



Electric Truck Developments

May 30, 2023



IN PARTNERSHIP WITH



DEPOTS Electric Truck Bootcamp Series

1. **Best Practices for Utility-Fleet Relationships** (April 25th) ✓
2. **Grants and Incentives for the Trucks and Infrastructure** (May 16th) ✓
3. **Electric Truck Developments** (May 30th)
4. **Faster Charging — Opportunities and Challenges at 350KW and higher** (June 13th)
5. **Opportunities to Extend BEV Range** (June 27th)
6. **Electricity Resiliency and Availability** (July 11th)
7. **Current and Future Regulations for Zero Emission Trucks** (July 25th)
8. **Managed Charging to Improve Availability, Cost and Range** (August 8th)
9. **Scaling Charging Infrastructure Equipment** (August 22nd)
10. **Electric Depot Site Planning and Construction** (September 5th)

2021 Bootcamp is still available at: <https://runonless.com/electric/bootcamp-electric/>



Up Next: Faster Charging - Opportunities and Challenges at 350kW and Higher

June 13, 2023 1:00p ET



Ted Bohn

*Principal Electrical Engineer
Argonne National Laboratory
(ANL)*



Watson Collins

*Senior Technical Executive
Electric Power Research
Institute (EPRI)*



Emil Youssefzadeh

*Founder & Chairman of the
Board
WattEV*



Ryan Menze

*Charger Hardware and
Software Engineering Manager
Daimler Trucks North America*

2023 DEPOT Fleets



Update from The
Run Planning...

Follow the Fleets, Drivers, OEMs, EVSEs, Utilities and more at:

RunOnLess.com and on Twitter [@RunOnLess](https://twitter.com/RunOnLess)



Today's Bootcamp Sponsor



Quiz for Today's Session

Completing Today's Quiz:

- Go to runonless.com and click back into the session
- Click 'Take Quiz' button
- Create username and password to keep track of your progress
- Spend a few minutes answering the questions and receive your 2023 RoLE - DEPOT badges



What You Should Know

Q&A

Submit your questions to the host using the Q&A box in the upper right-hand corner

Recording

A recording of today's webinar will be available on runonless.com

Technical Issues

Contact Stephane Babcock at stephane.babcock@gladstein.org



Today's Bootcamp Speakers

Electric Truck Developments



Chad Burchett

*Chief Technology Officer
Trova*



Jessie Lund

*Truck Program Manager
CALSTART*



Ben Sharpe

*Senior Researcher and Canada
Lead
The ICCT*



Matt Wetta

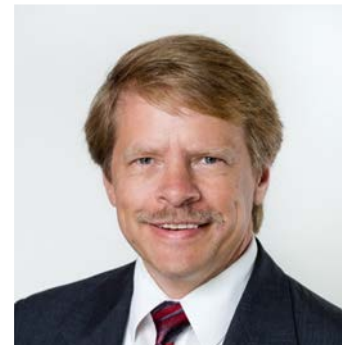
*National Account Manager –
Alternative Powertrain
Peterbilt Motors Company*



Hosted by:

Rick Mihelic

Director of Emerging Technologies





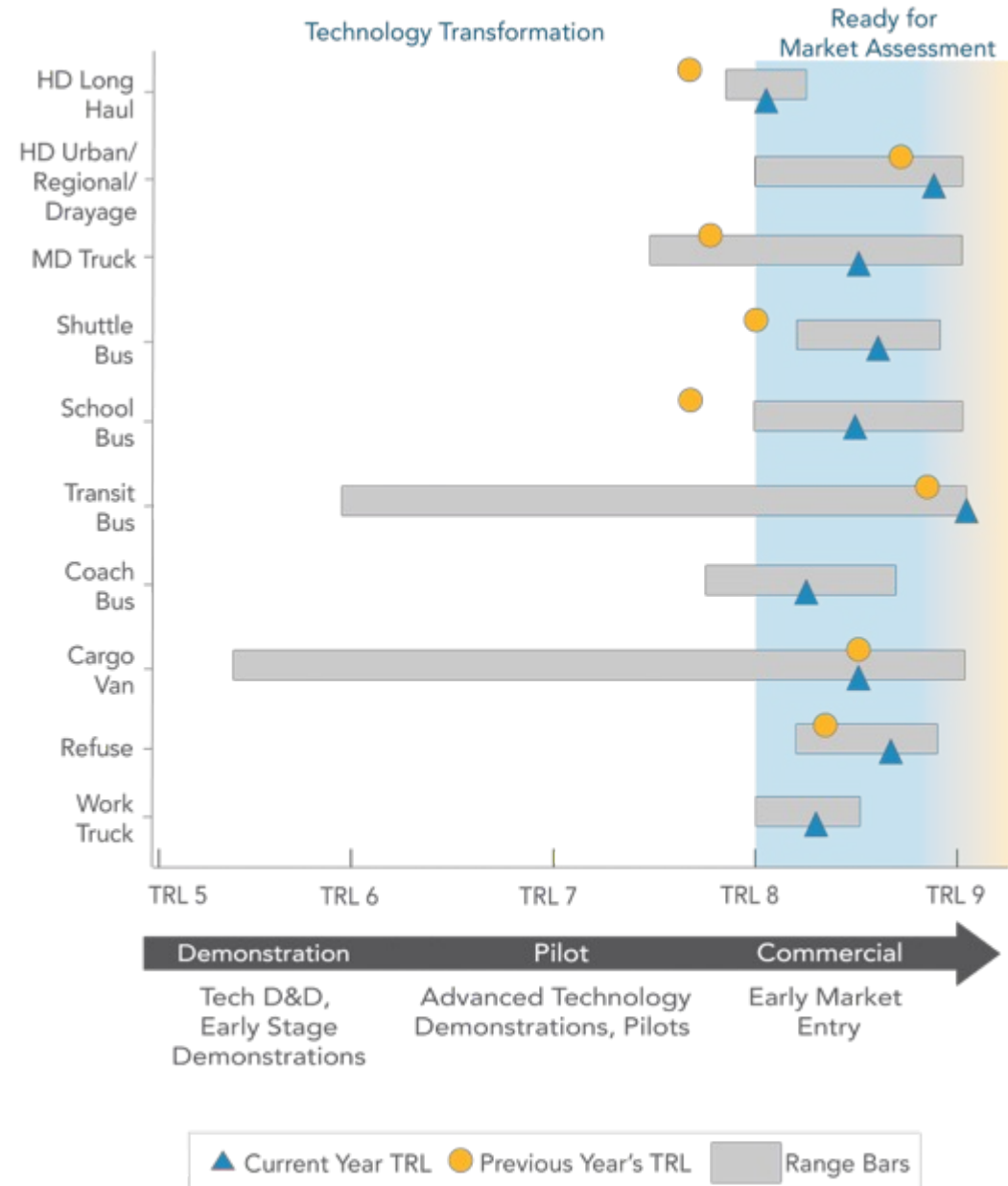
Electric Truck Developments

Run on Less – Electric Depot Bootcamp

May 30, 2023

[CALSTART.org](https://www.calstart.org)

Zero-emission trucks are technologically viable and commercially available across all segments.



Over 140 ZE truck models available today

ZETI Data Explorer

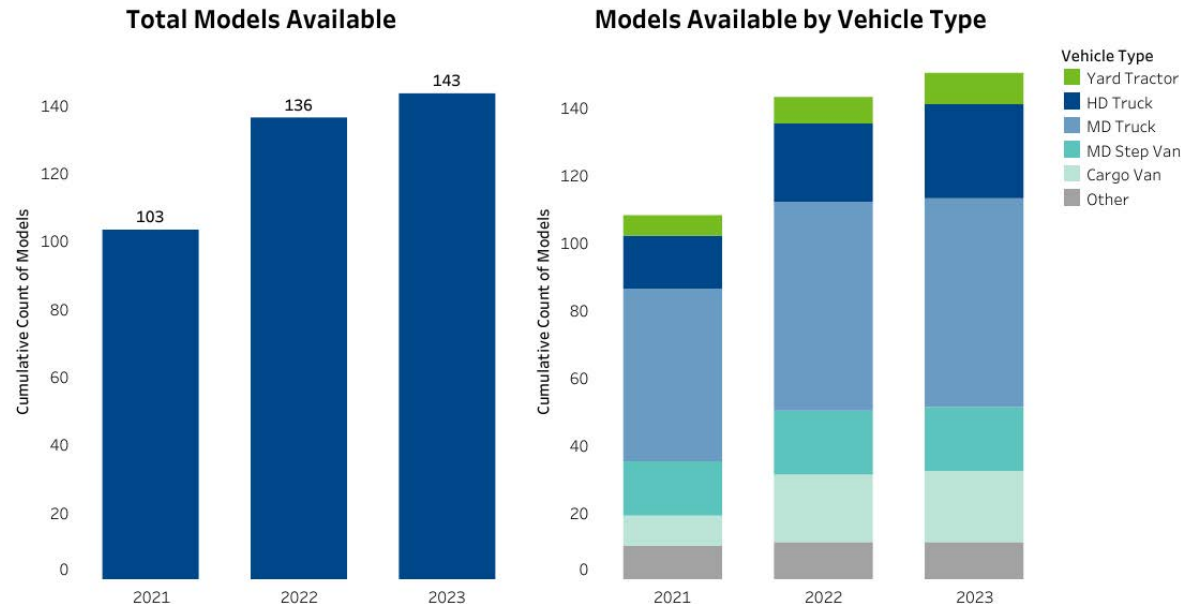
Models Available	Growth by Region	OEMs by Vehicle Types	Top 10 OEMs by Range	Truck Range	Bus Range	Truck Bubble Chart	Bus Bubble Chart
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Select Regions
U.S. & Canada

Select Vehicle Types
Multiple values

Select Technologies
All

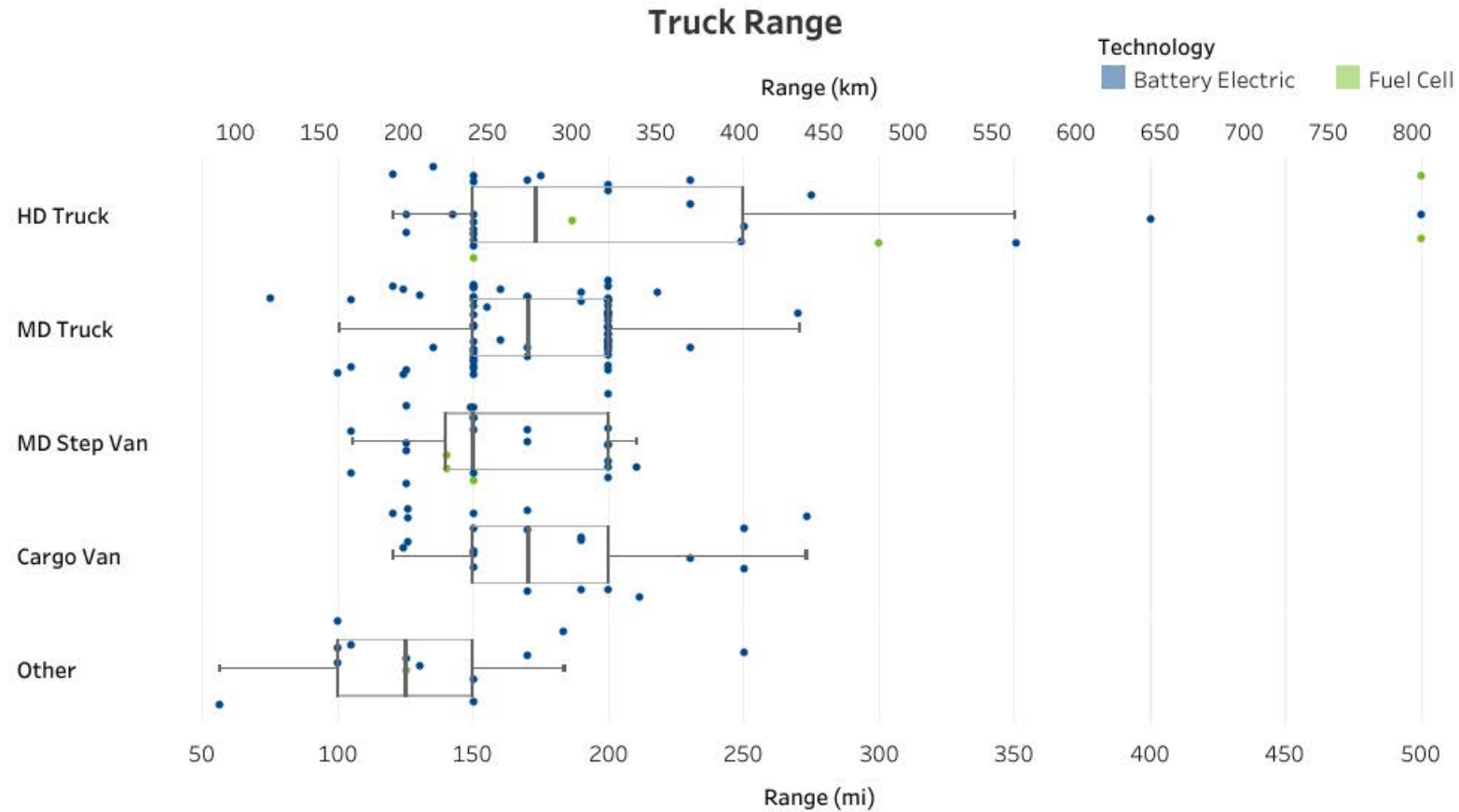
Available Through ⓘ
To 2023



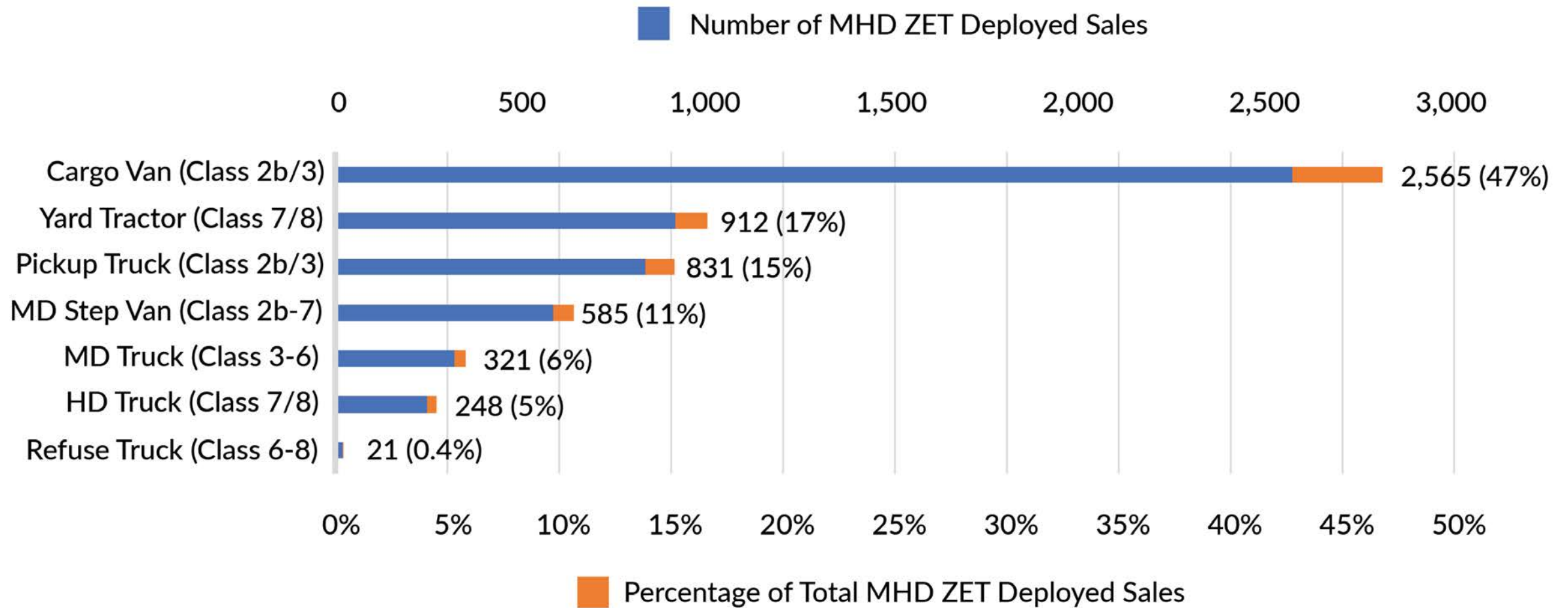
ZETI Data Explorer is a product of CALSTART's Global Drive to Zero Program. Version: v3.2 Last Update: May 2023



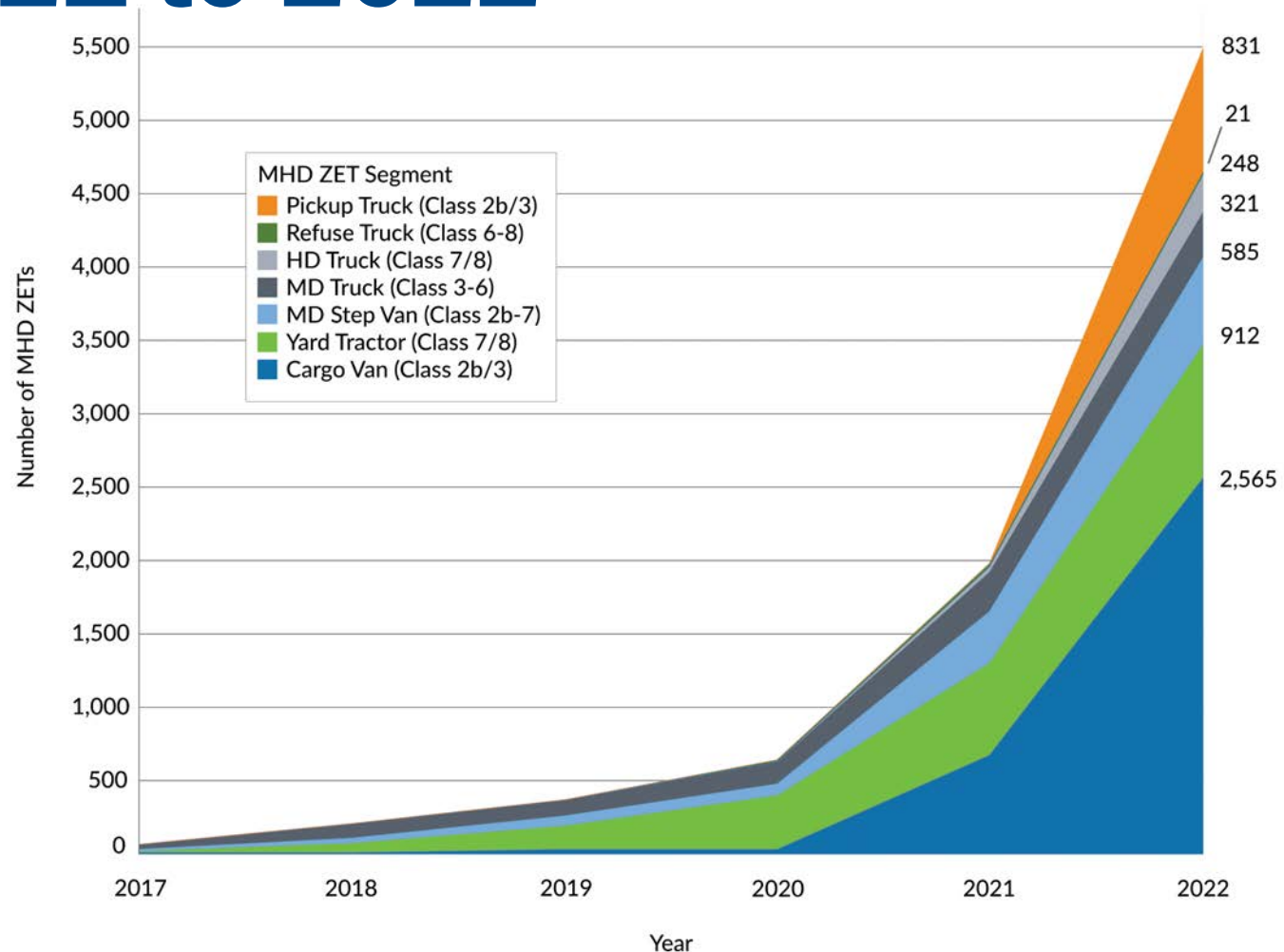
The range of available models is increasing



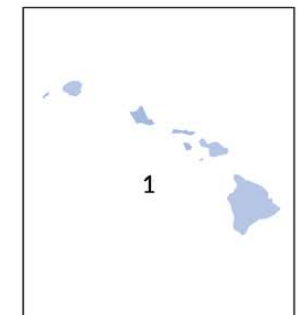
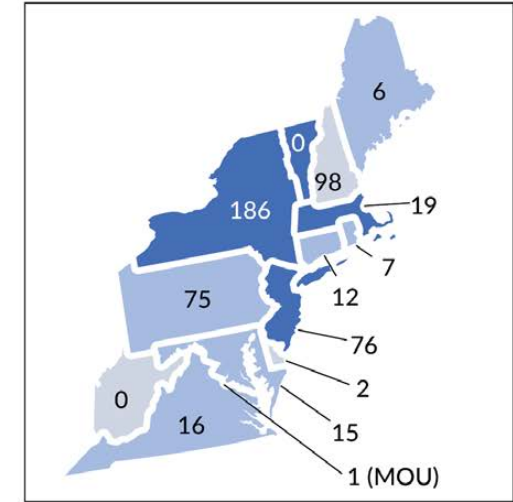
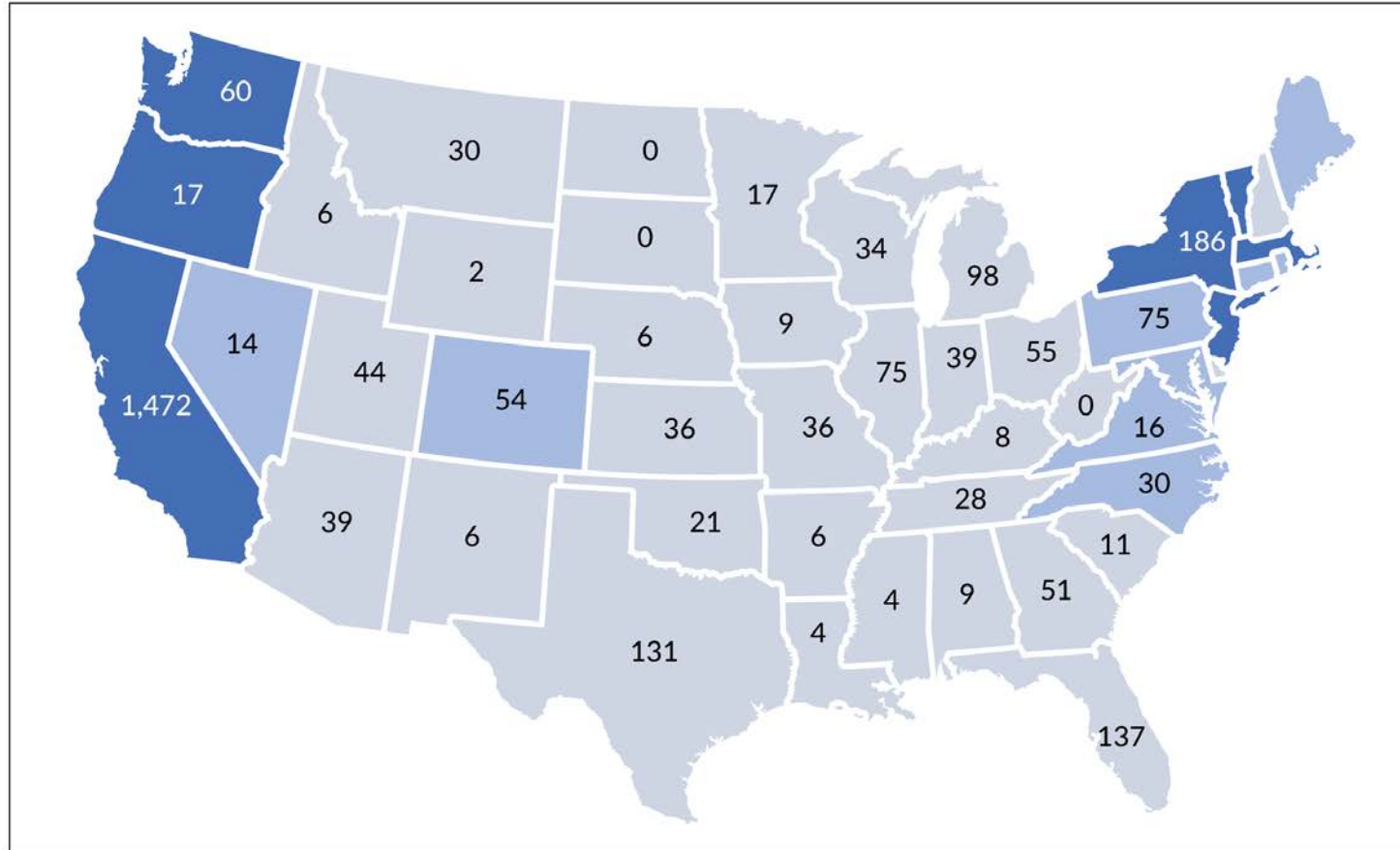
Over 5,480 ZETs already deployed



ZET deployments increased by >160% from 2021 to 2022



Almost 60% of deployments in ACT states



Legend

ACT (MOU)* MOU Non-MOU

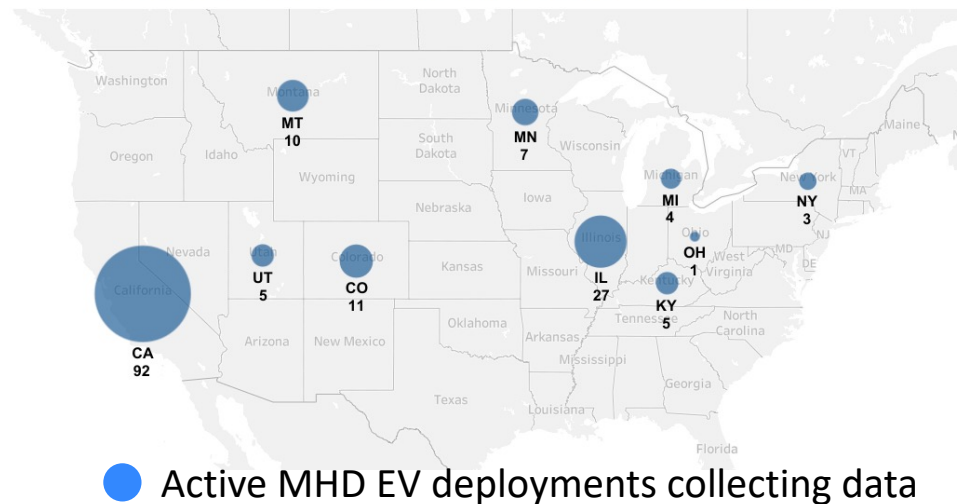
*Note: This map displays states that adopted ACT through 2022. Colorado has since adopted ACT.



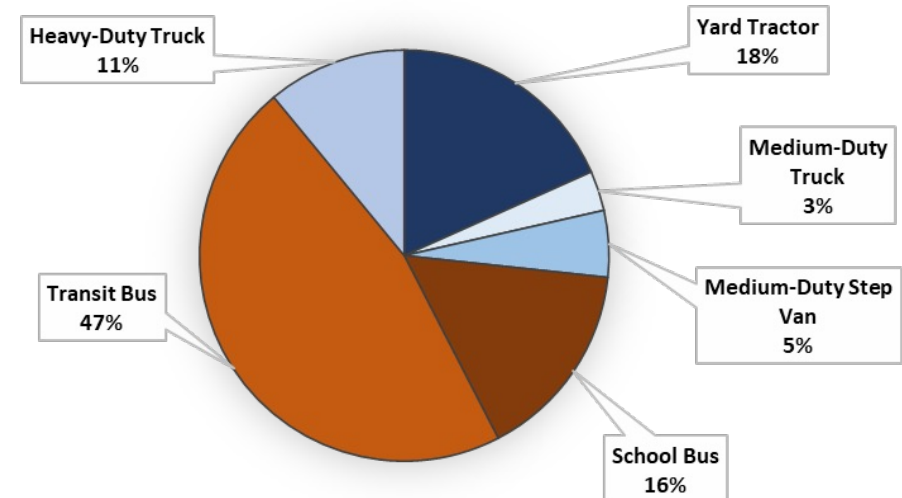
We are learning a lot from real-world deployments.

- DOE-funded project to collect, validate, analyze, & provide summary results on operational data from ZE M/HDs
 - October 2019 – September 2023
 - Capturing diverse data from **165 vehicles** across **10 states** and **32 distinct fleets** participating in the program

Count and Location of Currently Available MHD EV Datasets



Confirmed Vehicle Makeup



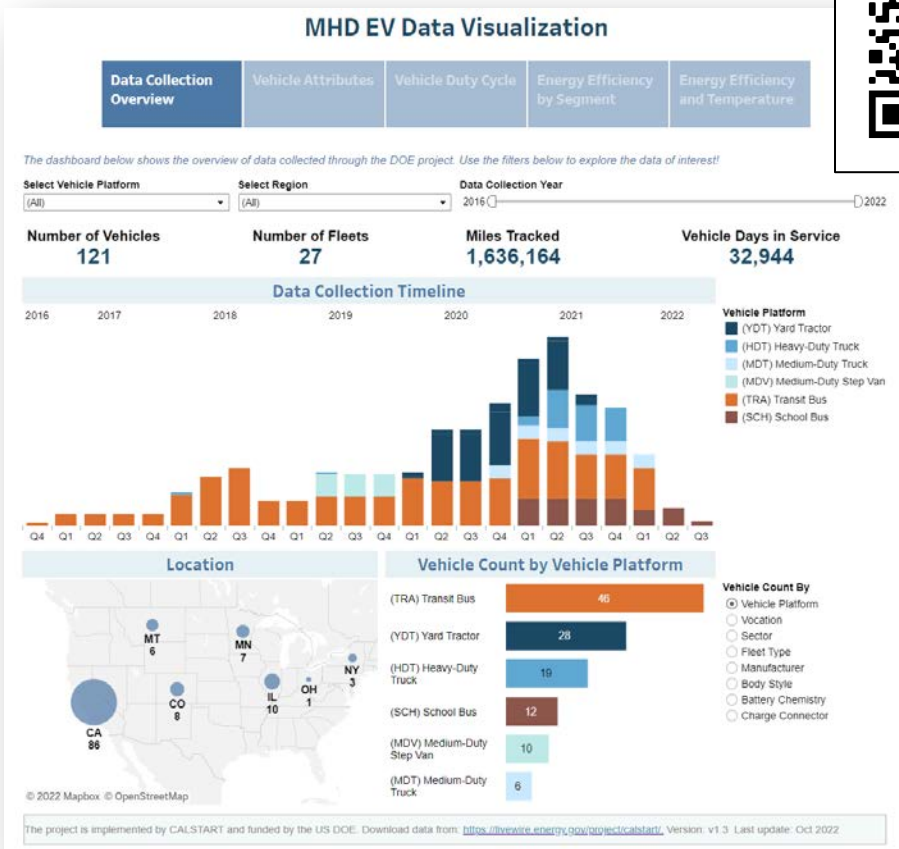
© 2023 Mapbox © OpenStreetMap contributors

d May 2023

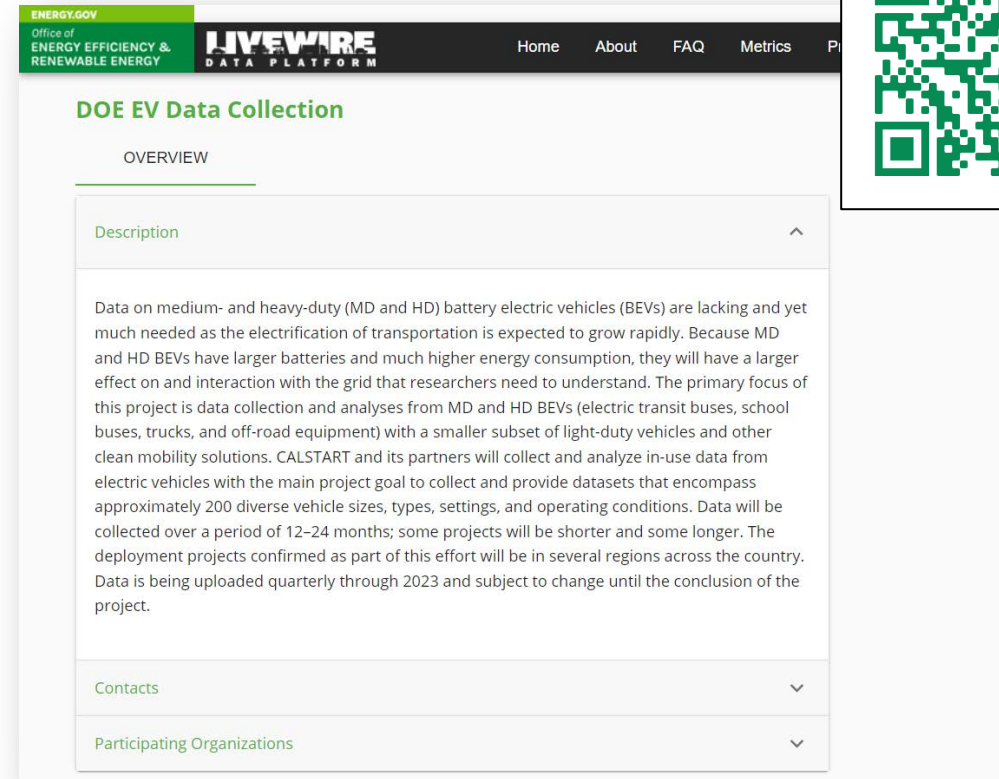


Learn more!

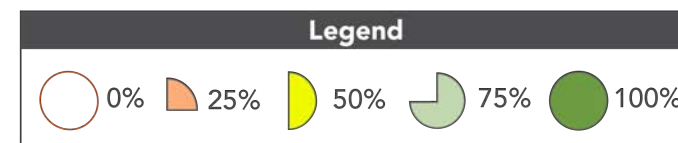
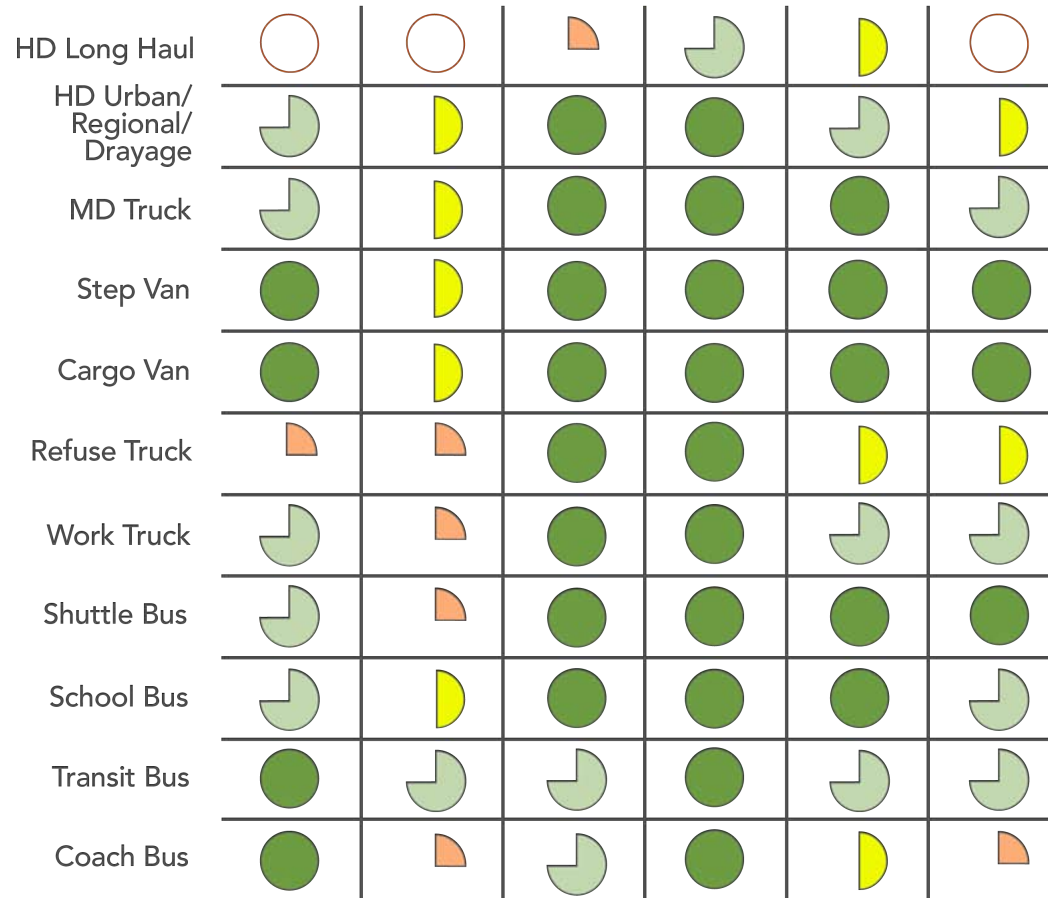
Access the Dashboard in Project Website:
<https://calstart.org/projects/medium-heavy-duty-ev-deployment-data/>



Download Data from LiveWire:
<https://livewire.energy.gov/project/calstart>



Focus now on market readiness



2040 Roadmap



1. ESTABLISH BEACHHEADS

Launch all beachhead ZE-MHDV applications



2. SECURE POLICY ALIGNMENT

Secure aligned and ambitious targets and policies



3. LAUNCH LONGHAUL

Establish priority zero-emission long-haul corridors by 2025



4. SATURATE CITIES

Reach 100% sales in cities by 2030



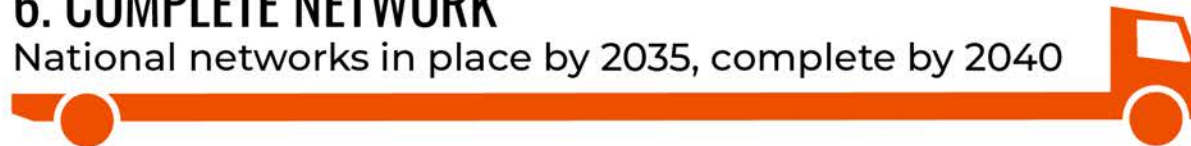
5. BUILD BACKBONE

Build priority freight corridors by 2030



6. COMPLETE NETWORK

National networks in place by 2035, complete by 2040



We are here →

2020

2025

2030

2035



Thank You

We change transportation for good.

Jessie Lund

Trucks Program Manager

jlund@calstart.org

 [@Jessie_ETrucks](https://twitter.com/@Jessie_ETrucks)

Peterbilt

EV



The Whole EV Package

Truck



220EV

Funding



Charger

PACCAR PARTS

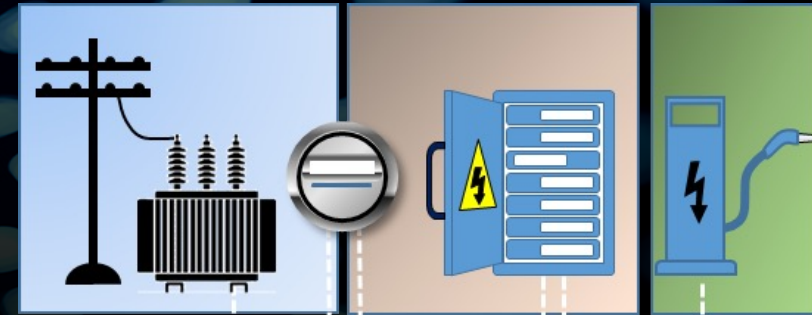


Infrastructure

ENTECH SOLUTIONS

FAITH TECHNOLOGIES

Schneider Electric



Utility Assets

Meter

Electrical Panel

Charger

Applications for EV Adoption



Less than 200 Miles per Charge

Cube Out / LTL / Diminishing Load

Stop Start Duty Cycle

Return Home Every Night



579EV



520EV

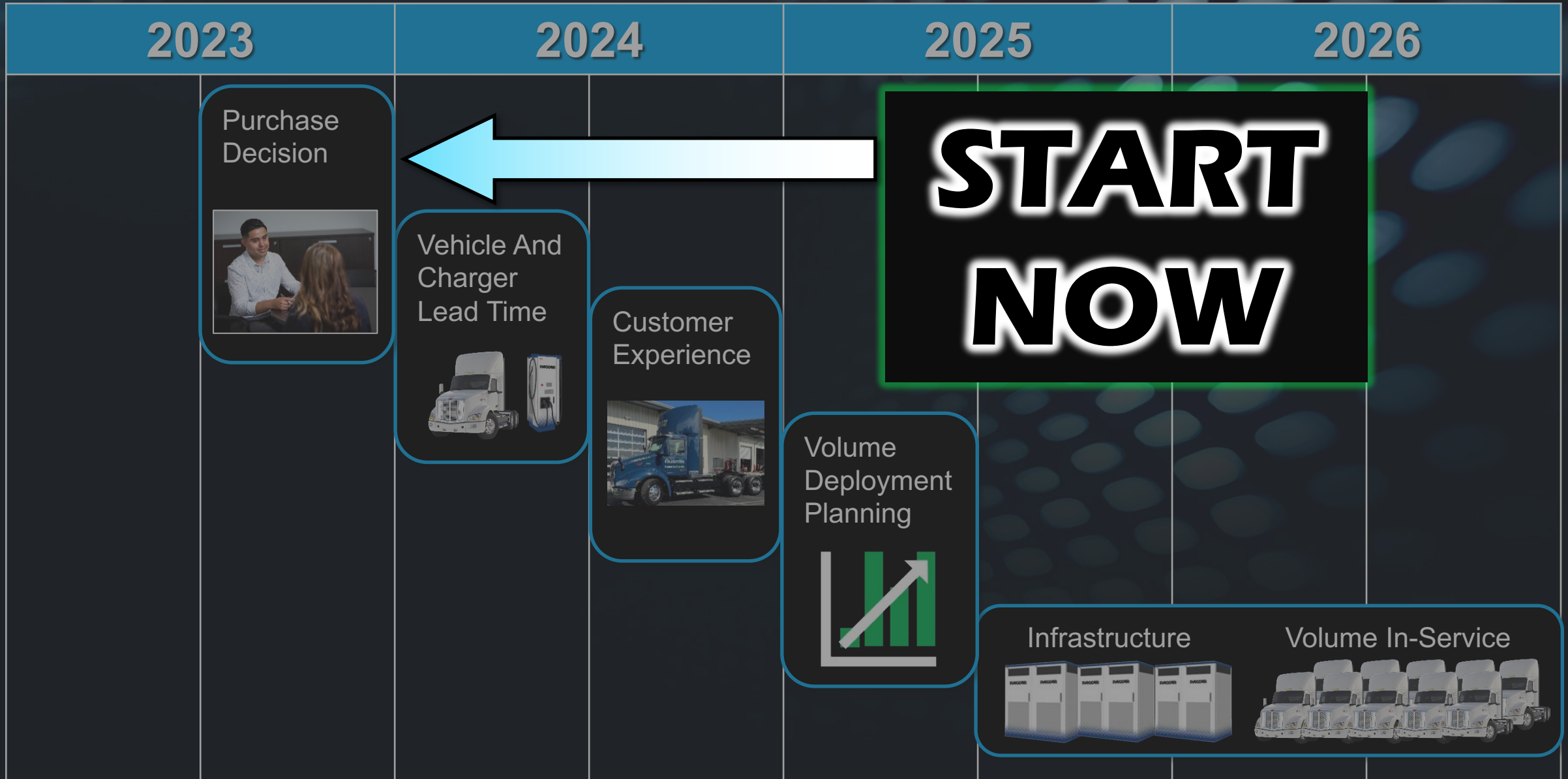


220EV

What is the Future of Transportation?

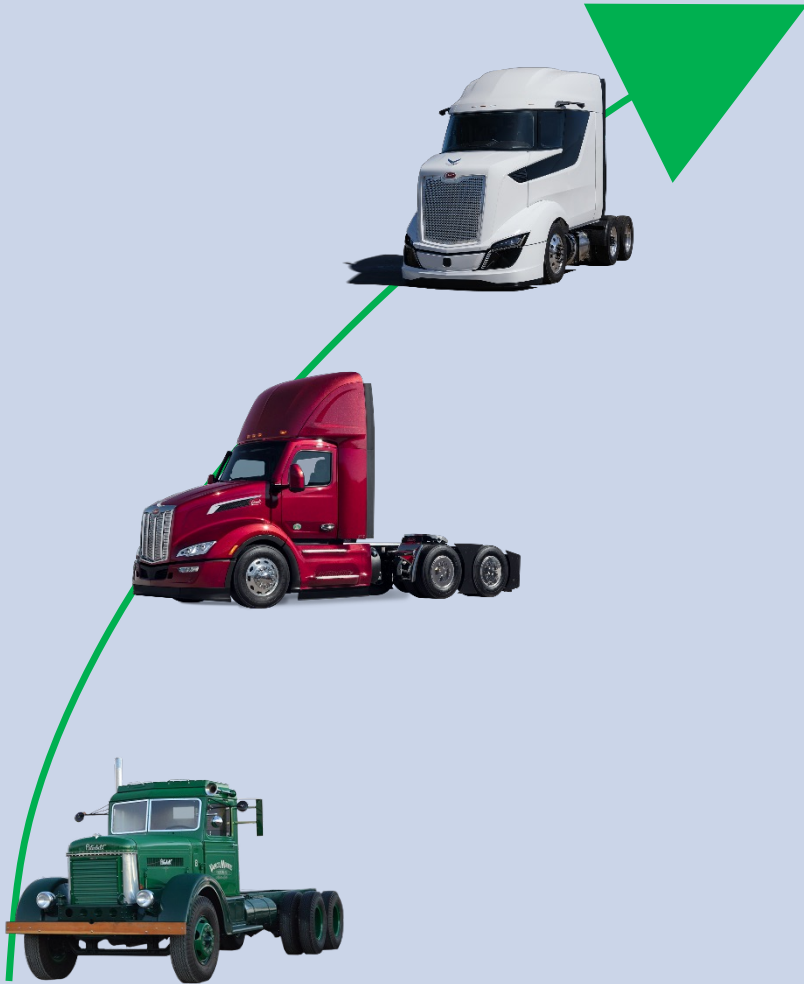


Customer Journey

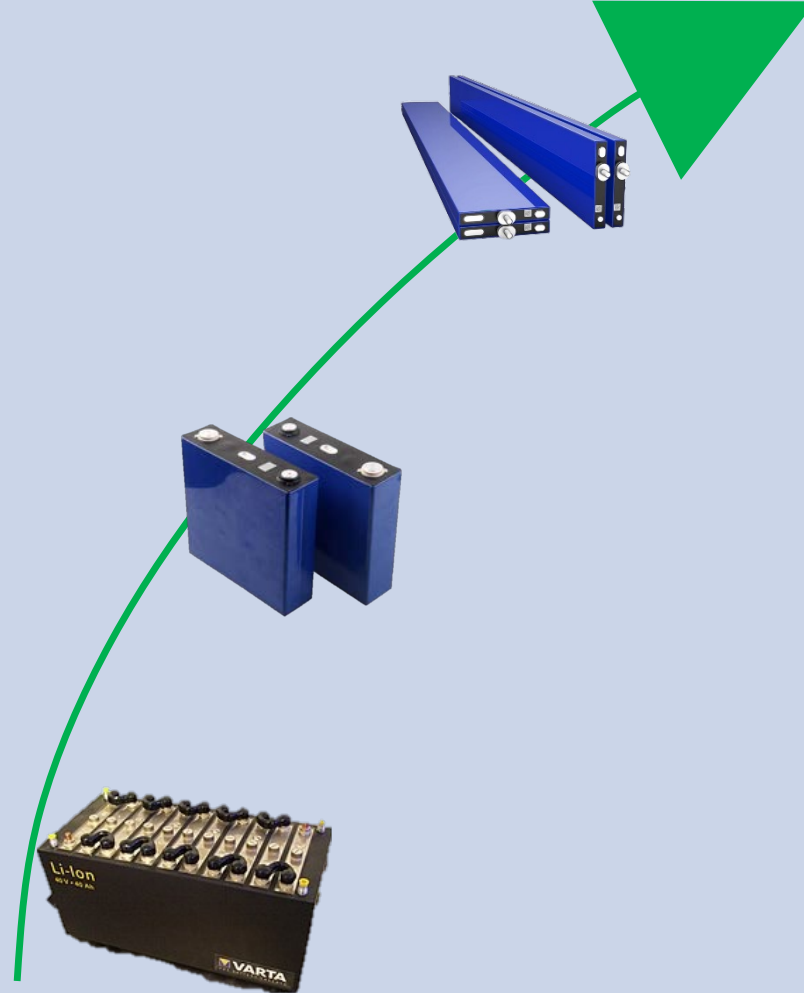


EV Technology Progression

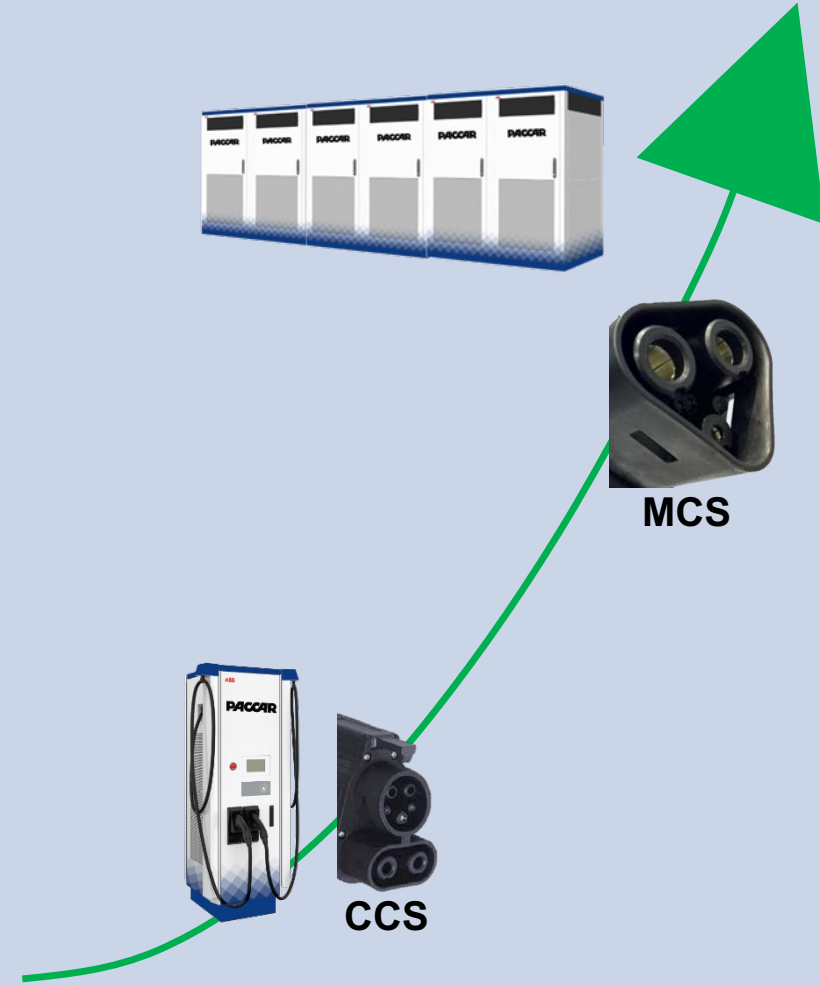
Efficiency



Energy Storage



Charging Speed



Past

Current

Future

Past

Current

Future

Past

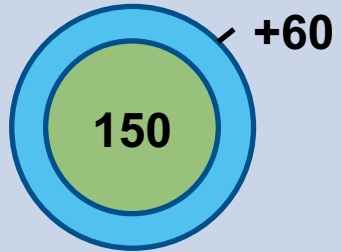
Current

Future

EV Technology Progression

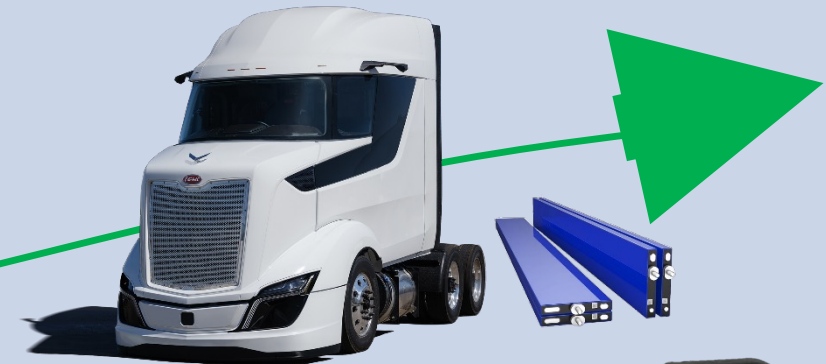
Current

Future



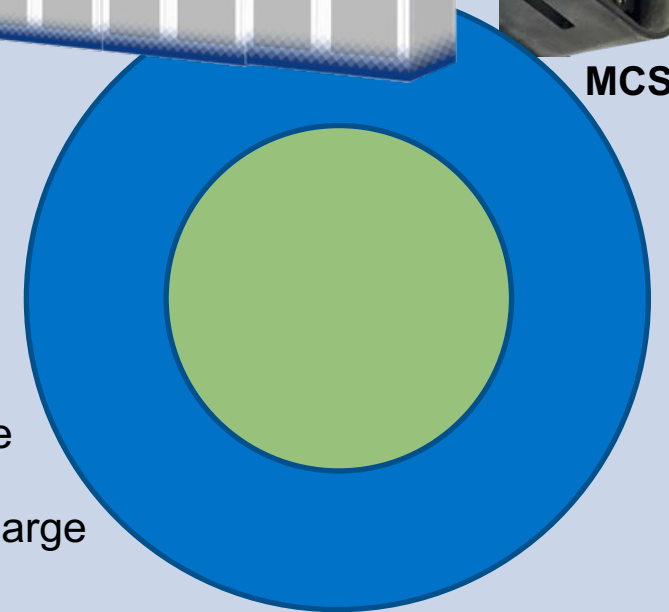
Base Range

+1 hr Opportunity Charge



Base Range

+45 min Charge



NACFE: 'The Messy Middle'

(Total Cost of Ownership) TCO



BEV



FCEV



Diesel



(Range & Payload) Productivity

PETERBILT

Peterbilt

EV





**Run On Less Electric
DEPOT Bootcamp #3:
Electric Truck Developments**

May 2023



BUILT TO ELECTRIFY



Key Executives



Patrick Collignon
CEO/President
Former COO Volvo Americas



Chad Burchett
CTO TrovaCV
Former Volvo EV & Autonomous



Any Questions

Please contact

Chad Burchett

Chad.Burchett@trovacv.com

Board



Dennis Slagle
Former President



Collin Peel
CEO



Tom Duvall
CEO



Advisory Board



Susan Alt
Former SVP

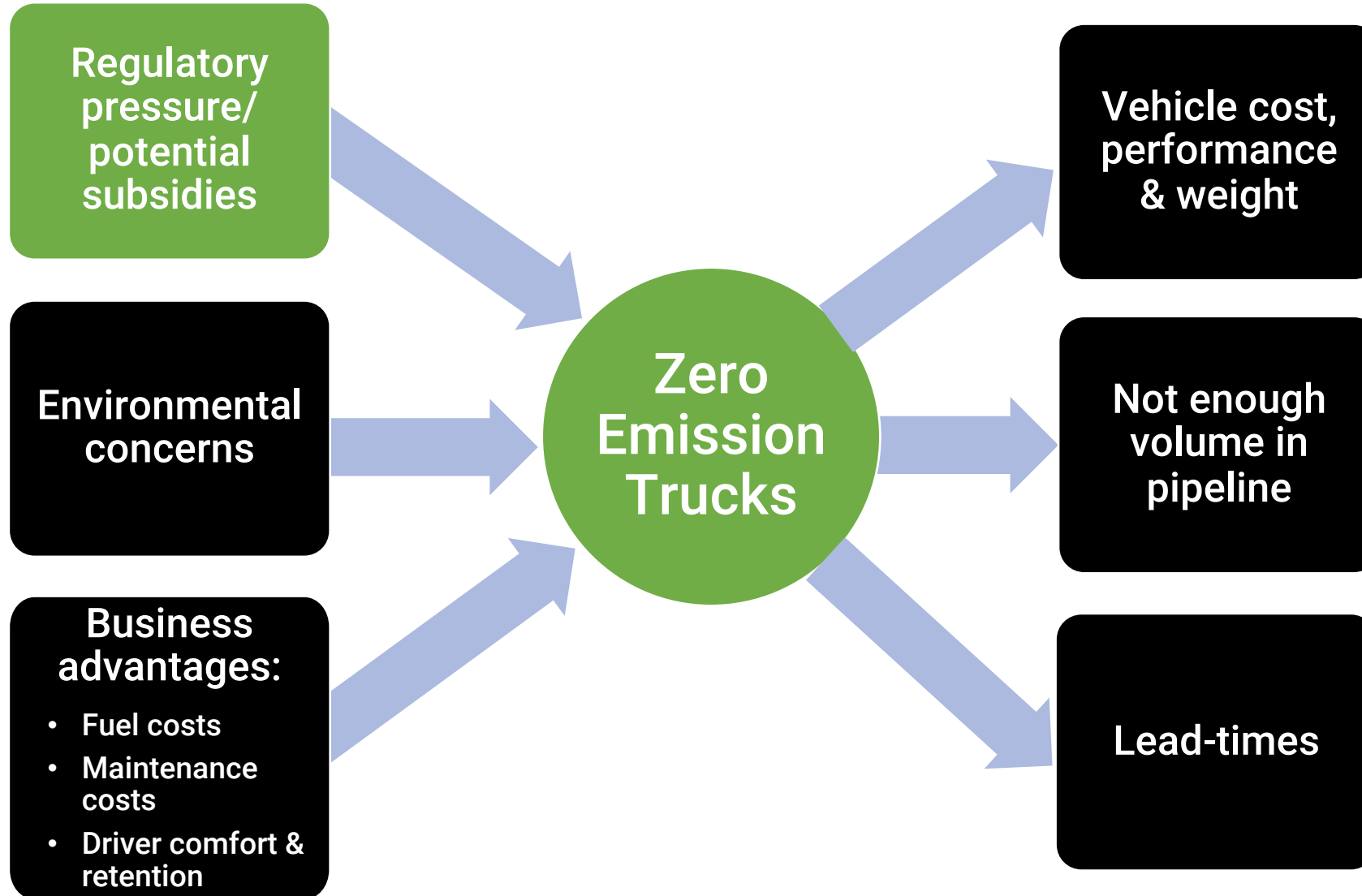


Russ Tedder
Former SVP



Paul Kegels
CEO eTrova, ex GM



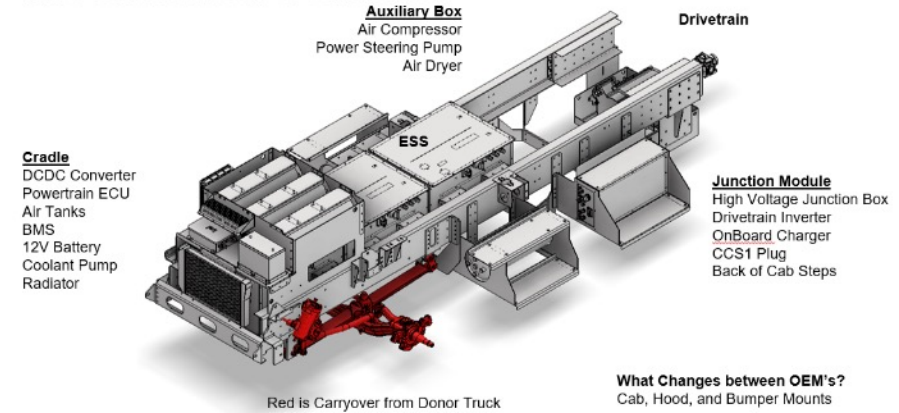


TROVA Repowering

Repowering of existing diesel trucks by means of: (SOP Q2 2025)

- A new innovative chassis
 - High voltage (800V) driveline
 - Proprietary software
 - Proprietary battery packs
- Or
- Component Kits

The Skateboard Chassis



Authorized dealers & carriers will transplant original truck components to the new chassis

Diesel Truck



2/23/2023



50%
Recovery
40%
Resale
10%
Recycle



Electric Truck



48 working hours later... lower cost
Utilizes existing national service providers

Today and into Tomorrow

- Current 6x2T

- Diesel reference 14,150 lbs
- 264 KWH 20,500 lbs 78 lbs/KWH
- 565 KWH 24,500 lbs 43 lbs/KWH

- Future 6x2T D2E (SOP Q2 2025)

- D2E 150 KWH 14,050 lbs 94 lbs/KWH
- D2E 720 KWH 20,600 lbs 29 lbs/KWH

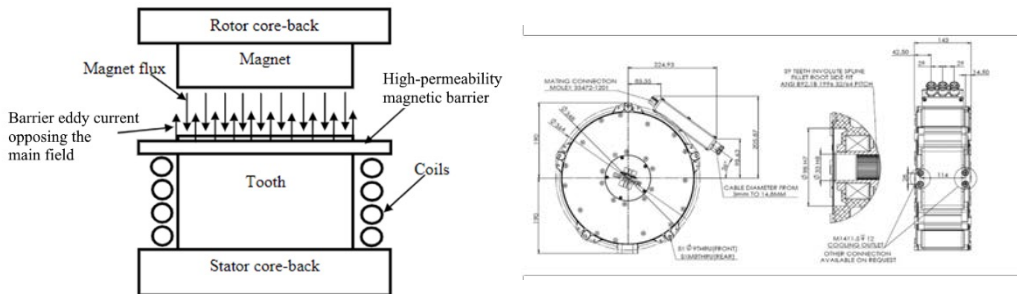
Parity with diesel weight is possible for some applications
Balance battery size with charging opportunities

Bespoke Chassis = More Payload



Electric Motors

- Current (Permanent Magnet Asynchronous)
 - 340 KW Continuous
 - 400 KW Peak
- Future (Axial Flux) (SOP Q2 2025)
 - 384 KW Continuous
 - 872 KW Peak
 - Higher volumetric efficiency



Charging

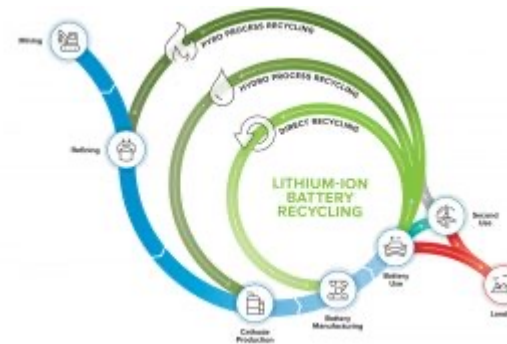
- Wireless Inductive (SOP Q2 2024)
 - In ground installation
 - Up to 600 KW
 - Use CCS1 or MCS as well*



* Not at the same time as wireless

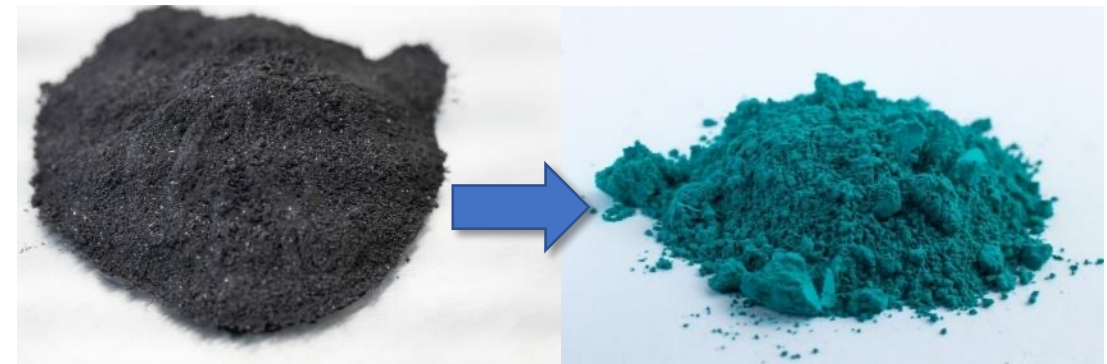
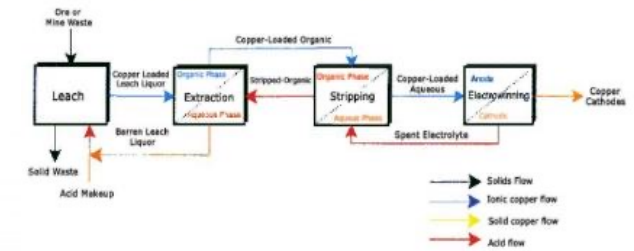
End of life battery cells have value

- After second life on a trailer, and third life as solar energy storage cells can be recycled
- Cells are ground up into “Black Gold”
- Raw materials are extracted
- 95%+ recovery of material
- Recovered elements make new cells
- SOP Q2 2024



Hydrometallurgical Processing

Simplified Flow Chart Leach - Solvent Extraction - Electrowinning Process



Sympathy for the devil (in the details)

Zero-emission truck model availability, costs, and infrastructure

Ben Sharpe

NACFE Run on Less Depot Bootcamp

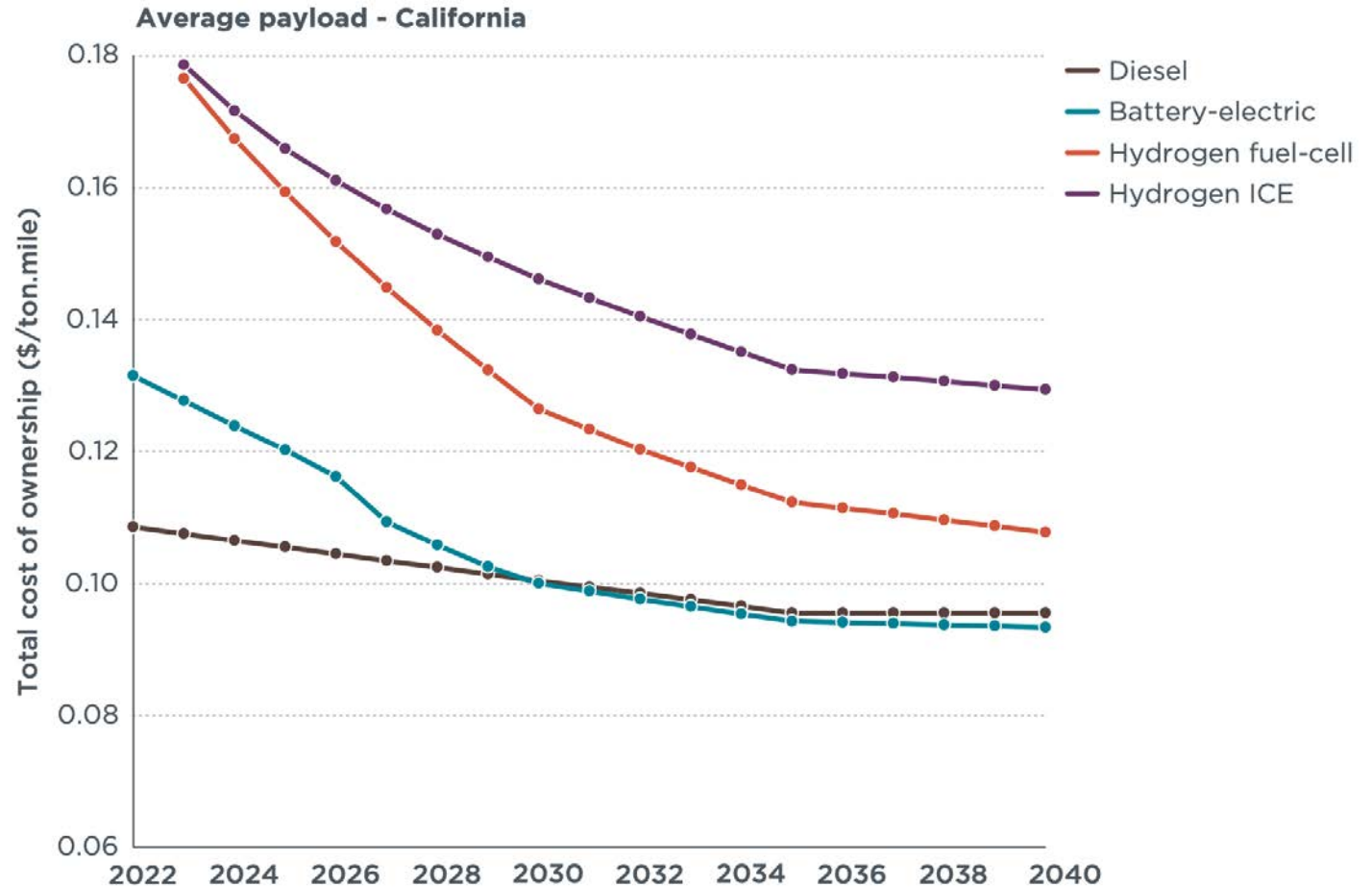
30 May 2023

Variety is the spice of (e-truck) life

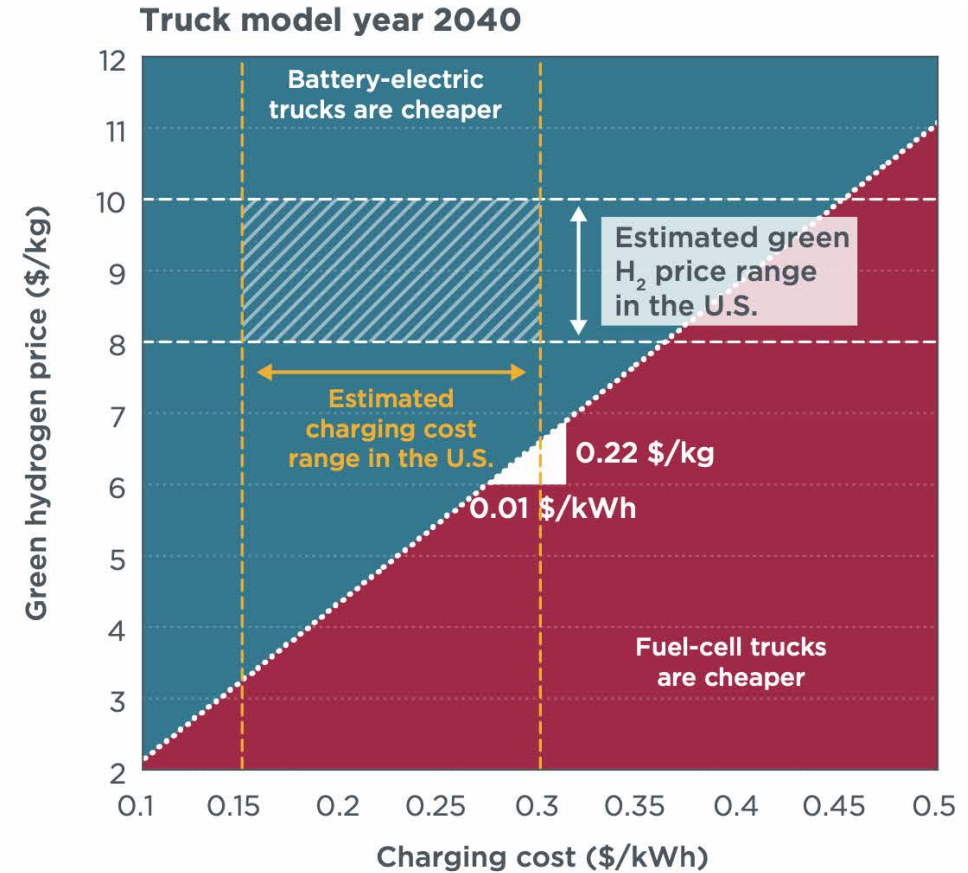
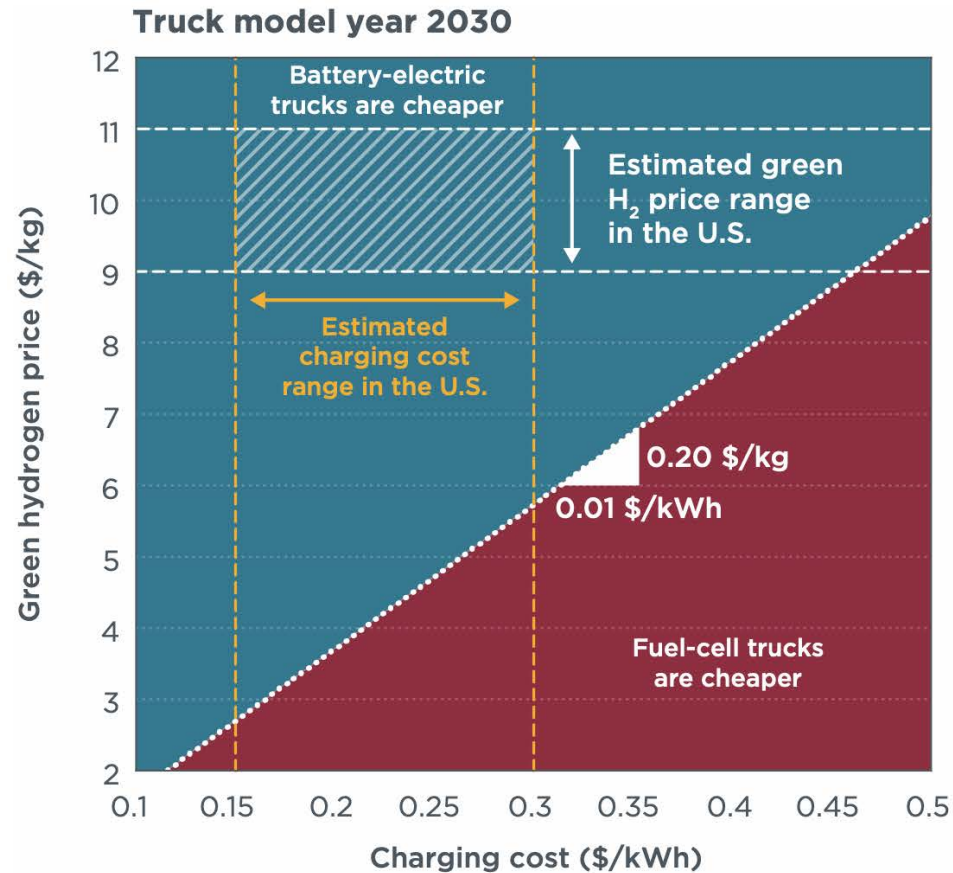


C.R.E.A.M...so very true for the trucking industry!

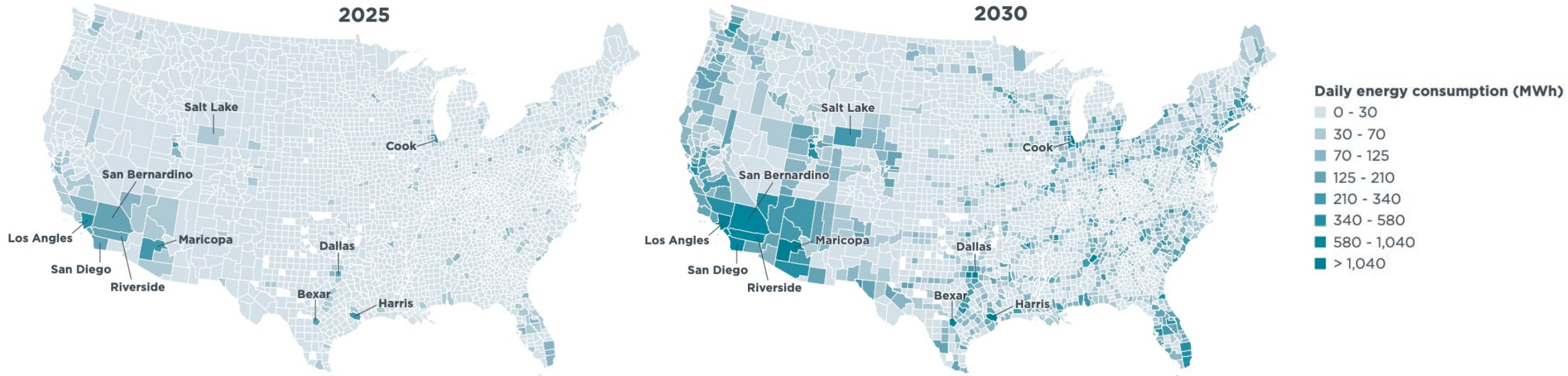
Cash Rules Everything Around Me.



Can't we (batteries & hydrogen) just all get along?

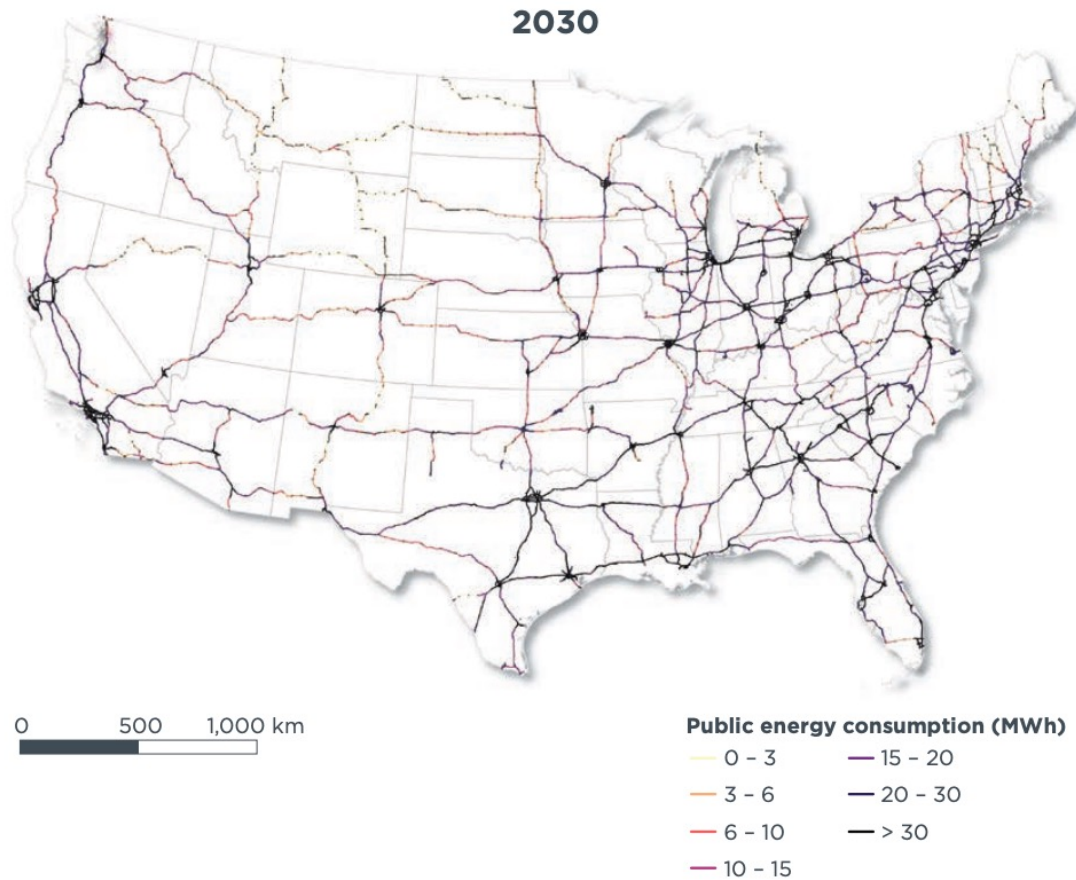


If you build it (**infrastructure**), they will come...



Growth in energy demand will be concentrated in freight zones, such as ports, industrial zones, and freight corridors

Setting targets for charging station deployment along key NHFN corridors can accommodate up to 85% of long-haul charging needs by 2030



Minimum size of public charging stations every 50 miles along the NHFN to support long-haul trucks

Percentile of annual average daily traffic count on the NHFN	2025 minimum station size	2030 minimum station size
0% - 25%	350 kW/station	2,900 kW/station
25% - 50%	550 kW/station	7,800 kW/station
50% - 75%	940 kW/station	12,000 kW/station
>75%	1,900 kW/station	22,000 kW/station
NHFN national average	900 kW/station	10,000 kW/station

NHFN = National Highway Freight Network

Thank you!
ben@theicct.org



Electric Truck Developments



Chad Burchett

*Chief Technology Officer
Trova*



Jessie Lund

*Truck Program Manager
CALSTART*



Ben Sharpe

*Senior Researcher and Canada
Lead
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Matt Wetta

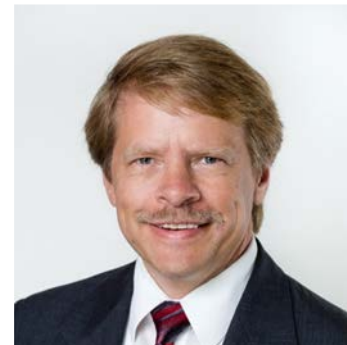
*National Account Manager –
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Peterbilt Motors Company*



Hosted by:

Rick Mihelic

Director of Emerging Technologies





CCS1



CCS2



CHAdeMO



J1772



MCS or CharIN



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**Let's Stay Connected...
... And charged up!**



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