

Class 6-8 Truck Hybrid Powertrain Systems Market

Open for Business

HTUF 2009
Atlanta

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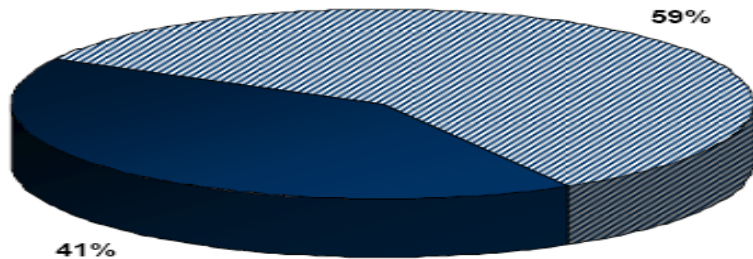
F R O S T & S U L L I V A N

Consumer Research: Voice of your Customers Must Be Heard to Develop Winning Solutions

Fleet Managers belonging to private and for-hire vocational and on-highway fleets will be instrumental in offering growth momentum to the hybrid powertrain systems market.
 → It is time to listen to the **VOICE of YOUR CUSTOMERS**

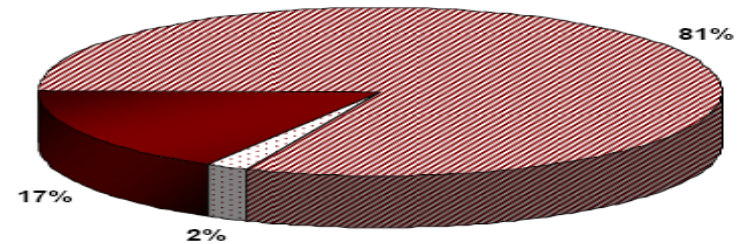
Type of Fleet (Private/Hired)
(N=109)

■ Private ▨ For Hire

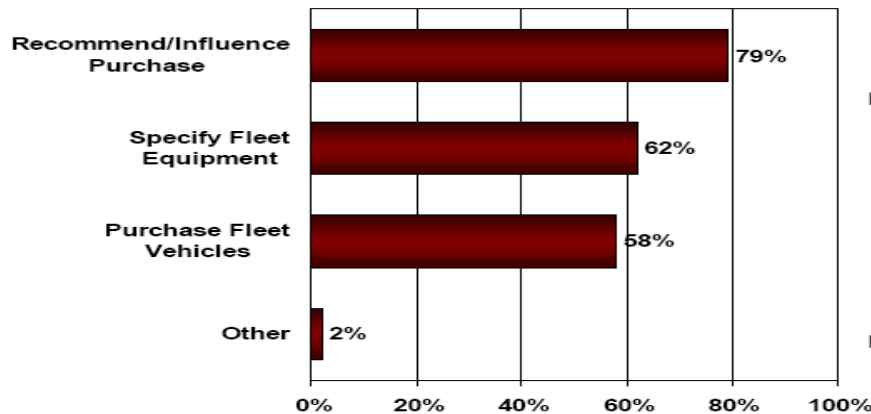


Type of Fleet
(N=109)

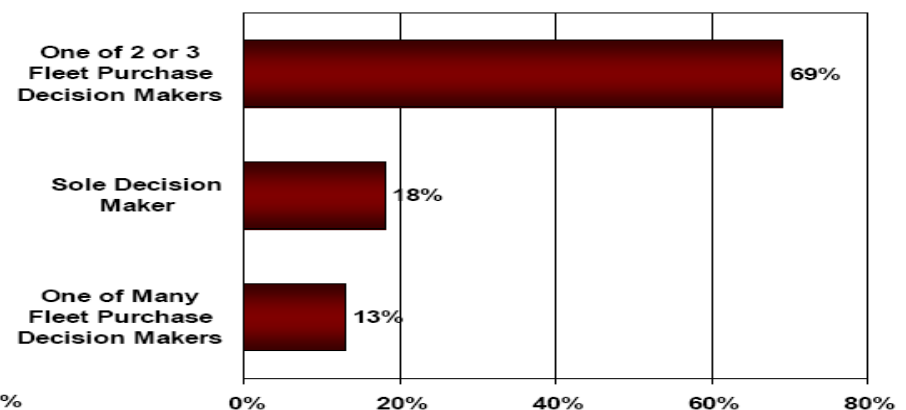
■ Vocational ▨ On-highway □ Don't Know



Scope of Influence of Fleet Purchase
(N=109)

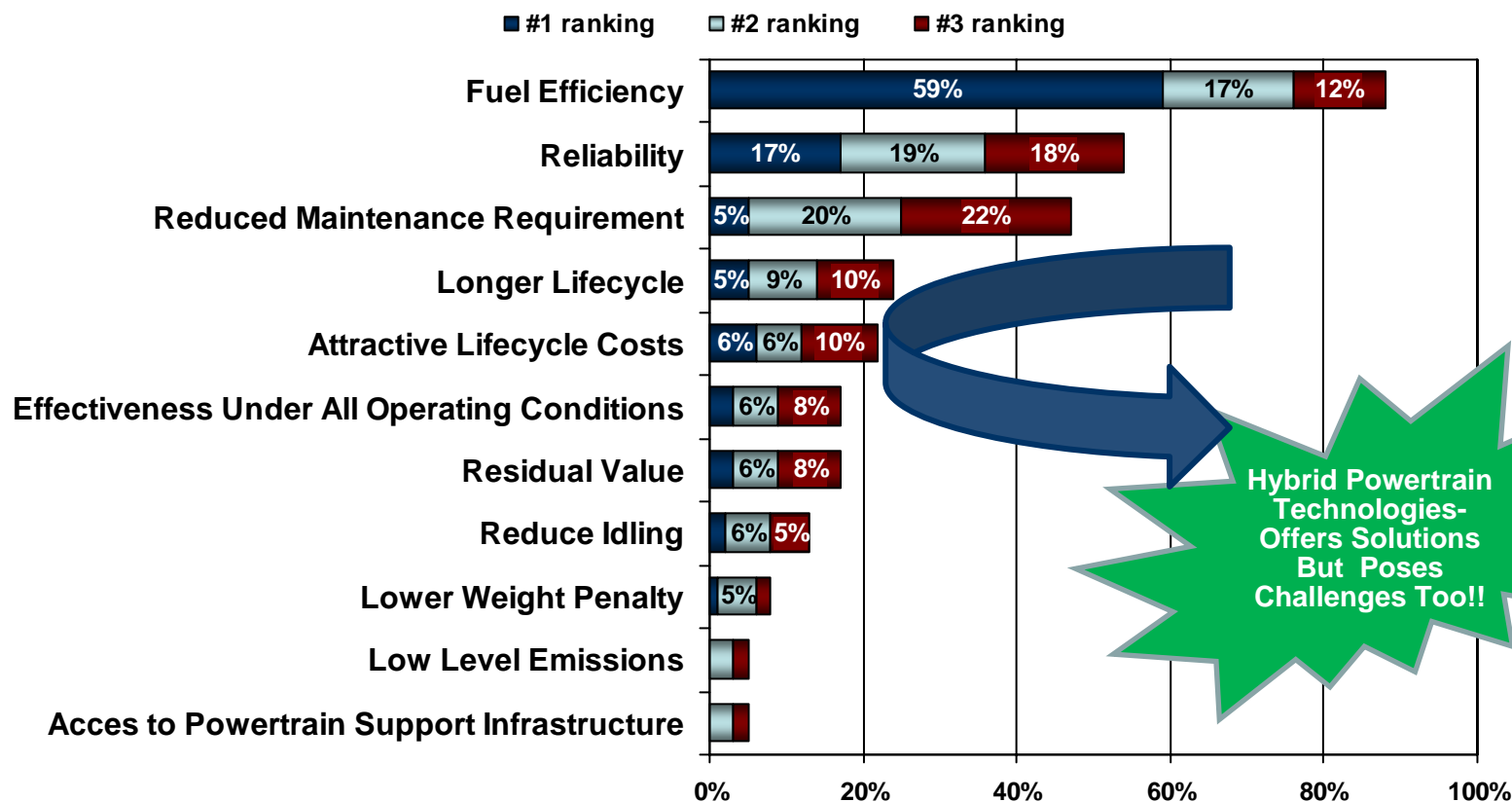


Degree of Involvement in Fleet Purchase
(N=109)



Highest Ranking Benefits of Powertrain Technologies: Clear and Present Demand for Hybrid Powertrain Technologies

Highest Ranking Benefits of Powertrain Technologies
(N=109)



Purchase Intentions of Powertrain Technologies: Hybrids Gaining Traction Among Fleet Managers

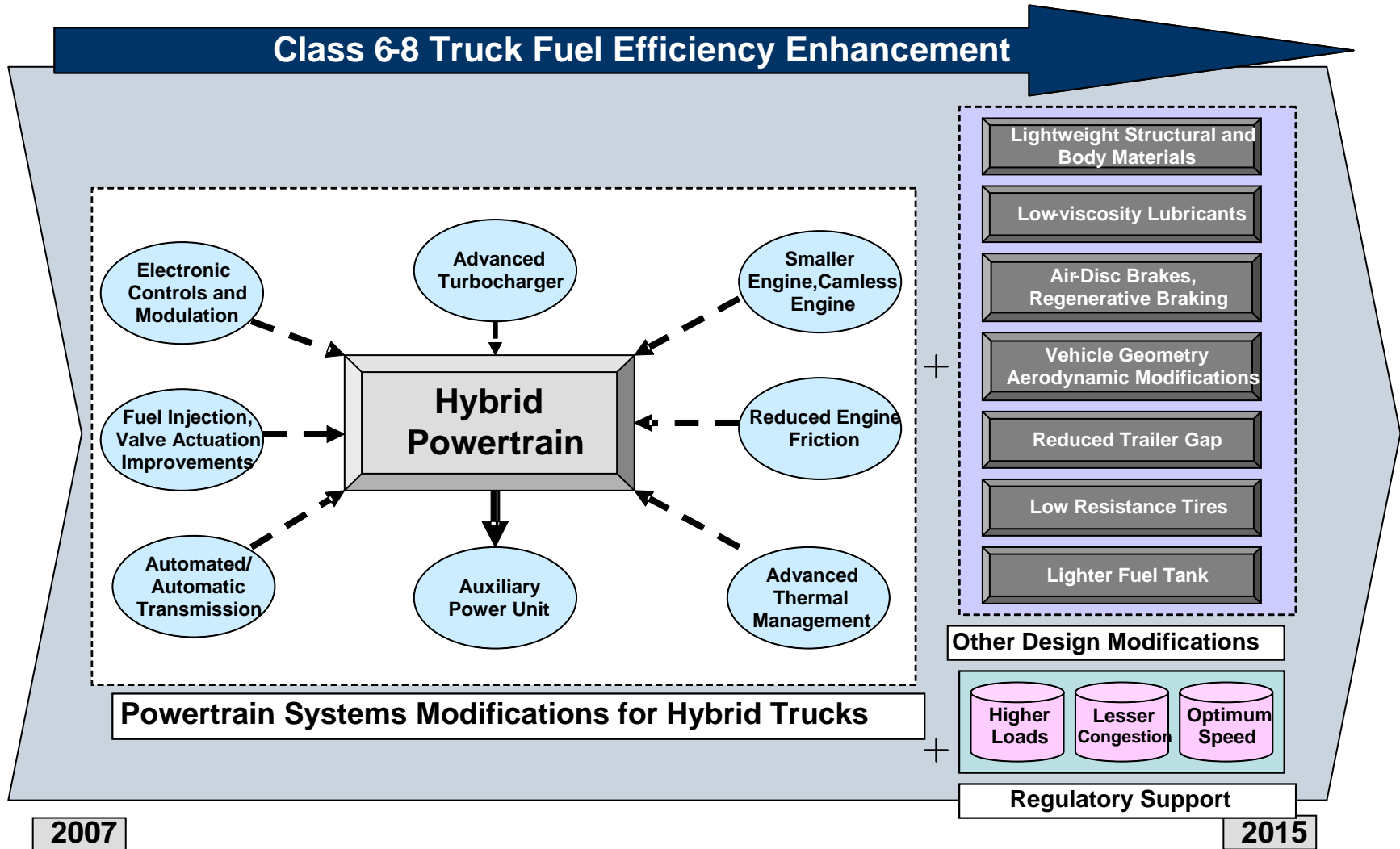
Powertrain Technology (N=109)	Level of Purchase Intention		
	Active (Are Considering)	Passive (Might Consider)	No Interest
Automatic/Automated Transmission	50%	42%	8%
Selective-Catalytic Reduction (SCR)	39%	51%	9%
Biodiesel	38%	57%	5%
Compressed Natural Gas	15%	57%	28%
Hybrid Trucks	24%	61%	16%
Navigation Based Fuel Consumption Optimization	22%	66%	12%

In January, 2009 85% of the top 100 fleet managers reported either active or passive interest in purchasing hybrid trucks

However, amongst alternative powertrain technologies biodiesel emerged as a more preferred technology when compared to hybrid powertrain technology.

Demand for hybrid trucks slowly but surely on the rise, especially in the current environment as diesel prices show promise of an increase and regulations get stronger.

Fuel Efficiency Enhancement of Class 6-8 Trucks Through A Combination of Modifications and Regulatory Support



2007

2015

Hybrid Powertrain Systems Market: Convergence of Advanced Technologies, Creation of New Revenue Streams

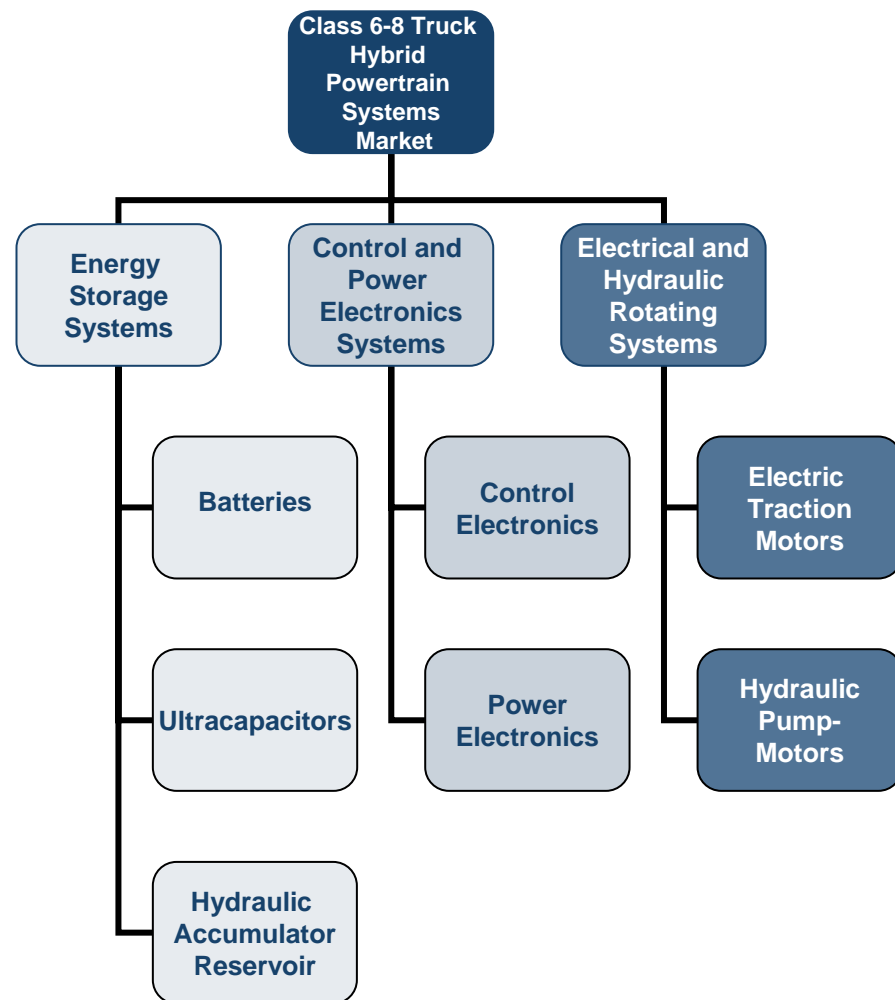
There are two broad categories of hybrid Class 6-8 trucks, based on the energy storage system and the hybrid propulsive power delivery mechanism. These two categories are:

- Electric Hybrids
- Hydraulic Hybrids

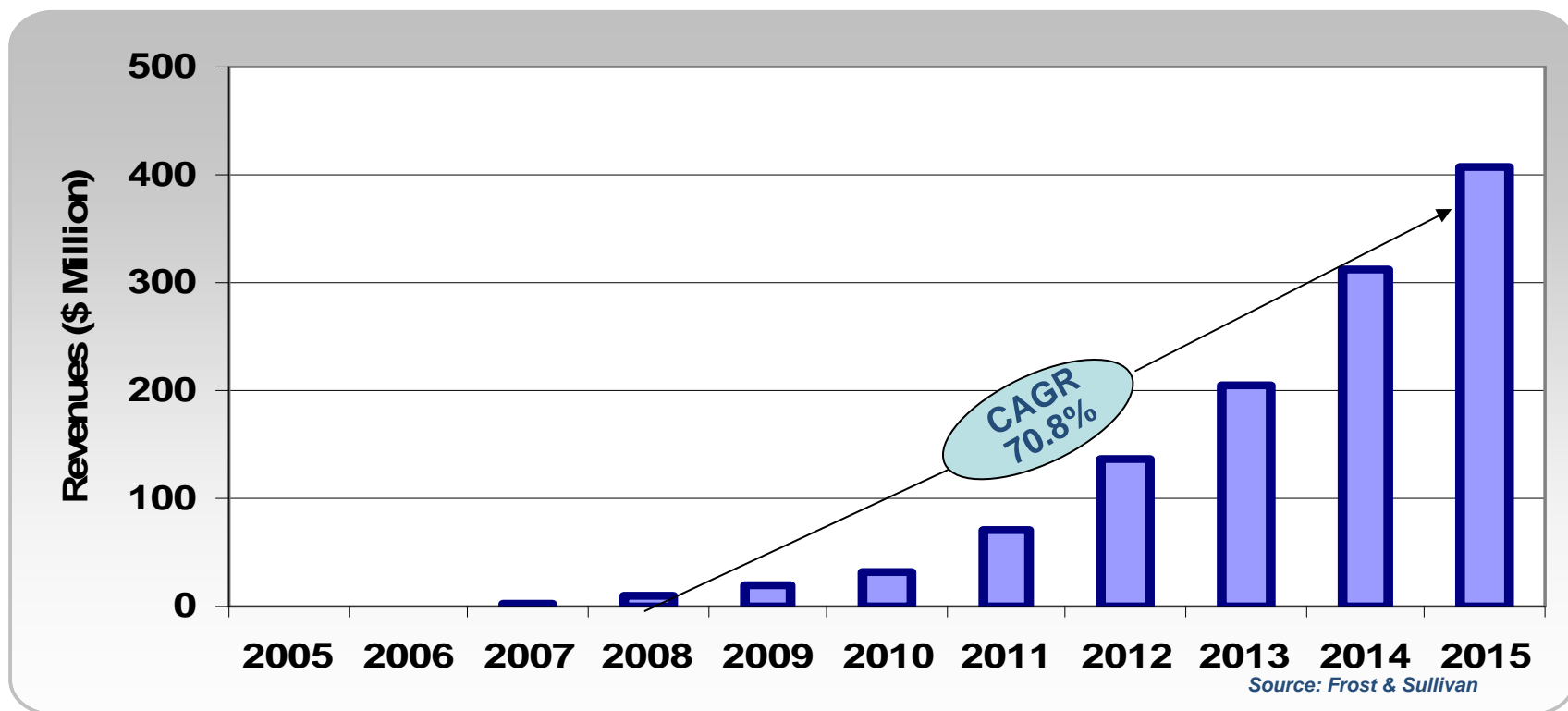
Since most Class 6-8 trucks use diesel fuel, the hybrid trucks are referred as diesel-electric or diesel-hydraulic hybrids.

Class 6-8 truck hybrid powertrain systems market can be segmented into the following market segments:

- Energy storage systems market
- Control and power electronics systems market
- Electric and hydraulic rotating systems market



Total Class 6-8 Truck Hybrid Powertrain Systems Market: Revenue Forecast (North America), 2005-2015



- The North American Class 6-8 truck hybrid powertrain systems OE market, consisting of energy storage systems, control and power electronics systems, and electrical and hydraulic rotating systems, is expected to generate \$406.8 million by 2015.
- The hybrid powertrain systems market's revenues will start showing robust growth rates post 2010, after the industry puts the EPA 2010 regulation compliance issues and the economic slowdown behind it.
- A healthy compound annual growth rate of 70.8 percent reveals that this market offers lucrative growth opportunities to market participants in the medium-long term.

Total Class 6-8 Truck Hybrid Powertrain Systems Market: Key Market Engineering Measurements, 2008

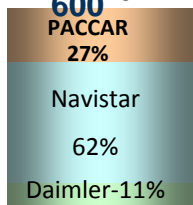
Measurement Name	Measurement	Trend
Market age (2008)	2 Yrs	Infancy
Revenues (2008)	\$ 9.6 Million	Increasing
Potential revenues (2015)	\$ 406.8 Million	---
Base year market growth rate (2008)	292.3%	Increasing
Forecast period market growth rate (2008-2015)	70.8%	---
Hybrid truck production (2008)	0.6 Thousand	Increasing
Forecast period units growth rate (2008-2015)	81.8%	---
Average Price: Diesel-Electric Hybrid Powertrain System/Module (2008)	\$ 15,976	Decreasing
Average price: Hydraulic Hybrid Powertrain System/Module (2009)	\$ 7,440	Decreasing
Average product development time	2 Yr -2.5 Yrs	Decreasing
Industry average R&D expenditure per System	\$ 1,918	Decreasing
Market Concentration (Combined market share of top 3 competitors, 2008)	100 %	Decreasing
Competitors (Active market competitors in base year)	41	Increasing
Degree of competition (Scale of 1 to 10: 1 being minimum)	7	Increasing
Degree of technical change (Scale of 1 to 10: 1 being minimum)	8	Increasing
Customer satisfaction (Scale of 1 to 10: 1 being minimum and 10 maximum)	7	Increasing
Customer loyalty	7	Decreasing

Class 6-8 Hybrid Truck Production: Hybrid Trucks to Set to Account for 8 Percent of Total Truck Production by 2015

Hybridization of North American Commercial Trucks (Class 6-8) : Production Volumes and Market Shares of Major OEMs (2008-2015), Hybrid Power Source (2009-2012)

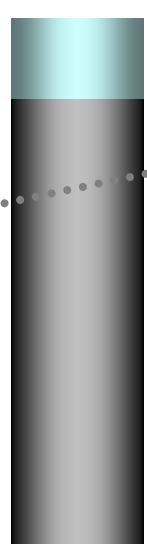
Electric Hybrid
 Hydraulic Hybrid

Hybrid Production



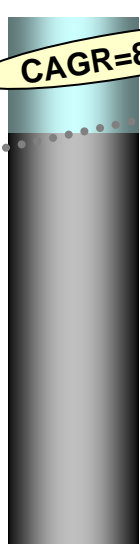
2008

Installation (%)



2009

CAGR=80.8%



2010



2011

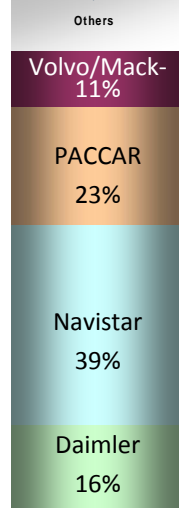


2012

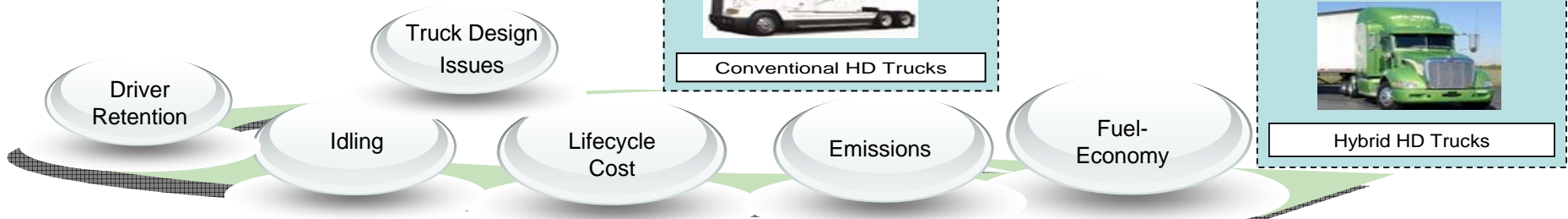
8% of Truck Production

Hybrid Production

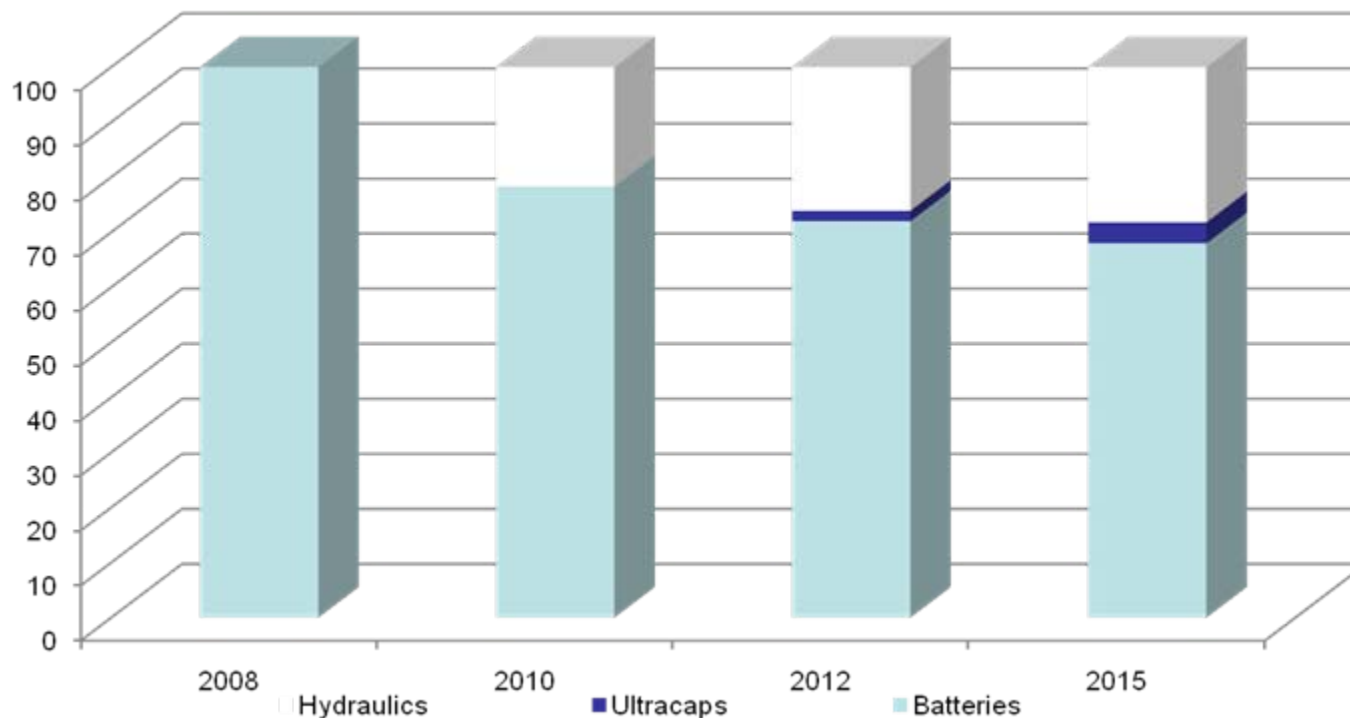
39,400



2015

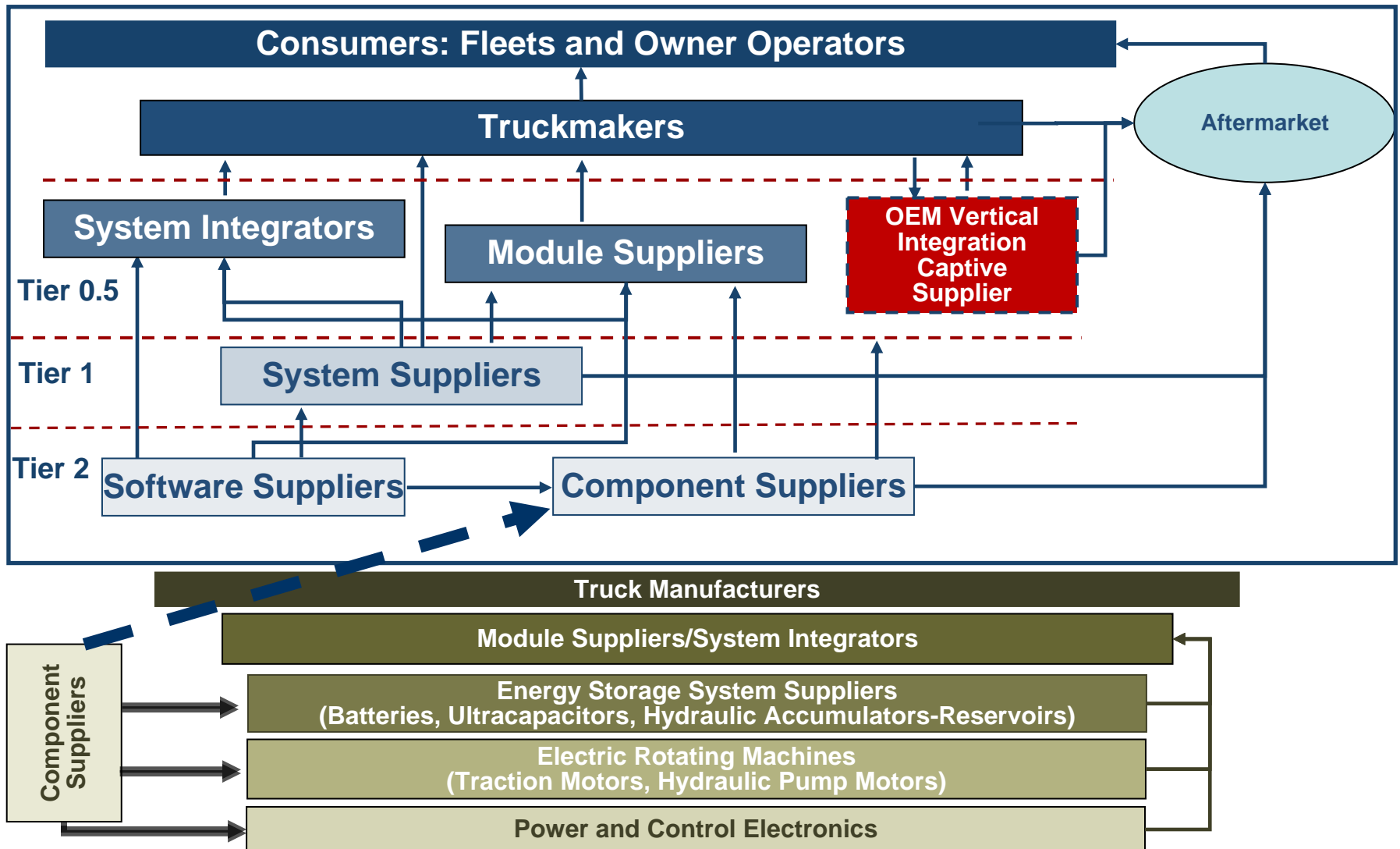


Energy Storage Systems: Batteries Will Store Energy in Vast Majority of Diesel Hybrids, 2005-2015



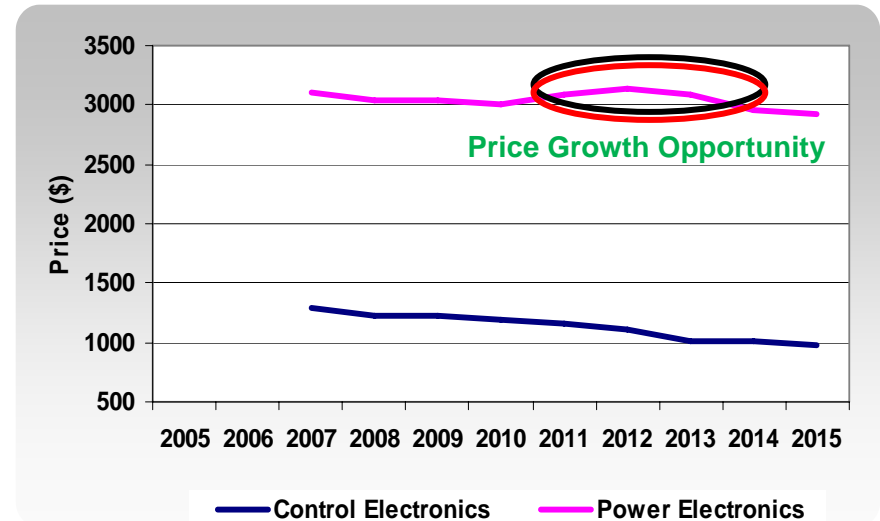
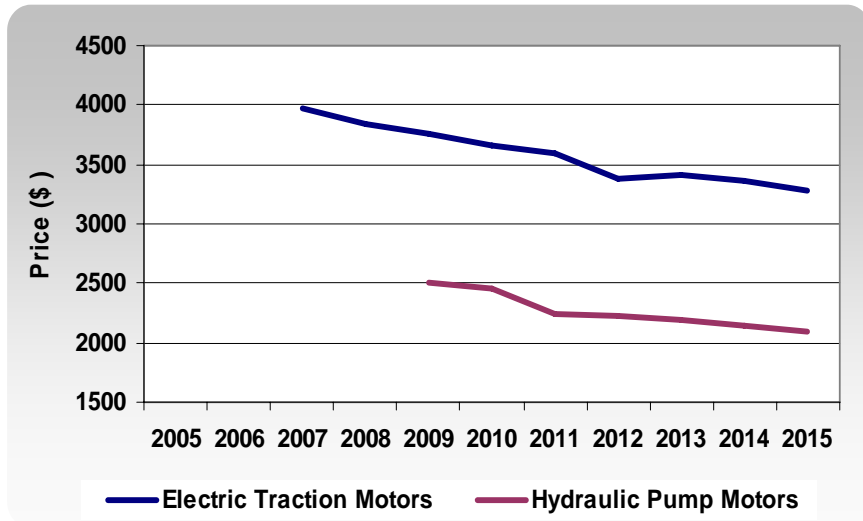
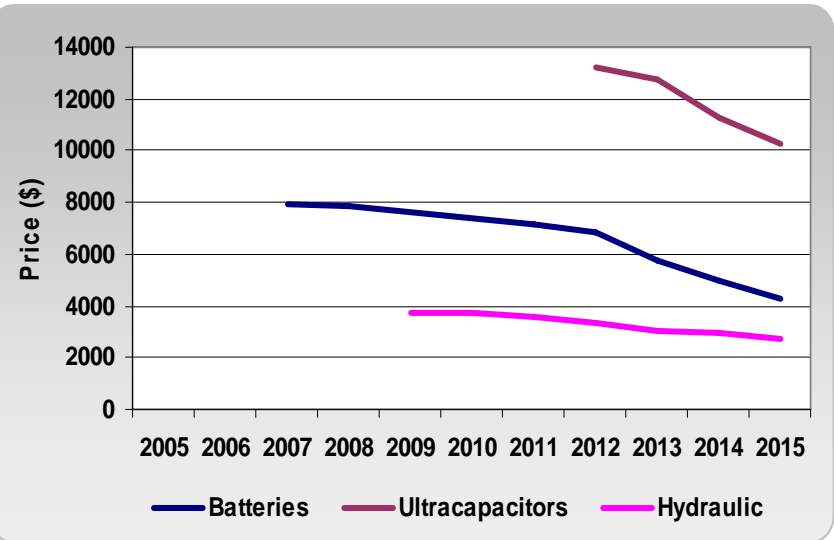
- Batteries will continue remaining the most widely installed energy storage system in Class 6-8 hybrid trucks.
- Hydraulic energy storage systems will start experiencing OE market adoption in 2008. By 2015, 28.2 percent of all Class 6-8 trucks manufactured will feature hydraulic energy storage systems.
- Ultracapacitors will be able to penetrate a very small portion of the total hybrid truck production over the 20012-2015 period. In 2015, 3.8 percent of all hybrid trucks manufactured will feature ultracapacitors.
- Lithium-ion batteries will be the overwhelming choice for energy storage systems in Class 6-8 hybrid trucks.

Industry Structure and OE Market Supply Chain: Interesting New Market Dynamics Underlining Need for Synergetic Relationships

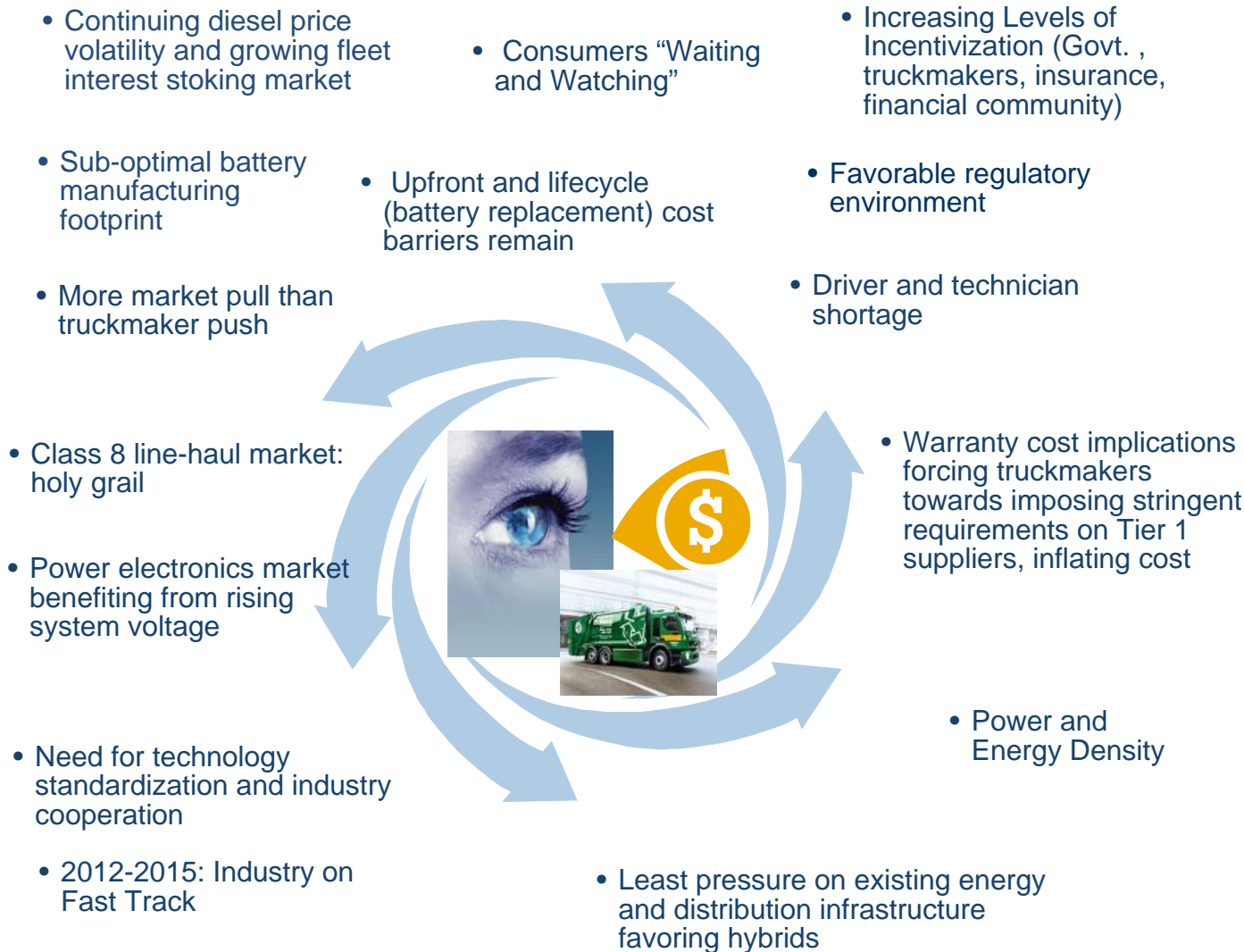


Pricing Analysis: Diminishing Upfront Cost Barriers for Potential Adopters

- Steady price declines in the battery, hydraulics, ultracapacitors, control electronics, electric and hydraulic pump-motors.
- Price growth expected in the power electronics systems market.
- OEMs interested in gaining greater control of the power electronics market.
- Overall price decline will be prodded by economies of scale
- Increasing market competition and competition from global suppliers will expedite price declines in the medium-long term.



Key Market and Technology Trends and Resulting Competitive Factors for System Suppliers



Key Competitive Factors

- Efficiency
- Upfront and Lifecycle Cost
- Quality and Reliability
- Robustness and Attractive Form Factor
- Seamless Interfacing with the Truck makers Hybrid Platform
- Safety Value
- Scalable and Flexible Supply Chain
- Proximity with Truck makers, Large Fleets, and Policy Makers

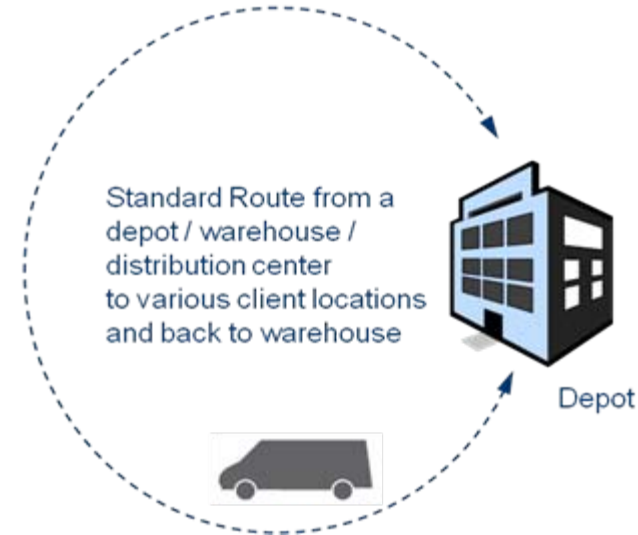
Electric Commercial Vehicle Market: Friend or Foe??

Best Fit for Electric Commercial Vehicles: Depot-based urban delivery fleets cover known routes (typically under 100 miles) and they return to base every night where they can be recharged

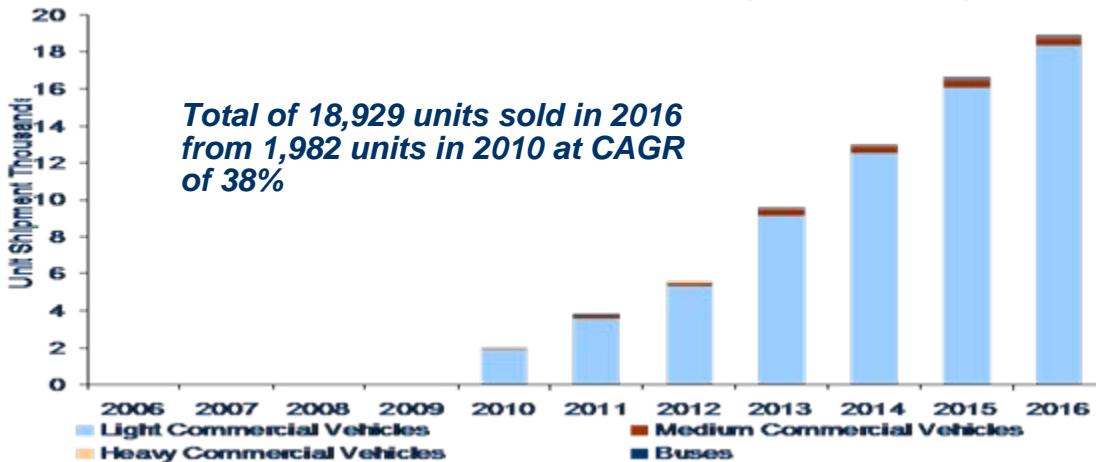
Electric Vehicle Market: Definition of Electric Commercial Vehicle Attractiveness (NA), 2009

GCW / GVW 1* (ton)	Load Capacity (ton)	Typical Application	Pure Electric Attractiveness
3.5	1.5	Urban distribution	✓✓✓
7.5	4	Urban distribution	✓✓
12	7.2	Urban distribution	✓
18	11	Inter Urban distribution	✗
26	17	Long distance	✗
40	25	Long distance	✗

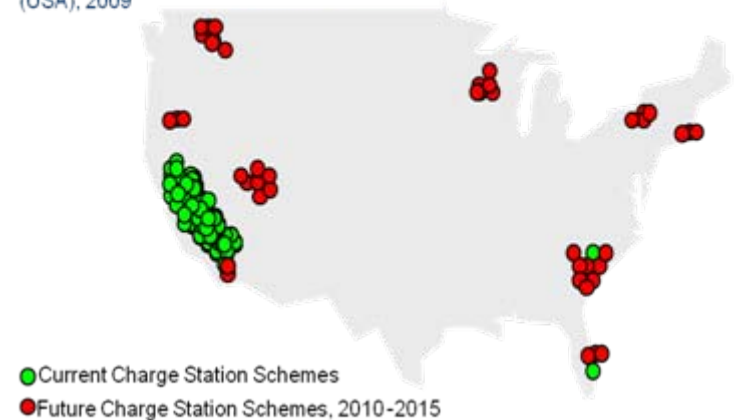
Without Government funds EV do not have a future, as initial cost is very high



Electric Vehicle Market: Total Market Forecasts (North America), 2009-2016



Electric Vehicle Market: Definition of Electric Commercial Vehicle Attractiveness (USA), 2009



CALSTART Member Benefits

Frost & Sullivan study entitled:
North American Class 6-8 Truck Hybrid Powertrain Systems Market
is available to CALSTART members at a discounted price.

This study offers in-depth research, analysis, and forecasts of the North American market for Class 6-8 hybrid trucks, energy storage systems, power and control electronics, and electric and hydraulic rotating machines.

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