



Electric Vehicles: More than a Truckload of Changes

Dave Schaller
June 2021



North American Council for Freight Efficiency



www.NACFE.org

- Unbiased, non-profit
- Mission to double freight efficiency
- All stakeholders
- Scale available technologies, guide future change and Run on Less demonstrations.
- Primary focus: Tractor-trailers



No Membership Fees: Thanks to Sponsors

Gold



Silver



Bronze

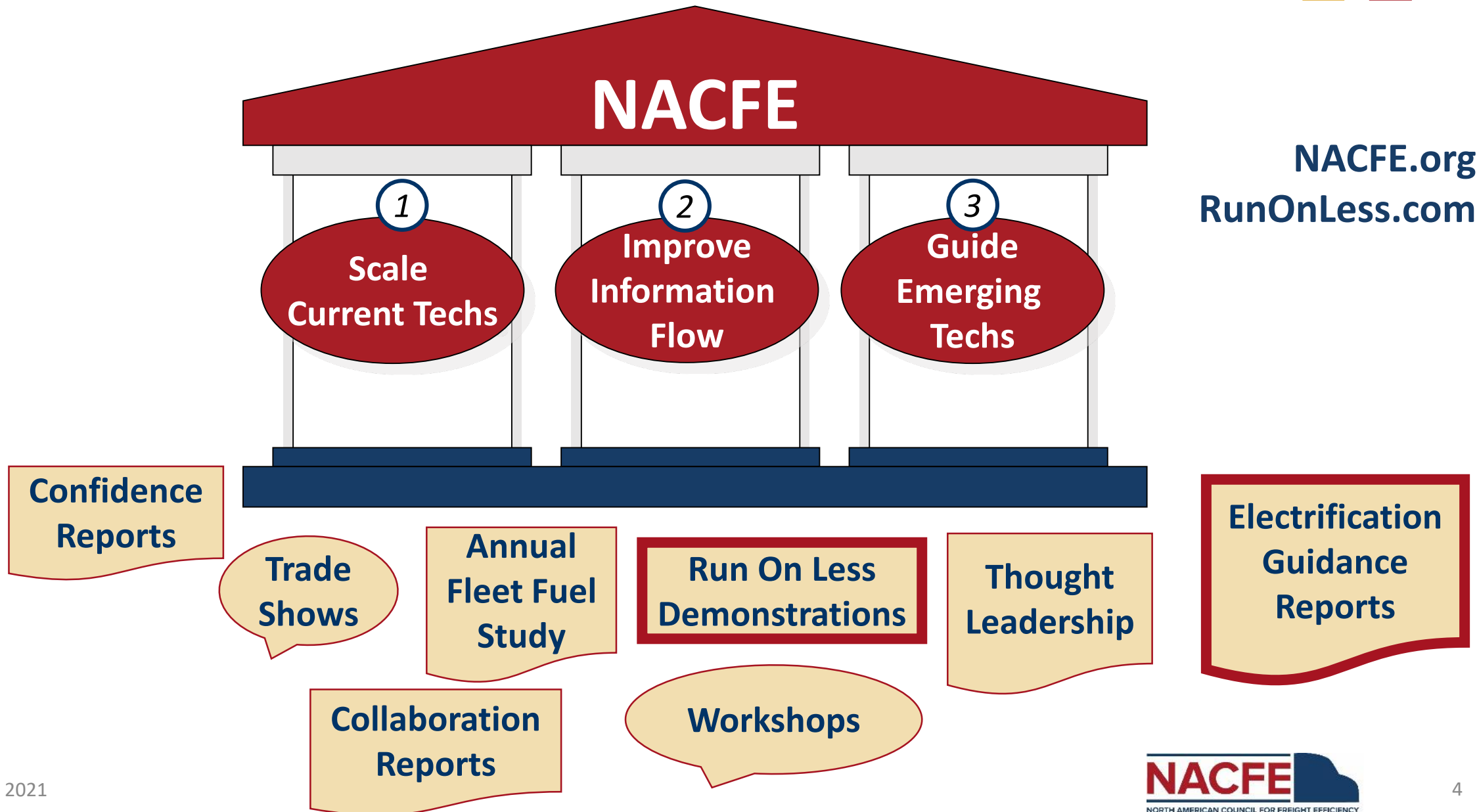


Electric Trucks



2021 Fiscal Supporters

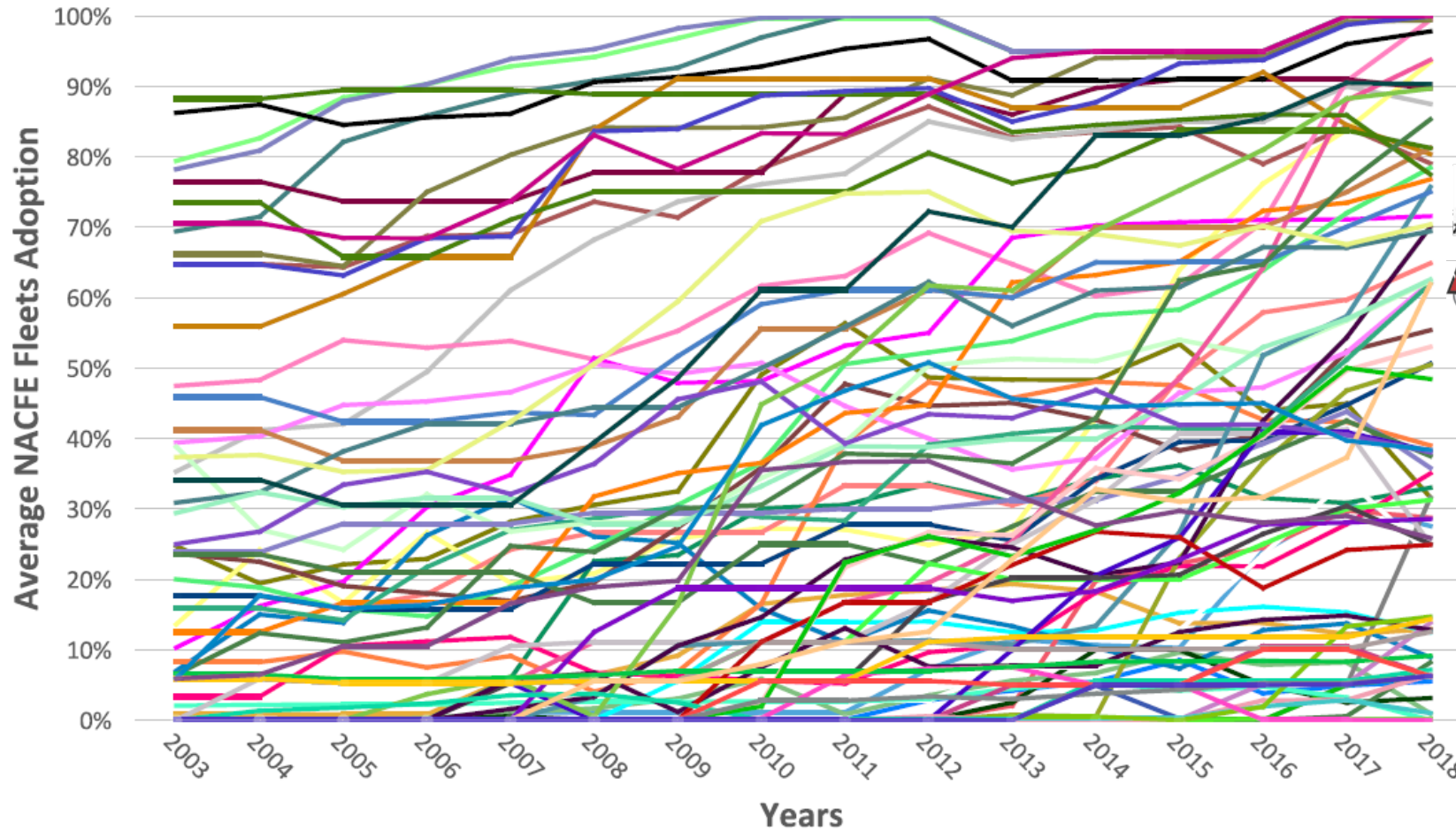
Three Pillars of NACFE Work



2019 Annual Fleet Fuel Study



All Technologies



<https://nacfe.org/annual-fleet-fuel-studies/>

Best of the Best

2017



Long Haul
7 Fleets
10.1 MPG

2019



Regional Haul
10 Fleets
8.3 MPG

2021



All BEVs
13 Fleets
New metrics!



Timeline for Run on Less – Electric

Announcement

- Participants' fleet, truck and location detailed
- Bootcamp registration
- Website launched



- 10 Trainings every other Tuesday
- April 20 to August 24
- Summarize learnings

Pre-Run

- Visit all participants in June & July
- Continued promotion
- Profiles on runonless.com August 16



- Starts September 3 at ACT Expo
- Metrics and daily stories
- TMC Cleveland, SAE COMVEC Chicago, NYC Climate Week, MOVE Austin

Post-Run

- Initial Report at ATA MCE October 26-28
- Workshops & Conferences
- Analyses and publish reports in 2022



IN
PARTNERSHIP
WITH



with
title
sponsors

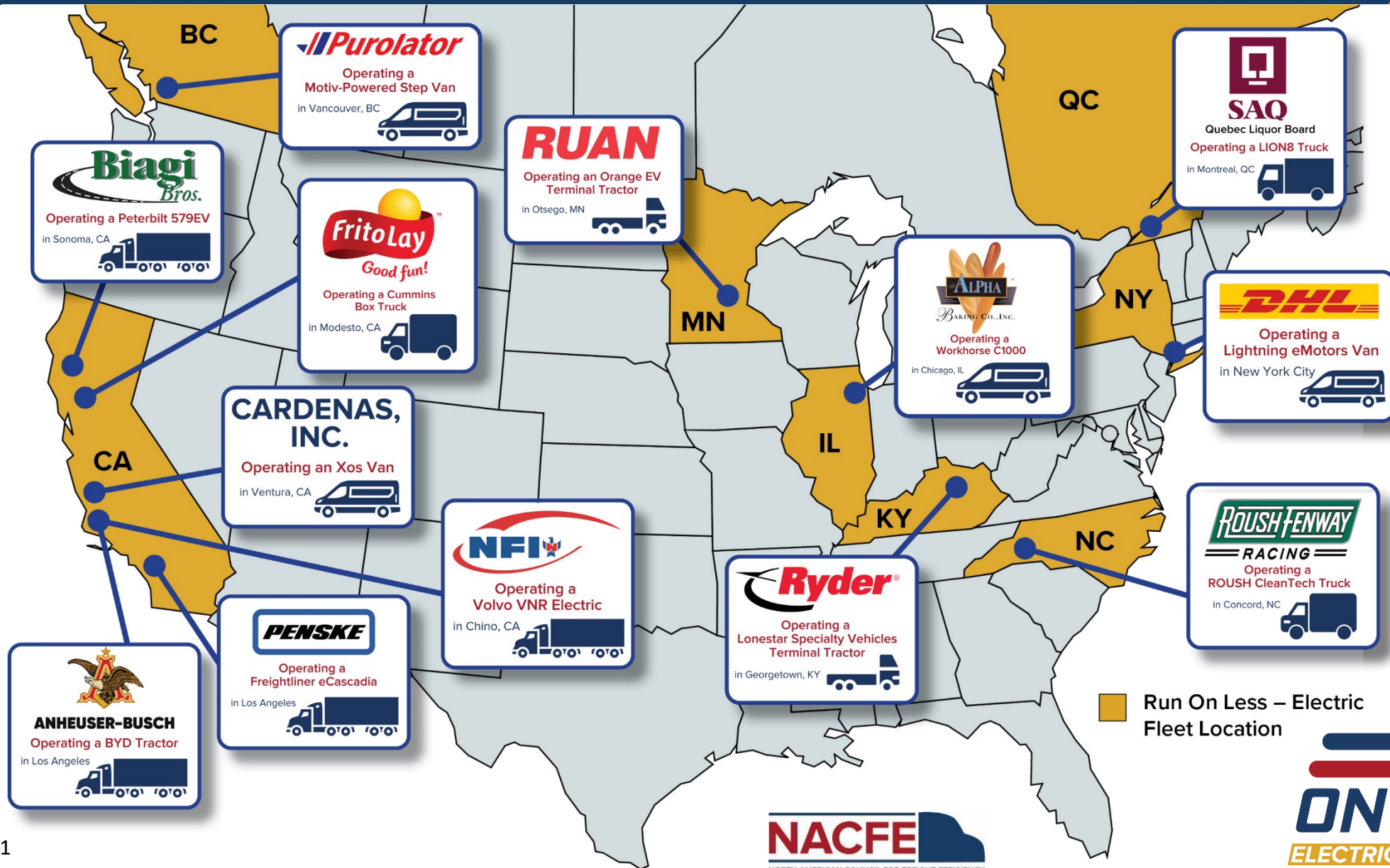


RoL-E Participants



- Interviewed 30+ potential pairs
- Required trucks to be in-service by June 1st
- Mix
 - Multiple classes and duty cycles
 - Multiple truck OEMs
 - Locations around NA
- Selection Criteria
 - Uptime, design maturity
 - Scale potential
 - Mix
 - Fleet / OEM commitment

Run on Less – Electric Participants



Fleet Electrification Waves

Electrification waves drive
RoL-E scope

1. Forklifts
2. ***Yard Tractors***
3. ***MD Urban Delivery***
4. ***Drayage***
5. ***Regional Haul Tractors***
6. Long Haul Tractors



Run on Less – Electric Sponsors

Title Sponsors



Event Sponsors

• APTIV •



GEOTAB



Supporting Sponsors



Electric Truck Bootcamp

- | | |
|---------|---|
| 4/20/21 | 1. Why Electric Trucks? |
| 5/4/21 | 2. Charging 101 - Planning & Buildout |
| 5/18/21 | 3. Charging 201 - Power Management & Resilience |
| 6/1/21 | 4. Working with Your Utility |
| 6/15/21 | 5. Incentives for Electrification |
| 6/29/21 | 6. Maintenance, Training & Safety |
| 7/13/21 | 7. Finance & Innovative Business Models |
| 7/27/21 | 8. Battery Supply Chains & End of Life |
| 8/10/21 | 9. Global Perspectives |
| 8/24/21 | 10. Drivers & Electric Trucks |

Register at:

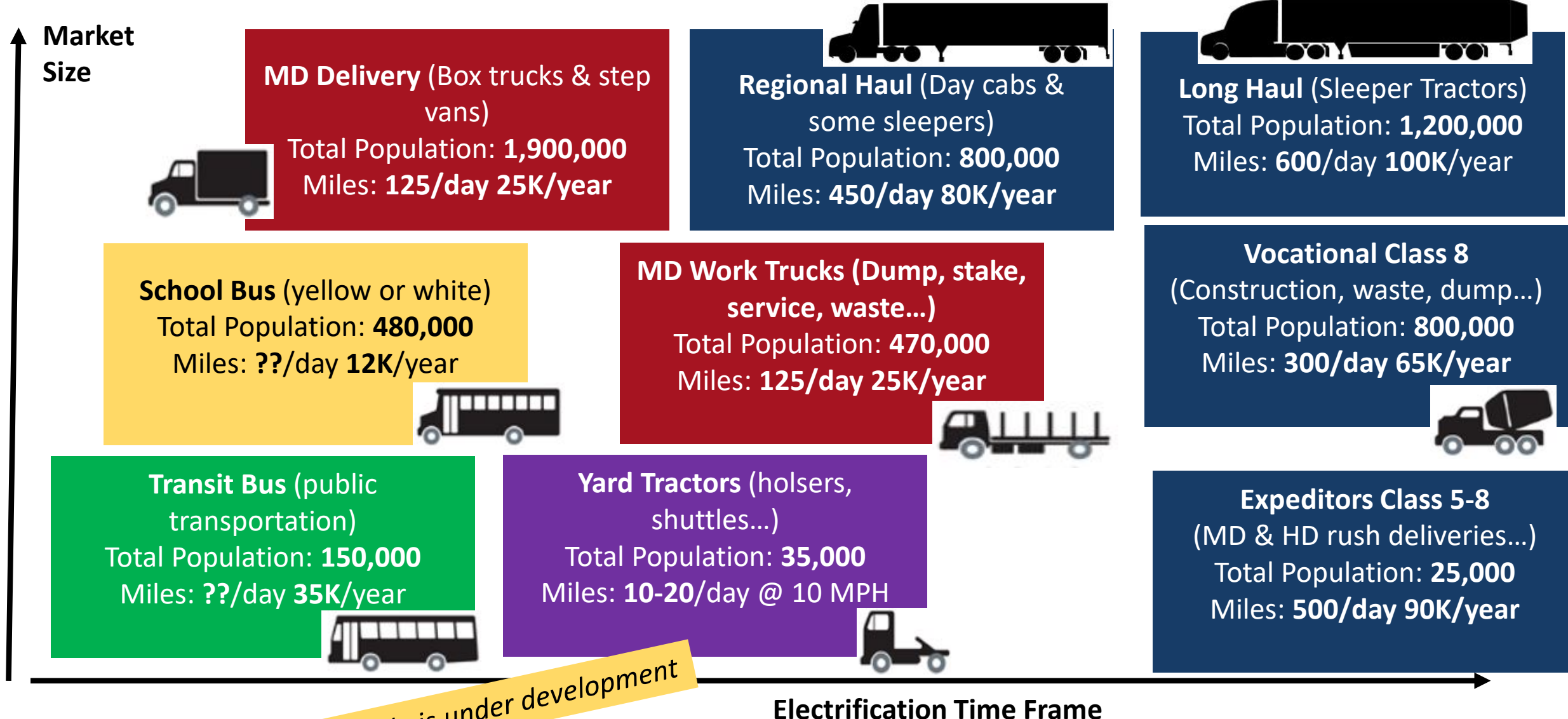
<https://subscribe.act-news.com/NACFE-RoL-e-2021>

All sessions:

- Start at 1 PM EDT
- Can be viewed later



MD & HD Industry Segments



This slide is under development

Guidance on Electric Trucks

1

Electric Trucks: Where They Make Sense

May 2018



MD Electric Trucks: Cost Of Ownership

October 2018

2

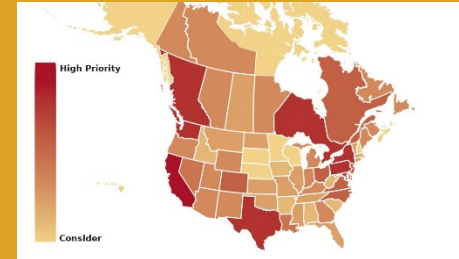
Viable Class 7 & 8 Electric, Hybrid & Alt Fuels Tractors



4

December 2019

High Potential Regions



5

November 2020

Heavy-Duty Hydrogen Fuel Cell Tractors



6

December 2020

3

Electric Trucks: Charging Infrastructure

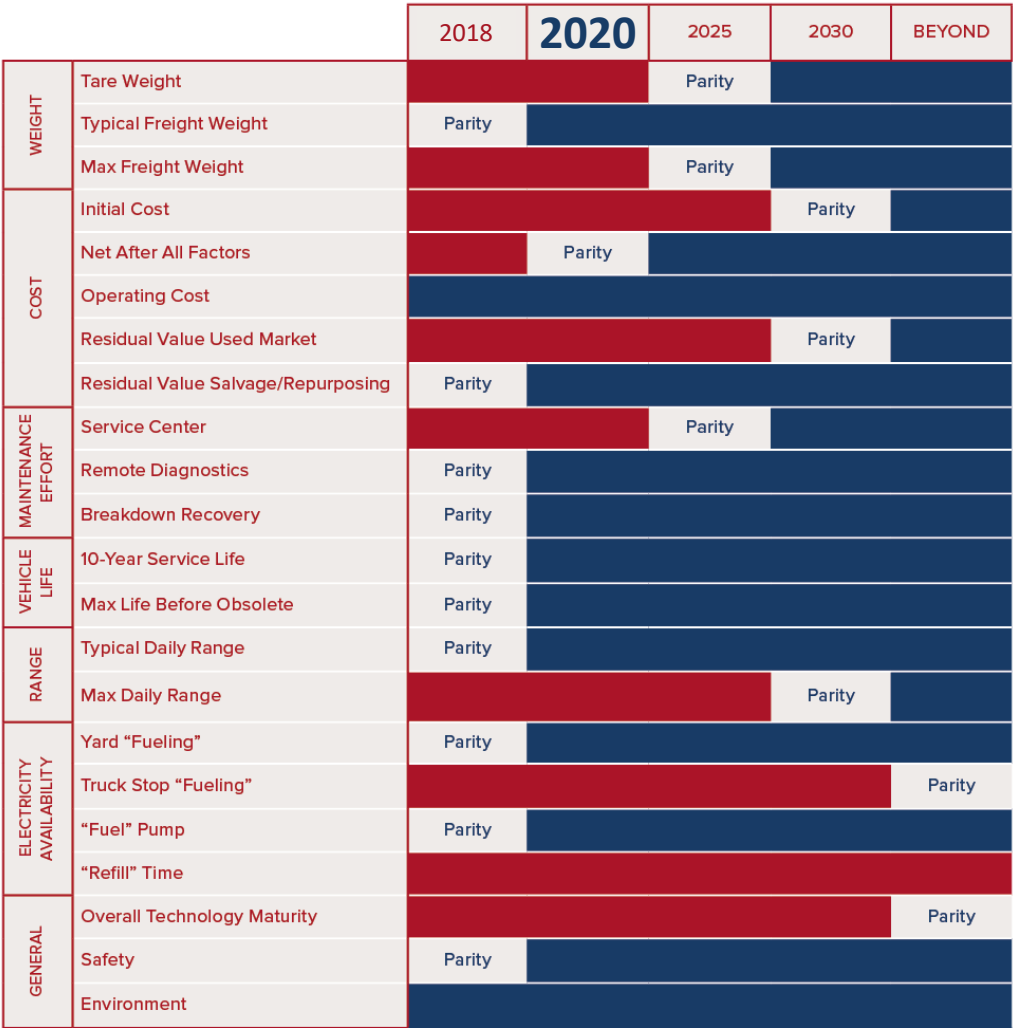
March 2019



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

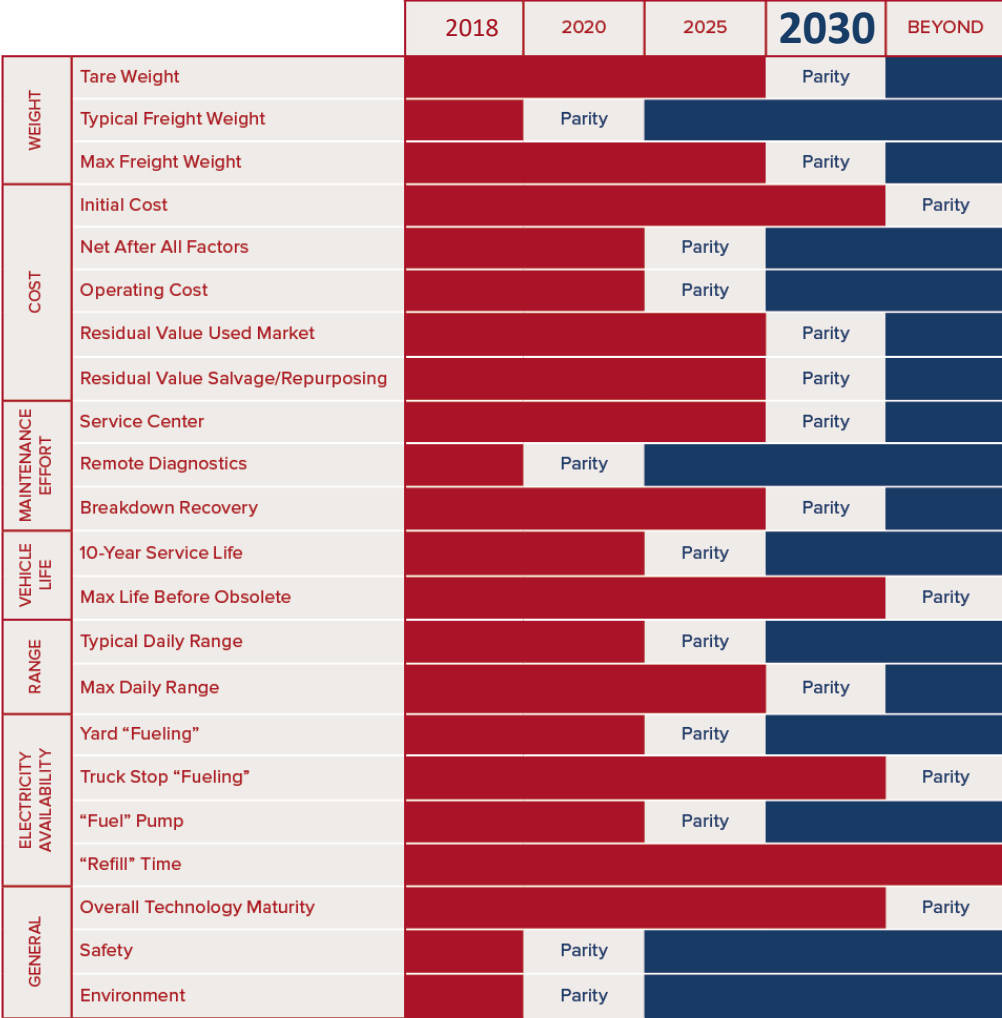
Findings: Parity To Diesel

CLASS 3 THROUGH 6 CBEV PARITY VS. DIESEL SYSTEM (NACFE)



Key: Comparison to 'Equivalent' Diesel Baseline: ■ Worse ■ Parity ■ Better

CLASS 7 AND 8 CBEV PARITY VS. DIESEL SYSTEM (NACFE)



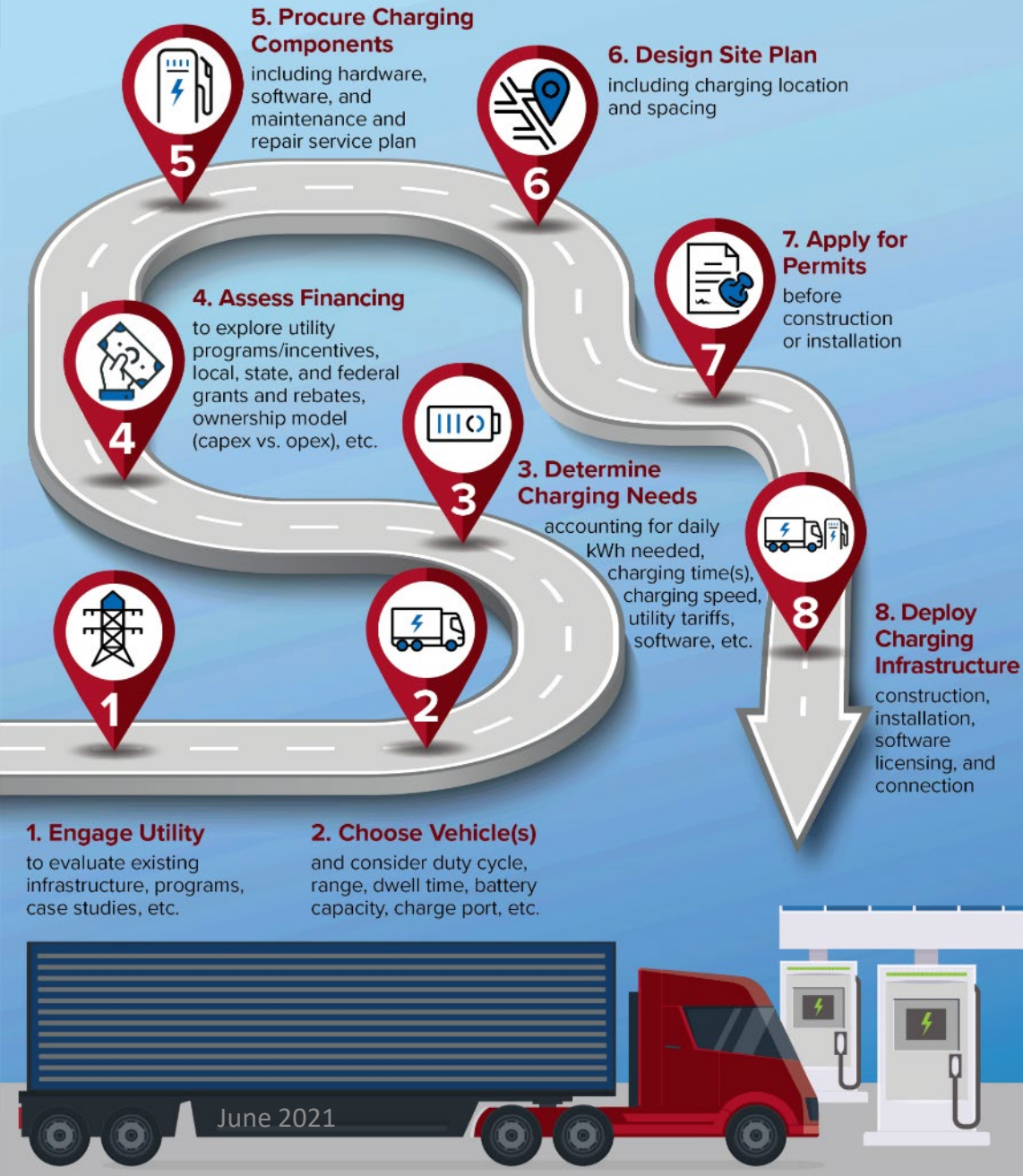
Key: Comparison to 'Equivalent' Diesel Baseline: ■ Worse ■ Parity ■ Better

Class 3 - 6

Dark Blue = EV is Better

Class 7 & 8

Charging Procurement Roadmap



Infrastructure

- Complex
- Large amount of power fast
- Involve all stakeholders early
- Time to complete with truck availability
- Be flexible

Pathways to HD Truck Charging



1) Fleet Depot Based



**2) Opportunity Charging
Stores, Ports, Warehouses...**



3) Shared Card Lock Locations



4) Truck Stops



5) Toll Road Rest Areas



6) Interstate Rest Areas

- 7) Mobile Roadside Charging (emergencies & service calls)**
8) In Motion Charging

Challenges

- Difficult to forecast MD & HD Electrification (loads & locations)
- Most truck fleets don't currently warrant an account manager
- Utilities know about bucket trucks and pickup trucks, but may well be unfamiliar with other applications

Opportunities

- Work with truck dealers (who themselves may need charging systems)
- Investigate the large industrial parks & distribution centers in your area
- Research ports including water, air and rail as potentials
- Join your state trucking association

HD Tractors Green Future

PRESENT: 2020

Technology immature
Many unknowns
& challenges



“MESSY MIDDLE”: 2030

Many optimized solutions
Growing infrastructure
Multi fuel choices

Innovation & maturation
Facts replace estimates
Learning curves

FUTURE: 2040

Fast charging everywhere
Long life, low cost batteries
Acceptable weights



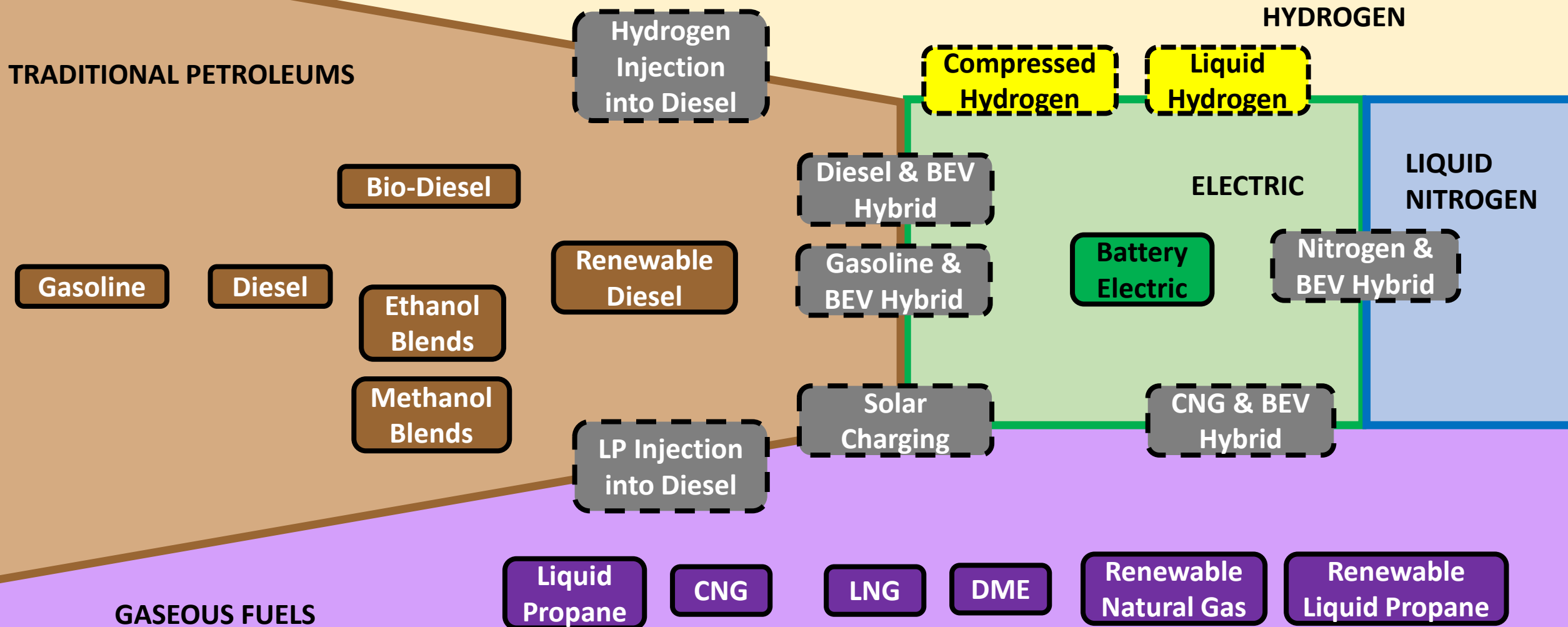
Legacy Diesels
Natural Gas

Diesel Advancements
Natural Gas
Hybrids

Battery Electric
Hydrogen Fuel Cells
Renewable Natural Gas & Diesel

CBEV & HFCEV from
Clean Energy

Alternative Fuels



NACFE is Fuel Agnostic

More Efficiency

More RANGE

Less ANXIETY

Tire Pressure
Tire Rolling Resistance
Tractor Aerodynamics
Trailer Aerodynamics
Lightweighting
Idle Reduction

Confidence Reports

Complete, unbiased review of available technologies for fleet confidence to adopt.



Tire Pressure Systems



6x2 Axles



Idle Reduction



Transmissions



Engine Parameters



LRR Tires



Lightweighting



Downspeeding



Maintenance for FE



Trailer Aerodynamics



Tractor Aerodynamics



Lubricants



Platooning



Engine Accessories



Solar

Can be viewed as either:

1. Diesel fuel savings
2. Range extenders for alternative fuels

Electric/Hybrid Trucks Catalog

The screenshot shows the 'ZERO-EMISSION TECHNOLOGY INVENTORY' website. At the top, there is a navigation bar with links: HOME, ABOUT, NEWS, EVENTS, RESOURCES, CALSTART, and CONTACT. Below this is a header section with the title 'ZERO-EMISSION TECHNOLOGY INVENTORY' and a sub-header 'SELECT A VEHICLE PLATFORM TO EXPLORE'. Underneath, there are ten circular icons representing different vehicle types: Transit Bus, School Bus, Shuttle Bus, Cargo Van, Yard Tractor, MD Truck, MD Step Van, HD Truck, and Other. Below the icons, there are two more selection options: 'SELECT A REGION' with a map of North America, and 'SELECT A VEHICLE MANUFACTURER' with a grid of 48 manufacturer logos including Alstom, BYD, Ford, GM, and many others. At the bottom left, there is a timeline titled 'REPORTED VEHICLE AVAILABILITY THROUGH 2023' with markers for 'Available', 2020, 2021, 2022, and 2023. A 'RESET FILTERS' button is located below the timeline.

- “ZETI”
- Calstart on-line tool
- Part of **Drive to Zero** program at Calstart
- Launched March 2020
- Current & future production models
- Links to OEM web pages

<https://globaldrivetozero.org/resources/zero-emission-technology-inventory/>

Some CBEVs: “Range Extended”



Several OEMs and suppliers are working on hydrogen fuel cell powered electric trucks



Hyllion “Hypertruck” is being called ERX: Electric Range Extender and runs on CNG or RNG



CNG Infrastructure

From DOE Alt Fuels Data Center

Hydrogen & Battery Electric Trucks

Both Competitors *AND* Teammates

Hydrogen Fuel Cell Trucks	Truck Subsystem	Battery Electric Trucks
Yes (but less)	Rechargeable Batteries	Yes
Yes	Electric Drive Motors	Yes
Yes	High Power Cables	Yes
Yes	Software Management	Yes
Yes	Regenerative Braking	Yes
Yes	Hydrogen Fuel Cell	--
Yes	Hydrogen Fuel Tank	--
Hydrogen Station	Refueling	Electric Charging Station
Large	Electricity Consumption	Large

Guidance on Hydrogen

Hydrogen Color Spectrum

GREEN

Hydrogen produced by electrolysis of water, using electricity from renewable sources like hydropower, wind, and solar. Zero carbon emissions are produced.

TURQUOISE

Hydrogen produced by the thermal splitting of methane (methane pyrolysis). Instead of CO₂, solid carbon is produced.

PINK/PURPLE/RED

Hydrogen produced by electrolysis using nuclear power.

BLACK/GRAY

Hydrogen extracted from natural gas using steam-methane reforming.

YELLOW

Hydrogen produced by electrolysis using grid electricity.

BLUE

Grey or brown hydrogen with its CO₂ sequestered or repurposed.

WHITE

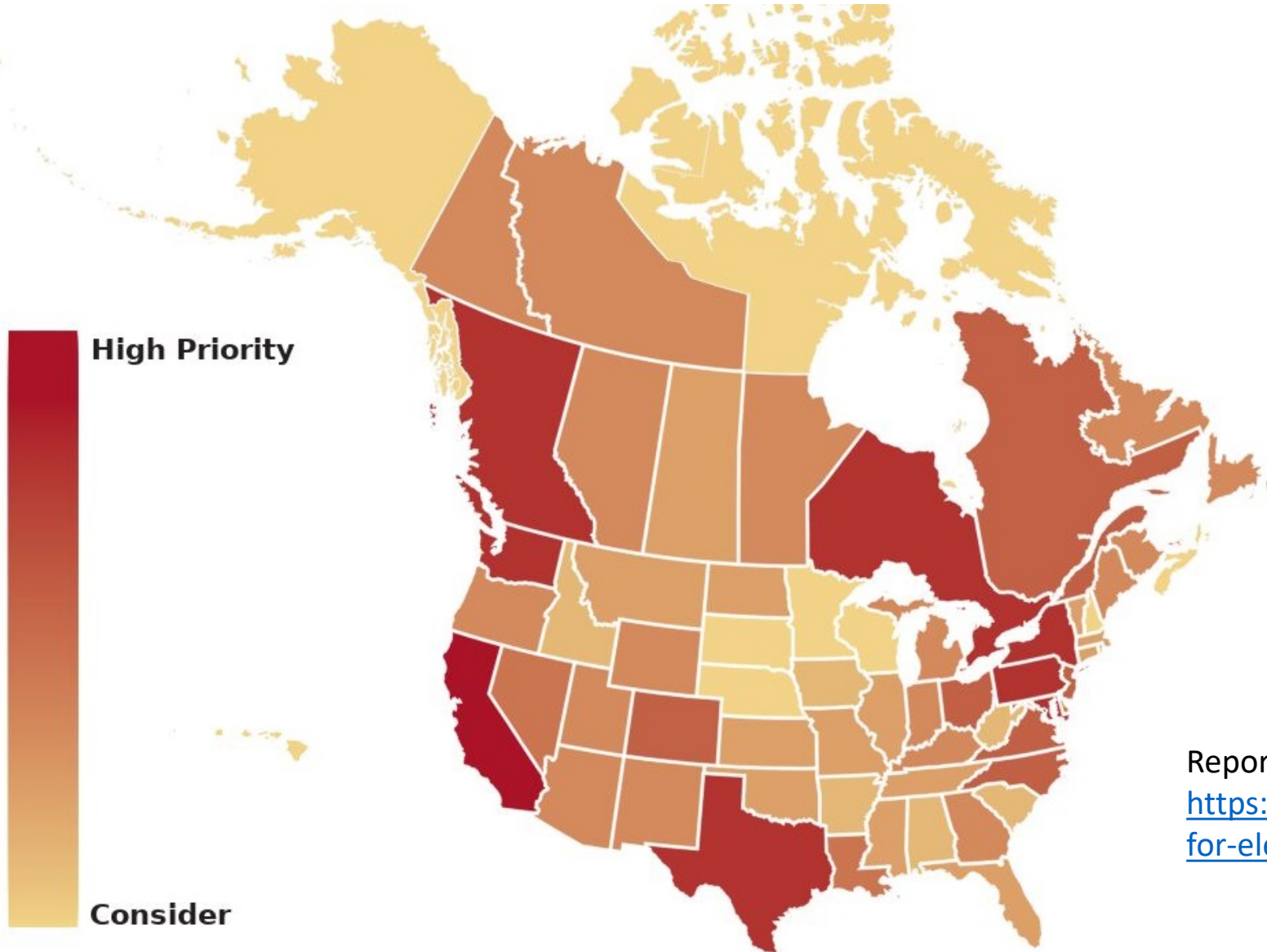
Hydrogen produced as a byproduct of industrial processes.

BROWN

Hydrogen extracted from fossil fuels, usually coal, using gasification.



High Potential Regions Report



Megaregions with particularly high potential

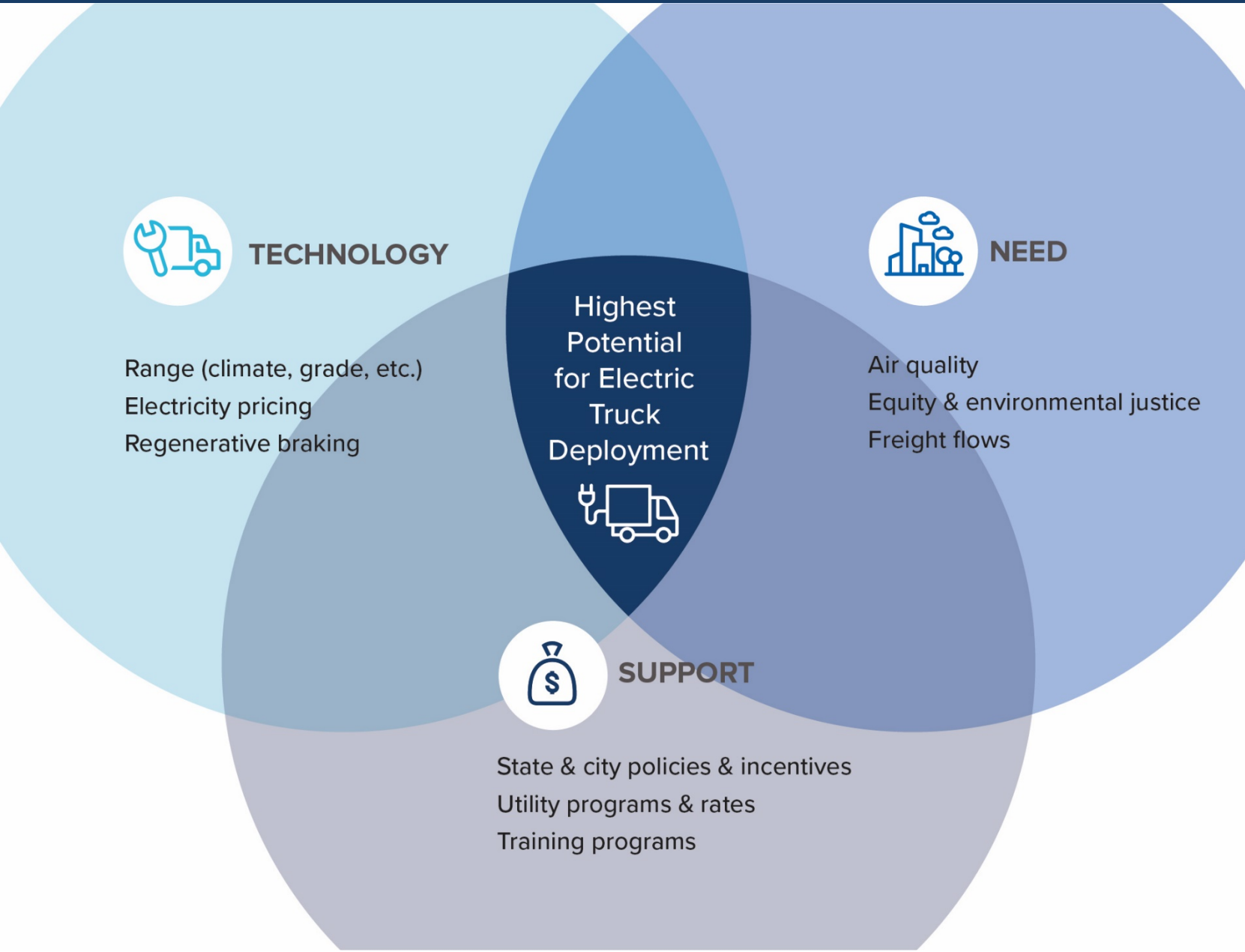
- Northern California
- Southern California
- Texas Triangle
- Cascadia (WA,OR & BC)
- Front Range (CO & NM)
- Northeast
- Toronto & Montreal

Report Link:

<https://nacfe.org/downloads/high-potential-regions-for-electric-truck-deployments-technical-appendix/>

June 2021

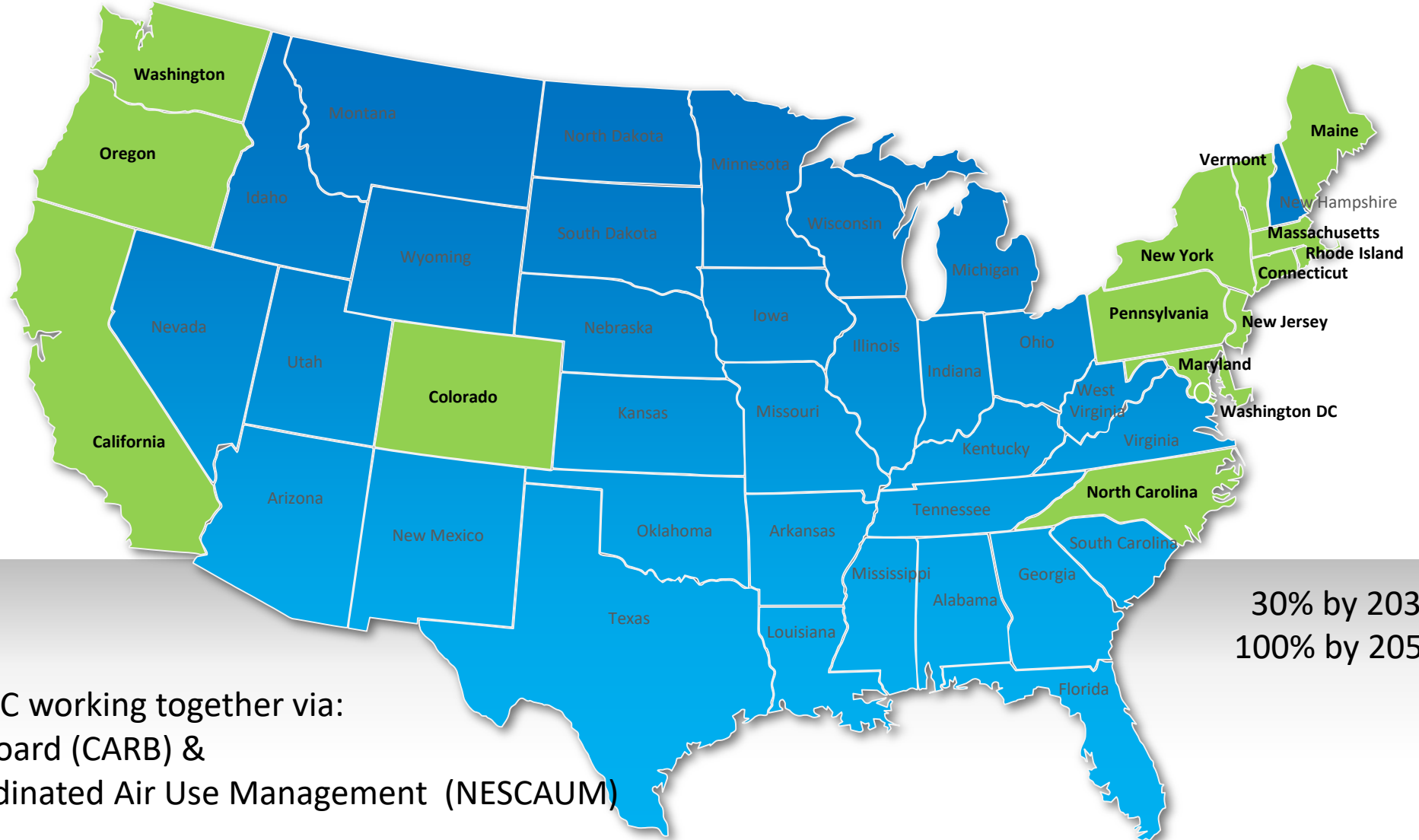
High Potential Regions Report



To develop strategies to advance zero-emission trucks collaboration is needed from:

- fleets
- policymakers
- regulators
- utilities
- suppliers
- other stakeholders in their region

Transition to Zero-Emission Trucks



30% by 2030
100% by 2050

15 States & Washington DC working together via:
California Air Resources Board (CARB) &
Northeast States for Coordinated Air Use Management (NESCAUM)

June 2021

Memorandum Of Understanding signed July 14th, 2020

Why Consider Electrification Now?

2021

JANUARY

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OCTOBER

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NOVEMBER

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DECEMBER

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Financial

- Incentives are/will be available that can cover some of the costs of conversion

Facilities

- Obtain required power levels BEFORE your neighbors
- Obtaining power/infrastructure can take years
- Might be easier to relocate than upgrade
- Physical layout of your lot will change

Change is Coming: Even with diesel

- Regulations & tech changes for NOx & GHG

Electric Trucks

Collaboration

- Fleets
- OEMs (Existing *& New*)
- Suppliers
- Dealerships (Sales/Service)
- Governments
- *Charging System Suppliers*
- *Utility Companies*



Electric Trucks In Regional Haul



School Buses



Transit Buses



Regional Haul Tractors

Population:
(U.S.A)

480,000

150,000

800,000

**Annual
Mileage:**
(typical)

12,000

35,000

65,000

**Total Annual
Mileage:**
(estimate)

5,760,000,000

5,250,000,000

52,000,000,000

Sources: DOE Fuels Data Center, APTA Fact Book, Reference.com, NACFE reports

10 Trends of Regional Haul Growth



June 2021

Regional Haul

More Regional Haul: An Opportunity for Trucking?

- Drop in Length of Haul
- Warehousing
- Technology Trends
- An Opportunity
 - Drivers
 - Alternative Fuels
 - Others?

Report published April 2019.

<https://nacfe.org/regional-haul/>

Run on Less Regional



Results Fleets Technologies Videos News & Events ▾ About ▾

Day 18 of 18

Congratulations to Our
Drivers!

OCTOBER 7 – 25 2019

Run on Less Regional Sets Impressive
Efficiency Benchmark



RESULTS

[See the results](#)

8.3

Average MPG

\$8,249

Dollars saved

\$9,003,550,961

Annualized Potential Savings

Potential savings represents the savings that are possible across the industry if all regional-haul trucks operated at this level.

June 2021



Results Fleets Technologies Videos News & Events ▾ About ▾

All Results

RESULTS BY FLEET

C&S Wholesale Grocers

Hirschbach

Hogan Transportation

J.B. Hunt

Meijer

PepsiCo

Ploger Transportation

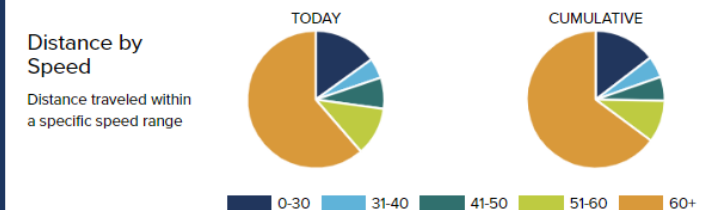
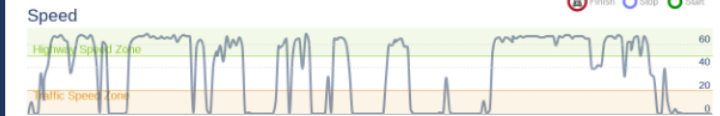
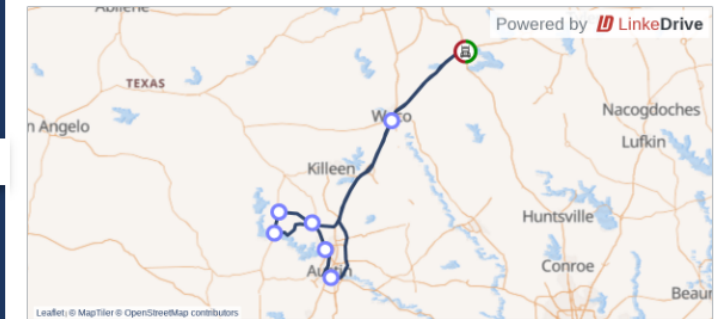
Schneider

Southeastern Freight Lines

United Parcel Service

OCTOBER 16, 2019: DAY 10 OF 18

Day 10



Run on Less Regional Reports

Conclusions

1. High efficiency requires commitment
2. Optimize performance using big data and connectivity
3. Understand and act on the variety in duty cycles
4. Drivers are attracted to regional haul
5. Return to base is ideal for electric trucks
6. Growth in Regional Haul is Good

Run On Less Data Benefits

- Run on Less Regional data analysis: [RoLR final report](#)
- NREL/NACFE Report: [Battery Electric Powertrains](#)
- Ballard/NACFE Report: [Hydrogen Fuel Cell Trucks in Regional Haul](#)
- Free [downloadable data set](#)



Getting to Know Each Other

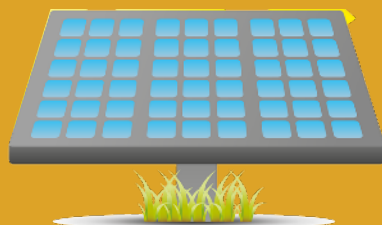
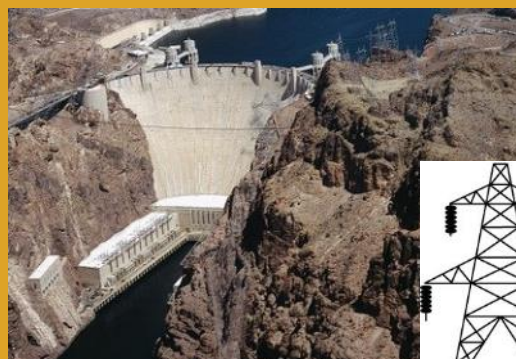
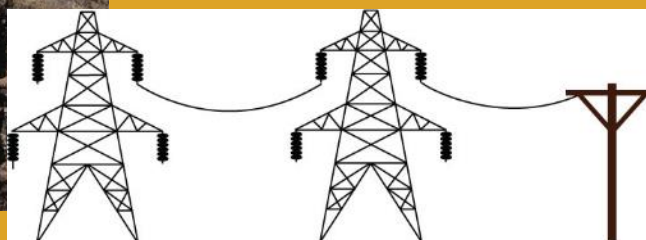
FLEETS



Primer:
UTILITIES
on
FLEETS



Primer:
FLEETS
on
UTILITIES



UTILITIES



June 2021

Wave Of Changes Coming



A collection of terms related to the trucking industry's future, arranged in a curved, wave-like pattern. The terms include: Covid-19, Autonomous Vehicles, Driver Retirement, Electrification, IMO 2020, Hours Of Service, 2 Truck Platooning, GreenHouse Gas Phase 2, Alternative Fuels, Solar, Cameras, Lightweighting, Parking Shortage, Aerodynamics, Artificial Intelligence, Driver Retention, Blockchain, and BIG DATA.

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