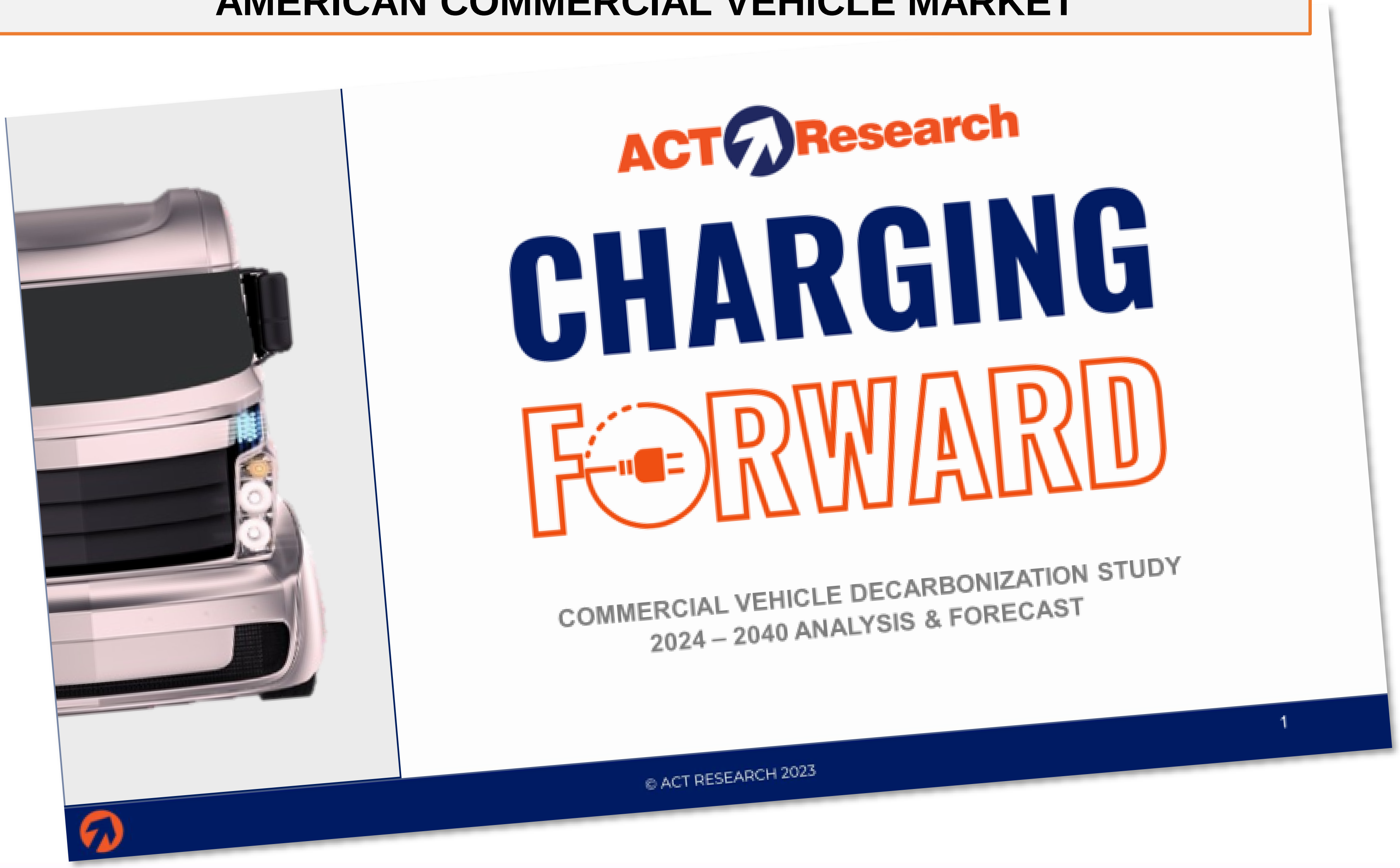
LEADER IN COMMERCIAL VEHICLE INDUSTRY DATA, MARKET ANALYSIS, & FORECASTING SERVICES FOR THE NORTH AMERICAN COMMERCIAL VEHICLE MARKET

1986
FOUNDED

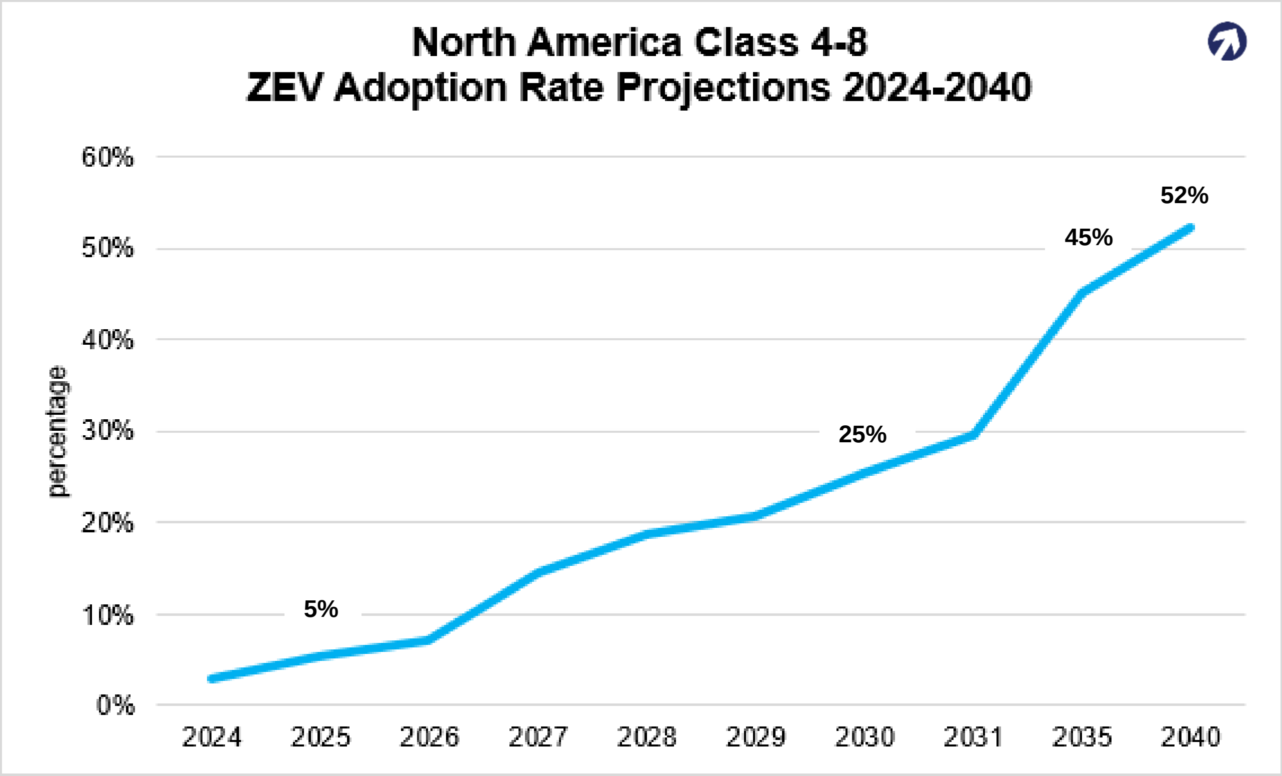
18
MO./QTR. REPORTS

2
SEMINARS/YEAR

50+
SPEAKING/YEAR



North America ZEV Adoption



Source: ACT Research Co. Copyright 2023

- **Regulations** exert greatest influence in early years, especially in Heavy-duty applications
- **BEV & FCEV** costs continue to decrease over time, while diesel powertrains increase over time thanks to low NOx regulations
- **Technology gains far exceed regulatory influences** for increasingly favorable TCO
- By **2035-2040** technology advances have greatest influences, combined with some regional ZEV mandates to push adoption rates **past 50%**

What is Driving CV Decarbonization?

MARKET PUSH

REGULATORY

- Low-NOx
- GHG/CO2
- ZEV Mandates
- Funding & Incentives

TECHNOLOGY

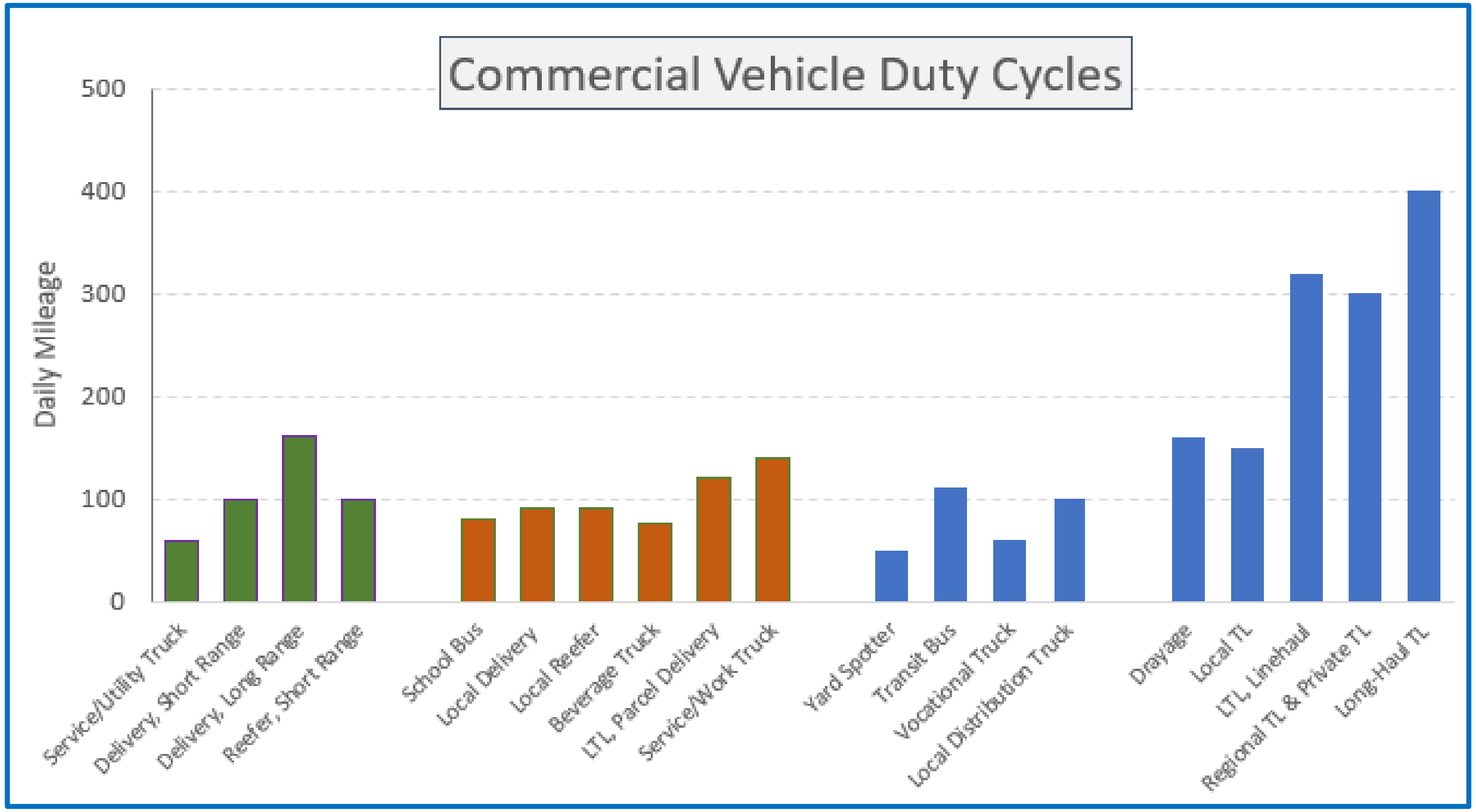
- Battery Energy Density
- Battery Costs
- Fast Charging Capability
- Fuel Cell Developments

MARKET PULL

FLEETS / CONSUMERS

- Net Zero Goals
- ESG – Corporate Sustainability Goals

Commercial Vehicle Duty Cycles

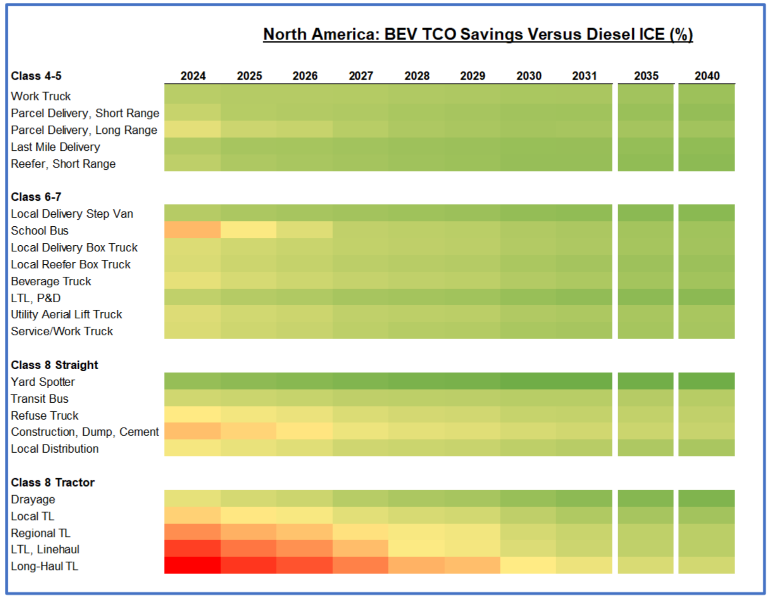


CLASS 4/5

CLASS 6/7

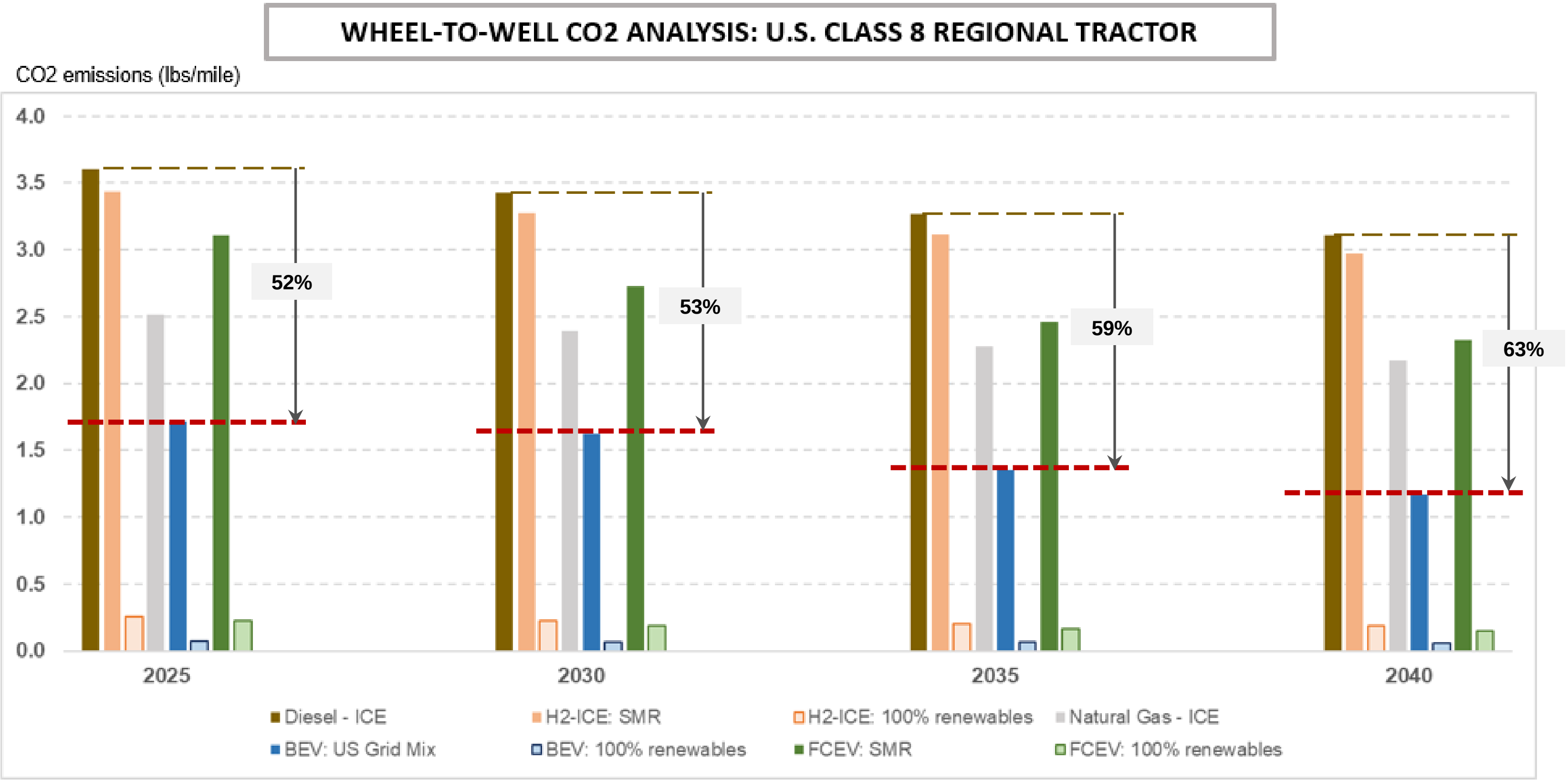
CLASS 8 STRAIGHT

CLASS 8 TRACTORS



Propulsion Systems Carbon Intensity

- ✓ BEV provides lowest CO2 emissions with average US Grid
- ✓ BEV provides lowest CO2 emissions using renewables for H2 & Electricity



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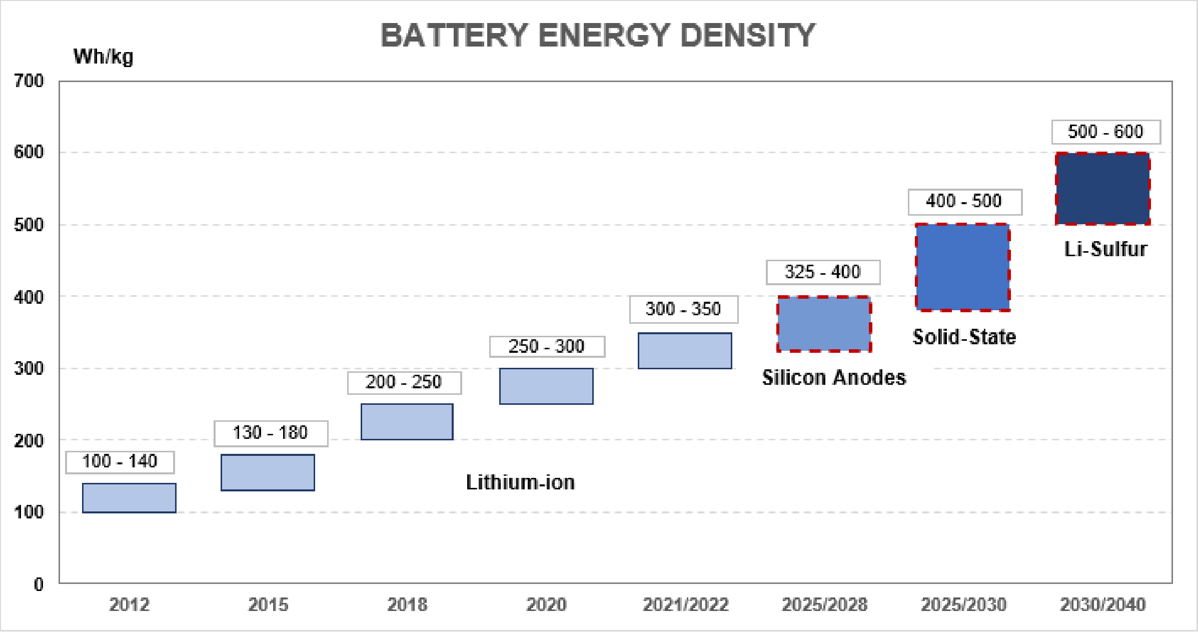
Technology: Battery Improvements

Advancements in battery energy density continue to improve:
- ✓ Silicon-rich anodes should be a viable technology by 2025/28
- ✓ Solid State continues to advance towards commercialization
- ✓ Li-Sulfur should commercialize sooner than anticipated

Long-term downward cost trend impacted by:
- ✓ Increased volumes provide manufacturing cost reductions “Wright’s Law”
- ✓ Improved energy density yields decreased material costs
- ✓ Technology shifts to lower cost chemistries



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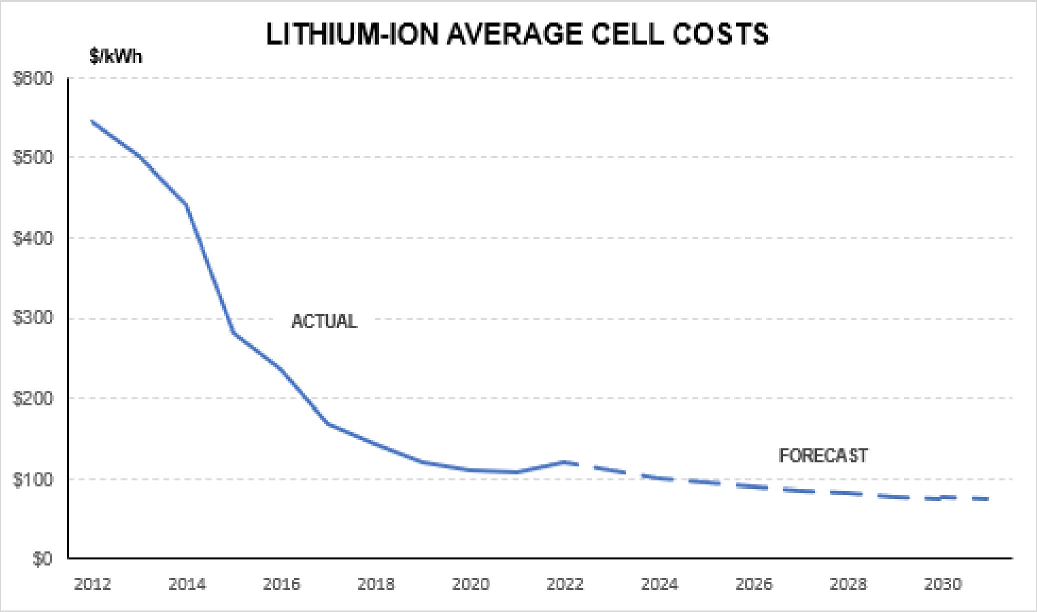

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CV Decarbonization Conclusions

- Diesel isn't going away, but **favorable TCO will drive EV adoption**
- Medium Duty & some local Heavy Duty applications provide favorable economics … optimum early adopters
- **Regulations provide significant influence** in setting adoption rates during this decade … particularly for higher GVW applications
- EV & H2 **Infrastructure build-out challenge/constrain adoption**
- **Battery Technology continues to improve**, enhancing BEV adoption
- **Fuel-cell Technology development faces challenges**
- **CV Decarbonization is happening** and growing … the future continues to draw ever more near …

THANK YOU!!

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