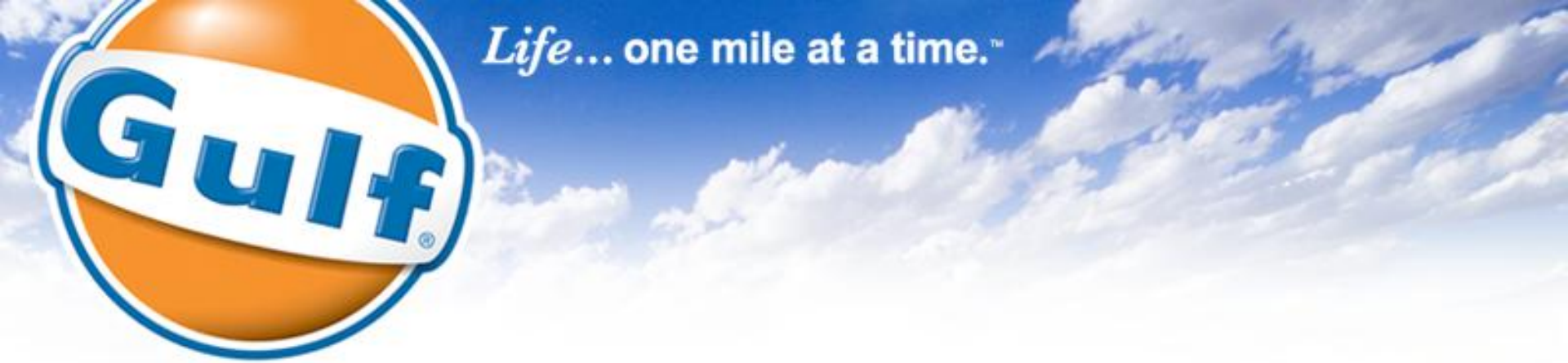


PA Public Utility Commission Alternative Fuel Vehicle Forum

Drexel University

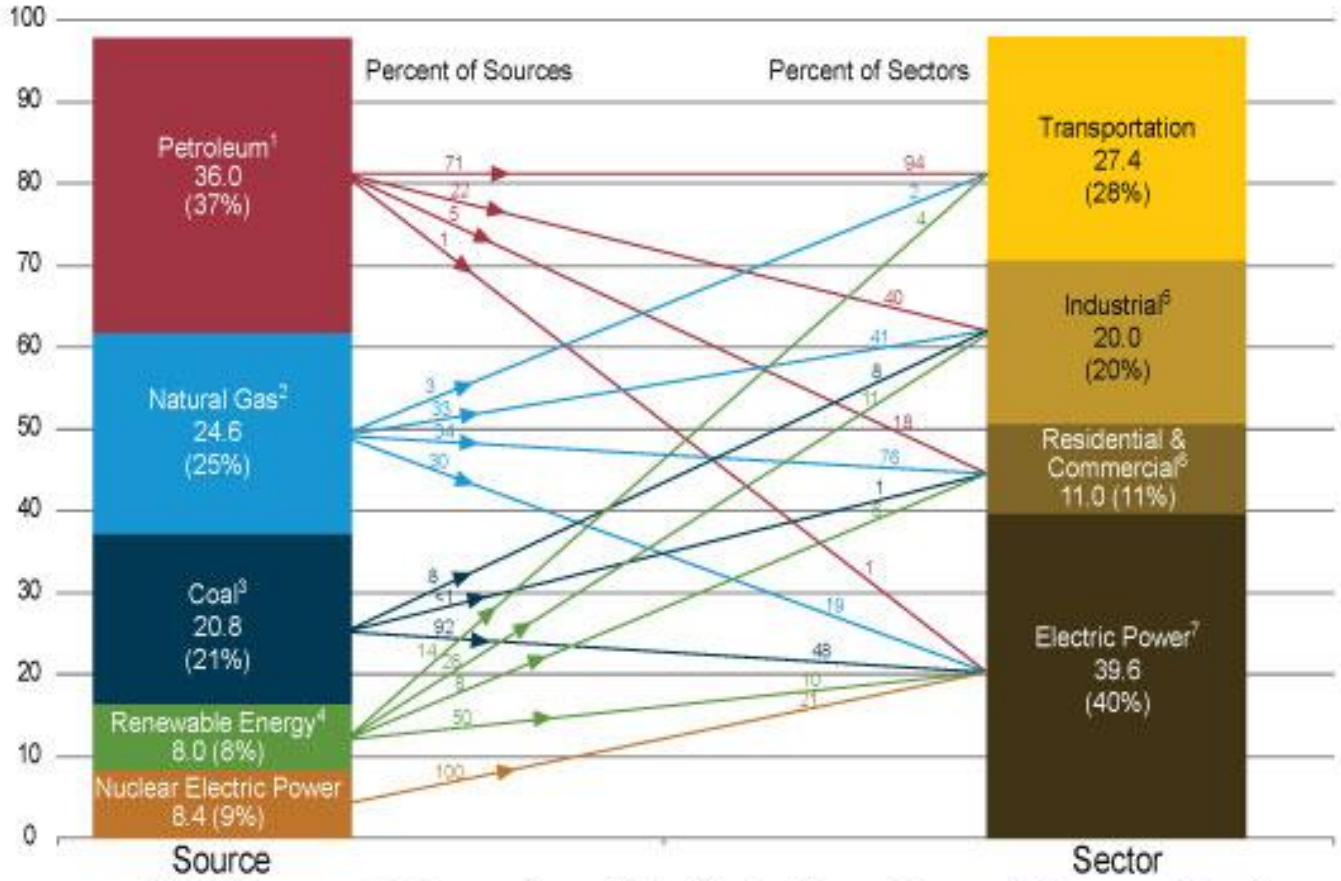
May 31, 2012

Topics

- Natural gas as a vehicular fuel
  - Passenger cars
  - Heavy duty trucks
- Implementation of a 34 truck LNG fleet
  - How Gulf is converting some of its petroleum transport trucks to LNG

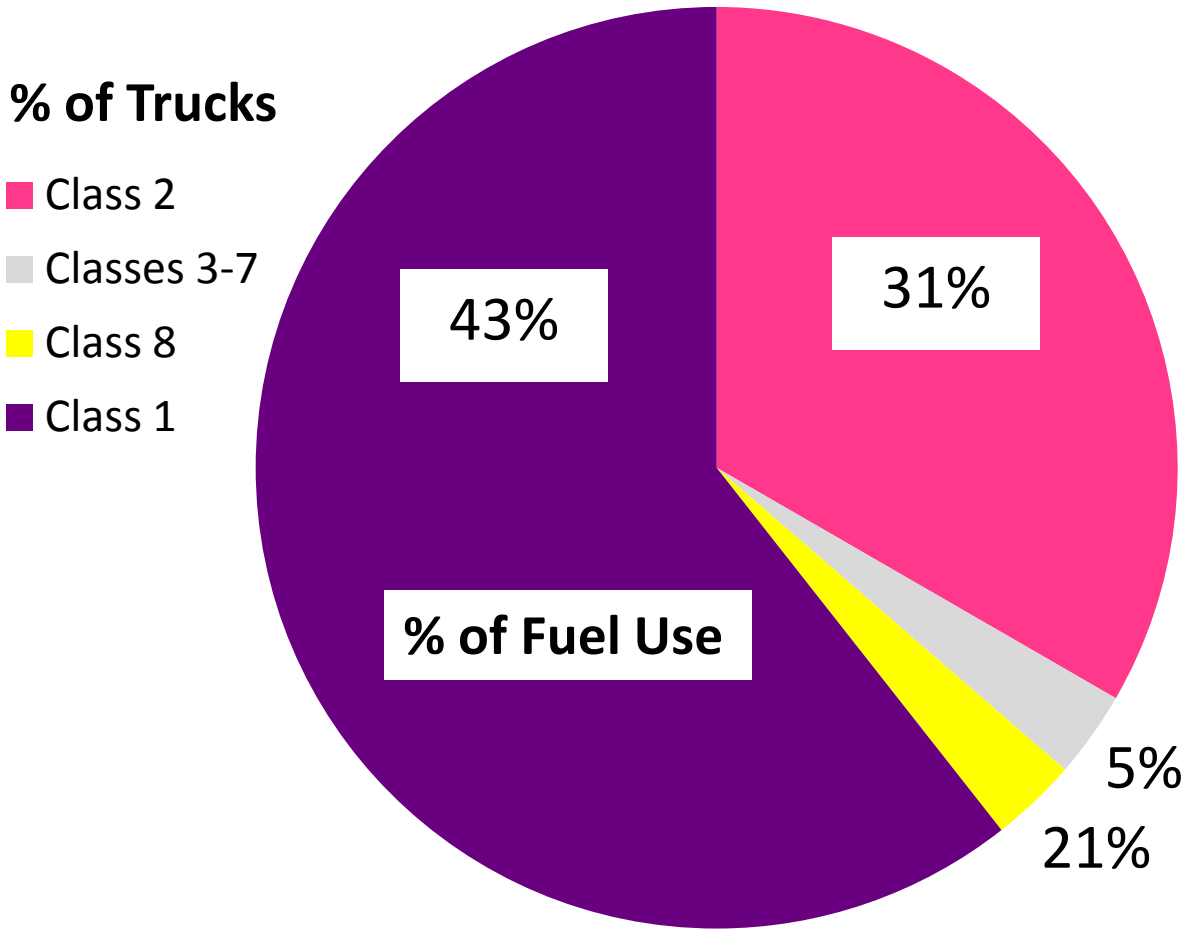
Primary Energy Consumption By Source and Sector, 2010

Quadrillion Btu



Sources: U.S. Energy Information Administration, *Annual Energy Review 2010*, Tables 1.3, 2.1b-2.1f , 10.3, and 10.4 (October 2011).

Diesel Fuel Use Concentration



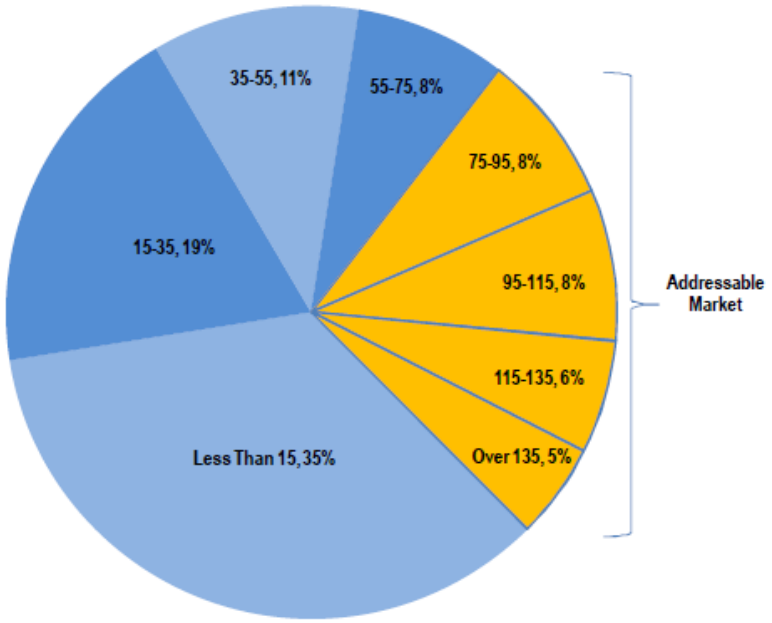
US Vehicles	MM
Autos	131.0
Trucks	110.0
Pickups	40
SUVs	40
Vans	18
Buses	.9
Total	**242**

Adoption Rate Potential

Current population of HD Class 8 trucks ~ 2.2 million vehicles
Turnover ~ 200,000 units per year

Long Haul (75k Miles+) Is ~25% Of Overall Population

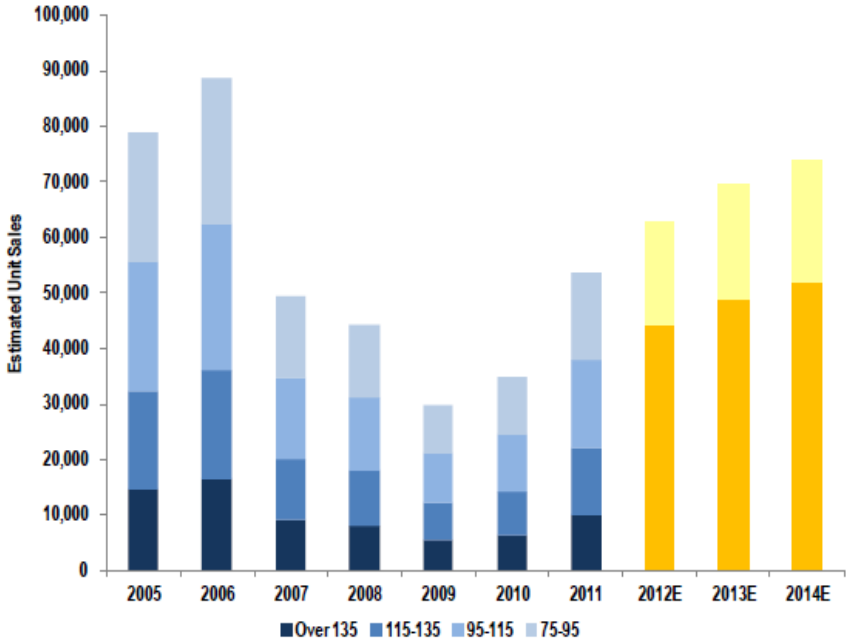
U.S./Canada Class 8 Truck Population (2011: ~200k Units; miles in thousands)



Source: Company reports and J.P. Morgan estimates

Addressable Market ~50k Units/Year; Could Grow To ~70k

U.S./Canada: Heavy-Duty Natural-Gas Truck Addressable Market (by 000 miles/yr)

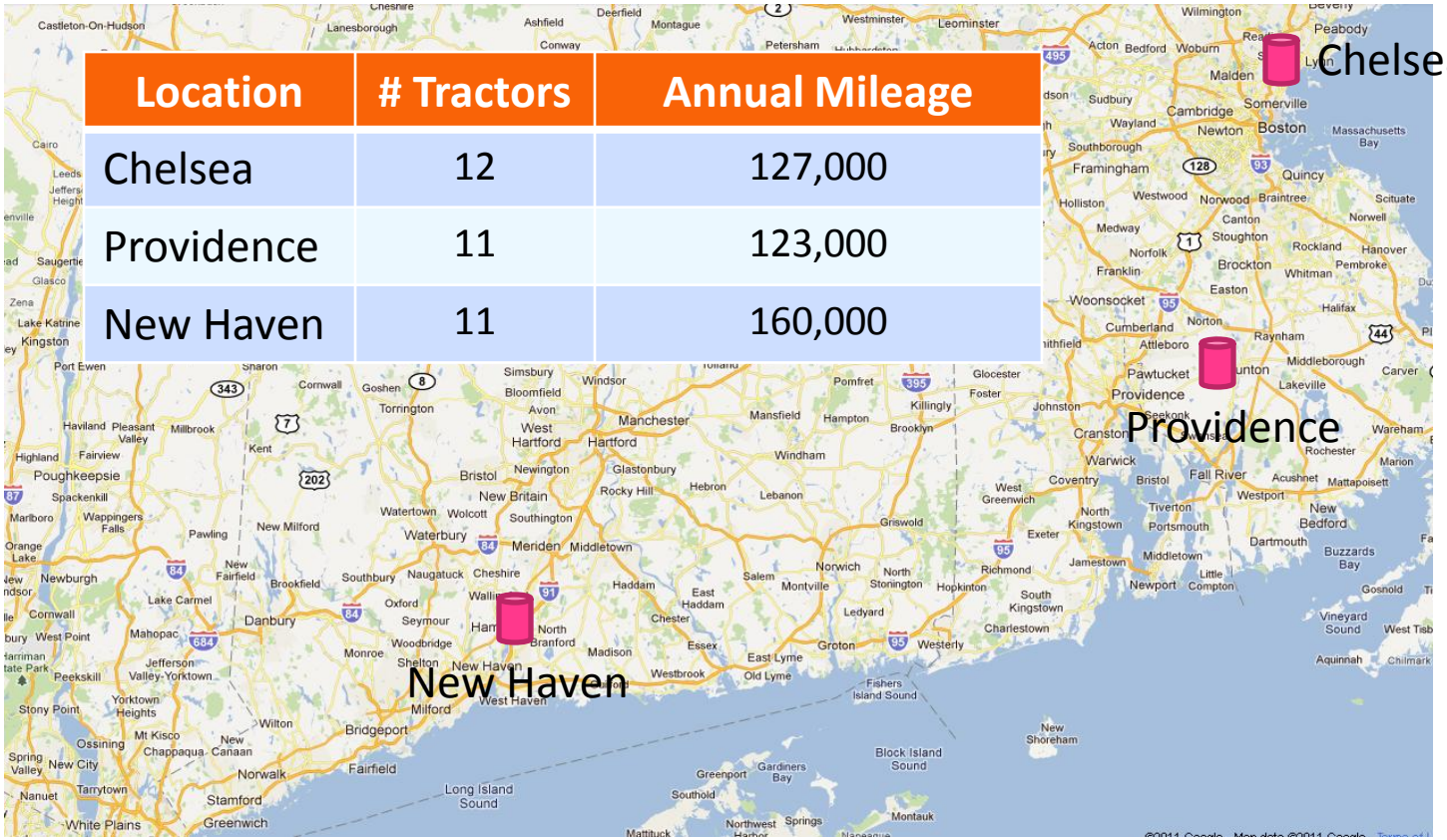


Source: ACT Research and J.P. Morgan estimates

Gulf and LNG

34 Peterbilt 386 LNG trucks with Westport Heavy Duty 15 liter HPDI systems to be positioned at 3 of Gulf's petroleum distribution yards

Location	# Tractors	Annual Mileage
Chelsea	12	127,000
Providence	11	123,000
New Haven	11	160,000



LNG ASSETS

MOBIL FUELING UNIT
Total capacity – 6,000 gals
Usable capacity – 5,000 gals
Cost - ~$500K

LNG TRUCKS
No. of trucks – 34
LNG vehicles require specialized vacuum-insulated pressure vessels to store LNG at cold temperatures.
LNG is typically only used in heavy-duty vehicles

Range

The energy density of LNG is 2.4 x greater than that of CNG, but is still 35% lower than diesel

Tank Type and Rated Capacity (gal)	Amt of Gas Actually Stored (gal)	Diesel Equivalent (gal)	NG Tanks Full (lbs)	Diesel Tank Full (lbs)	Fuel Weight Compare (lbs)
LNG 119	102	63	870	480	390
LNG 149	128	78	1093	588	505
CNG 5-15	75	68	2025	516	1509
CNG 2-41	82	74	1650	559	1091

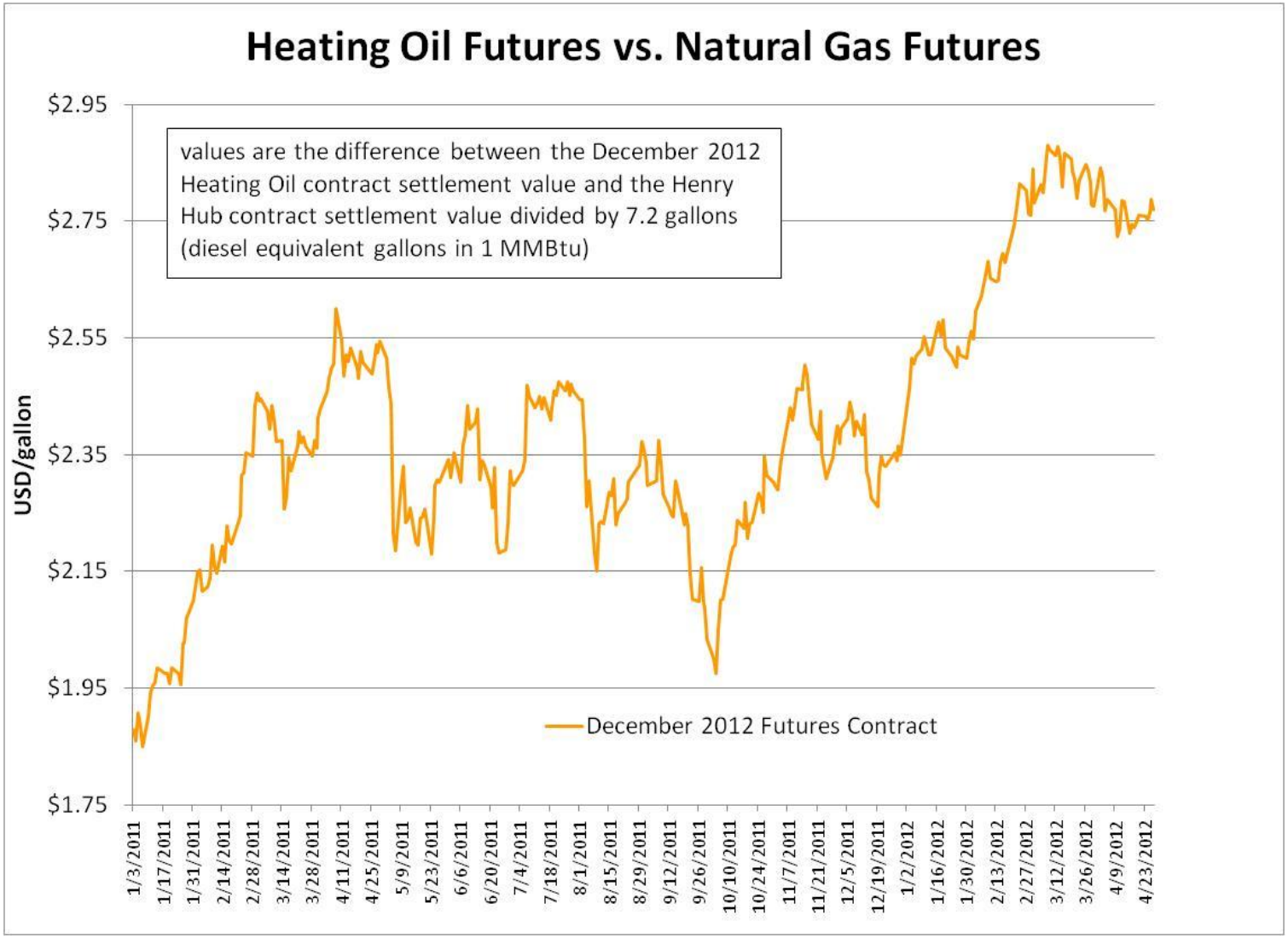
Source: American Trucking Associations December 9,2011

- Given the cost and weight differential of multiple tanks, Gulf opted for a single 120-gallon tank
- Chose round trip routes of 300 miles or less
- Cost premium versus diesel equivalent ~ $65,000

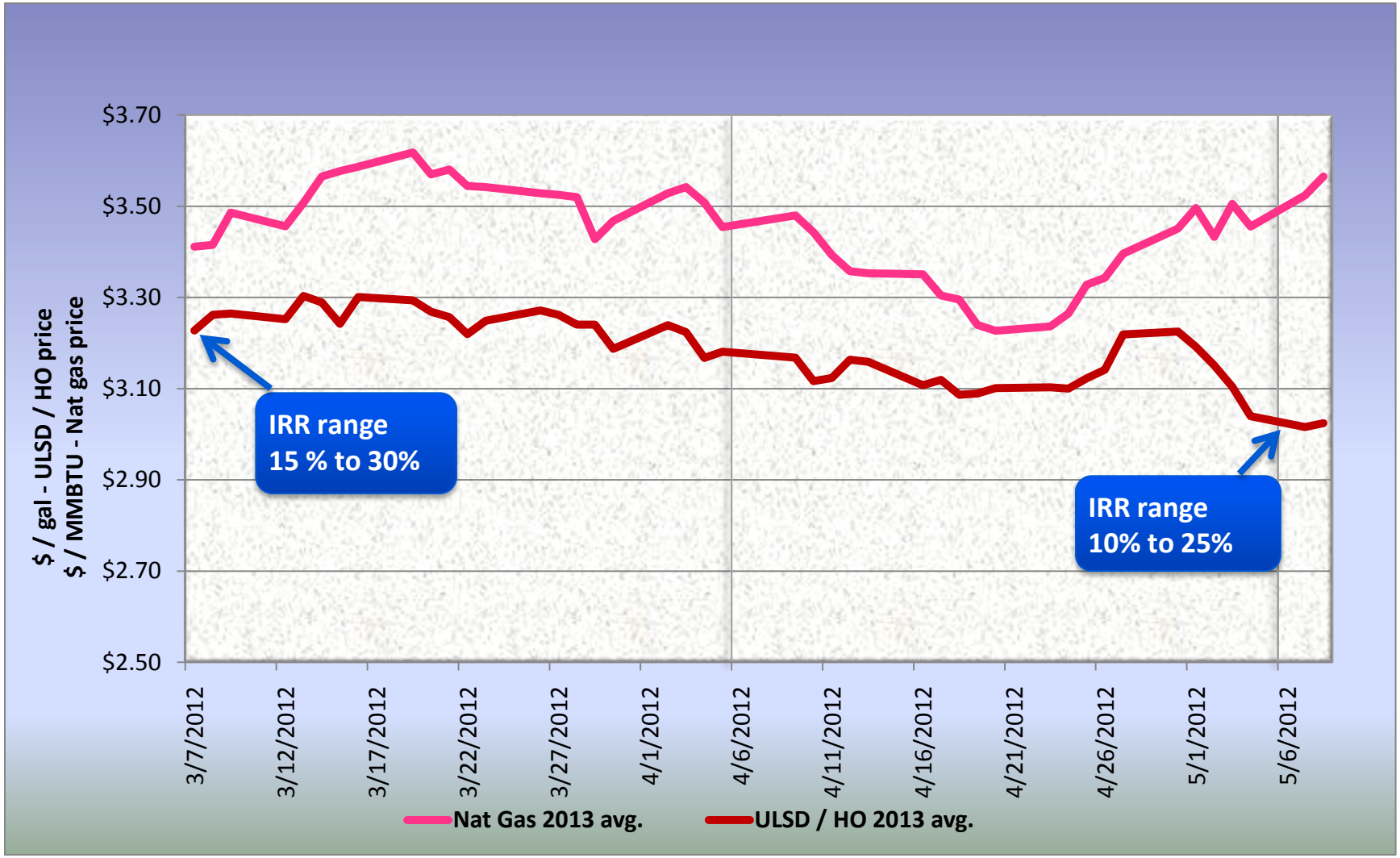
Assumptions

- Truck model: Cummins/Westport 15 liter LNG compression engine
- Cost Premium For LNG Truck ~ $65,000
- Cost for Maintenance Shop retrofits: $125,000 to $750,000
- Incremental O&M due to 1) fuel delivery system pump and 2) electronics on engine and fuel delivery system
- Fuel Savings ~ $1.25 to $2.00 per diesel gallon equivalent
  - Highly dependent upon freight costs to destination and
  - State tax treatment
- IRR between 10 and 30%

Spread Volatility



Natural Gas Vs. Diesel Spread



Tax Rate

STATE	FEDERAL TAX ($/gal)			STATE TAX ($/gal)		
FUEL	DIESEL	LNG		DIESEL	LNG	
		LNG gal	DGE		LNG gal	DGE
MA	.2430	.2430	.4131	.2100	.2020	.3434
RI	.2430	.2430	.4131	.3200	.3200	.5440
CT	.2430	.2430	.4131	.4620	.2600	.4420

- On an energy equivalent basis
  - ~ 1.7 LNG gals = 1 Diesel gal
- Federal level - LNG taxed at the diesel rate
- State level - Inconsistent tax treatment across states
- Investment rate of return varies by state

LNG Advantages

- Operational similarities to diesel
  - Dense fuel with high energy content for long distance travel before a refuel
  - LNG provides almost the same MPG as diesel
  - Comparative horsepower and torque in LNG trucks
- More cost effective in some applications
  - Supply costs
  - Freight costs
  - Taxation

LNG Constraints & Roadblocks

- Major investment required throughout the LNG transport system.
  - Specialized equipment to handle and store LNG at low temps (-260F) and high pressures
- Absence of ready availability of LNG trucks to replace diesel fleets .
  - LNG Vehicle count (1,000), CNG Vehicle Count (110,000)
- Economics currently work for only a small portion of ULSD on-highway use.
- Requires continuous use to prevent fuel loss.
- No alternative fuel source for fleets in case of LNG fueling station downtime.

Best Use Given Constraints – Heavy Duty Centrally Fueled Trucks

- Vehicles with a ~600 mile driving range that return to a central fueling facility rather than depending on public fueling infrastructure.
- Vehicles that are in continuous use to avoid fuel loss.
- Due to capital intensive requirements the LNG infrastructure must be supported by a large fleet.