



Electrification of the Commercial Vehicle Segment:

Trends, Trials & Tribulations

Rick Dauch, CEO

August 23, 2023





Agenda


- Government Regulations, Mandates & Funding
- Supply & Demand Factors
- ICE vs. EV Chassis
- Competitors & Application by Segment
- Workhorse Product Portfolio & Initiatives
- Summary

100% Electric



Consumer concerns & government regulations are driving the shift to EVs

- Paris Greenhouse Gas Accord (2040)
- China Govt Mandate & EU Govt Policies
- U.S. Government
 - CARB Mandates (Auto, Commercial Vehicles)
 - U.S. Federal Govt Funding & Commitments



U.S. commercial EV adoption is steadily increasing, but at a **slower pace** than the rest of the world.

Automotive & Commercial Segments

The next EV frontier: CL 4-6 "Return to Station" delivery trucks

CL 1-3

- ✓ Sufficient Range and TCO
- ✓ Commitment to CAPEX

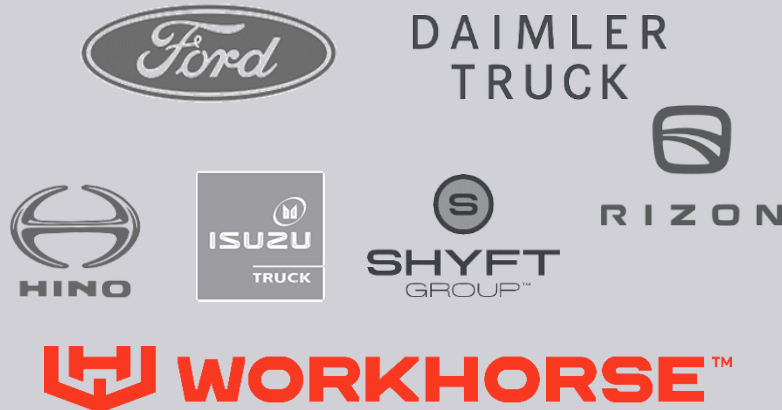
- High-volume market, global platforms
- Simple sales model
- Chassis and components leveraged between passenger and commercial
- OEM CAPEX in battery & infrastructure



CL 4-6

- ✓ Sufficient Range and TCO
- ? Commitment to CAPEX

- Low-volume, TCO & range sweet-spot
- Complicated sales model (body / upfits)
- Chassis and components for BEV constrained by higher ICE volumes



CL 7-8

- X Sufficient Range, Payload, TCO
- ? Commitment to CAPEX

- Medium-volume market by region
- Payload & range limits
- HFC economics remain challenging
- Natural gas technology adoption



CL 4-6: Next EV Frontier

Source: ACT Research Charging
Forward © 2023

North America BEV payback period versus diesel ICE (years)

RED

Payback beyond vehicle's useful life, low adoption

YELLOW

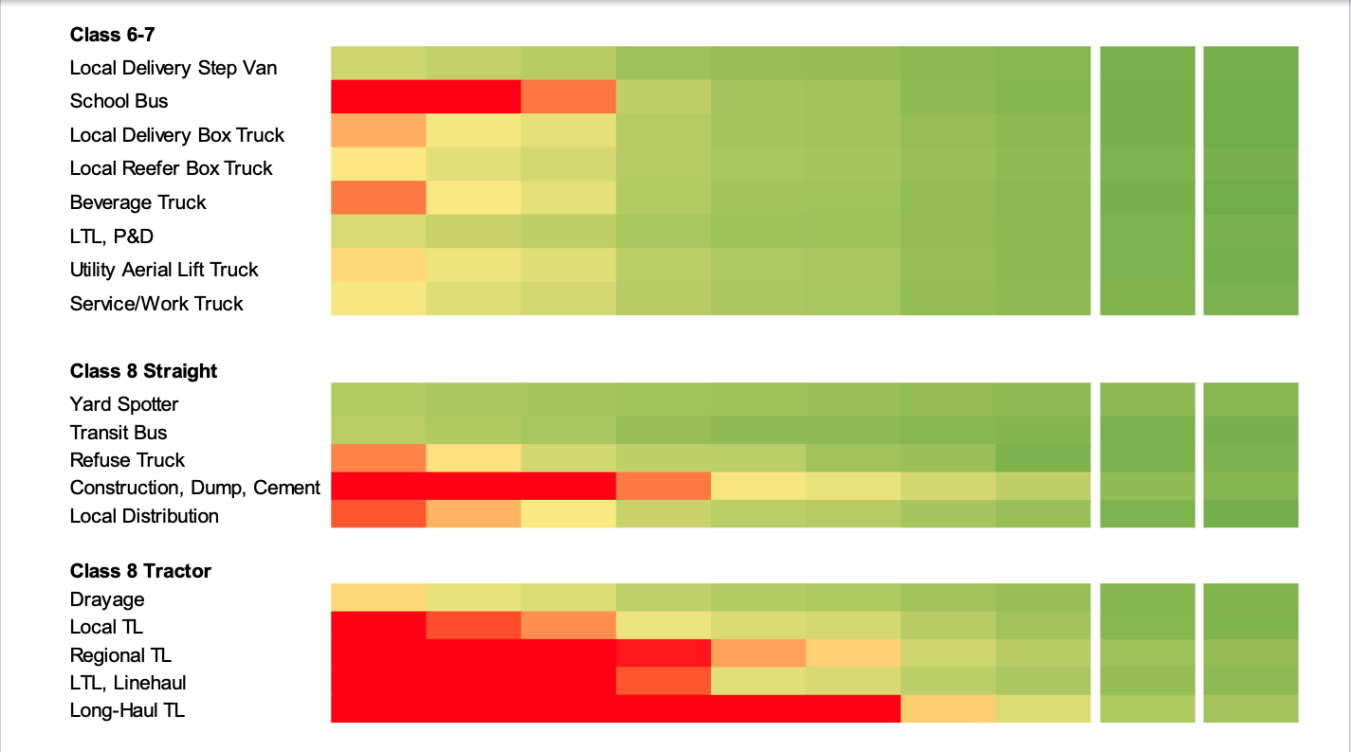
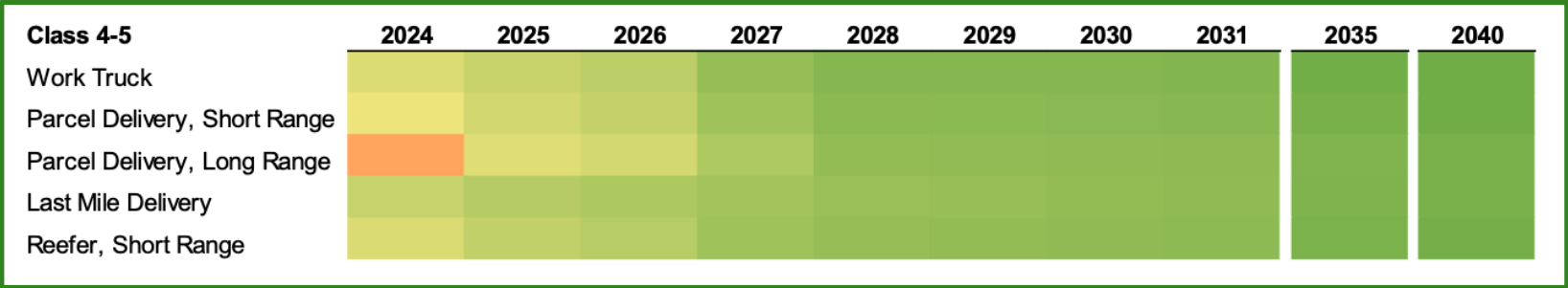
Long payback / limited adoption

GREEN

Payback acceptable for adoption

DARK GREEN

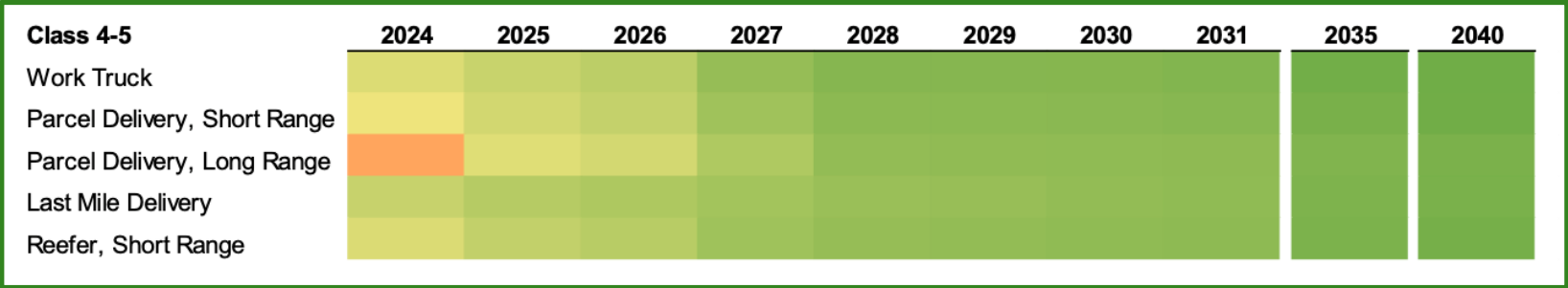
Price parity or less than ICE/ accelerated adoption



CL 4-6: Next EV Frontier

Source: ACT Research Charging Forward © 2023
and NACFE

North America BEV payback period versus diesel ICE (years)



RED

Payback beyond vehicle’s useful life, low adoption

YELLOW

Long payback / limited adoption

GREEN

Payback acceptable for adoption

DARK GREEN

Price parity or less than ICE/ accelerated adoption

71% of CL 4-6 Routes are <100 miles

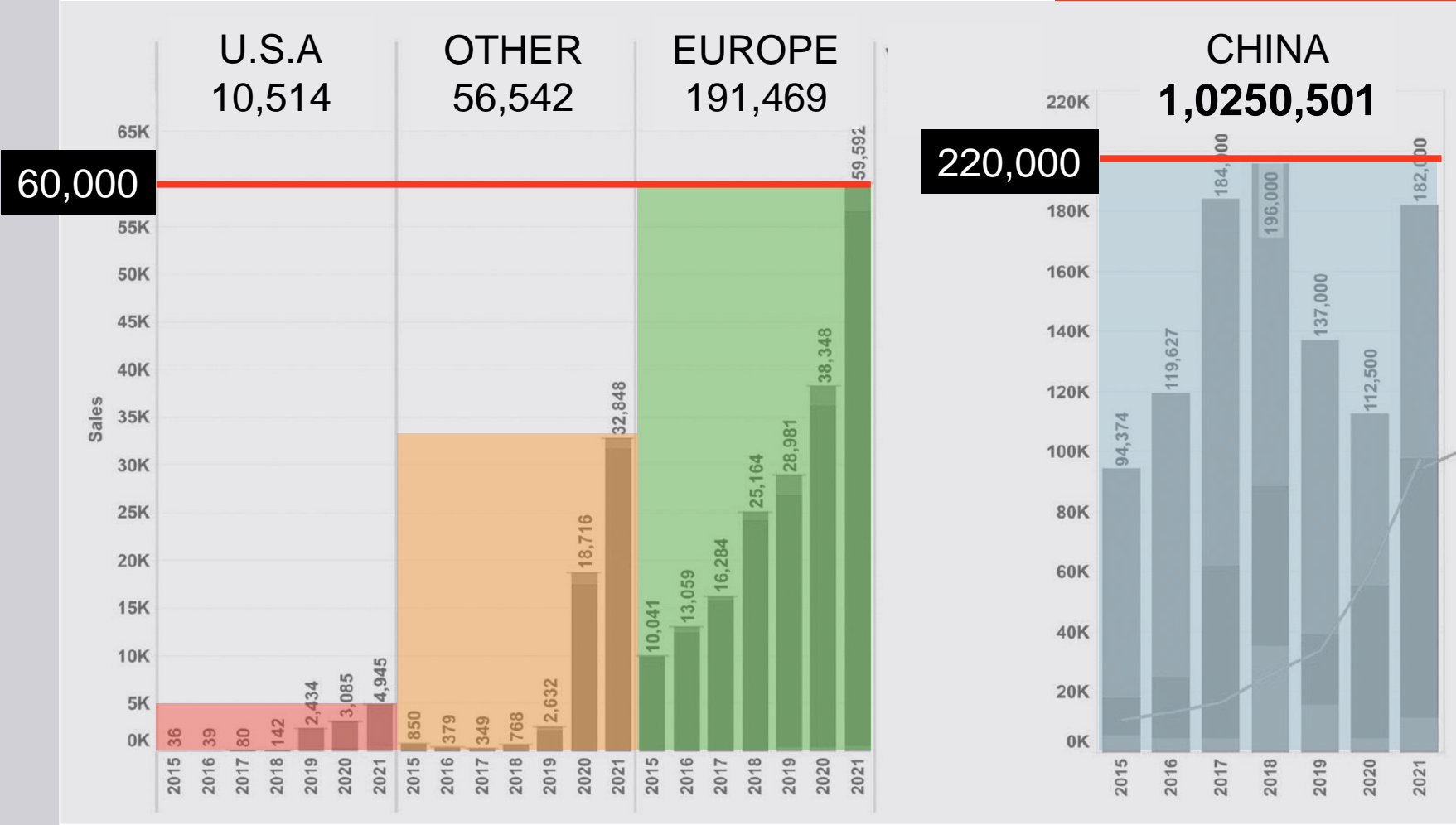
97% are < 150 miles



Playing Catch-Up in the USA

Volume of ZE MHDV sales (2015-2022)

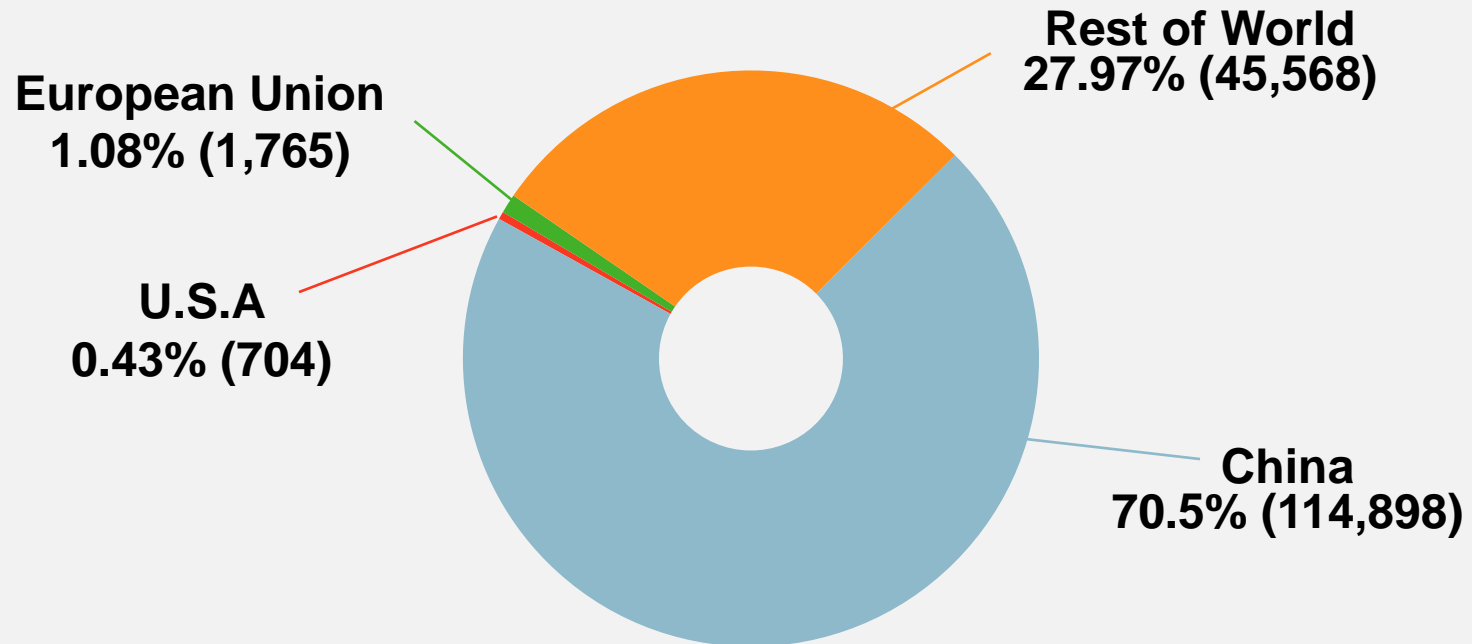
BUSSES, VANS,
& TRUCKS



Playing Catch-Up in the USA

Volume of ZE MHDV sales (2015-2022)

TRUCKS



Source: CALSTART June 2023

CARB Standards Impacting Supply & Demand

Regulations tightening on CL4-8

Advanced Clean Truck (supply)

- Manufacturers to sell ZEVs in all vehicle classes as a percentage of total sales
- Fleet data reporting requirement to inform future regulations

Advanced Clean Fleet (demand)

- Phase-in ZEVs over 10 - 20 years
- Milestone option schedule based on ZEV suitability

Expanding Adoption of ACT

- 16 States + D.C. adopting or under review















CA ZEV Sales Percentage Requirements

Model Year	Class 2b-3	Class 4-8	Class 7-8 Tractors
2024	5%	9%	5%
2025	7%	11%	7%
2026	10%	13%	10%
2027	15%	20%	15%
2028	20%	30%	20%
2029	25%	40%	25%
2030	30%	50%	30%
2031	35%	55%	35%
2032	40%	60%	40%
2033	45%	65%	40%
2034	50%	70%	40%
2035	55%	75%	40%
2036+	100%	100%	100%



"Supply" - CV OEM Commitments

Source: ACT Research Charging
Forward © 2023

OEM	2025	2030	2040	2050
 DAIMLER    FUSO		60%	100%	
TRATON  	10%	50%	100%	
  		35%	100%	
   	Goals focused on Scope 3 emissions			
ISUZU 				100%

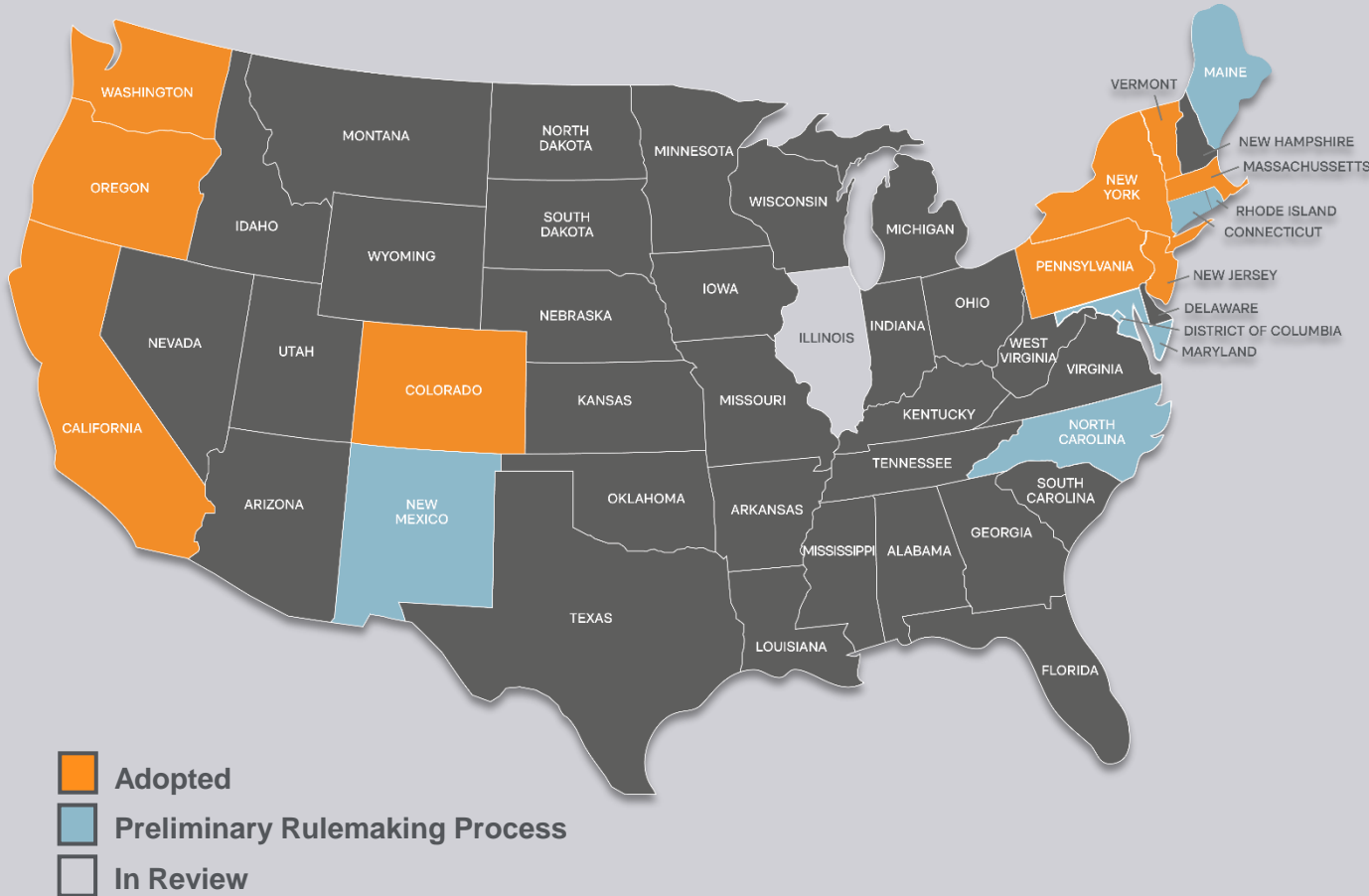


"Demand" – Private Fleet Green Targets



Source: ACT Research Charging Forward © 2023

States Adopting ACT Rule & Incentives



Commercial Clean Vehicles Tax Credit (IRS)

- \$7,500 cap for vehicles < 14,000 lbs.
- \$40,000 cap for vehicles > 14,000 lbs.

West Coast

- California HVIP: \$250M / \$60k CL 4-5
- ISEF: up to 90% of vehicle cost

East Coast

- New York \$100-125K / CL 4-6
- New Jersey \$65-90K / CL 4-6

South Central

- Texas 10 programs, \$65M, 80% of vehicle and/or 25 units

Utilities (examples)

- PG&E (CA) - \$4K for local delivery trucks, school buses, and other vehicles
- Rebate up to 50% of charger cost

ICE vs. BEV Chassis

ICE

> 1,000 Components



BEV

< 500 Components



1.5 - 2X
higher cost

Commercial EV Startups

OEM funded/sponsored vs. true startups



 RIVIAN



 brightdrop



 RIZON



ARRIVAL



- C A N O O -



BLUE ARC
EV SOLUTIONS



 LION ELECTRIC



XOS



 WORKHORSE™

Segment consolidation
has begun as startups
run out of cash.



BOLLINGER MOTORS



 MULLEN
COMMERCIAL



ELMS
ELECTRIC LAST MILE SOLUTIONS



OEMs vs. Startups

High capital costs, auto design & production experience, capable value stream partners

■ OEM Sponsored Advantages

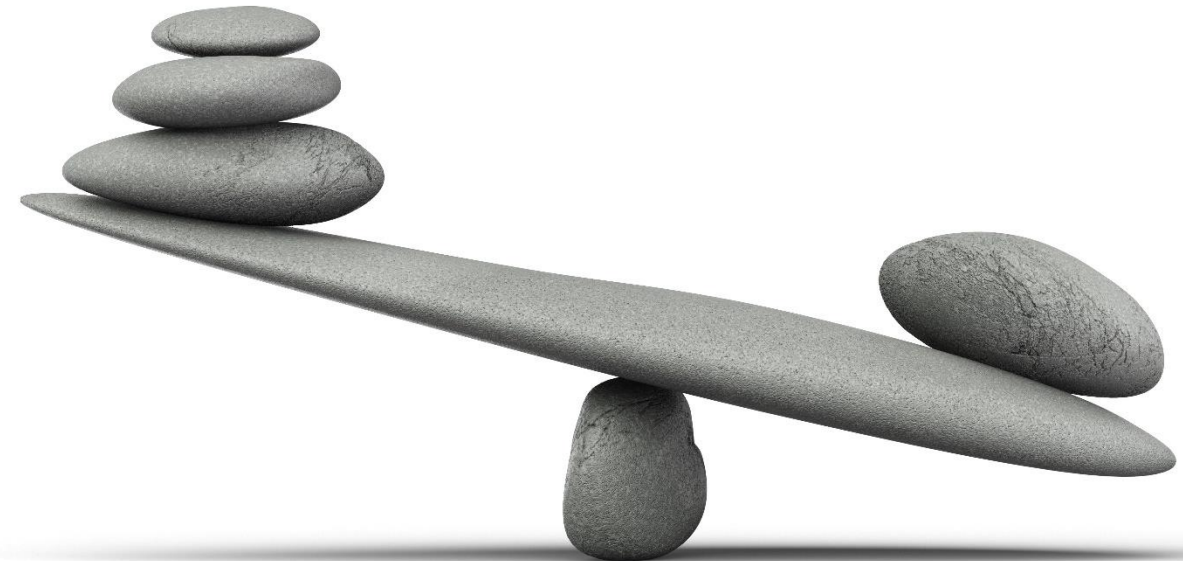
- Funding from OEM balance sheet
- Shared parts bin / economy of scale
- Established sales & service networks
- Established financing partnerships or internal financing arm
- Existing ICE customer relationships
- Rivian (Amazon 100k unit order)

■ Start-Up Challenges

- Funding requirements > forecast
- Engineering staff experience
- Vehicle & part testing costs
- Access to Tier 1 suppliers and parts, supplier tooling CAPEX
- Manufacturing site & CAPEX; state licenses
- Dealer agreements

**No shortcuts to
"safe, reliable vehicles."**

**Auto & CV
experience counts!**



Ready to Run

Over two decades of EV and chassis technology



WORKHORSE RANCH Union City, IN

World-class EV manufacturing
facility in America's Heartland

- 420K FT², 100+ acres
- NVH Test Track
- Bailment Yard



Meet our Class 4-6 Fleet

All-electric commercial vehicle lineup



W4 CC

CL4
5000-lb. payload
150-mile range



W750 Step Van

CL4
5000-lb. payload
150-mile range



W56

CL5-6
10,000-lb. payload
150-mile range

Safe, Reliable, Durable, Capable Vehicles for the Work Truck & Delivery Van Segment

Frontline Feedback

Trial deployments



W750

LA Department of Sanitation

- 115 miles w/AC | 20% SOC return
- Impressed that vehicle met stated range
- Drivers expressed joy at comfort, performance, and handling



W4CC

Utility Truck Trial - CA

- 191-mile incl. "Grapevine Hill"
- 6% grade for five miles
- Single 1-hour L3 fast charge
- 17% SOC at end of route



W750

Last-Mile Delivery Trial

- Stand up in cab and cargo area
- Cargo and floor same height
- Comfortable ride, low step height
- Ample range covered 60-mile routes

Infrastructure Challenge?



US DoT EV Alternative Fuel Corridors

- Currently 160,000 EV chargers in the US
- 1.2M needed by 2027
- Over 2M needed by 2033




Fleet electrification for independent contractors and operators

- Last-mile package delivery service for FedEx Ground
- Five CL 4 EV units in the delivery fleet & expanding
- Reviewing options to establish second location in an incentive-based state
- White Paper on ICE-to-EV transition & business case

Implications & Conclusions

- Transition to commercial EVs will take decades, not years
- Return-to-station commercial work trucks (CL4-6) is first segment to “convert” to EVs
- OEMs and OEM-funded startups have a distinct advantage
- True Start-Ups will merge, consolidate, or fail!
- Infrastructure timing & costs are CRITICAL!



A long & costly technology transition
is underway, picking up steam
as CARB mandates take effect.

Questions?

