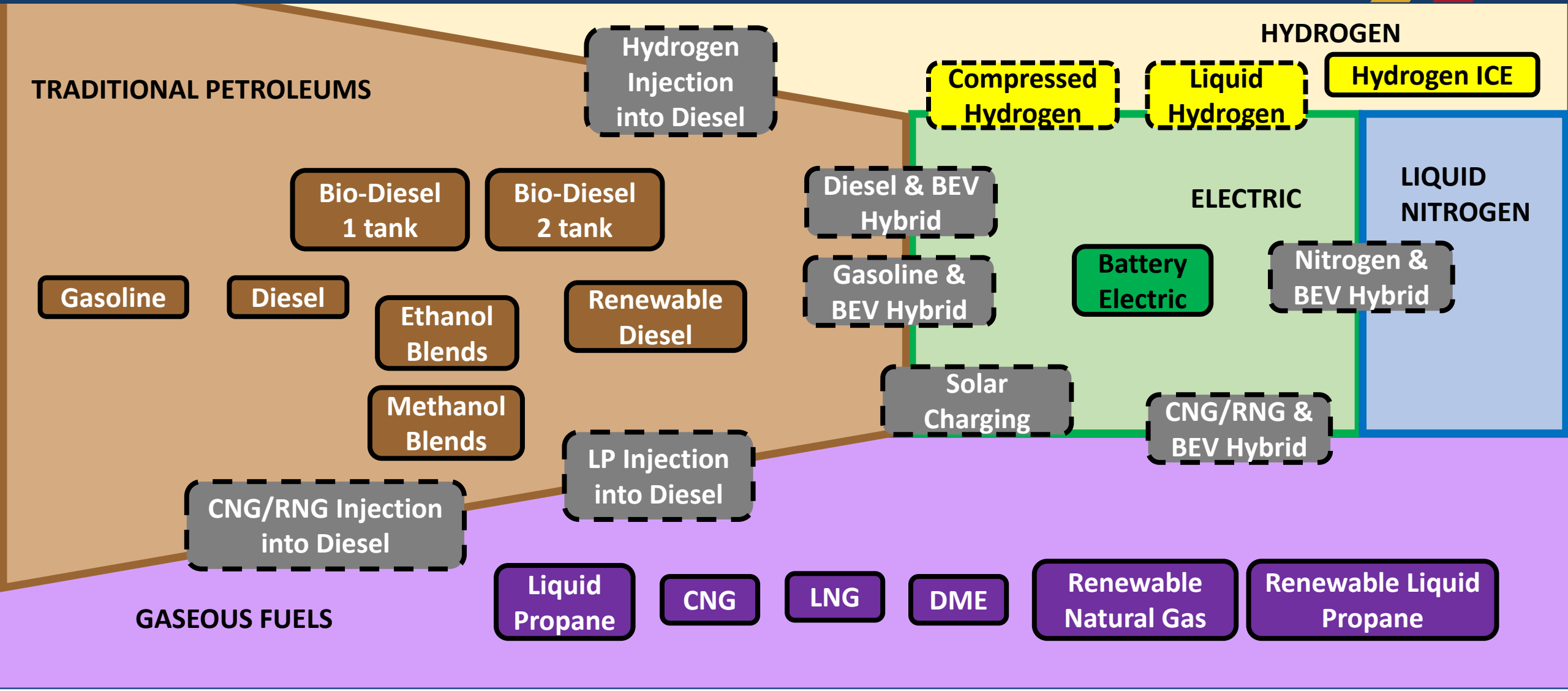
Alternative Fuels



THE MESSY MIDDLE: A TIME FOR ACTION

PRESENT

- Technology immature
- Many unknowns & challenges

"MESSY MIDDLE"

- Many optimization solutions
- Growing infrastructure
- Multi-fuel choices
- Innovation & maturation
- Facts replacing estimates
- Learning curves

FUTURE 2050

- Fast charging
- Hydrogen everywhere
- Long-life, low-cost batteries
- Acceptable weights & costs

- Legacy Diesels
- Natural Gas

- Diesel Advancements
- Natural Gas
- Hybrids
- Hydrogen ICE

- Battery Electric
- Hydrogen Fuel Cells
- Renewable Natural Gas & Diesel
- More

- CBEV & HFCEV from Clean Energy

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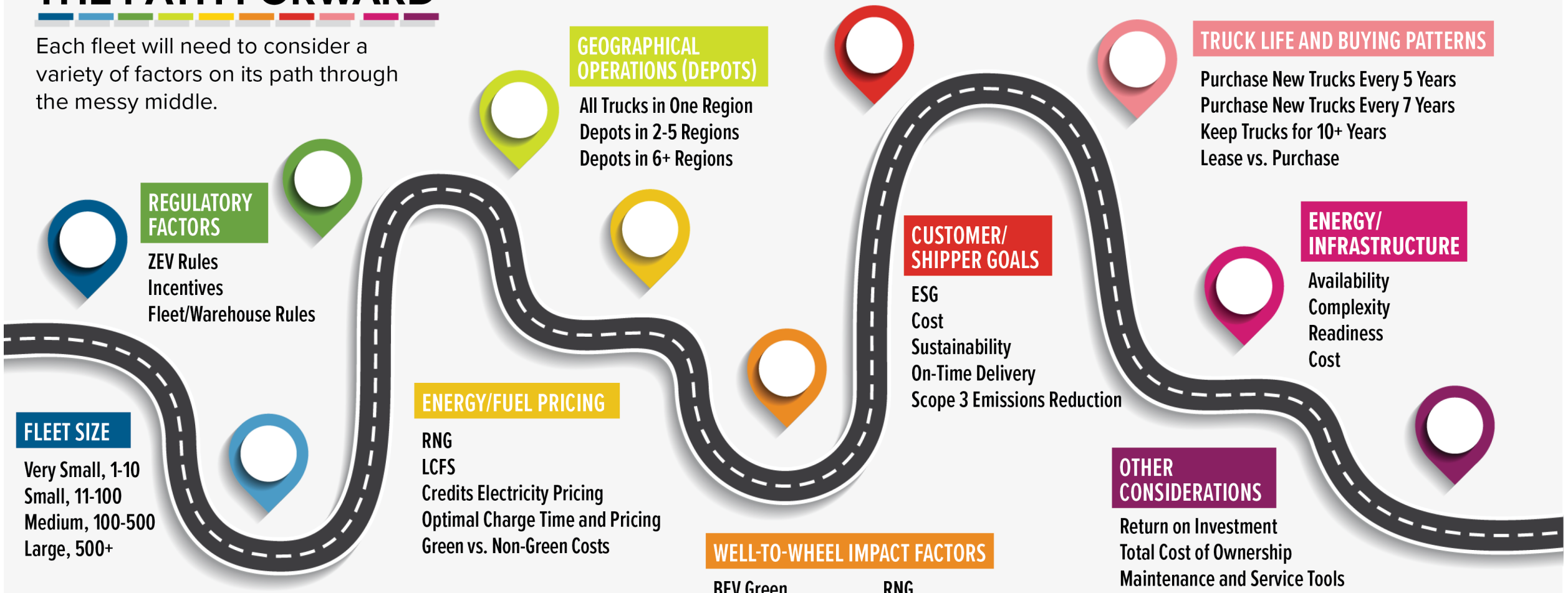
THE PATH FORWARD

Each fleet will need to consider a variety of factors on its path through the messy middle.



FLEET SIZE

Very Small, 1-10
Small, 11-100
Medium, 100-500
Large, 500+

REGULATORY FACTORS

ZEV Rules
Incentives
Fleet/Warehouse Rules

DUTY CYCLES

Favorable
Less Favorable
Unfavorable
Repeatability of Duty Cycle

GEOGRAPHICAL OPERATIONS (DEPOTS)

All Trucks in One Region
Depots in 2-5 Regions
Depots in 6+ Regions

ENERGY/FUEL PRICING

RNG
LCFS
Credits Electricity Pricing
Optimal Charge Time and Pricing
Green vs. Non-Green Costs

WELL-TO-WHEEL IMPACT FACTORS

BEV Green
BEV 50%
BEV 25%

Hydrogen Green
Hydrogen Blue
Hydrogen Grey

RNG
CNG
Renewable Propane
Propane

Renewable Diesel
Biodiesel
Diesel

CUSTOMER/ SHIPPER GOALS

ESG
Cost
Sustainability
On-Time Delivery
Scope 3 Emissions Reduction

TRUCK LIFE AND BUYING PATTERNS

Purchase New Trucks Every 5 Years
Purchase New Trucks Every 7 Years
Keep Trucks for 10+ Years
Lease vs. Purchase

ENERGY/ INFRASTRUCTURE

Availability
Complexity
Readiness
Cost

OTHER CONSIDERATIONS

Return on Investment
Total Cost of Ownership
Maintenance and Service Tools
Second Life Considerations
Capital Spend Willingness (for a good TCO)
Ability to Change Operations
Own or Lease Depot
Truck Life
Corporate Philosophy

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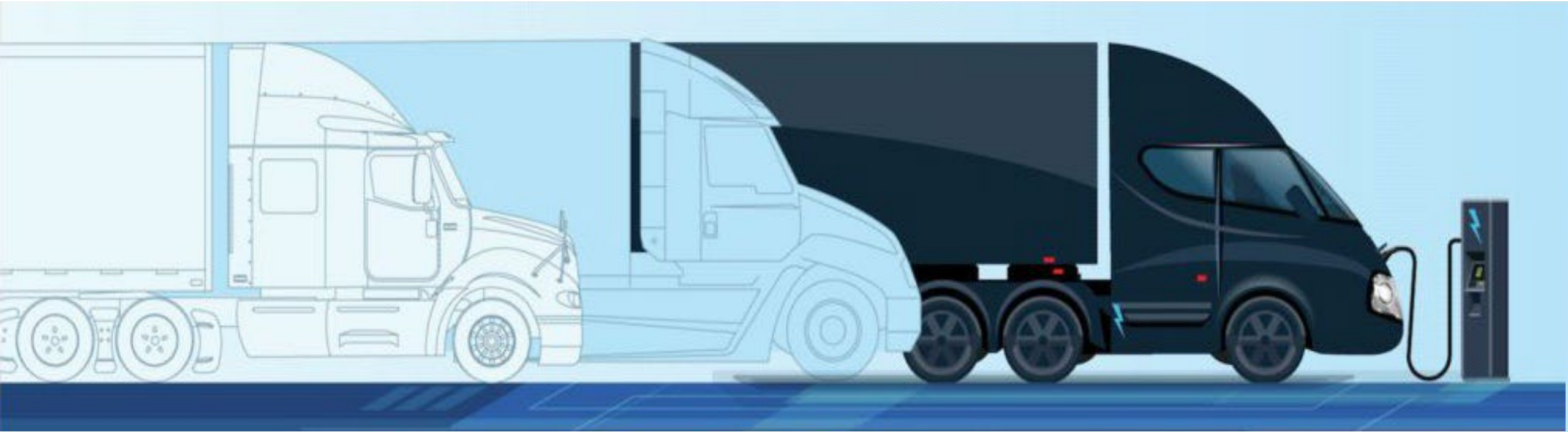
RUN ON LESS ELECTRIC DEPOT

EV Trucks & Run on Less

August 2023 – Dave Schaller, Industry Engagement Director



North American Council for Freight Efficiency

TIRE PRESSURE AERODYNAMIC

SUSTAINABILITY CONFIDENCE

MPG AUTONOMY GUIDING

EFFICIENCY BENCHMARKS

ELECTRIFICATION UNBIASED

HYDROGEN IDLE REDUCTION

FUEL AGNOSTIC NON-PROFIT

Run on Less - “Best of the Best”

2017

RUN ON LESS BY NACFE

Long Haul
7 Fleets
10.1 MPG

2019

RUN ON LESS REGIONAL

Regional Haul
10 Fleets
8.3 MPG

2021

RUN ON LESS ELECTRIC

All BEVs
13 Fleets
New metrics!

2023

RUN ON LESS ELECTRIC DEPOT

BEV Depots
8 Depots
Infrastructure

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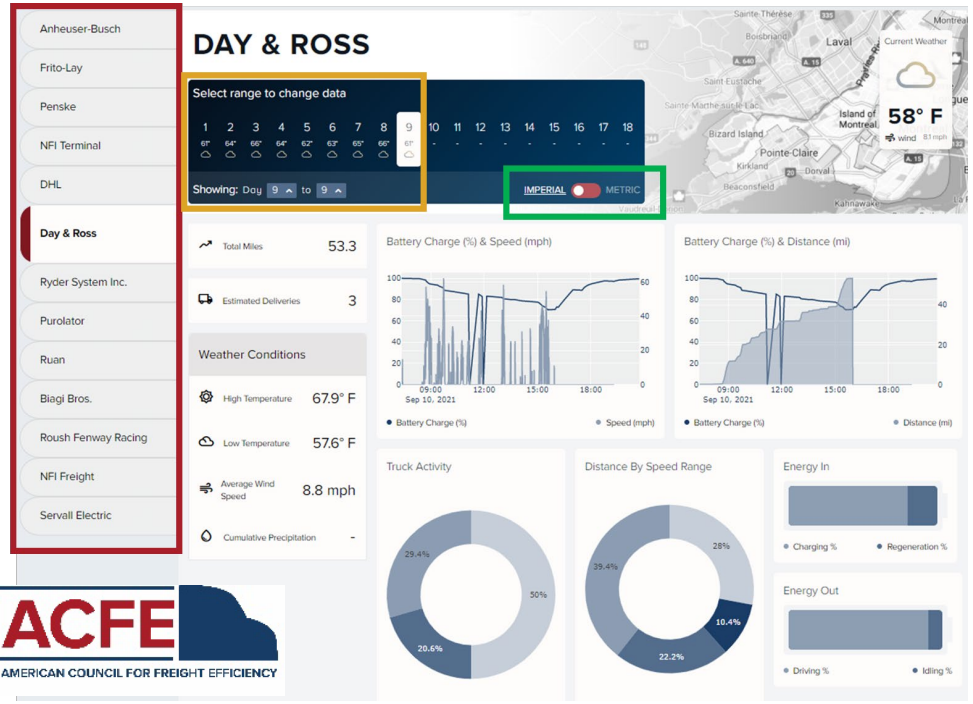
Real-World, Real-Time Case Studies

- For each fleet & OEM
- Fleet Interviews: Drivers & Leaders
- OEM Interviews & more

1. Select any of the 13 fleets
2. Select a day or range of days
3. Select Units of Measure
4. Use the data!



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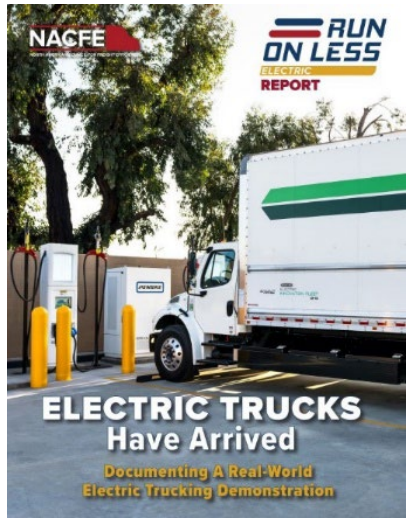
RoL–E Reports



January 12, 2022
Review Of Complete Demonstration:
Electric Trucks Have Arrived

March 6, 2022
The Use Case For
TERMINAL TRACTORS

April 11, 2022
The Use Case For
VANS & STEP VANS

May 5, 2022
The Use Case For
REGIONAL HAUL TRACTORS

June 28, 2022
The Use Case For
MEDIUM DUTY BOX TRUCKS

Other NACFE Whitepapers on Truck EVs:
https://nacfe.org/research/electric-trucks/

RUN ON LESS ELECTRIC

Run on Less - Electric DEPOT 2023

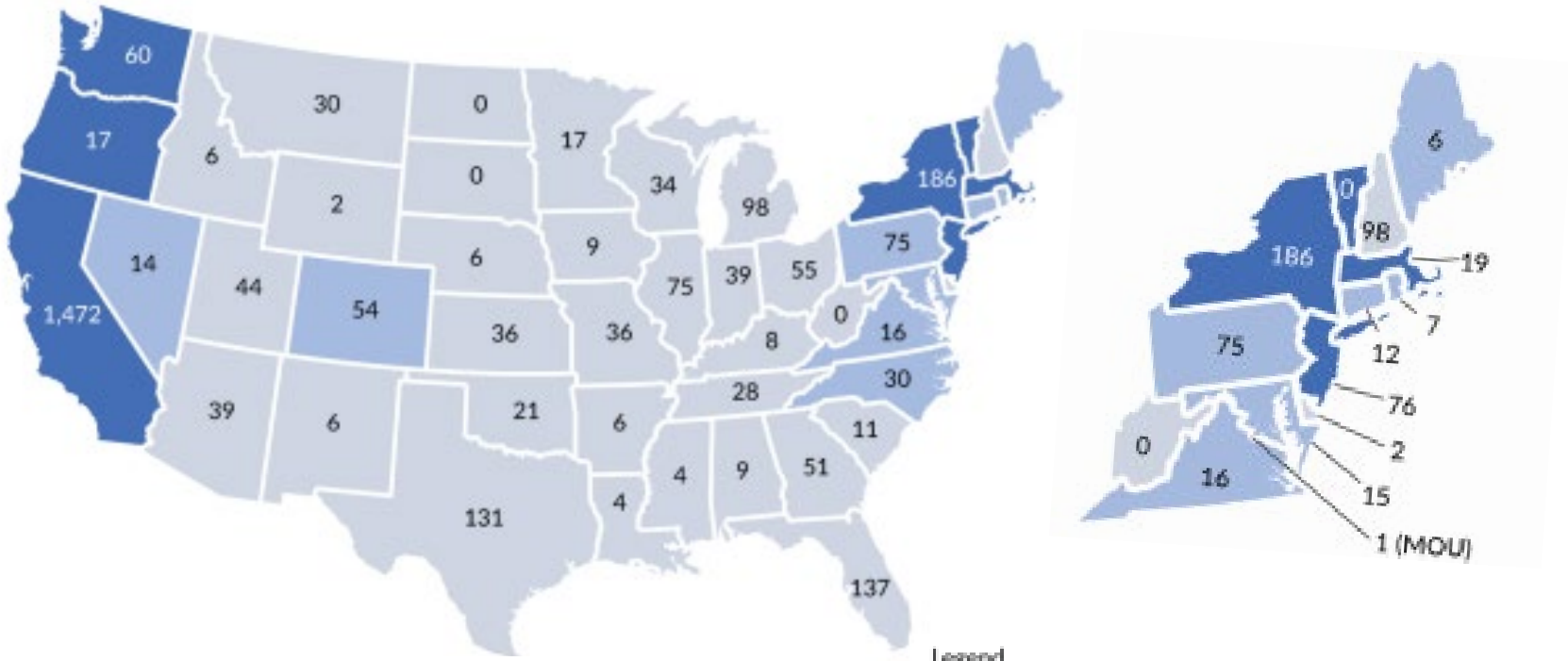
5 more EV OEMs

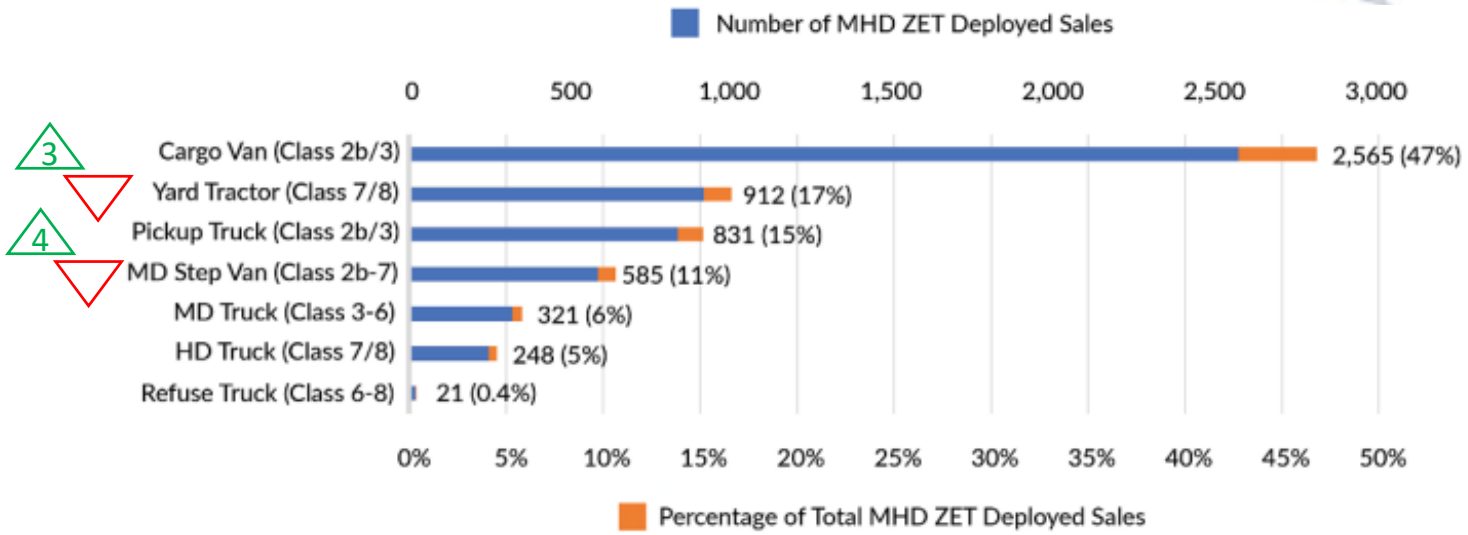
- Ford
- BrightDrop
- Navistar
- Nikola
- Tesla

- Each location has at least 15 EV trucks
- Many have more

EV Truck Deployments (May '23)

- 5,483 Zero Emission Trucks Deployed 2b-8 (2021=1,895)
- 46% are in California ('21=60%)





Source: Calstart May 2023
Zeroing-in-on-ZETs-May-2023-Market-Update.pdf (calstart.org)

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DEPOT Filming

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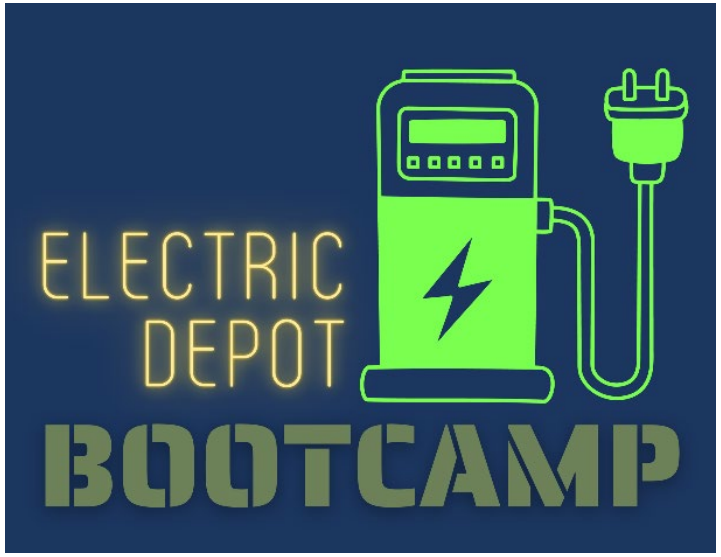
DEPOTS Electric Truck Bootcamp

1. **Best Practices for Utility-Fleet Relationships**
2. **Grants and Incentives for the Trucks and Infrastructure**
3. **Electric Truck Developments**
4. **Faster Charging — Opportunities and Challenges at 350KW and higher**
5. **Opportunities to Extend BEV Range** (via charging technologies)
6. **Electricity Resiliency and Availability** (microgrids, renewable energy…)
7. **Current and Future Regulations for Zero Emission Trucks**
8. **Managed Charging to Improve Availability, Cost and Range**
9. **Scaling Charging Infrastructure Equipment**
10. **Electric Depot Site Planning and Construction**

RUN ON LESS ELECTRIC DEPOT



Register here

Guidance on Electric Trucks

 # 1

Electric Trucks: Where They Make Sense

May 2018

MD Electric Trucks:

Cost Of Ownership

October 2018

 # 2

Viable Class 7 & 8 Electric, Hybrid & Alt Fuels Tractors

 # 4

December 2019

 # 3 & # 8

Electric Trucks: Charging Infrastructure

March 2019

June 2023

High Potential Regions

 # 5

November 2020

Heavy-Duty Hydrogen Tractors

 # 6 & # 7

December 2020

April 2023

Now Free Online at https://nacfe.org/emerging-technology/electric-trucks-2/

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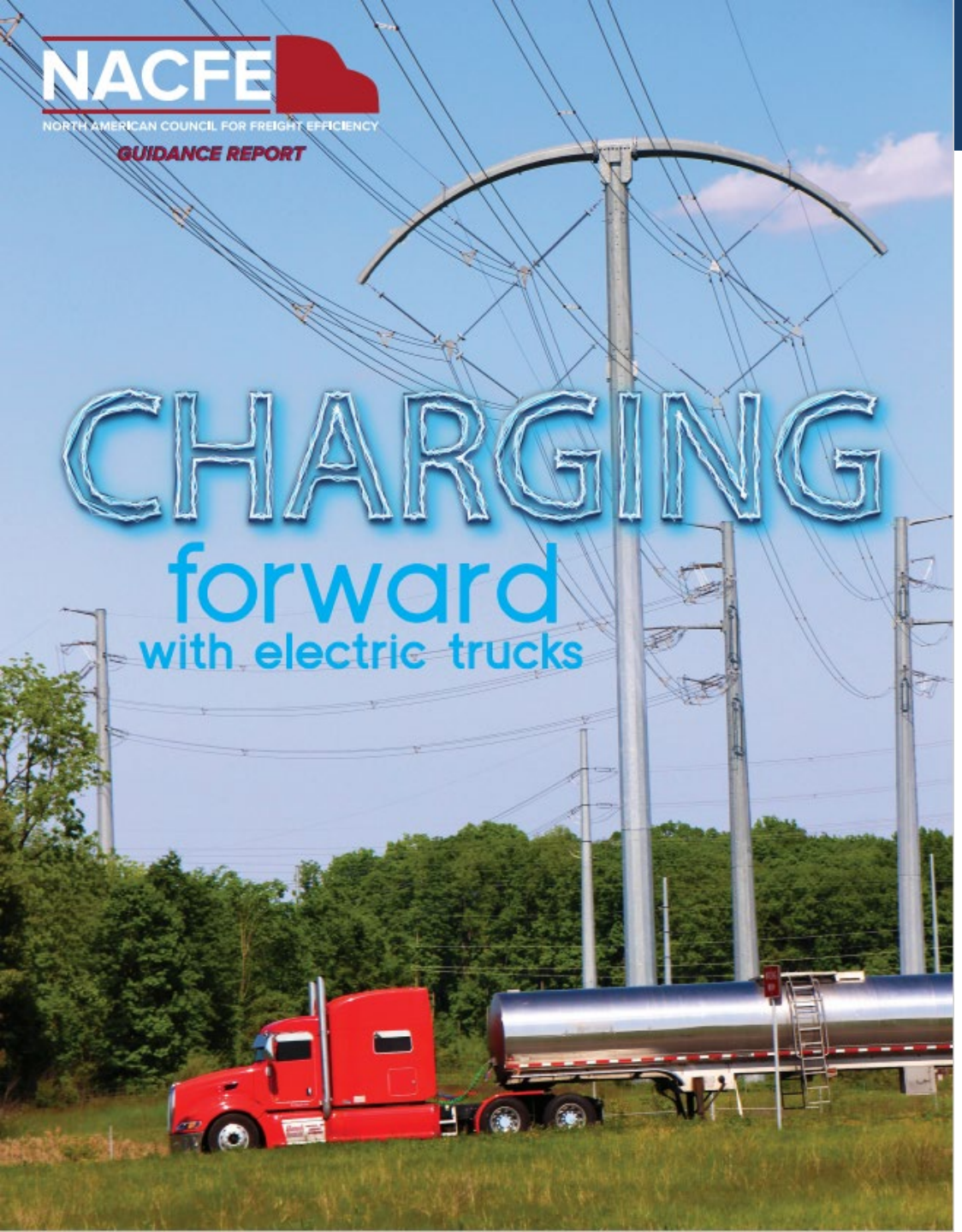
13



Charging Forward GR

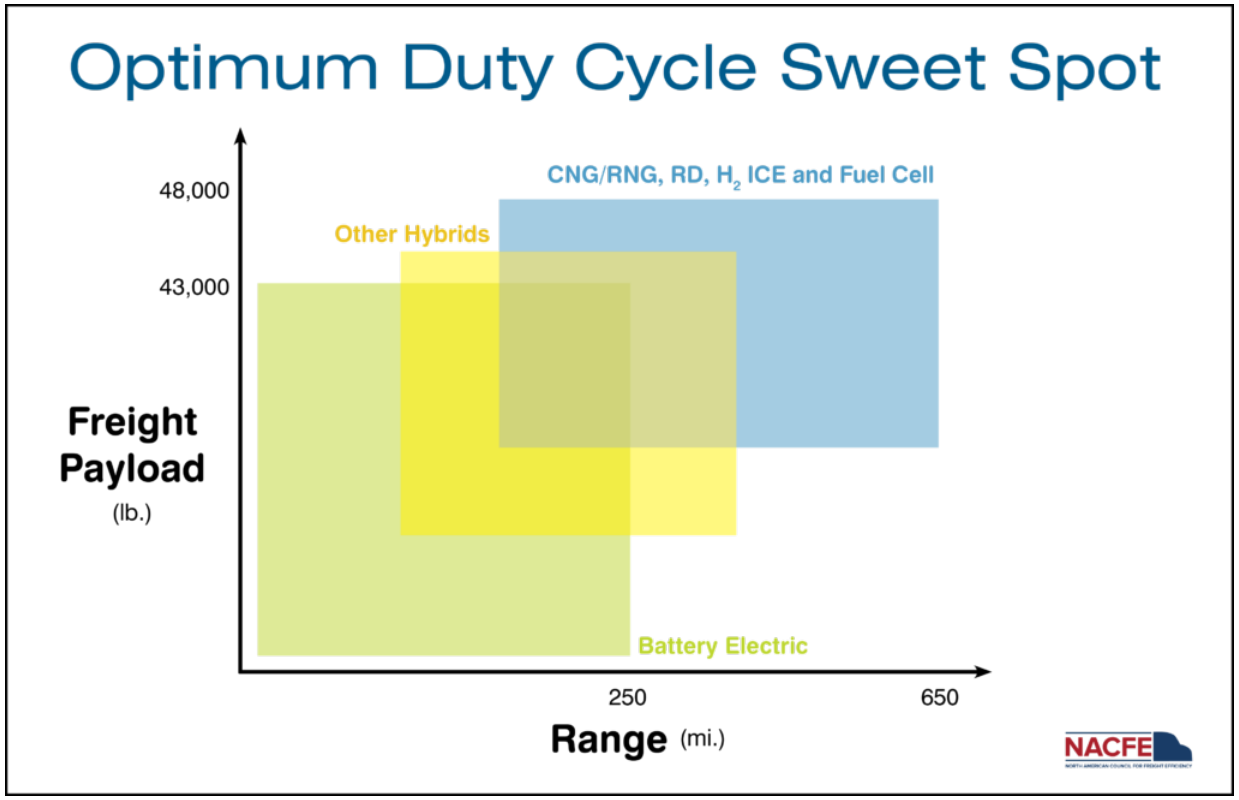
Conclusions:

- Electric trucks and chargers must work together
- Your utility is a key partner
- Use and design greatly affect charging cost
- The transition requires staff and attention
- Consider other charging business models
- Other key considerations
  - Grants & incentives
  - Microgrids
  - Landlords
  - Reliability and interoperability of chargers
  - And more…

https://nacfe.org/research/electric-trucks/#charging-infrastructure

Latest NACFE Electric Reports

Hydrogen Trucks: Long Haul's Future?



Published April 4, 2023; https://nacfe.org/research/electric-trucks/#hydrogen

Charging Forward with Electric Trucks

Published June 5, 2023; https://nacfe.org/research/electric-trucks/#charging-infrastructure

How is industry changing?


CCS1


CCS2


CHAdeMO


J1772


MCS or CharIN

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NACFE.org

Let's Stay Connected…
… And charged up!

RUN ON LESS ELECTRIC

RunOnLess.com

LinkedIn NACFE (& Spanish: NACFE LATAM)

NACFE

@NACFE_Freight & @RunOnLess

NACFE

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THANK YOU