNG from dairy cow waste
+ Operation consists of 140 drivers, 40 tractors, & 85 tankers
+ 333,000 gallons of milk moved daily; 122 million gallons of milk per year
+ Approx. 60 million miles since 2011
+ RNG fueling displaces 1.8 million gallons of diesel annually
+ Fleet life extended with engine work and cab refresh
  • Many units in the CNG fleet have well over 1 million life-to-date miles
Special Considerations for Renewable Natural Gas Projects

+ Key RNG Stakeholders and their primary roles
  - Natural gas producer – Capital investor (digester)
  - Local Utility – Bringing RNG from digester to pipeline (Capital and rates/fees)
  - Shipper – Willing to sign up for multi-year transportation commitment
  - Carrier – Purchase vehicles, sign up for multi-year fuel supply agreement
  - Fuel retailer / Station management – Card readers, site maintenance, fuel invoicing
  - Governmental agencies – Grants / incentives, project permitting
  - Maintenance provider – CNG compliant shops, maintenance contracts (or Carrier)
  - Vehicle manufacturer – Appropriate vehicle specs and pricing
Please reach out with questions:

Steve Larsen
slarsen@ruan.com
Propane Autogas & the Future for Fleets

Joy Alafia
President/CEO
Aftermarket Certified Fuel Systems
(Outside California)
Why Autogas?

- Proven safe technology.
- Reliable performance.
- Affordable infrastructure.
- Domestic, portable, and clean.
- Ease of adoption.
- **Lowest total cost-of-ownership.**
Reliable

• Propane autogas performs in the coldest climates.
  • Cranks reliably down to -50F
  • No block heaters or fuel conditioners.
  • Fast warm up w/our lengthy idle periods.
  • Produces consistent heat throughout the passenger compartment.
Efficient
Scalable Infrastructure Options
Scalable Infrastructure Options
Non-toxic & non-contaminant of air, soil & water resources
What’s important for your company?

GREEN  GREEN
For General Information Visit
www.propane.com

For California Vehicle Incentive Visit
www.usecaliforniapropane.com
Joy Alafia
President/CEO

joy@westernppga.org
916-447-9742
Propane Autogas Vehicles
Product Overview

Todd Mouw, President, ROUSH Clean Tech
Enterprise Brand Portfolio

ROUSH Industries
OEM manufacturing, engineering, prototyping and design

Roush Fenway Racing
Dominant NASCAR Sprint Cup racing team

ROUSH Performance
Industry leading high performance vehicles

ROUSH CleanTech
Propane autogas powered commercial vehicles.
<table>
<thead>
<tr>
<th>Feature</th>
<th>Gas</th>
<th>Propane</th>
<th>CNG</th>
<th>Electric</th>
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</thead>
<tbody>
<tr>
<td>Ease of Adoption</td>
<td>✓</td>
<td>✓</td>
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<tr>
<td>Energy Independence</td>
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<td>✓</td>
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<tr>
<td>NOx Emissions</td>
<td>✓</td>
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<td></td>
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<tr>
<td>Fuel Infrastructure</td>
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<tr>
<td>Cost of Ownership</td>
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<tr>
<td>Range</td>
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<tr>
<td>Maintenance</td>
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<td></td>
<td>✓</td>
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<tr>
<td>Scalable</td>
<td>✓</td>
<td></td>
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<tr>
<td>Cold Weather Operation</td>
<td></td>
<td></td>
<td>✓</td>
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</table>
Propane School Bus Deployments
Liquid Propane Autogas

- Medium-duty Ford trucks, Blue Bird school buses.
- Factory Ford warranty maintained.
- No loss of HP / torque / towing capacity.
- Serviceable with existing diagnostic equipment.
- EPA & CARB Certified.
Lowest NOx Offering

**PROPAKE**
- Purchase price: $95,000
- NOx reduced: 1,048.9 lbs.
- Cost per pound of NOx reduced: $91

**DIESEL**
- Purchase price: $90,000
- NOx reduced: 67.7 lbs.
- Cost per pound of NOx reduced: $1,330

**ELECTRIC**
- Purchase price: $300,000
- NOx reduced: 1,119 lbs.
- Cost per pound of NOx reduced: $268

800.59.ROUSH ROUSHcleantech.com
JOIN US NEXT WEEK

You're Invited: California Roadshow
Learn how propane autogas provides the most cost-effective solution to reduce your fleet's NOx emissions.

Todd Mouw
734.466.6522
Todd.Mouw@roush.com
ALTERNATIVE FUEL OPTIONS

- Ethanol
- Propane Autogas
- Biodiesel
- Renewable Diesel
PROPANE AUTOGAS IS SAFE...

- Meets all federal motor vehicles safety standards.
- Fuel tanks are 20 times more puncture-resistant than gasoline and diesel tanks.
- Stored at relatively low pressure, about 250 psi.
Unit life cycle is 12 years.

Units will include Ford gaseous fuel prep package $350 (Harden valves required)

EPA Propane Bi-Fuel Conversion Kit average price $9,000

Projected 20% reduction in maintenance cost can be expected with propane Autogas compared to gasoline.
## Savings Calculator
Ford F250 w/Servcie Body

<table>
<thead>
<tr>
<th>Capital Costs</th>
<th>Gasoline (V10)</th>
<th>Propane (V10)</th>
<th>Savings (Costs)</th>
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<tbody>
<tr>
<td>Base Ford Vehicle Purchase Price</td>
<td>$27,000</td>
<td>$27,000</td>
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<tr>
<td>Ford Gaseous Prep Package ( Harden Valves)</td>
<td>$0.00</td>
<td>$350.00</td>
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<tr>
<td>Propane Conversion</td>
<td>$0.00</td>
<td>$9,000</td>
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<tr>
<td>State or Federal Incentive (if applicable)</td>
<td>$0.00</td>
<td>$0.00</td>
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<tr>
<td><strong>Total Capital Savings (or Investment)</strong></td>
<td><strong>$27,000</strong></td>
<td><strong>$35,350</strong></td>
<td><strong>($8,350)</strong></td>
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<table>
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<tr>
<th>Operating Costs</th>
<th>Gasoline (V10)</th>
<th>Propane (V10)</th>
<th>Savings (Costs)</th>
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<tr>
<td>Total Vehicle Life (miles)</td>
<td>130,000</td>
<td>130,000</td>
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<tr>
<td>Average Miles Per Gallon*</td>
<td>8.7</td>
<td>6.7</td>
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<tr>
<td>Gallons of Fuel Over Lifetime</td>
<td>14,943</td>
<td>19,403</td>
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<tr>
<td>Fuel Price**</td>
<td>$3.00</td>
<td>$1.15</td>
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<tr>
<td>Fuel Tax Credit / Gallon</td>
<td>$0.00</td>
<td>$0.00</td>
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<tr>
<td>Adjusted Fuel Price / Gallon</td>
<td>$3.00</td>
<td>$1.15</td>
<td></td>
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<tr>
<td><strong>Total Fuel Savings (or Costs)</strong></td>
<td><strong>$44,828</strong></td>
<td><strong>$22,313</strong></td>
<td><strong>$22,514</strong></td>
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<table>
<thead>
<tr>
<th>Miscellaneous Costs</th>
<th>Gasoline (V10)</th>
<th>Propane (V10)</th>
<th>Savings (Costs)</th>
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<tr>
<td>Maintenance Costs***</td>
<td>$64,000</td>
<td>$51,200</td>
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<tr>
<td>Maintenance Rate (cost per miles)</td>
<td>$0.49</td>
<td>$0.39</td>
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<tr>
<td>Fuel Loss From Pillerage / Theft</td>
<td>$0.00</td>
<td>$0.00</td>
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<tr>
<td><strong>Total Misc. Savings (or Costs)</strong></td>
<td><strong>$64,000</strong></td>
<td><strong>$51,200</strong></td>
<td><strong>$12,800.00</strong></td>
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**Gross Vehicle Lifetime Savings (Loss)**   $35,314

**Net Vehicle Lifetime Savings (Loss)**     $26,964
Fuel Use

- Consumed ~8,300 gallons of Autogas since April
- Displacing ~5,810 gallons of Unleaded (70% MPG)
- Average Autogas fuel cost $1.31 (including fuel site equipment surcharge)
- Average Unleaded fuel cost $3.27
- 8,300 gallons Autogas @ $1.31 = $10,837.00
- 5,810 gallons Unleaded @ 3.27 = $18,998.70
- Savings $8,161.70 in the past 6 months
CONCLUSION

- ROI is the best!
- Maximized fuel range
- Fueling infrastructure is reasonably priced and can be found almost anywhere
- Fuel supply partners are numerous and financially sound
- EPA Certified Systems availability is the widest and deepest of all alternative fuels
- “Cradle to the Grave” emissions are among the best!
Thank You

- Dan Zenger
- Equipment Services Superintendent
- City of Vancouver, WA
- P: 360-487-8205
- Email: dan.zenger@cityofvancouver.us
Discussion

Please raise hand & submit a comment via GoToWebinar.

1. Where do we see important infrastructure development opportunities to support alternative fuel corridors for natural gas/propane fleets?

2. What incentives are available for natural gas and propane vehicles and infrastructure?

3. How can multi-state planning lead to more infrastructure deployment assistance resources?

4. Are any webinar participants interested in developing natural gas and/or propane fueling infrastructure for medium and/or heavy-duty equipment operating in California, Oregon, or Washington?
Join Us for Our Next Webinar

Plug- In Electric and Hydrogen Fuel Cell Technologies Webinar
November 6th, 2018
10:30 a.m. – 12:30 p.m. (PST)

Register Here:
https://attendee.gotowebinar.com/register/926801834837034242
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agilde@calstart.org