

# Importance of Growing the Heavy-Duty Vehicle Market in the Success of Dairy Digester Development

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# GNA: Heavy-Duty Commercial Transport





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# Role of NGV Market Growth

- Dairy biogas costs ~\$20 - ~\$25/MMBTU to produce
- Need revenue from RIN & LCFS credit sales to be financially sustainable
- Only way to produce RIN & LCFS credits is to sell to California transportation market
- Can California NGV consumption support development of needed dairy digesters?

# Existing Market for CNG in California

Category	Units	Metric
Total number of NGVs registered in CA	20,963	Vehicles (2015 data)
Total Volume of NG sold in CA	143.8	Million DGE
Total Volume of NG registered in LCFS (fossil & RNG)	112.7	Million DGE
Total Volume of RNG registered in the LCFS	88.5	Million DGE

- Data for LCFS volumes from Q2 2016 thru Q1 2017
- RNG = 78.5% of CNG/LNG in LCFS
- RNG = 61.5% of total CNG/LNG sold in CA



# Existing Inventory of Medium and Heavy Duty NGVs in California (2015 data)

Vehicle Class	Units
Class 4	548
Class 5	32
Class 6	507
Class 7	2,257
Class 8	13,547
<b>Total</b>	<b>16,891</b>

- Data derived from R. L. Polk & Co. query for CA NGV registrations

# What is the Impact of Incentives on NGVs Market Growth in California?

- Historically, incentive programs that pay for the incremental cost have moved the market
  - Incremental cost = to delta between NGV and diesel baseline vehicle
- Several proposals currently circulating to increase funding for programs that would promote purchase of Near Zero Emission NGVs using RNG



**Modeled Scenario:**  
**What does an investment of \$500 million do to the number of NGVs on the road, volume of RNG required, and reductions in pollutants?**



# Assumptions about Growth in the NGV Inventory

Vocation	VMT	Fuel Economy	Typical Retention Period
Diesel Baseline	miles/year	mpDGE	years
Regional Haul Tractor	90,337	6.56	5
Short Haul Tractor	52,119	6.58	7
Refuse	14,417	2.90	12
Transit	44,670	5.20	12

- All data presented here from CARB EMFAC 2014

# Distribution of New NGVs by Vehicle Class

Vehicle Type	Percentage
Regional Haul Tractor	53%
Short Haul Tractor	34%
Refuse	10%
Transit	4%

- All data presented here from CARB EMFAC 2014

# Ultra-Low NOx HD Trucks





# Projected Incremental Cost for Near Zero Emission NGVs

Vocation	Diesel CapEx	CNG NZE CapEx	CapEx-Only Increment
Regional Haul Tractor	\$120,000	\$200,500	\$80,500
Short Haul Tractor	\$104,000	\$164,500	\$60,500
Refuse	\$210,000	\$253,000	\$43,000
Transit	\$485,000	\$538,000	\$53,000

- Data from TIAX, ANGA, ARB and AFLEET

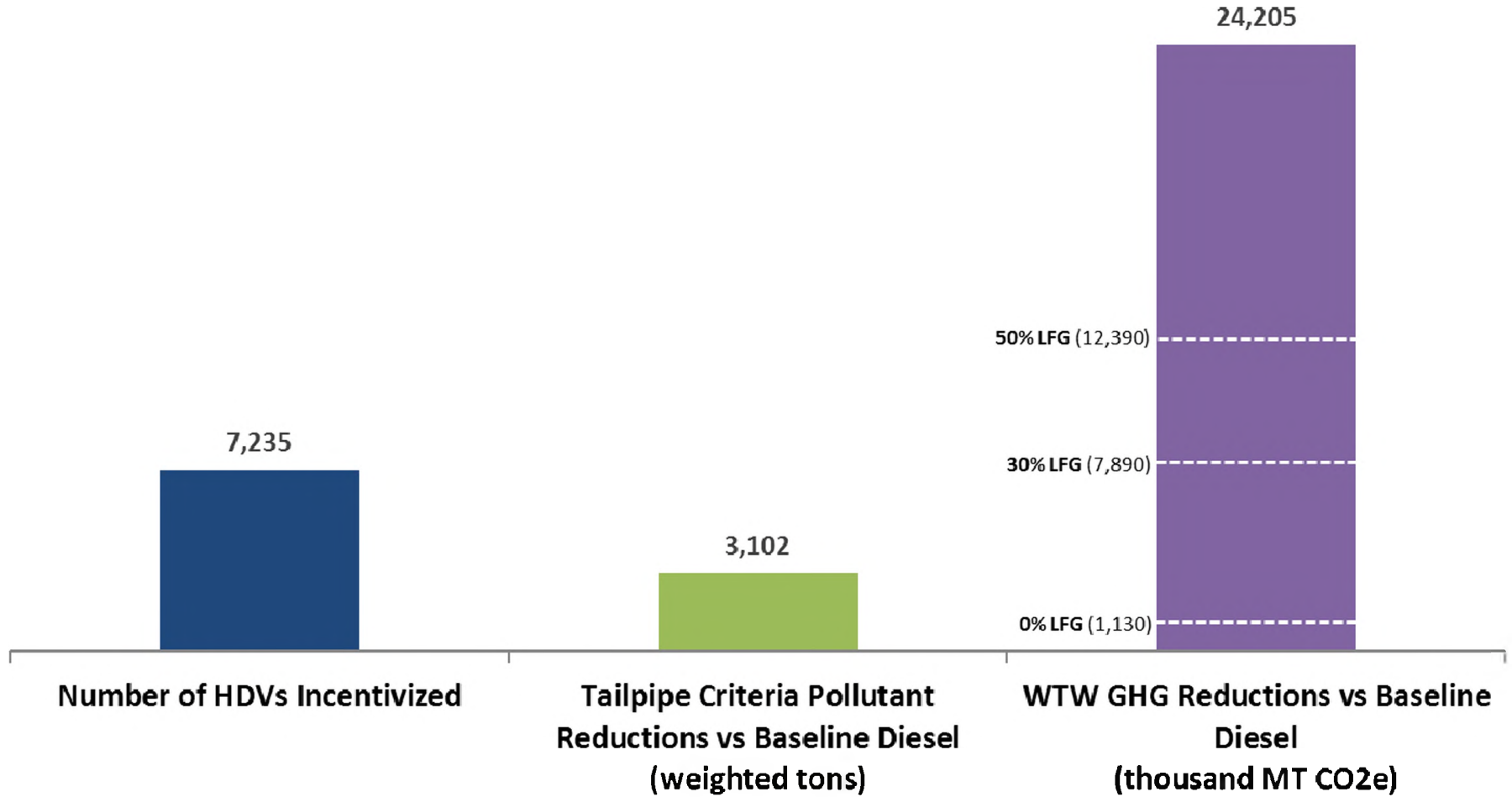
# Increase in Fuel Consumption from Investment of \$500MM in NZE NGVs

Vocation	VMT (miles/year)	Fuel Economy (mile/DGE)	Fuel Consumption (per year in DGE)	Distribution (Percent of New Vehicles)	Number of New Vehicles (out of 7,235)	Total Fuel Consumption (DGE/year)
Regional Haul Tractor	90,337	6.56	13,767	52.81%	3821	52,602,522
Short Haul Tractor	52,119	6.58	7,926	33.96%	2457	19,473,605
Refuse	14,417	2.90	4,971	9.65%	698	3,469,332
Transit	44,670	5.20	8,597	3.58%	259	2,228,197
					<b>Total</b>	<b>77,773,658</b>

- Based on vehicle activity data from CARB EMFAC 2014

# Near-zero+RNG HDV Incentives

## What does \$500 million buy?



Incentive amounts based on incremental purchase cost of advanced heavy-duty trucks over baseline diesel truck

Based on emissions and vehicle activity data from CARB EMFAC 2014

Weighted emissions =  $\text{NO}_x + 20 \times \text{PM}_{10} + \text{ROG}$

GHG emissions based on provisional dairy biogas pathway calculated by ARB Staff using CA-GREET 2.0

Cost effectiveness uses Moyer program capital recover factors based on typical retention period of first owner



# Summary

- RNG is quickly becoming the dominant fuel for CA NGVs
- 61% of all CNG sold in CA is RNG; expected to climb to near 100% by 2020
- High priced dairy RNG needs robust transportation market to ensure economic sustainability
- Need to invest in NGV market expansion to ensure success of dairy digester strategy
- \$500 million investment in NGV market growth will increase RNG consumption in state by 50%

# Projections of Dairy RNG Production

	Cow/Year	Unit	2016 Milker Population	50% of 2016 Milker Population	Unit
Biogas Production	22,849.12	ft <sup>3</sup>	39,713,826,981	19,856,913,490	ft <sup>3</sup>
Methane Content	14,851.93	ft <sup>3</sup>	25,813,991,014	12,906,995,507	ft <sup>3</sup>
Biomethane Production	12.82	MMBtu	22,282,314	11,141,157	MMBtu
Diesel Gallon Equivalent	99.77	DGE/yr	173,403,220	86,701,610	DGE/yr

## Assumptions:

Methane content: 65%  
 BTU/ft<sup>3</sup> = 1158  
 DGE = 128,500 BTU/g

Information from the Economic Feasibility of Dairy Digester Clusters in California: A Case Study, prepared by the California Dairy Campaign for the US Department of Agriculture, Rural Development Agency, Value Added Producer Grant (VAPG) Program, June 2013