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Carbon Footprint Reductions with Alternative Fuels

Propane Autogas:
The World's Most Popular Alternative Fuel

9th Annual GA Environmental Conference
August 20, 2014

What is Propane Autogas?

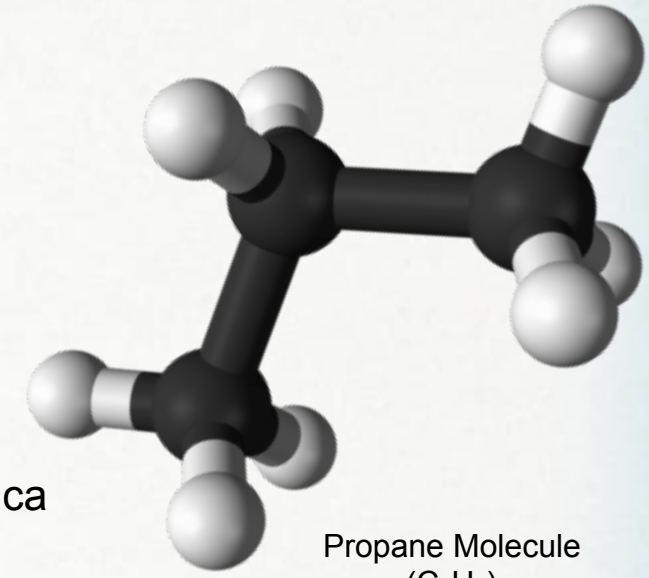
- **Popular:**
  - Third most widely used vehicle fuel in the world
  - Powers over 23 million vehicles worldwide

- **Clean:**
  - 24% reduction in Greenhouse Gas (GHG) emissions.
  - 20% reduction in Nitrogen Oxide (NOx) emissions.
  - 60% reduction in Carbon Monoxide (CO) emissions.

- **Domestic:**
  - 98% of propane used in U.S. comes from North America

- **Abundant:**
  - Major natural gas shale found in northeast U.S.
  - Most refueling infrastructure of any alternative fuel.

- **Safe:**
  - Low pressure (~ 200 psi).
  - Narrow flammability range.
  - Fuel tanks are 20 times more puncture resistant than gasoline.
  - Propane is a nontoxic, non carcinogenic, and noncorrosive fuel. It poses no harm to groundwater, surface water, or soil.



Propane Molecule
(C_3H_8)

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Why Propane Autogas?

- Reduced Emissions
- Domestically Produced Fuel
- Lower Fuel Costs

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Reduced Emissions

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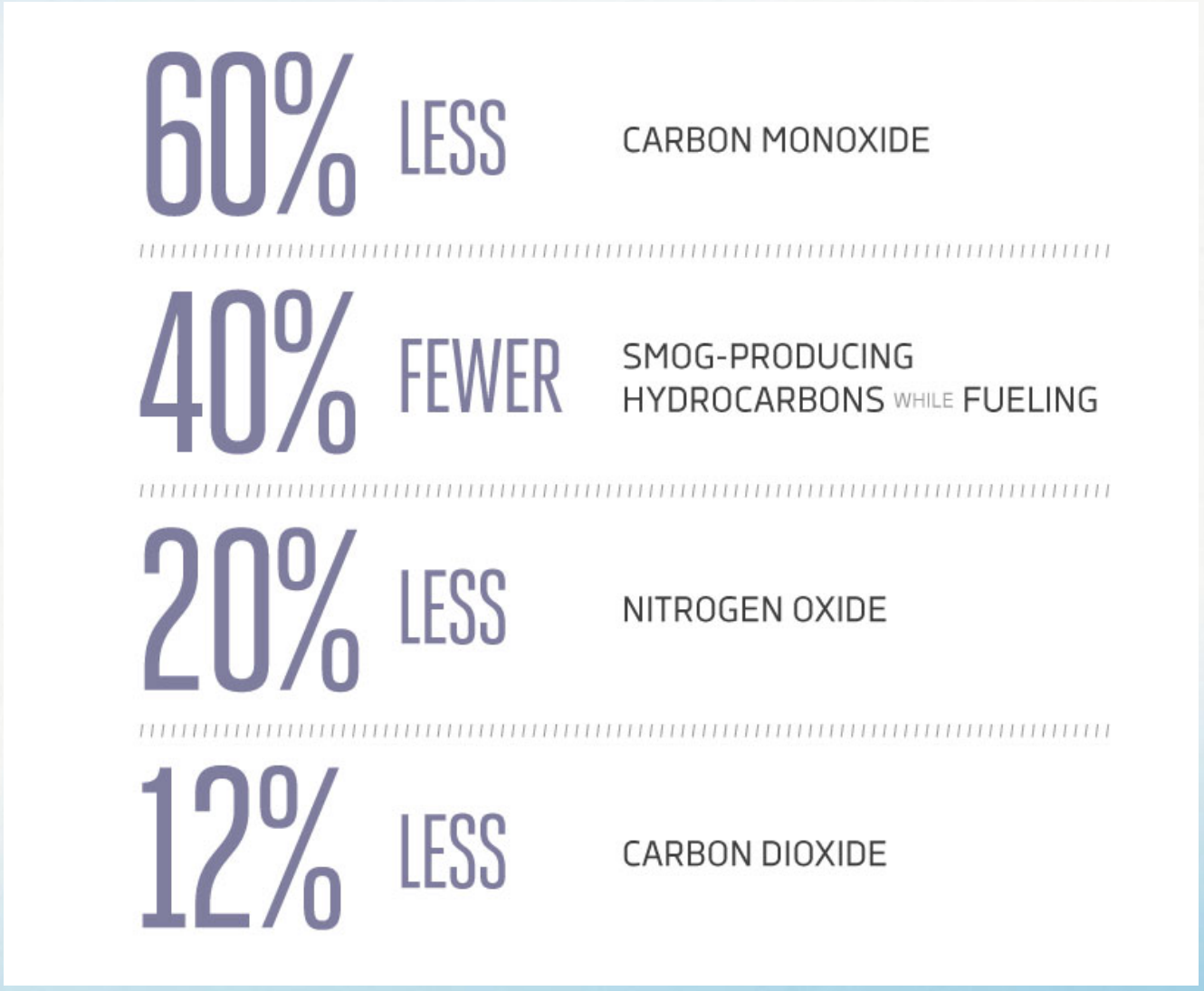
Reduced Emissions



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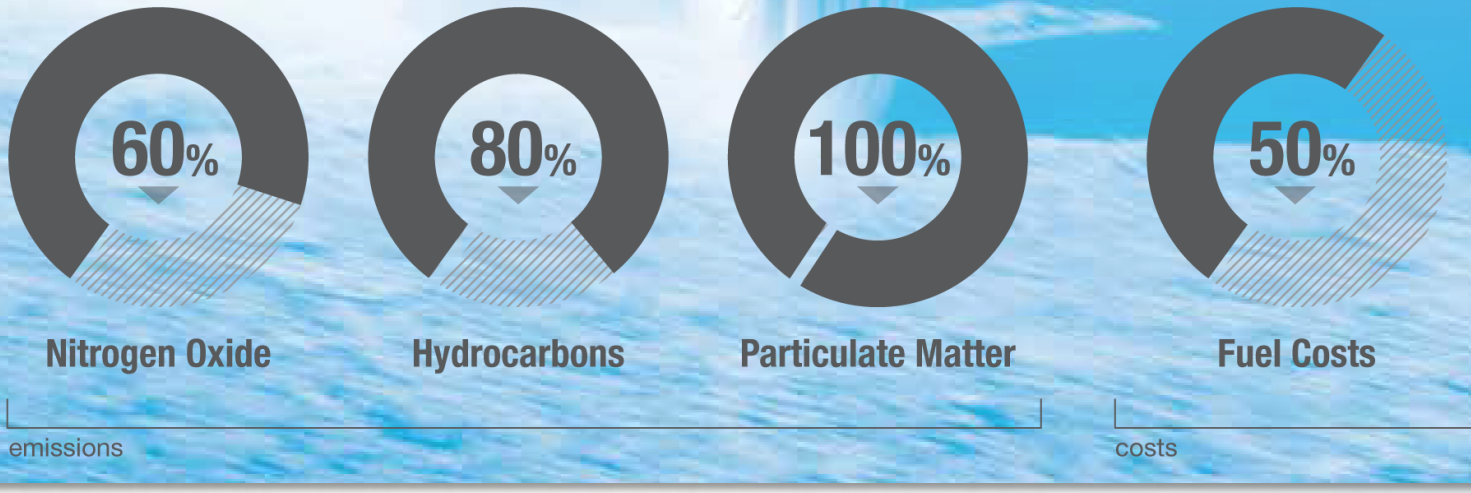
Emissions Benefits

PROPANE AUTOGAS vs. DIESEL

For heavy-duty engines using propane autogas the following reductions occur when compared to diesel:



Blue Bird
2014 (6.8L V10)

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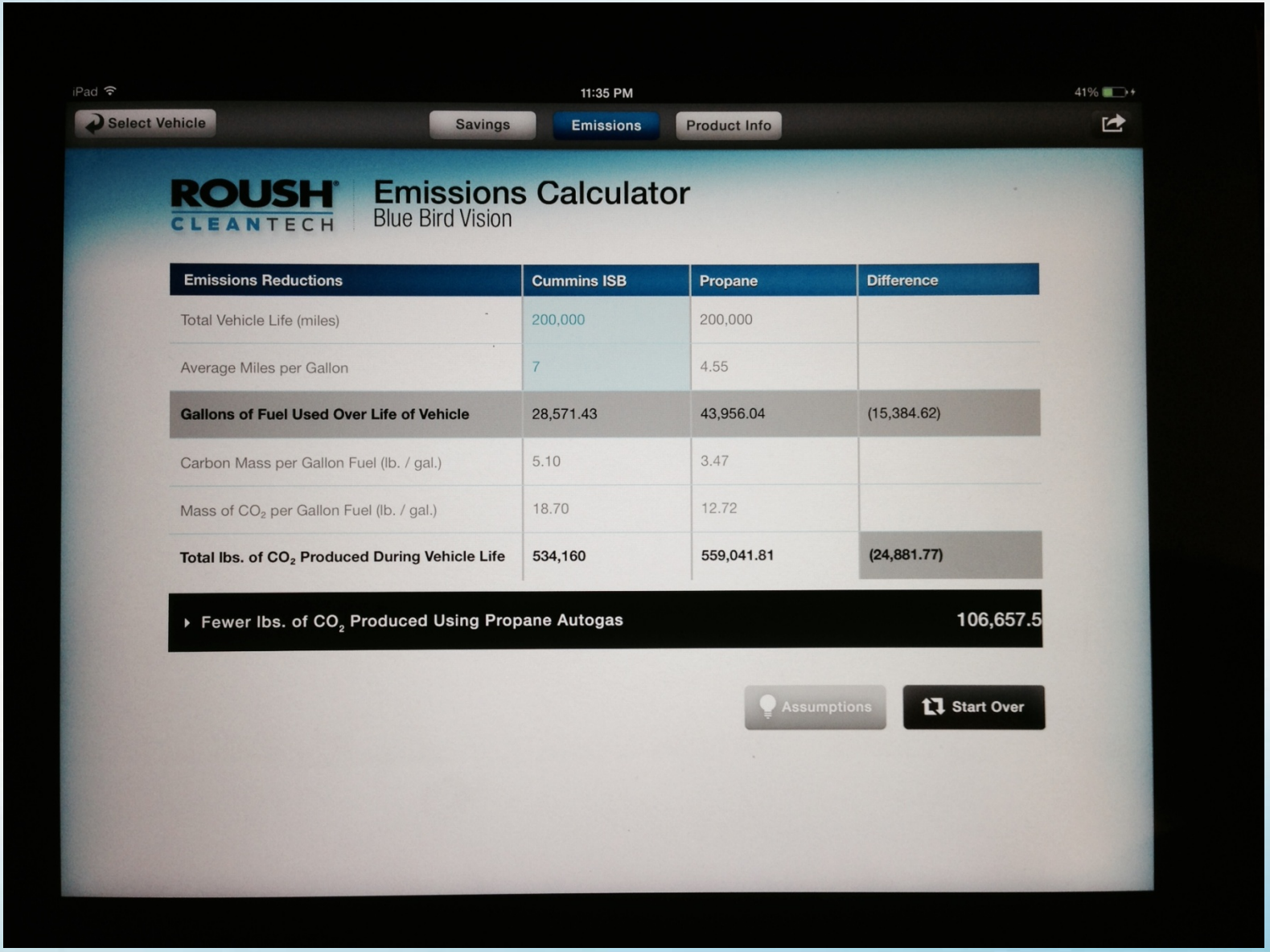
iPad App



LPG Emission Benefit Examples

- Charlotte-Mecklenburg Schools
  - 5 Ford F550 maintenance fleet vehicles
  - Replacing vehicles either greater than 10 years old or greater than 150,000 miles (2002 gasoline F550's)
  - Roush dedicated LPG systems
  - 15, 000 miles per year (conservative)
  - Average MPG 8-10

Charlotte-Mecklenburg Schools

- Per Vehicle Estimated Annual Emissions Benefit* (kg's)
  - CO2 (W-T-W) 3,344 kg (9.5%)
  - NOx 25 kg (97%)
  - CO 12.4 kg (33%)
  - VOC 39.8 kg (98%)
  - PM 0 kg (0%)

*Emissions calculation using EPA certification data for baseline gasoline and LPG.

LPG Emission Benefit Examples

- Asplundh Tree Expert Co.
  - Ford F650 bucket truck
  - Replacing diesel bucket truck
  - Roush dedicated LPG system
  - 15,000 miles per year
  - Due to duty cycle 3-4 MPG (idle time)

Asplundh Tree Expert Co

- Per Vehicle Estimated Annual Emissions Benefit* (kg's)
  - CO2 (W-T-W) 2,770 kg (6%)
  - NOx 70 kg (81%)
  - CO 203 kg (54%)
  - VOC 1.7 kg (13%)
  - PM 6.1 kg (100%)

*Emissions calculation using AFLEET 2013 data for NC 2006 short haul single unit diesel as baseline and Roush 2014 CARB certification data.

CO2 based on GGE of fuel used from AFLEET Tool 2013:

Argonne tailpipe CO2 per GGE (g)

Gasoline (10% ethanol)	Diesel	B20	E85	CNG	LPG	Electricity
8,948.51	9,236.78	9,258	8,980.05	7,522.29	7,960.72	0

Argonne well-to-wheels CO2 per GGE (g)

Gasoline (10% ethanol)	Diesel	B20	E85	CNG	LPG	Electricity
11,072.02	11,795.02	10,005	8,894.55	9,912.50	10,030.56	16,489.02

Considering Alternative Fuels

- Contact: the **Clean Transportation Program** at the **North Carolina Clean Energy Technology Center**
- http://www.cleantransportation.org/

or

http://nccleantech.ncsu.edu/clean-transportation/

  - Fleet consultations, case studies, analysis tools, technical information, . . .

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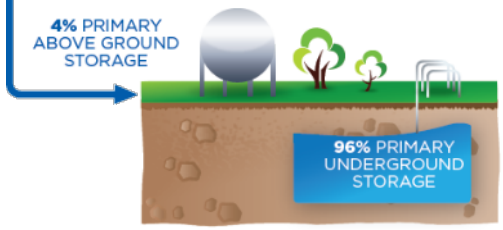
Domestically Produced Fuel

PROPANE AUTOGAS WELL TO WHEEL
Supply Chain

68% FROM U.S. NATURAL GAS PROCESSING

30% FROM U.S. PETROLEUM REFINING

2% FROM CANADA & OTHER IMPORTS



OVER **70,000 MILES** OF PIPELINES IN THE UNITED STATES

AUTOGAS RETAILER
BULK STORAGE

ON SITE FUEL STATION

1 AUTOGAS SOURCES

2 PRIMARY STORAGE

3 AUTOGAS TRANSPORT

4 SECONDARY STORAGE

5 AUTOGAS DELIVERY

6 AUTOGAS FLEETS

98%

of the U.S. autogas supply is made in America. So, using autogas reduces our dependence on foreign oil and increases American energy security.

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Shale Map of US

Source: U.S. Energy Information Administration

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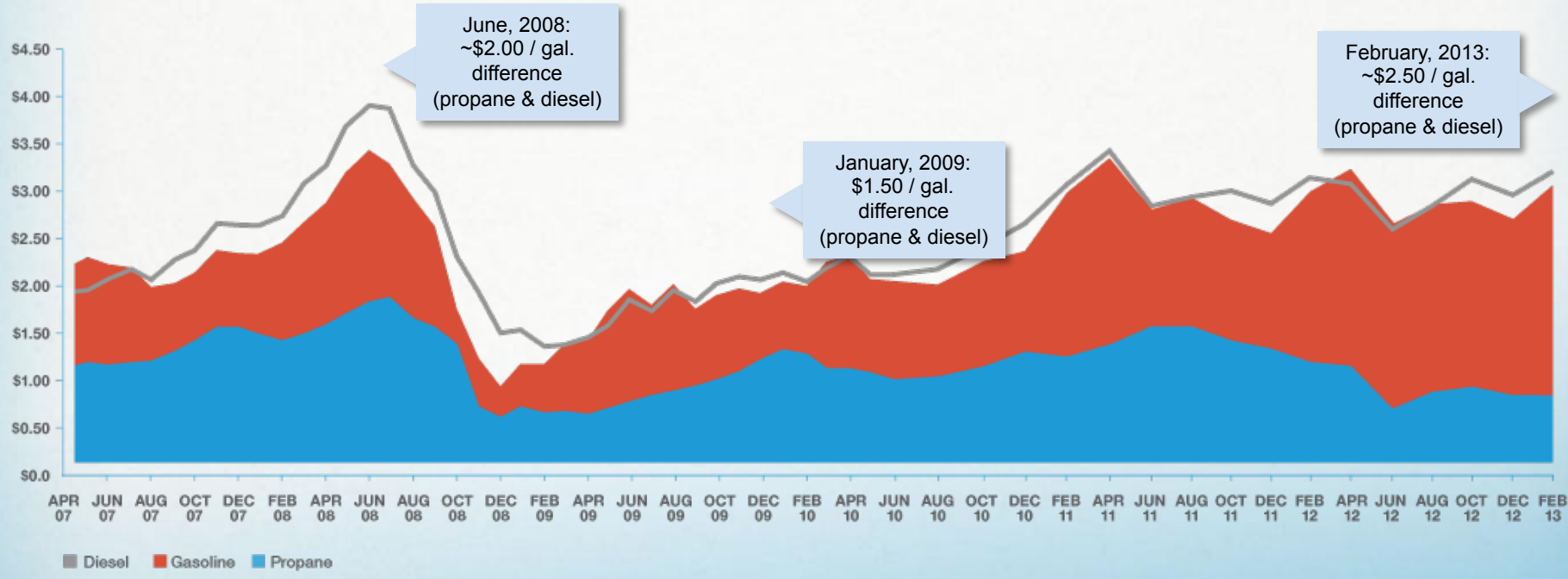
Lower Fuel Costs

- The price gap between propane and diesel continues to widen over time.

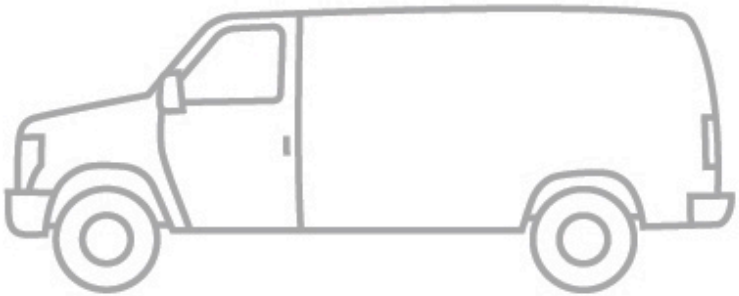


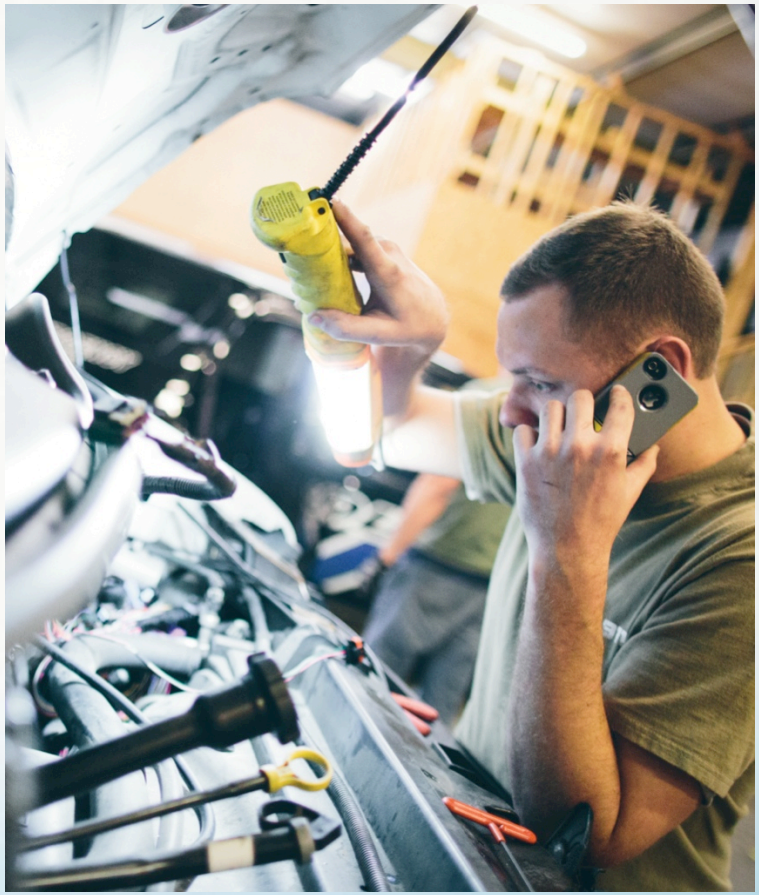
No Costly Modifications to Service Centers

RESEARCH

GARAGE

REQUIREMENTS





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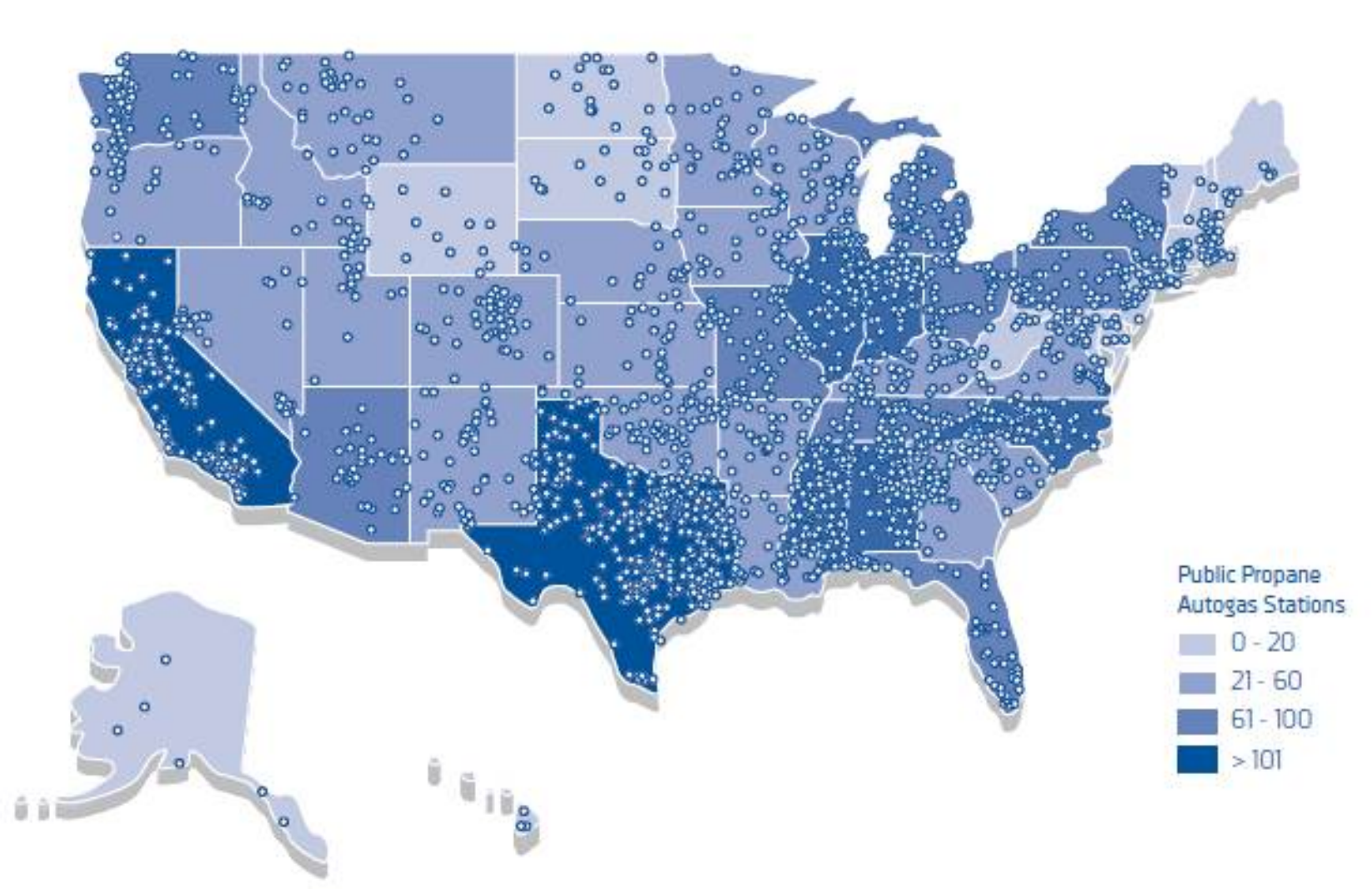
Infrastructure is everywhere



Infrastructure is simple

Fueling station can be installed at no cost to the fleet:

- Autogas station installed on-site at fleet base and/or public/shared autogas stations installed to serve multiple fleets
- Fully scalable to serve fleets of all sizes
- Interfaces with fuel management systems
- All necessary training for fleet personnel

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Infrastructure is scalable

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Infrastructure is portable

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Most Widely Available Alt Fuel

Alternative Fueling Station Locator

Find alternative fueling stations near an address or ZIP code or along a route in the United States. Enter a state to see a station count.

Find Stations | Plan a Route

23451

20009

Go

Liquefied Petroleum Gas (...

more search options

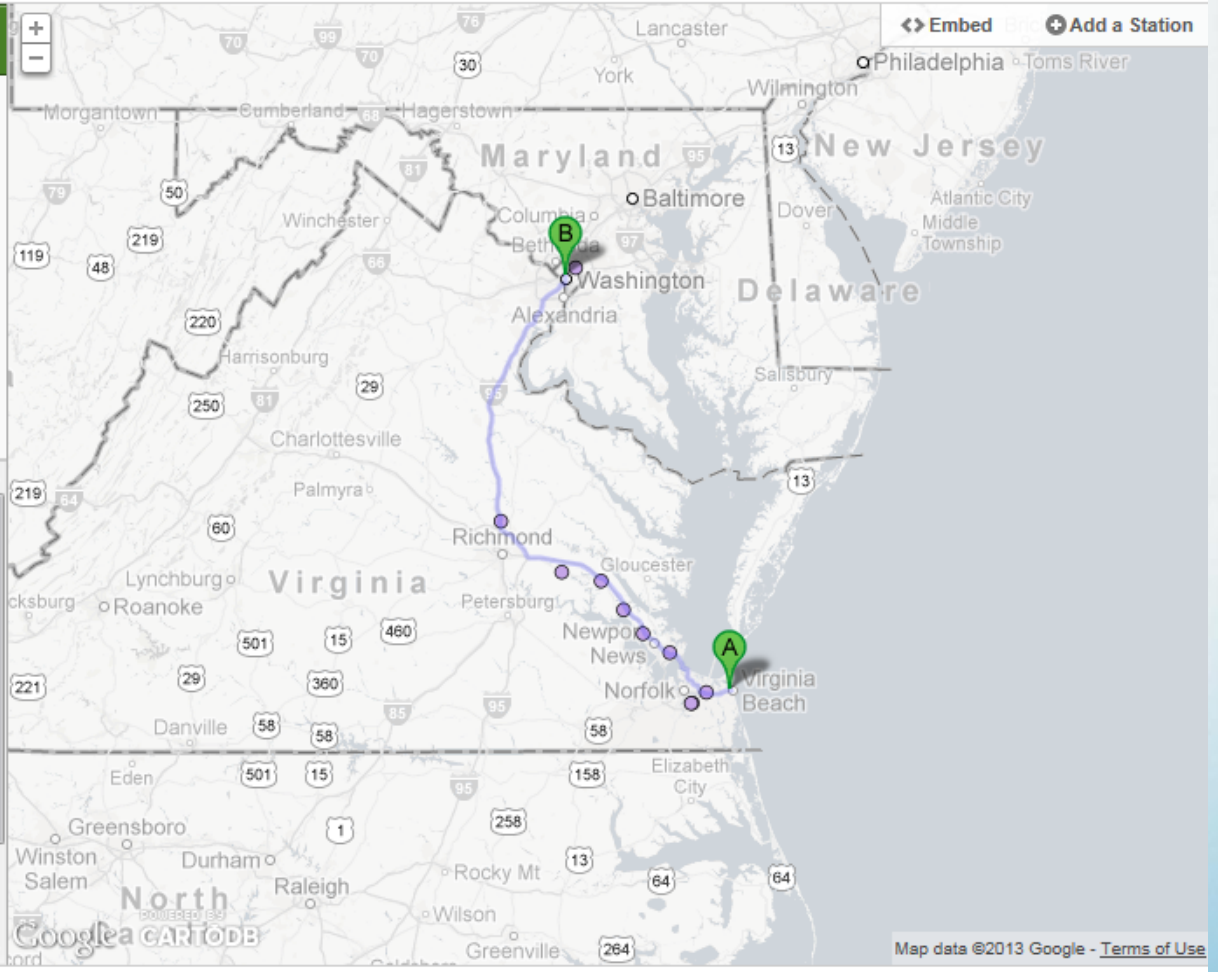
10

Propane stations along the route

Excluding private stations

Download spreadsheet of matching stations

Location details are subject to change. We recommend



Enterprise Brand Portfolio

Roush Fenway Racing
Dominant NASCAR Sprint Cup racing team.

ROUSH Performance
Industry leading high performance vehicles.

ROUSH Industries
OEM manufacturing, engineering, prototyping and design.

ROUSH CleanTech
Propane autogas powered commercial vehicles.

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Alt. Fuel Experience

- Compressed Natural Gas (CNG)
  - Design of fuel system.
  - Calibration.
  - EPA and CARB certification.
  - Vehicle integration.

- Electric
  - Over 16,000 recharging stations built.
  - Blink ECOtality contract with U.S. DOE.

- Hydrogen
  - 207.297 MPH (world land-speed record.)
  - Vehicle design.
  - Aerodynamics development.
  - Vehicle fabrication.
  - Propulsion system integration.

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Liquid Propane Autogas

- Light & medium duty Ford trucks & vans, school bus.
- Factory Ford warranty maintained.
- No loss of HP / torque / towing capacity.
- Serviceable with existing diagnostic equipment.
- EPA & CARB Certified.

Ford F-250/350 | Ford E-150/250/350/450 | Ford F-450/550 | Ford F-650 | Ford F-53 / F-59 | Blue Bird Vision | Micro Bird G5

ROUSH CLEANTECH

Product Overview

Model Years

2012 - 2015

Engine Size

6.8L V10 (2V)

Applications

158” / 176” / 186” / 190” / 208” wheelbase.

Stretched chassis.

5-speed automatic transmission.

Fuel Tank Capacity

Aft-axle: 41 gallons (usable)

Technical Specifications

EPA and CARB approved.

GVWR: < 14,500 lbs.

Requires “91G” gaseous fuels prep. package.

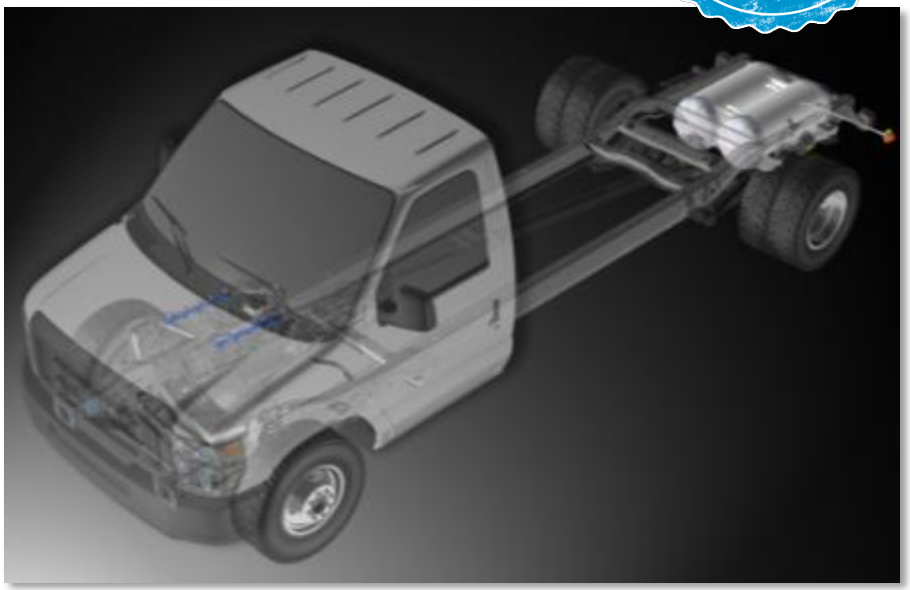
Order Availability

Ford Ship Through.

Conversion Kits.

Ford E-450 Cutaway & Strip Chassis

ALTOONA TESTED



ROUSH CLEANTECH

Product Overview

Model Years

2012- 2015

Engine Size

6.8L V10 (3V)

Applications

All cab configurations.

All wheelbase configurations.

6-speed automatic transmission.

Fuel Tank Capacity

Short Tanks (Clean CA): 45 gallons (usable)

Long Tanks (Non-Clean CA): 83 gallons (usable)

Technical Specifications

EPA and CARB approved.

GVWR: < 30,000 lbs.

Requires “98G” gaseous fuels prep. package.

Order Availability

Available Now

Ford F-650 Chassis Cab

ROUSH CLEANTECH

Product Overview

Model Years

2013

Engine Size

6.8L V10 (3V)

Applications

All wheelbase configurations.

All rear-axle configurations.

5-speed automatic transmission.

Fuel Tank Capacity

Extended Range: ~65 gallons (usable)

Technical Specifications

EPA and CARB approved.

GVWR F-53: < 26,000 lbs.

GVWR F-59: < 22,000 lbs.

Requires “98G” gaseous fuels prep. package.

Order Availability

Available from Green Alternative Systems.

Ford F-53 / F-59 Strip Chassis

City of Santa Ana, CA

Industry: Government
Location: Santa Ana, CA
Vehicles: Ford F-250 Pickup Trucks
Ford F-550 Trucks

By The Numbers:

- Paying **$1.50 / gallon** for propane.
- **2,000** gallon refueling station on-site.
- Reduce CO_2 emissions by **55,000 pounds**.

"The City of Santa Ana is serious about providing its citizens with clean air by embracing alternative energy and conserving natural resources. The fact that we anticipate dramatic fuel and maintenance cost savings is a bonus."

- Rick Longobart, **facilities, fleet and central stores manager,** City of Santa Ana

City of Cincinnati

Industry: Government
Location: Cincinnati, OH
Vehicles: Ford F-250 Pickup Trucks
Ford F-350 Pickup Trucks

By The Numbers:

- **10,500** fewer gallons of gasoline year.
- **40,280** fewer lbs of CO_2 / year.
- **$1.06 per gallon** reduction in fuel costs.

"The ROUSH CleanTech trucks have the same horsepower, torque and towing ratings as gas vehicles… They appreciate how quiet the idle is, too."

- Maraskeshia Smith, Deputy Director, Department of Public Works, City of Cincinnati

King County, WA

Industry: Government
Location: Seattle, WA
Vehicles: Ford F-250 Pickup Trucks
Ford F-350 Pickup Truck
Ford E-250 Cargo Van

By The Numbers:

- **11,200** fewer gallons of gasoline year.
- **77,280** fewer lbs of CO_2 / year.
- **$15,338** reduction in fuel costs / year.

"For the driver, it's pretty much seamless other than you fill up at a propane tank instead of a gas dispenser. Range is approximately the same and fuel economy is approximately the same. A big advantage is that with the federal rebate being offered on propane autogas fuel, the cost of fuel is currently considerably less than the price of gasoline. So right now that's a big advantage."

- Robert Toppen, Equipment Supervisor, King County

DeKalb County, GA

Industry: Government
Location: Decatur, GA
Vehicles: 75 Ford Pickup Trucks

By The Numbers:

- **340,000** fewer lbs of CO_2 / year.
- **$1.50 / gallon** savings (with $.50 / gal credit).
- **$135,000+** reduction in fuel costs over 2 years.

"The propane performed immediately. The county saw savings right away in both costs and environmental integrity."

"The ROUSH brand has a reputation for dependability and quality, so we chose to work with them when acquiring new trucks. The offered a fair price, and we have been pleased with the ROUSH CleanTech product."

- Richard Miller, Superintendent of Fleet Management, DeKalb County

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Flint Mass Transit Authority

Industry: Para-transit

Location: Flint, MI

Current Vehicles: 83 E-450 shuttle buses

By the Numbers:

- **$1.19 per gallon** for propane autogas for t
  next twelve months.
- **20,400 fewer pounds of CO_2** emitted annually per shuttle bus.

"Propane autogas is a good fit for us. We anticipate purchasing propane fuel for half the price of diesel. It will reduce our dependency on diesel and drive down our cost of operation."

– **Edgar Benning,** General Manager, Flint Mass Transit Authority

Tippecanoe School Corp.

Industry: Education
Location: Lafayette, Ind.
Vehicles: Blue Bird Type C school buses

By The Numbers:

- **70%** savings per gallon **($1.13** for propane autogas compared to **$3.84** for diesel).
- **739,055 pounds of carbon dioxide** eliminated over the life of their fleet.

"Before tax credits, we pay nearly half the price of diesel for propane, cutting our fuel expenditures by more than 50 percent. So far **we've saved $10,000 on the five Blue Bird buses alone."**

- Kevin Neafie, Transportation Director for TSC

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Economic Sustainability

A Positive Return,
Even Without Government Incentives for Vehicle Technology

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Savings Calculation

Ford F-250
2014 (6.2L V8)

Capital Costs	Gasoline (6.2L V8)	Propane (6.2L V8)	Savings (Costs)
Base Ford Vehicle Purchase Price	$30,060.00	$30,375.00	
ROUSH CleanTech Propane Conversion	$0.00	$11,450.00	
State or Federal Incentive (if applicable)	$0.00	$0.00	
Total Capital Savings (or Investment)	**$30,060.00**	**$41,825.00**	**($11,765.00)**
Operating Costs	**Gasoline (6.2L V8)**	**Propane (6.2L V8)**	**Savings (Costs)**
Total Vehicle Life (miles)	200,000	200,000	
Average Miles Per Gallon*	12.00	10.20	
Gallons of Fuel Over Lifetime	16,666.67	19,607.84	
Fuel Price (per gallon)**	$3.41	$1.90	
Fuel Tax Credit / Gallon	$0.00	$0.00	
Adjusted Fuel Price / Gallon	$3.41	$1.90	
Total Fuel Savings (or Costs)	**$56,833.33**	**$37,254.90**	**$19,578.43**
Miscellaneous Costs	**Gasoline (6.2L V8)**	**Propane (6.2L V8)**	**Savings (Costs)**
Maintenance Rate (per mile)***	$0.030	$0.015	
Maintenance Costs	$6,000.00	$3,000.00	
Fuel Loss From Pilferage / Theft	$0.00	$0.00	
Total Misc. Savings (or Costs)	**$6,000.00**	**$3,000.00**	**$3,000.00**

Gross Vehicle Lifetime Savings (Loss)	**$22,578.43**
Net Vehicle Lifetime Savings (Loss)	**$10,813.43**

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Savings Calculation

Ford F-59
2014 (6.8L V10)

Capital Costs	Gasoline (6.8L V10)	Propane (6.8L V10)	Savings (Costs)
Base Ford Vehicle Chassis Purchase Price	$27,000.00	$27,315.00	
ROUSH CleanTech Propane Conversion	$0.00	$16,900.00	
State or Federal Incentive (if applicable)	$0.00	$0.00	
Total Capital Savings (or Investment)	**$27,000.00**	**$44,215.00**	**($17,215.00)**
Operating Costs	**Gasoline (6.8L V10)**	**Propane (6.8L V10)**	**Savings (Costs)**
Total Vehicle Life (miles)	200,000	200,000	
Average Miles Per Gallon*	7.00	5.95	
Gallons of Fuel Over Lifetime	28,571.43	33,613.45	
Fuel Price (per gallon)**	$3.45	$1.90	
Fuel Tax Credit / Gallon	$0.00	$0.00	
Adjusted Fuel Price / Gallon	$3.45	$1.90	
Total Fuel Savings (or Costs)	**$98,571.43**	**$63,865.55**	**$34,705.88**
Miscellaneous Costs	**Gasoline (6.8L V10)**	**Propane (6.8L V10)**	**Savings (Costs)**
Maintenance Rate (per mile)***	$0.030	$0.015	
Maintenance Costs	$6,000.00	$3,000.00	
Fuel Loss From Pilferage / Theft	$0.00	$0.00	
Total Misc. Savings (or Costs)	**$6,000.00**	**$3,000.00**	**$3,000.00**

Gross Vehicle Lifetime Savings (Loss)	**$37,705.88**
Net Vehicle Lifetime Savings (Loss)	**$20,490.88**

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Customer Adoptions

Sears

AutoZone

DHL WORLDWIDE EXPRESS

DIRECTV SATELLITE TELEVISION

Microsoft

BLUE BIRD

ARAMARK

MV We Provide Freedom™

GO Airport Express THE ONLY WAY TO GO

MTA

Creative Bus Sales

Mesa Public Schools Unprecedented Excellence in Education

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Customer Adoptions

Safelite AutoGlass

UPS

TRUGREEN Go greener.

FedEx Ground

STA STUDENT TRANSPORTATION OF AMERICA

WIS INTERNATIONAL

dish NETWORK

AutoZone

SAN JOAQUIN COUNTY CALIFORNIA

EMCOR

DHL WORLDWIDE EXPRESS

Miami-Dade County Public Schools
giving our students the world

ADMIRAL LINEN AND UNIFORM SERVICE

ValleyCrest Landscape Companies

ASPLUNDH TREE EXPERT CO.

MasterPark AIRPORT VALET PARKING

Southeast Alternative Fuels Conference & Expo

Driving the New Economy

http://www.altfuelsconference.org/

NC CLEAN ENERGY TECHNOLOGY CENTER

Formerly the NC Solar Center

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Questions?

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