WHITE PAPER

TAKING COMMERCIAL FLEET ELECTRIFICATION TO SCALE:
FINANCING BARRIERS AND SOLUTIONS

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Proenergy Consulting LLC

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CALSTART is the nation's leading clean transportation nonprofit organization, working nationally and internationally with businesses and governments to develop clean, efficient, and equitable transportation and mobility solutions. CALSTART is a solutions network that connects companies and government agencies and helps them do their jobs better. From technology firms to transit operators and from vehicle manufacturers to research institutions, we connect every element of the clean energy sector, offering customized services, information and programming. CALSTART's 270+ member firms and agencies include vehicle fleets, manufacturers, suppliers, technology firms, alternative fuel providers, electric utilities, government agencies, academic institutions, non-governmental organizations (NGOs), financial institutions and other businesses interested in the future of sustainable transportation.

ACKNOWLEDGMENTS

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Robert Gurman is Managing Consultant of Proenergy Consulting LLC, with a focus on vehicle electrification/clean mobility from a variety of perspectives. In addition to his work for CALSTART, he is a consultant and financial advisor to a commercial fleet charging infrastructure/ EV finance developer, establishing a nationwide US footprint in the commercial electric transit sector. For a major US investment bank, Mr. Gurman wrote a White Paper on commercial EV fleet electrification in the United States, as well as a Business Plan for their eventual entrée into the EV financing market in the US and Europe.

On behalf of NY Green Bank, Mr. Gurman developed an extensive marketing program, covering EV stakeholders from OEMs, charging infrastructure developers, fleet operators, technology suppliers, and capital & financing sources, etc.; and additionally worked on developing NYGB's financing structures, and co-wrote its EV industry presentation. On behalf of the US Department of Energy's Loan Programs Office, he is advising on business models being pursued in transportation electrification (e.g., vehicle/ component manufacturing, vehicle/battery leasing, charging infrastructure) and the financial products that could be provided to support these through LPO programs. Mr. Gurman is also the commercial consultant to NYSERDA in its Clean Transportation Roadmap initiative. Within the growing NY State electrification market, interface includes all commercial participants, as well as cover the range of government instrumentalities, including constant dialogue with NYSERDA's Clean Transportation Team, and numerous other NYS, regional and NYC agencies, as is reflected in the article he authored for Environmental Law in New York, published in Dec 2019.

More generally, Mr. Gurman is an experienced commercial & finance professional in the clean energy, renewable energy, and project & infrastructure finance space, having closed over $28 billion of transactions in his 30+ year career. In addition to electrification, additional areas of expertise are solar, storage & microgrids, energy efficiency for real estate, conventional electric generation, and the emerging US offshore wind sector. He serves as Chairman of the Utility Debt Securitization Authority, an appointee of NY State Governor Andrew M. Cuomo, for the securitization of $5 billion of debt of Long Island Power Authority; and is a co-founder, and on the Investment Committee, of Newmarket Capital-International Infrastructure Finance Company Funds (approx. $1.2 billion combined). Mr. Gurman is the Transportation Electrification Advisor for the Build Edison consulting firm, and teaches project & infrastructure finance for Standard & Poor's Global Market Intelligence, and has also taught and lectured at Johns Hopkins – SAIS (adjunct professor), Columbia University Business School, and New York University.

LIST OF ACRONYMS

ACT	California's Advanced Clean Trucks regulation
ATVM	US DOE LPO's Advanced Technology Vehicles Manufacturing loan program
BNEF	Bloomberg New Energy Finance
CaaS	Charging-as-a-Service
CARB	California Air Resources Board
CEC	California Energy Commission
CEV	commercial electric vehicle
CFO	Chief Financial Officer
CHE	Cargo Handling Equipment
CLCPA	New York State Climate Leadership and Community Protection Act
CLEEN	California Lending for Energy and Environmental Needs
CO2	Carbon Dioxide
CPUC	California Public Utilities Commission
DEEP	CT Department of Energy and Environmental Protection
DER	distributed energy resources
DERA	The Diesel Emission Reduction Act
DOE	US Department of Energy
DPGe	Dollar per gallon-equivalent
EaaS	Electrification-as-a-Service
EDF	Environmental Defense Fund
EPA	US Environmental Protection Agency
EPIC	Electric Program Investment Charge
ESG	Environmental, Social and Governance investing
EV	electric vehicle
FinCo	finance company
FLPP	First Loss Protection Provider

LIST OF ACRONYMS

FTA	Federal Transit Administration
GHG	greenhouse gas emissions
GSE	ground service equipment
IaaS	Infrastructure-as-a-Service
IBank	The California Infrastructure and Economic Development Bank
ICE	internal combustion engine
ICT	California's Innovative Clean Transit regulation
IPO	initial public offering
IRR	internal rate of return
LCFS	Low carbon fuel standard
LMI	low-to-medium income demographic category
LP	Limited Partner
LPO	US DOE's Loan Programs Office
MHD	medium- and heavy-duty (vehicles)
M&A	Merger & Acquisition
NRDC	Natural Resources Defense Council
NCSL	National Conference of State Legislatures
NESCAUM	Northeast States for Coordinated Air Use Management
NGA	National Governors Association
NGDV	next-generation delivery vehicles
NGO	non-governmental organization
NOx	nitrogen oxides
NYCCTP	New York City Clean Trucks Program
NYGB	NY Green Bank
NYSERDA	NY State Energy Research and Development Authority
NYS PSC	NY State Public Service Commission

LIST OF ACRONYMS

NYTVIP	NY Truck Voucher Incentive Program
OEM	original equipment manufacturer
PANYNJ	Port Authority of New York and New Jersey
PG&E	Pacific Gas & Electric
PIPE	private investment in a public equity
PPA	power purchase agreement
PM2.5	small particulate matter
RFP	request for proposal(s)
RGGI	Regional Greenhouse Gas Initiative
RV	residual value
SB	Senate Bill
SCE	Southern California Edison
SDG&E	San Diego Gas and Electric
SME	small-to-medium size enterprises
SPAC	special purpose acquisition corp.
3PL	third party logistics provider
TCE	total cost of electrification
TCI-P	Transportation and Climate Initiative Program
TCO	total cost of ownership
USPS	United States Postal Service
VC	venture capital
V2G	vehicle to grid
VW	Volkswagen AG
ZE/ZEV	zero emission technology or vehicle
ZEB	zero-emission bus
ZECV	zero emission commercial vehicle

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I

I. INTRODUCTION

A. BACKGROUND

Commercial vehicles have a disproportionate impact on energy consumption, climate, and air pollutant emissions. Globally, gas and diesel trucks and buses currently represent about 4 percent of the on-road fleet but contribute to 36 percent of on-road fuel consumption and GHG emissions, and emit over 70 percent of on-road nitrogen oxides (NOx) emissions and 60 percent of PM2.5 emissions, resulting in air pollution and negative human health impacts.[1] Thus commercial fleet electrification can lead to substantial energy, climate, and health benefits.

Recent research has indicated that electric-drive technologies for trucks can reduce lifecycle carbon dioxide (CO_2) emissions by more than 60 percent for hydrogen trucks and more than 70 percent for electric trucks, with even higher savings as the share of renewables for hydrogen and electricity production increases.[2] Previous research has also highlighted the health impacts from vehicle noise,[3] indicating another health benefit from quieter, zero-emission commercial vehicles (ZECVs).

Directly addressing the transportation sector's importance in reducing GHGs and the disproportionate human health toll of diesel emissions from trucks and buses on overburdened communities, CALSTART's Global Commercial Vehicle Drive to Zero™ Program (Drive to Zero) aims to accelerate commercialization of zero- and near-zero-emission commercial vehicles (ZECVs) in key regions globally.[4] Drive to Zero's core objectives are for ZE technology to become commercially viable and cost-competitive in first-success applications (e.g., transit buses and urban last-mile delivery) in early-mover regions by 2025, and for ZE technology to dominate sales of new commercial vehicles across segments in leading regions by 2040.

1 Welch, D., Façanha, C., Kroon, R., Weken, H., and Bruil, D. (2020). CALSTART & FIER Automotive & Mobility. Moving Zero-Emission Freight Toward Commercialization. Retrieved from: https://globaldrivetozero.org/publication/moving-zero-emission-freight-toward-commercialization

2 Moultak M., Lutsey N., Hall D. (2017). International Council on Clean Transportation. Transitioning to Zero-Emission Heavy-Duty Freight Vehicles. Retrieved from https://theicct.org/sites/default/files/publications/Zero-emission-freight-trucks_ICCT-white-paper_26092017_vF.pdf

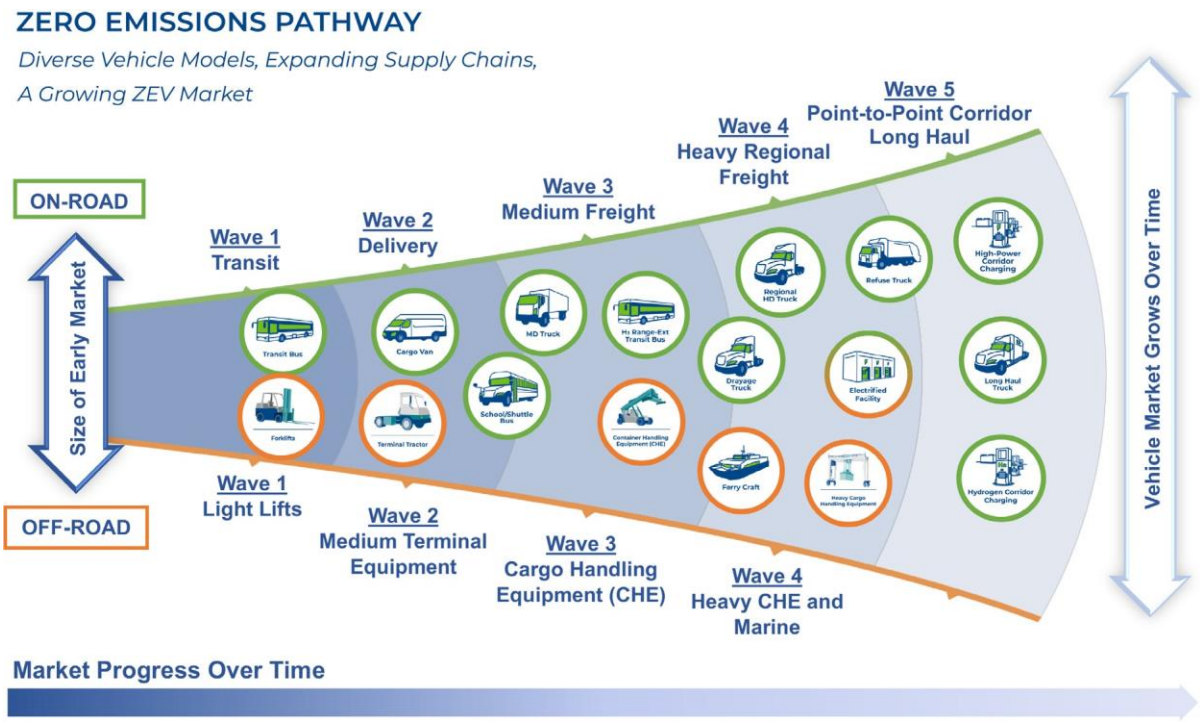
3 European Environmental Agency (2020). Environmental Noise in Europe – 2020. Retrieved from https://www.eea.europa.eu/publications/environmental-noise-in-europe

4 CALSTART (2020). Global Commercial Vehicle Drive to Zero Campaign. Retrieved from: https://globaldrivetozero.org

Drive to Zero is built upon a technological theory of change called the "Beachhead Model"—a strategy that identifies the commercial vehicle market segments where zero- and near-zero technologies are most likely to succeed and help drive growth in other segments by cultivating the emergence of localized supply chains and harnessing inherent transferability in supply chain components across vehicle platform types.[5]

Some applications are more conducive to ZE technologies today–such as transit buses and urban delivery vans–owing to their short duty cycles, fixed-route service, and back-to-base operation, and as such are first-to-market for ZE solutions. Because many of the components used in such vehicles are essentially the same as in larger trucks and other ZECVs (e.g., battery-electric powertrain components, power electronics, etc.), investing in these nascent markets will lay the foundation for faster economies of scale as technology matures so it can be more viably implemented in heavier vehicles that drive over longer distances.

Figure 1. Drive to Zero's beachhead commercialization strategy for zero-emission commercial vehicles



Drive to Zero is undertaking activities to accelerate ZECV adoption throughout the United States, as well as working with partner fleets, manufacturers, suppliers, governments and agencies in Canada, China, Chile, Finland, Germany, Japan, Netherlands, Norway and Sweden, with additional regions to join in the coming years. As CALSTART works with global partners through the Drive to Zero platform to

5 Welch, D. (2020). CALSTART. The Beachhead Model: Catalyzing Mass Market Opportunities for Zero-Emission Commercial Vehicles. Retrieved from: https://globaldrivetozero.org/public/The_Beachhead_Model.pdf

bridge demand and supply for commercial fleet electrification solutions,[6] the need to mobilize large sums of capital appears time and again as a central barrier to ZECV deployment at scale. In conjunction with technological and commercial advancements as well as public policy support, the availability of capital to finance a ZECV transformation is a prerequisite and interacts in profound ways with the other necessary ingredients.

Accordingly, this white paper, "Taking Commercial Fleet Electrification to Scale: Financing Barriers and Solutions," seeks to enhance transparency on the state-of-play for solutions to activate capital that can facilitate ZECV deployments and enable fleets to convert their vehicles on a scalable basis toward ZE technologies. The purpose of this white paper is therefore threefold:

1. to assess the current state of the financing markets, across all types of capital providers, in terms of their interest and engagement with, and actual investment in, commercial fleet electrification;
2. to identify key barriers to such financings; and
3. to outline emerging financial, commercial and technology solutions, as well as public policy recommendations, to overcome such barriers and to accelerate the ZE commercial vehicle transformation.

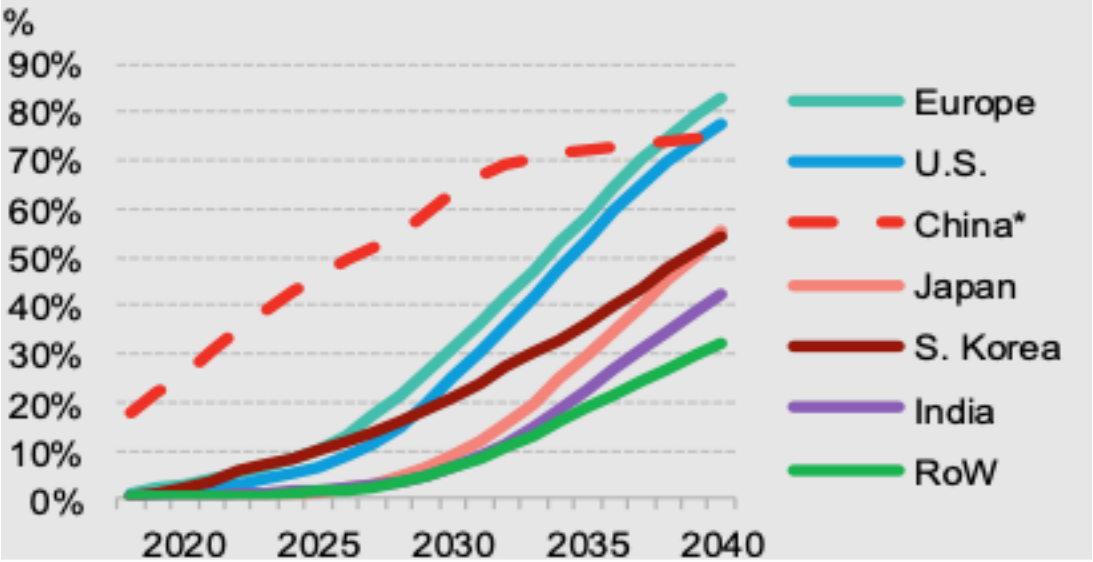
B. DRIVERS OF COMMERCIAL ELECTRIFICATION

1. INDUSTRY ADVANCES

There are numerous factors contributing to the acceleration of electrification in the commercial transportation sector and, based upon these factors, Bloomberg New Energy Finance (BNEF) predicts significant growth in ZE market share across categories of commercial vehicles (light, medium- and heavy-duty) and, in particular, electric municipal buses. Globally, adoption of electric transit buses to this point has been dominated by China, but quick gains are projected for Europe and the United States over the coming decade, per BNEF (see Figure 2).

6 For the purposes of this white paper, commercial fleet electrification is defined as any vehicle, available in a zero-emission model (battery electric or hydrogen fuel cell), that will be deployed for commercial, as opposed to private or individual consumer, purposes.

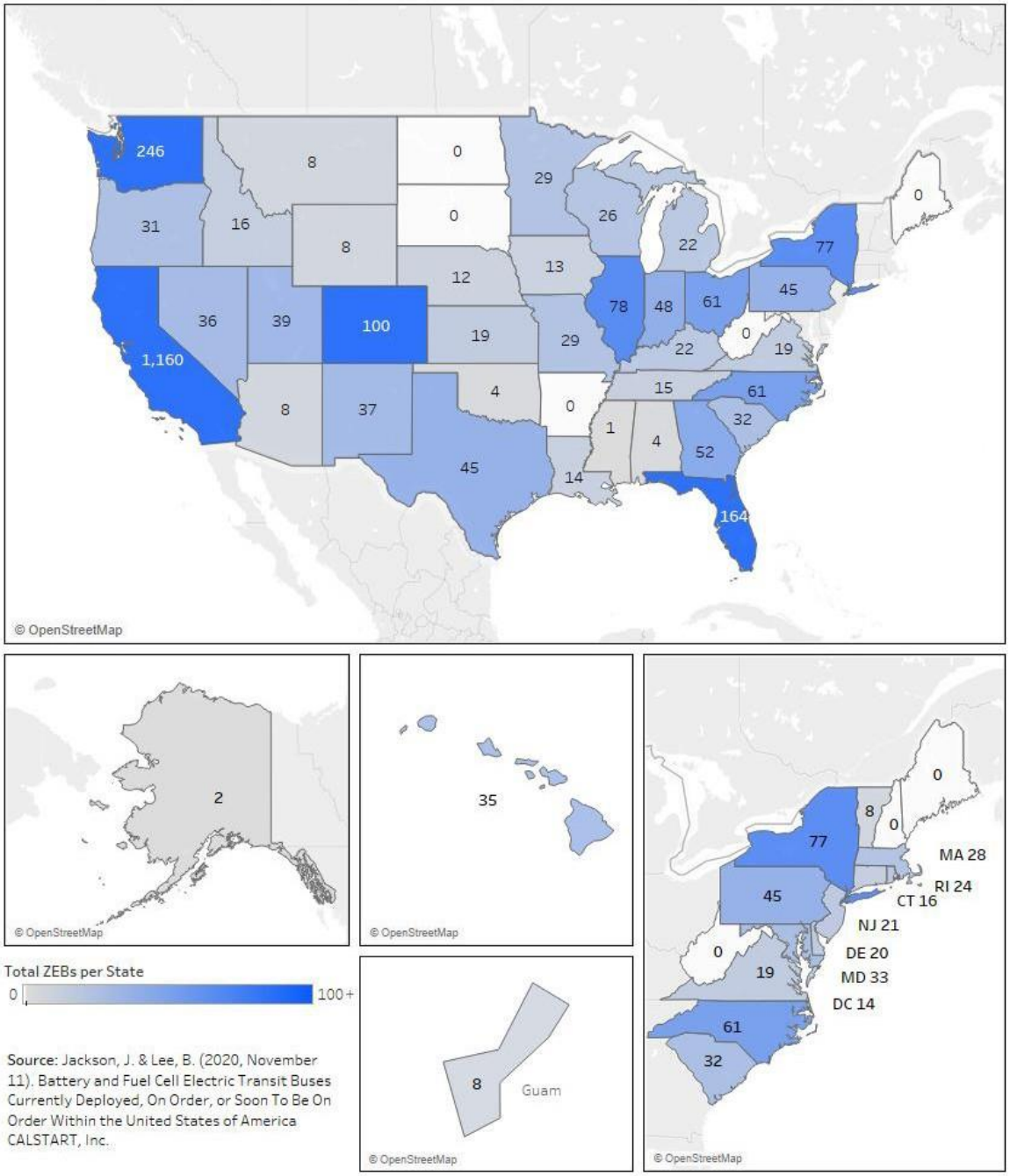
Figure 2. EV share of global bus fleet (BNEF Electric Vehicle Outlook 2020, Figure 189)



While still at relatively modest levels of market penetration in the US, zero-emission transit buses are taking root quickly, driven by a combination of policy commitments by governors or transit boards and robust funding from the Federal Transit Administration (FTA) and individual states' Volkswagen Settlement programs. As of December 2020, CALSTART tallies 255 agencies nationwide with 1015 zero-emission buses active and another 1775 expected shortly for a total of 2790 zero-emission buses nationwide.[7]

7 Jackson, J., Lee, B., and Silver, F. (2020). CALSTART. Zeroing in on ZEBs 2020 Edition – The Advanced Technology Transit Bus Index: A North American ZEB Inventory Report. Retrieved from: https://calstart.org/zeroing-in-on-zebs-2020-edition

Figure 3. Battery and fuel cell electric transit buses currently deployed, on order, or soon to be on order within the United States (CALSTART 2020)

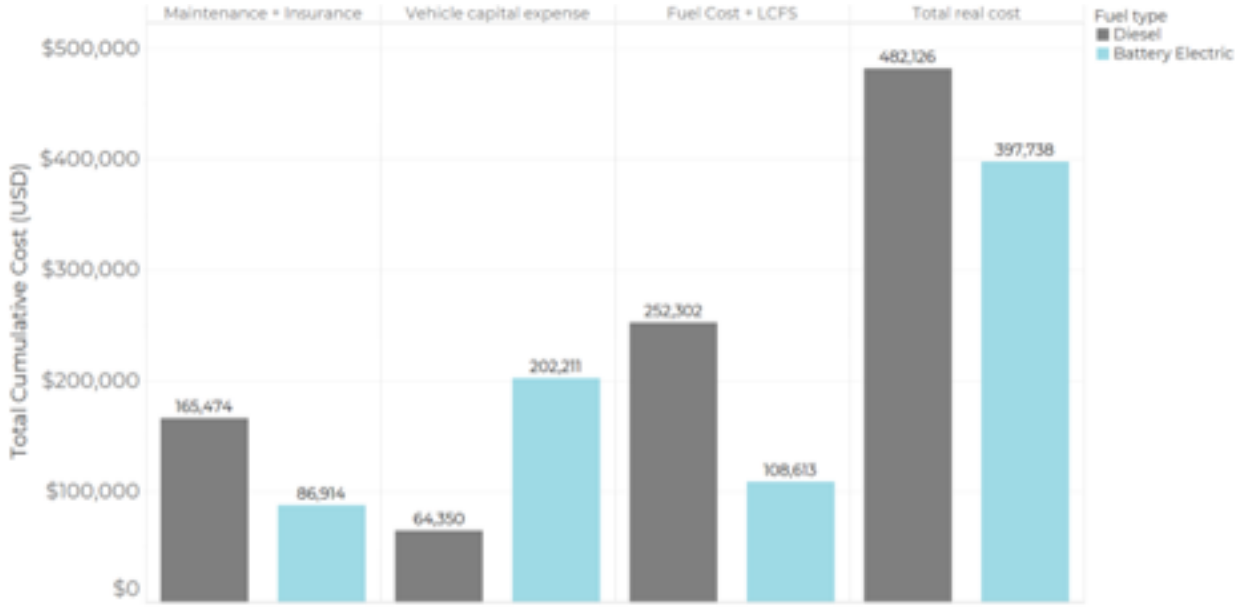


The market drivers of commercial electrification include, but are not limited to:

- Economics: In certain duty cycles, for certain categories of commercial electric vehicles, total cost of ownership (TCO) is already beneficial for electric vs. diesel vehicles in spite of the upfront cost premium associated with ZE vehicles. This tangible life-cycle advantage is

attractive to corporate Chief Financial Officers (CFOs), and others in corporate management, in evaluating whether to switch to an electric fleet. Facilitating the assessment is a growing array of analytical tools, such as CALSTART's Total Cost of Ownership Estimator (see Figure 4).[8]

Figure 4. Sample output from CALSTART's TCO Estimator for a high-mileage Class 6 BEV delivery truck compared to diesel (120 miles/day, 312 days/year, 12 years in service, no purchase incentives or LCFS credits) (CALSTART HVIP TCO Estimator).



According to BNEF, "The rapidly declining cost of batteries opens up electrification opportunities in some segments of the trucking market, starting within a year or two. In urban duty cycles, battery electric delivery vans and trucks become the cheapest option from 2021-22 in [light commercial vehicles]… Theuptakeofelectrificationforcityandsuburbanapplicationswillbedominatedbybattery electric vehicles and will create a market for almost 4.8 million light-duty commercial EVs by 2040."[9]

More broadly, BNEF predicts that for medium-size electric vehicles, TCO will be lower than comparable internal combustion engine (ICE) vehicles, at a crossover point of approximately $0.45/mile, by 2025 in the US.[10] It should be noted, however, that EVs in virtually all categories have a higher upfront cost than comparable ICE models, which is an important barrier to commercial fleet electrification. From the purchaser's perspective, this is a challenging obstacle, made even more difficult when the added cost of associated charging infrastructure is factored into the front-end equation.

- Battery Advancements: Battery prices make up between 25% and 50% of an electric vehicle's cost, depending upon model, etc. Improvements in vehicle batteries will come from a combination of a

8 CALSTART (2020). Total Cost of Ownership Estimator. Retrieved from: https://globaldrivetozero.org/tools/calculator

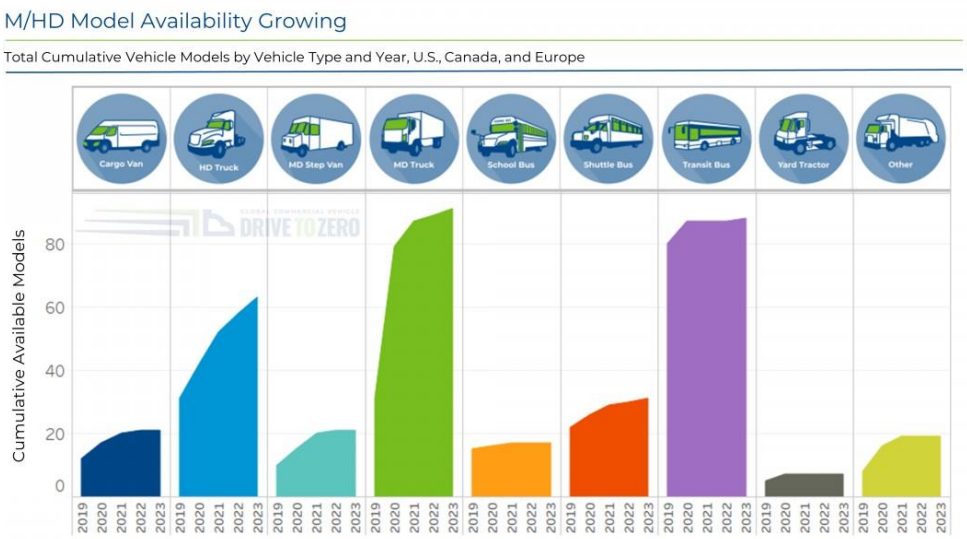
9 Bloomberg New Energy Finance (2020). Electric Vehicle Outlook 2020, pp. 61-62

10 Ibid, Figure 296

decrease in material prices and scrappage, along with increases in energy density and production volumes. This is projected to result in the cost of indicative battery packs dropping from $156/kWh in 2019 to around $100/kWh within three years.

- Model Availability: A complaint in the not-so-distant past was that there simply were not enough commercial electric models available to support widescale adoption of electric fleets. Consistent with the Beachhead Model, however, model availability for early-success ZE applications such as transit/school bus and medium-duty delivery formats is already robust and expanding rapidly, though model availability is still lacking for heavier applications and certain specific commercial and industrial applications (see Figure 5).

Figure 5. Commercially available ZECV models by vehicle platform from 2019-2023 in the US, Canada, and Europe



- Sustainability and Stewardship: In 2019, UPS collaborated with GreenBiz and released a study on commercial fleet electrification, "Curve Ahead: The Future of Fleet Electrification." Based upon a survey of companies with over $1 billion in sales, the study found that 83% of respondents said that sustainability and environmental goals were a prime motivator. An additional 30% indicated public relations and reputation as an additional driver.[11]

  There are programs directed specifically to the EV aspect of corporate sustainability efforts, such as the Ceres-led Corporate Electric Vehicle Alliance,[12] which will help member companies including Amazon, AT&T, Clif Bar, Consumers Energy, DHL, Direct Energy, Genentech, IKEA, LeasePlan, Lime,

11 UPS/GreenBiz (2018). Curve Ahead: The Future of Commercial Fleet Electrification. Retrieved from: https://sustainability.ups.com/media/UPS_GreenBiz_Whitepaper_v2.pdf

12 Shaheen, T. (2020). Ceres. Major companies join new alliance to accelerate transition to electric vehicles. Retrieved from: https://www.ceres.org/news-center/press-releases/major-companies-join-new-alliance-accelerate-transition-electric

and Siemens achieve bold commitments to fleet electrification; and the Climate Group's EV100 initiative,[13] which is a global initiative of more than 90 companies committed to accelerating the transition to EVs and making electric transport the new normal by 2030.

2. PUBLIC POLICY

Policy is one of the most critical drivers in vehicle electrification, particularly in the commercial sector, by creating better adoption conditions, and thus greater demand, for ZECVs. Various levels of government all play a role in accelerating demand for, and thereby reducing barriers to purchasing and operating, ZECVs. These policies are particularly relevant context for this paper because high upfront costs are a major barrier to electrification adoption, according to both fleet operators and electrification-as-a-service (EaaS) charging infrastructure developers. The policies highlighted here facilitate one or more aspects of electrification adoption, through establishing clear market signals, or providing financial assistance and/or incentives.

As an example of clear market signals, businesses are directly anticipating the impacts of government-mandated phase-outs of ICE vehicles within defined geographic areas: at the end of 2019, 44 national, regional or local government entities had issued ICE phase-out mandates.[14] Importantly, however, a majority of these mandates have been promulgated outside the US, namely in Europe, where the legal environment is more conducive to outright combustion bans, exclusion zones, low-emission zones, and the like.

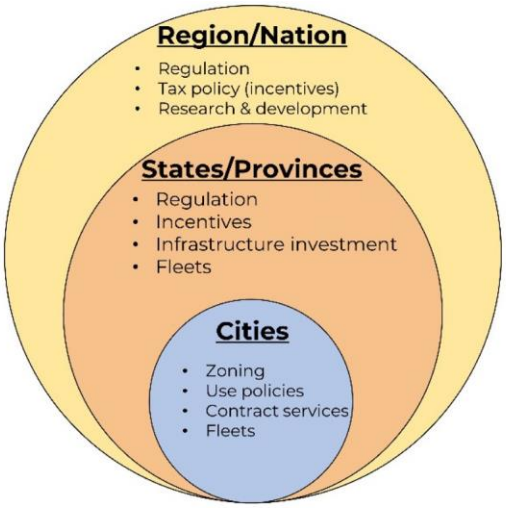


Figure 6. Policy interventions to catalyze ZECV adoption at various levels of government

Other policy-related drivers of fleet electrification are found at all levels of government in the form of current and prospective policies and programs.

A. LOCAL GOVERNMENT PROGRAMS

One of the most promising examples of a city-sponsored program for clean commercial vehicles is the New York City Clean Trucks Program (NYCCTP), launched in mid-2020.[15] NYCCTP aims to facilitate replacement of diesel trucks with cleaner alternatives, including ZECVs, for fleets domiciled in or operating near Industrial Business Zones within New York City. By dedicating funding to projects

13 The Climate Group (2020). Making Electric Transport the New Normal by 2030. Retrieved from: https://www.theclimategroup.org/ev100

14 Bloomberg New Energy Finance (2020). Electric Vehicle Outlook 2020, Figure 165. Retrieved from: https://bnef.turtl.co/story/evo-2020/page/1

15 NYC Department of Transportation (2021). NYC Clean Trucks Program. Retrieved from: https://www.nycctp.com

impacting communities housing truck depots, warehouses, and transportation hubs, this program aims to accelerate uptake of ZECVs to mitigate a major contributor of the dirtiest and unhealthiest air in New York City. NYCCTP offers generous point-of-sale vouchers toward the higher upfront costs of electric trucks, funded by VW Settlement money; however, with this funding comes a scrappage requirement for 2009 or older diesel trucks, which can restrict access to incentive funding for small fleets in particular.

While direct cash incentives represent one approach to accelerating fleet transition to ZECVs, regulation can provide another method—whether in conjunction with incentives or not. US cities have investigated implementing low-emission or zero-emission zones but generally lack the authority to do so without prompting federal preemption concerns.[16] An alternative to limiting access to specific areas of a city is to leverage the ability to ration access to specific facilities, namely port facilities. The Ports of Los Angeles and Long Beach, collectively the San Pedro Bay Ports and the busiest ports in the country, have developed a Clean Air Action Plan to pursue the Ports' goal of zero emissions by 2035, including a world-leading Clean Trucks Program that requires new drayage trucks to meet progressively more stringent emissions requirements until by 2035, when trucks will need to be zero-emission in order to avoid penalty.[17]

B. STATE PROGRAMS

California leads the United States in promoting the transition to electric vehicles, all across the product range from passenger cars to commercial trucks to specialized vehicles. California has incentivized ZEV purchases for many years and has also adopted ambitious vehicle regulations to galvanize markets toward zero-emission technologies from passenger cars to buses and, most recently, trucks. Under §177 of the Clean Air Act, fourteen other states have adopted elements of California's regulations in lieu of less stringent federal regulations, including 11 that have opted into a ZEV sales mandate for light-duty cars.[18] These, and potentially other, states will now consider adopting the medium and heavy duty (MHD) vehicle regulations California has enacted or is currently developing.

Regulations

On June 25, 2020, the California Air Resources Board (CARB) approved the Advanced Clean Trucks (ACT) regulation as "part of a holistic approach to accelerate a large-scale transition of zero-emission medium- and heavy-duty vehicles from Class 2b to Class 8." Most fundamentally, the regulation sets electric truck sales targets for manufacturers beginning with the 2024 model year, and by 2035, zero-emission truck sales need to be 55% of total class 2b-3 truck sales, 75% of class 4-8 straight truck sales, and 40% of tractor sales.[19]

In 2018, CARB adopted the Innovative Clean Transit rule, which sets zero-emission bus procurement

16 Turner, Amy (2020). Environmental Law Reporter, Forthcoming. Legal Tools for Achieving Low Traffic Zones (LTZs): LEZ, ULEZ & Congestion Pricing in the U.S. Law Context. Retrieved from: http://dx.doi.org/10.2139/ssrn.3534181

17 The Port of Long Beach and Port of Los Angeles (2017). San Pedro Bay Ports Clean Air Action Plan 2017. Retrieved from: https://kentico.portoflosangeles.org/getmedia/a2820d01-54f6-4f38-a3c5-81c228288b87/2017-Final-CAAP-Update

18 California Air Resources Board (2019). States that have Adopted California's Vehicle Standards under Section 177 of the Federal Clean Air Act. Retrieved from: https://ww2.arb.ca.gov/sites/default/files/2019-10/ca_177_states.pdf

19 California Air Resources Board (2020). Advanced Clean Trucks | California Air Resources Board. Retrieved from: https://ww2.arb.ca.gov/our-work/programs/advanced-clean-trucks

requirements for large and small transit districts, and essentially prohibited transit districts from purchasing diesel buses. A large transit agency would purchase zero-emission buses (ZEBs) according to the following schedule: Starting January 1, 2023, 25 percent of annual new bus purchases; starting January 1, 2026, 50 percent of annual new bus purchases; and starting January 1, 2029, 100 percent of annual new bus purchases. Smaller districts are on a somewhat slower timeframe to begin, but still must achieve 100% of purchases by 2029.[20] The impacts of this rule have already been quite notable, with more zero-emission buses now manufactured in California than any other state.[21]

Fifteen states and the District of Columbia have now signed a Memorandum of Understanding that articulates their intention to spur markets for ZE trucks and buses with a goal of achieving a 30% ZE sales share by 2030.[22] Northeast States for Coordinated Air Use Management (NESCAUM) will facilitate the development of an Action Plan for MHD ZEVs with these states during 2021, which will include recommended best practice actions to catalyze markets for MHD ZEVs and potentially include adoption of California's ACT and ICT regulations in addition to many of the other state actions captured below.

Grants and Incentives

In 2009, CARB, in partnership with CALSTART, launched the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP) to accelerate the adoption of cleaner, more-efficient trucks and buses. To date, HVIP has funded more than 1200 zero-emission trucks and buses, more than 700 of which (57%) have been deployed in disadvantaged communities.[23]

While California's incentive program is largely funded by the state's Greenhouse Gas Reduction Fund (cap-and-trade program), other states are looking to alternative revenue streams to accelerate adoption of ZECVs as one option to displace diesel emissions. In June 2016, the US Department of Justice issued a consent decree, settling claims against Volkswagen AG (VW) for fraud in emissions testing.[24] This resulted in $2.9 billion being set aside in an environmental mitigation trust to be disbursed to individual states for nitrogen oxide (NOx) emissions reduction programs, including promotion of vehicle electrification. Many states have dedicated their VW allocations exclusively to clean transit and/or school buses, and others have established competitive grant programs to disburse VW funds in tranches to projects that can best demonstrate cost-effective NOx mitigation. New York has used portions of its $127 million VW allocation to recapitalize the New York Truck Voucher Incentive Program (NYTVIP), which like California's HVIP provides point-of-sale voucher incentives to facilitate the purchase of all-electric and alternative-fuel trucks and buses. To date, NYTVIP has facilitated more than 600 vehicle replacements, including

20 California Air Resources Board (2020). Proposed Innovative Clean Transit Regulation, A Replacement Of The Fleet Rule For Transit Agencies. Retrieved from: https://ww3.arb.ca.gov/regact/2018/ict2018/ictuid.pdf

21 CALSTART internal research

22 Northeast States for Coordinated Air Management (2020). Multi-State Medium- and Heavy-Duty Zero Emission Vehicle Memorandum of Understanding. Retrieved from: https://www.nescaum.org/documents/multistate-truck-zev-governors-mou-20200714.pdf

23 CALSTART, California Air Resources Board, California Climate Investments (2020). California Hybrid and Zero-emission Truck and Bus Voucher Incentive Project. Retrieved from: https://www.californiahvip.org

24 VW Settlement Clearinghouse (2016). About the Settlement. Retrieved from: https://vwclearinghouse.org/about-the-settlement

more than 85 EV trucks or buses. Notably, because this program is funded with VW Settlement dollars, NYTVIP requires scrappage of a similar older diesel vehicle.[25]

Other states keen to accelerate markets for ZECVs are exploring regional carbon markets to fund new vehicle replacement programs. New Jersey, upon officially reentering the Regional Greenhouse Gas Initiative (RGGI) in 2020, has released a RGGI Strategic Funding Plan for 2020-2022 allocating 75% of its RGGI revenues toward "clean and equitable transportation," including MHD ZEV incentives.[26] Similarly, Massachusetts has taken initial steps in establishing an EV truck program using surplus RGGI funds.[27] The potential development of a cap-and-invest market through the Transportation and Climate Initiative Program (TCI-P) offers promise for billions in additional revenues that can help fund commercial vehicle replacement programs, among other transportation priorities, in the next decade.[28]

Clean Fuel Standards

California's Low Carbon Fuel Standard (LCFS), originally adopted in 2009 and most recently amended in 2018, reduces the carbon intensity of all fuels sold in the state. The LCFS program has diversified California's transportation fuel portfolio and reduced petroleum dependency, and is the single largest source of GHG reductions for the state, while also improving air quality. The program sets an annual carbon intensity standard, which is reduced over time. This standard has created a market in which fossil fuel providers are required to buy credits to cover their sales, and alternative fuel purchasers earn credits, which are then sold in the market, generating significant revenues for the lower carbon fuels. In this way, LCFS lets the market determine which mix of fuels will be used to reach the program's targets.[29] As discussed later, fleets earn credits by operating electric vehicles, which can then be turned into revenues, significantly improving the TCO for commercial EVs.

It should be noted that several other states are in some stage of study and/or adoption of an LCFS, including New York, Colorado, Minnesota, Washington and Michigan. The Oregon Clean Fuels program was launched by the Oregon Department of Environmental Quality in 2016, and was modeled on California's LCFS.

Infrastructure Programs

California's Senate Bill 350 (SB 350), passed in 2015, requires the California Public Utilities Commission (CPUC) to direct the state's six investor-owned electric utilities (IOUs) to file applications for programs

25 New York State Energy Research and Development Authority (2020). NY Truck Voucher Incentive Program Retrieved from: https://www.nyserda.ny.gov/All-Programs/Programs/Truck-Voucher-Program

26 New Jersey Regional Greenhouse Gas Initiative (2019). RGGI Strategic Funding Plan. Retrieved from: https://www.state.nj.us/rggi/docs/rggi-strategic-funding-plan.pdf

27 Massachusetts Department of Energy Resources (2020). MOR-EV Trucks Proposal. Retrieved from: https://www.mass.gov/doc/mor-ev-trucks-proposal/download

28 Connecticut, Massachusetts, Rhode Island, and the District of Columbia were the first signatories to the TCI-P Memorandum of Understanding on December 21, 2020: https://www.transportationandclimate.org/sites/default/files/TCI%20MOU%2012.2020.pdf

29 California Air Resources Board (2020). Low Carbon Fuel Standard. Retrieved from: https://ww2.arb.ca.gov/our-work/programs/low-carbon-fuel-standard

that "accelerate widespread transportation electrification." SB 350 recognized that transportation electrification was critical to the state's clean air and GHG reduction goals, and that the state's disadvantaged communities lacked equitable access charging and clean vehicles. As such, the CPUC ruled in 2016 that Southern California Edison (SCE), Pacific Gas & Electric (PG&E) and San Diego Gas & Electric (SDG&E) should file applications to promote widespread electrification, including for MHD vehicles specifically.[30]

Four years later, these processes have generally been accomplished through utility "applications" approved via CPUC proceedings. Each of the IOUs has filed, and had approved, a stand-alone make-ready program for MHD charging. In total, these programs will encompass nearly $700 million in make-ready investments to support commercial fleets, expected to support over 2,000 new make-ready installations that could serve nearly 20,000 MHD ZEVs statewide.

In July 2020, the New York State Public Service Commission (NYS PSC) issued an order authorizing $701 million in investment by the state's investor-owned utilities in electric vehicle supply equipment and charging infrastructure.[31] While the majority of this authorization is for EVSE installations that cater to light-duty passenger EVs, the order did contain promising commitments for commercial fleet electrification, including the following elements:

- A $15 million medium- and heavy-duty make-ready pilot to mitigate infrastructure costs for truck fleets in the process of securing electric truck incentives through either NYTVIP or NYCCTP;
- A $10 million transit electrification program that provides assistance to some of the state's largest transit providers to meet their bus electrification commitments from their local utility providers; and
- A $20 million Clean Medium- and Heavy-Duty Vehicle Innovation Prize to be administered by NYSERDA and designed to prove out innovative commercial electrification approaches that can be replicated at scale, including last mile delivery solutions. Proposals that benefit disadvantaged communities and environmentally burdened areas will be favored and prizes are expected to be awarded in early 2022.[32]

C. FEDERAL PROGRAMS

The outlook for federal policy in the US to support and accelerate vehicle electrification is improved by the results of the 2020 elections. The Biden administration has vowed to toughen fuel economy standards and take measures to incentivize accelerated adoption of electric vehicles and installation of charging stations, and to promote transit in large US cities with zero-emissions public transportation options. In addition, the new president's electrification-related plans also call for a "cash-for-clunkers"-type

30 California Public Utilities Commission. Rulemaking issued in OIR 13-11-007 on 9/14/16, "Regarding the Filing of Transportation Electrification Applications pursuant to SB 350"

31 State of New York Public Service Commission (2020). Case 18-E-0138. Order Establishing Electric Vehicle Infrastructure Make-Ready Program and Other Programs. Retrieved from: http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={6238DD07-3974-4C4E-9201-3E339E311916}

32 State of New York Public Service Commission (2020). Case 18-E-0138. Transportation Prizes Implementation Plan. Retrieved from http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={B0AD9C1B-1808-4C34-9E17-5F9DEB34215F}

program to offer incentives or rebates to replace gasoline/diesel-powered vehicles with electric vehicles; replacing the United States' government fleet with US-made electric vehicles to help spur demand; accelerating research on battery technology; and support for the development of domestic production capabilities.[33] Now with Democratic control of both the Senate (albeit with very narrow control) and House of Representatives, the Biden administration is expected to encounter easier passage of its bold clean energy and transportation agenda.

Regulations

Medium- and heavy-duty engine performance and GHG standards – so called "Phase 2" standards – are currently established for model years 2018-2027 for certain trailers and model years 2021-2027 for semi-trucks, large pickup trucks, vans, and all types and sizes of buses and work trucks. The timeline for post-Phase 2 standards, how these standards incorporate hybrid technologies and a greater focus on electrification, and how these standards address possible incentives within the regulatory structure are central issues facing the Biden administration's U.S. Environmental Protection Agency and the Department of Transportation's National Highway Traffic Safety Administration. How to address some of the Trump administration's rollbacks of parts of these standards, including regulators for glider vehicles, engines, and kits, will also be a part of the calculus for updating post-Phase 2 standards.[34]

In addition, the Biden administration's EPA is anticipated to advance rules on low-NOx, particulate matter, and other criteria pollutant regulations that had stalled under the Trump administration's Cleaner Truck Initiative in 2020.[35] Advancing aggressive and achievable standards for heavier on-highway commercial vehicles is an anticipated target of the administration's larger focus on equity and clean air in the transportation sector. How to harmonize federal low-NOx standards with similar California rules that have already been finalized also remains an open question.

As discussed above, with California and MOU-state movement on clean truck sales requirements, and with California's leadership on zero-emission bus procurement and potential ZECV fleet rules, the Biden administration will have to decide which of these mechanisms might serve as models for potential federal action. And whereas these new policies could be promulgated by executive action, interest from Congressional policymakers in particular in the California ACT rulemaking has shown that a growing political consensus around the view that the federal government can and should do more to regulate ICE medium- and heavy-duty vehicles, or promote ZECV sales outright, is increasingly widely held, and is ripe for further policy analysis and debate.

33 Biden-Harris Campaign (2020). The Biden Plan to Build a Modern, Sustainable Infrastructure and an Equitable Clean Energy Future. Retrieved from: https://joebiden.com/clean-energy

34 United States Environmental Protection Agency (2020). Regulations for Greenhouse Gas Emissions from Commercial Trucks and Buses. Retrieved from: https://www.epa.gov/regulations-emissions-vehicles-and-engines/regulations-greenhouse-gas-emissions-commercial-trucks

35 United States Environmental Protection Agency (2020). EPA Jumpstarts Cleaner Trucks Initiative. Retrieved from: https://www.epa.gov/newsreleases/epa-jumpstarts-cleaner-trucks-initiative

Grants and Incentives

Unlike the light-duty EV market, there is currently no federal incentive for ZECVs. Several tax incentives, including both production- and purchase-side credits, have been proposed or introduced in legislation, but none of these proposals have yet become law. Direct pay, or cash in-lieu of, tax incentives at the federal level have an opportunity to build on the experience of clean commercial vehicle voucher programs administered by states. The prospect of budget reconciliation—through which tax mechanisms and other policies that directly impact revenues or outlays can be advanced—in the 117th Congress provides one potential political avenue to enacting meaningful new policies that would be favorable to ZECV purchases or production.

Other federal programs subject to five-year surface transportation reauthorization, annual appropriations, or in some cases both, have become important catalysts for electrification or decarbonization of commercial fleets. For example, the FTA's Low or No-Emission (Low-No) Bus Program has provided hundreds of millions of dollars in recent years (with a high of $130 million for Fiscal Year 2019) in grants for predominantly zero-emission bus technologies for eligible transit agencies nationwide.[36] The Diesel Emission Reduction Act (DERA) program administered by the Environmental Protection Agency provides loans, grants, and rebates to projects that use certified engine configurations and verified technologies, or that develop and commercialize emerging technologies, in order to replace legacy diesel engines. A popular school bus rebate within DERA is also typically oversubscribed by a factor of 35:1, demonstrating that it is a promising tool for replacement of legacy commercial vehicles.[37]

The US federal government has provided loans for vehicle manufacturers and incentives for certain types of clean vehicles for many years, and in particular for transit fleets, these have gone a long way in helping public fleets afford the significantly higher up-front cost of zero-emission vehicles. For example, the US Department of Energy's Loan Programs Office (LPO) finances projects along the battery supply chain or involved in the manufacture of zero-emission vehicles, through LPO's Advanced Technology Vehicles Manufacturing (ATVM) loan program.[38]

3. ESG AND IMPACT INVESTING

Many institutional investors, banks, fund managers, etc. have publicly committed to putting ESG (Environmental, Social and Governance) at the forefront of their financing activities, which means prioritizing these three factors into their evaluation of investment decisions. Fund managers state that their LPs (Limited Partners, or investors) are demanding more attention to this as a key criterion.

For many firms, impact investing is core to their investment thesis, and they want to be out front of this trend for branding, marketing, and fund-raising purposes. Some managers are launching funds specifically for

36 United States Federal Transit Administration (2020). Fiscal Year 2019 Low or No-Emission (Low-No) Bus Program Projects. Retrieved from: https://www.transit.dot.gov/funding/grants/fiscal-year-2019-low-or-no-emission-low-no-bus-program-projects

37 Congressional Research Service (2021). The Diesel Emissions Reduction Act (DERA) Program. Retrieved from: https://crsreports.congress.gov/product/pdf/IF/IF11331

38 US Department of Energy, Loan Programs Office (2020). Advanced Technology Vehicles Manufacturing Loan Program. Retrieved from: https://www.energy.gov/sites/prod/files/2020/01/f70/DOE-LPO-ATVM-Jan2020.pdf

such mandates: for example, Ares Management is launching Ares Climate Infrastructure Partners, which will make investments aimed at cutting greenhouse-gas emissions and promoting better use of natural resources; EnCap Investments' Energy Transition team is raising capital that is focused specifically on investment opportunities from dramatic cost reductions in clean energy technologies that are driving transformation in the energy sector. Other funds, which had traditionally invested across the entire energy supply chain, including oil and gas and midstream assets, are raising new funds with zero oil and gas and an overweight toward sustainable and ESG-type of investments. Commercial banks, depending upon their home country's regulatory regime, have specific ESG targets, lending protocols, and performance targets.

In January 2020, Larry Fink, CEO of BlackRock, which has approximately $7.8 trillion assets under management, published his 2020 letter to CEOs, with the headline emphasis on climate risk, and stating that BlackRock was "putting sustainability at the center of how we invest."[39] Mr. Fink's 2021 letter, published recently, expanded on this and stated, "We know that climate risk is investment risk. But we also believe the climate transition presents a historic investment opportunity."[40] For industrial firms, there is an effort to show decarbonization of their energy portfolio, either through acquisition of renewable electricity as a production input, more sustainable manufacturing processes, or cleaner transportation and delivery services.

In parallel with the growth of ESG and impact investing has been the advent and accelerated growth of "green" types of financing, most notably green bonds (defined, generally, as fixed-income instruments specifically earmarked for clean energy or environmental-related projects). These have applications for projects in energy, transport, water, real estate (both energy efficiency and sustainability improvements, and new construction), and other infrastructure. According to BNEF, global green bond issuance rose 78% in 2019 to $465 billion, broke a monthly record for issuance with more than $50 billion of green bonds issued in September 2020, and cumulative issuance of sustainable debt reached $1.17 trillion.[41]

C. METHODOLOGY

From July through October 2020, confidential interviews were conducted with more than 80 market participants, which included finance professionals representing all layers of the capital stack and investment lifecycle, from venture capital investors to institutional senior debt providers, and many other types of capital providers in between; as well as numerous interviews with industry stakeholders such as original equipment manufacturers (OEMs) and charging station providers. The purpose of these interviews was to gauge the views of electrification market practitioners on availability of finance. It was not surprising to learn, in addition, of the various policy-relevant recommendations that many of the interviewees served up. Their policy ideas and observations, based on market-driven experience, have been incorporated herein, as and where relevant. The results of those interviews, plus extensive

39 Fink, L. (2021). BlackRock. Larry Fink's 2021 Letter to CEOs. Retrieved from: https://www.blackrock.com/corporate/investor-relations/larry-fink-ceo-letter

40 Ibid.

41 Bloomberg New Energy Finance (2020). Record Month Shoots Green Bonds Past Trillion Dollar Mark, Retrieved from: https://about.bnef.com/blog/record-month-shoots-green-bonds-past-trillion-dollar-mark

market outreach and research, have been distilled and consolidated into the substance of this report, and will demonstrate a broad and growing spectrum of financing solutions, options and providers.

II

II. ELEMENTS OF COMMERCIAL FLEET ELECTRIFICATION

A. ZERO EMISSION COMMERCIAL VEHICLES ("ZECVs")

The biggest components of the commercial vehicle electrification market are the vehicles themselves, as well as the expanding supply chain. This is a dynamic and fast-moving sector, with established gasoline and diesel manufacturers moving in with significant investments into electrification, as well as start-ups with new designs and approaches to vehicles "from the ground up." The biggest barrier to accelerated adoption of commercial electric vehicles at this stage is upfront cost: the price of an EV to a comparable ICE model can be 100% higher or more. Added to this is the associated upfront cost of charging infrastructure. As will be discussed in more detail in Section III, it is in the procurement and acquisition of commercial electric vehicle fleets where financing is needed most notably, and also where appreciable transaction size can be found.

Many OEMs are bringing ZECV products to market, but the technology and market readiness of these models vary widely. Zero-emission transit[42] and school buses have thousands of deployments around the country and world and have proven the viability of their technology in earlier prototyping and demonstrations. Last-mile delivery vans and trucks with battery electric powertrains are quickly approaching similar standing, as are low-mileage electric yard tractors. Heavier trucks used in drayage and longer-distance applications like regional and long-haul are not yet fully commercialized, but will be reaching increasing production volumes in coming years based on accelerating technology readiness and OEM model announcements.

Vehicle Categories: ZECVs fall into several broad categories, each mapping to a similar grouping as diesel commercial vehicles, including:

- Transit buses
- School buses
- Trucks (classes 3-8), including tractors, drayage, box trucks, step vans, straight trucks
- Shuttle buses and cargo vans (classes 2b-4)

42 Both battery electric and hydrogen fuel cell transit buses have been successfully deployed.

- Industry-specific / vocational equipment (e.g., waste hauling, utility bucket trucks, etc.)
- Airport ground service equipment (GSE), forklifts.
- Cargo-handling equipment (CHE) (i.e., yard/terminal tractors)

Numerous Stakeholders: The commercial EV segment has no lack of participants and innovation, and on a global scale, and this is a significant driver to increased model availability. These OEMs range from very familiar names in this sector to start-ups including companies specializing in ZE vehicles Section III covers how these OEMs are accessing capital and financing.

CALSTART has identified more than 200 ZECV models that are already commercially available, and projects that the number of commercially available ZECV models will nearly double by 2023 (see Figure 7). Many commercial vehicle applications show demonstrable fit with the model of fleet charging, especially as range increases with advances in heavy-duty battery pack technology. Tesla, Nikola and Hyundai, in particular, project significant jumps in range for heavy-duty trucks (both battery electric and fuel-cell electric) over the next 2-3 years (see Figure 8).

Figure 7. Number of commercially available ZECV models in the US, Canada, and Europe from 2019-2023

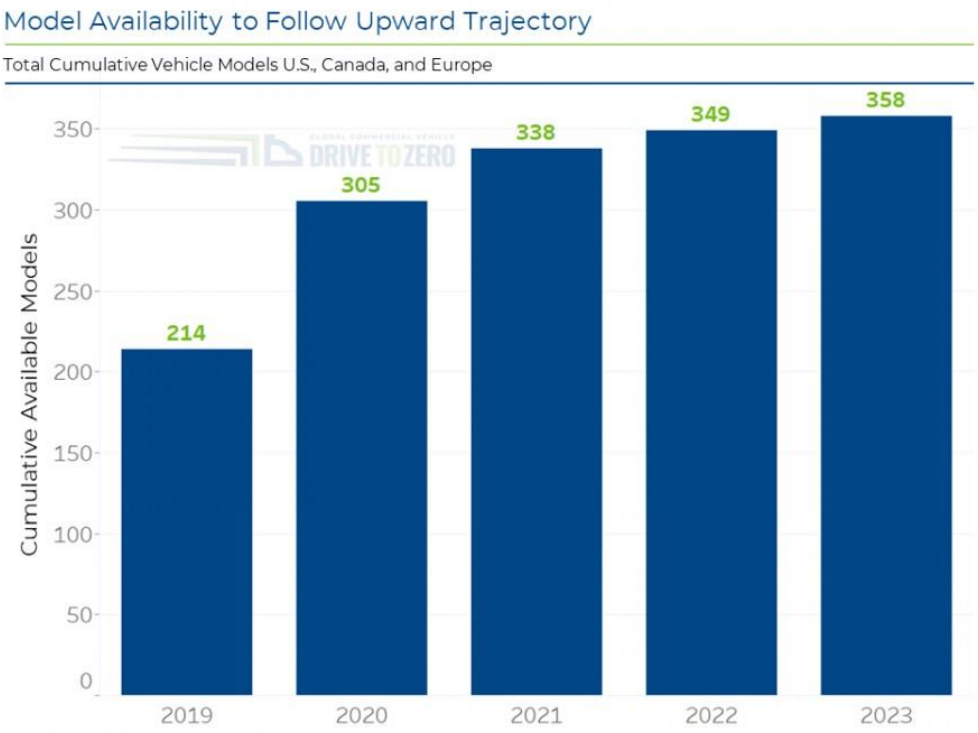
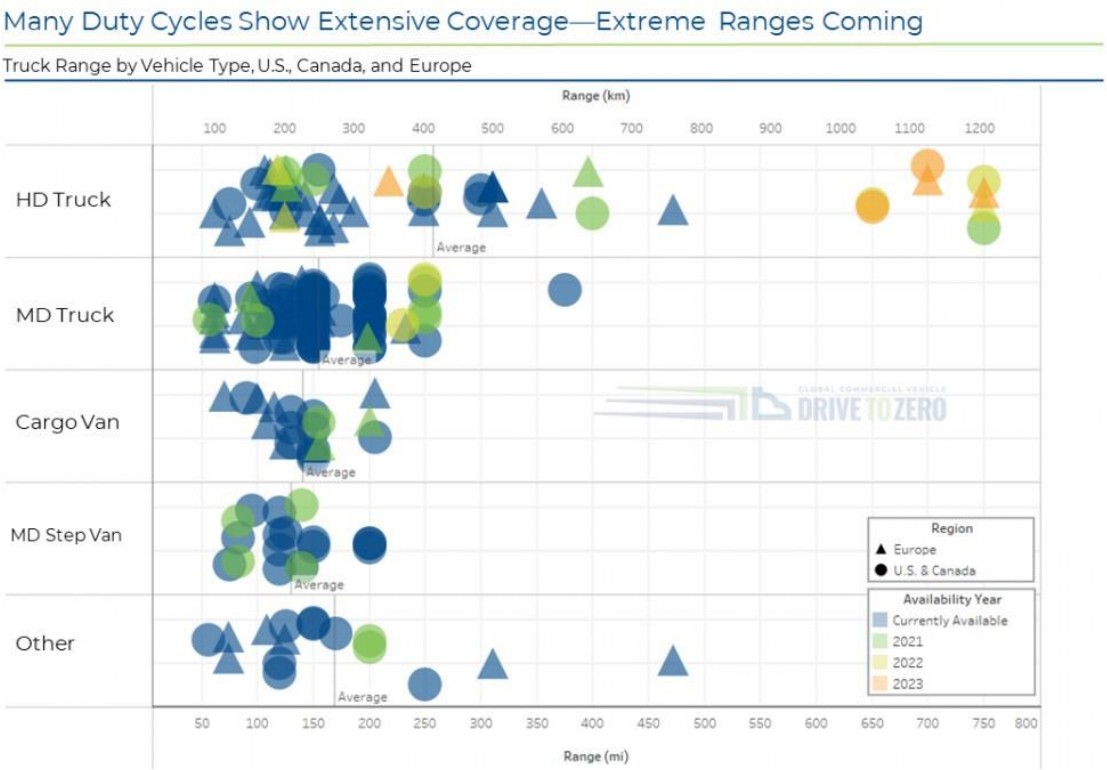


Figure 8. Driving range capabilities for commercially available ZECVs by platform type and year of availability



Expanding Supply Chain: In parallel with the expanding OEM universe is that of the supply chain, most notably battery and battery-pack providers, chassis and platform, electric motor and drive train, power electronics, etc. Again, we see a combination of established industry participants and new entrants: Cummins, BAE Systems, ABB, Panasonic, LG Chem, Romeo Systems, Flux Power, Spear, Pathion, and Proterra, to name a few. Greater demand from EV OEMs throughout the supply chain is serving to attract investment capital, ramp up production, and drive down costs. Previously mentioned was the anticipated reductions in battery costs; this will also be seen in all other parts of the supply chain.

The relationship between the light-duty and commercial supply chains provides opportunities to leverage systems and components, especially those related to energy storage. Many of the commercial EV (tracks and buses) manufacturers have successfully contracted with the same battery manufacturers that are supplying battery modules and packs to the passenger car OEMs. This area of energy storage is the main focal point since it is estimated that energy storage components comprise up to 80% of all the EV incremental costs when compared to ICE vehicles. That expanding supply chain for energy storage materials, components, and systems is expected to ultimately result in lower incremental costs and lower overall vehicle costs.

B. CHARGING INFRASTRUCTURE

There are two broad categories of charging infrastructure: public and commercial (private) charging.

Public Charging: This refers to charging stations placed in locations accessible by anyone who drives an electric vehicle. Leaving technology and compatibility issues aside, these stations are found in corners of public, hotel, mall or retailer parking lots, gas stations and highway rest stops, etc., and generally support the charging needs of passenger vehicles only. Sponsors or owners of these installations are typically EVSE owner-operators like EVgo and Electrify America, or customers of merchant EVSE providers such as ChargePoint, Greenlots, and EV Connect, which may include private site hosts or local distribution utilities. Tesla maintains its own proprietary "Supercharger" network across North America (as well as Asia, Europe and the Middle East), and Rivian is in the process of developing its own nationwide network of non-proprietary fast chargers to support sales of its own EV offerings.[43]

Public charging, at this stage of the passenger EV market's development, raises utilization risk in that most passenger EVs are charged at home, and public charging utilization patterns are sporadic at best. Therefore, some specific and credible stakeholder must step up for that risk to make it acceptable to any financing party, debt or equity (offset, where and when possible, with grants and incentives). While public charging is outside the scope of this White Paper, it provides useful context, plus many public charging operators are applying their skills and expertise to commercial fleet electrification.

Both utilization risk and the generally small size per public installation currently inhibit a more efficient, project finance-type of financing approach. However, innovative approaches such as GM and EVgo indicate that, in the future, it is possible to see a sponsor, with numerous public sites, seek to structure a "roll-up" into a capital-efficient project finance transaction. The GM-EVgo program aims to install more than 2,700 new fast-charging stations in urban areas over the next 5 years in support of the expansion of GM's EV lineup: "We know how important the charging ecosystem is for drivers, one that includes access to convenient and reliable public fast charging," said Mary Barra, GM's Chairman and CEO.[44]

To date, public charging for commercial fleets has been virtually non-existent. Market demand and utilization risk combine to be serious barriers, as well as charger placement. An additional complication of this latter factor is the higher infrastructure and interconnection requirements to support the more significant charging demands of the ZECV segment. This all adds up to higher up-front capital costs in the face of higher execution and revenue risks. As such, this is a feature of the commercial fleet electrification ecosystem that has yet to materialize. However, several "clean freight corridor" planning studies have been commissioned by federal agencies, electric utilities, and local planning organizations to enhance coordination and lay an analytical foundation for where high-speed truck-accessible charging can be

43 Korosec, K. (2020). TechCrunch. Rivian is Building its Own EV charging network, but with an Adventurous Twist. Retrieved from: https://techcrunch.com/2020/12/08/rivian-is-building-its-own-ev-charging-network-but-with-an-adventurous-twist

44 EVgo Fast Charging (2020). General Motors and EVgo Aim to Accelerate Widespread EV Adoption by Adding Fast Chargers Nationwide. Retrieved from: https://www.evgo.com/about/news/general-motors-and-evgo-aim-to-accelerate-widespread-ev-adoption-by-adding-fast-chargers-nationwide

strategically prioritized to support and catalyze the anticipated swell in ZECV uptake.[45 46 47]

Commercial Charging: This refers to dedicated charging infrastructure developed, installed and funded by a Sponsor, specifically for a particular commercial customer, such as at a depot, industrial location, distribution or warehouse facility. BNEF projects commercial charging connectors to grow to over 2 million by 2040,[48] with an investment of approximately $75 billion by that time.[49] Transaction size for charging infrastructure alone is a challenge (discussed in more detail for both debt and equity in Section III), as such investments are relatively small, between $0.5-10 million, which inhibits efficient financing.

In contrast to public charging, utilization risk is mitigated by the host or fleet operator's (the commercial customer) predictable and consistent fleet charging requirements. The reliability of fleets' charging behavior has supported the ability for new market participants to offer turnkey charging products, generally referred to as Charging-as-a-Service (CaaS). At its simplest, CaaS is a full-service charging approach that a sponsor provides to a fleet operator on a subscription/term basis. Based upon a detailed understanding of the operator's fleet, operations and charging requirements, the sponsor installs all charging equipment and infrastructure and provides the charging service to the fleet operator for a defined term (minimum 5 years, but preferably 7-10 years) and at a defined cost (usually fixed, plus annual escalator). The payment requirement is a direct obligation of the operator, who hopefully is of an investment grade credit; this creates a structure that is analogous to the renewable industry's power purchase agreement (PPA), and therefore financeable.

In certain locations and circumstances, a more expansive Infrastructure-as-a-Service (IaaS) is on offer. Under the IaaS model, in addition to the basic charging infrastructure, distributed energy resources (DER), such as solar panels and/or battery storage, are integrated. This adds to the capital budget, but provides potential benefits in terms of managing electricity costs and demand charges; increasing resiliency of the entire enterprise; and generating incremental revenue through vehicle-grid integration as well as demand response. The Volvo LIGHTS project in Southern California is a prominent example of turnkey installation of both charging infrastructure and various types of DER solutions by charging network provider Greenlots.[50] Still other providers offer an all-in Electrification-as-a-Service (EaaS) model, which includes electric vehicles, charging equipment and infrastructure, and possibly DER/microgrid integration.

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45 Gilde, A., Norris, J., Scott, C., Okazaki, K., and Gordon, J. (2020). CALSTART & West Coast Collaborative. Alternative Fuel Infrastructure Corridor Coalition (AFICC) Medium- And Heavy-Duty Alternative Fuel Infrastructure Strategic Development Plan. Retrieved from: https://westcoastcollaborative.org/files/sector-fuels/wcc-aficc-mhd-infrastructure-development-plan-2020-03-12.pdf

46 West Coast Clean Transit Corridor Initiative (2020). West Coast Clean Transit Corridor Initiative. Retrieved from: https://westcoastcleantransit.com

47 New York Metropolitan Transportation Council (2020). Clean Freight Corridors Planning Study: PFAC Introduction. Retrieved from: https://www.nymtc.org/Portals/0/Pdf/Presentations/PFAC%20presentations/PFAC%202020-06-04.pdf?ver=2020-06-11-131117-357

48 Bloomberg New Energy Finance (2020). Electric Vehicle Outlook 2020, Figure 26. Retrieved from: https://bnef.turtl.co/story/evo-2020/page/1

49 Ibid, Figure 277

50 Volvo (2020). Volvo LIGHTS HD BEV Demonstration Project. Retrieved from:https://www.lightsproject.com

The target private (commercial fleets and depots) markets include, but are not limited to:

- Ride share, taxi fleets, corporate
- Municipalities and other government agencies
- Logistics / last-mile delivery
- Campus (universities, corporate)
- Utilities
- Real estate portfolios
- School bus systems
- Public/municipal transit systems
- Airports, ports and terminals
- Industrial, warehouse and yard applications such as refuse collection and recycling, forklifts, drayage, etc.

Innovation is apparent in charging technology: in addition to the 'standard' pedestal and cable charge station, induction charging (sometimes referred to as wireless charging) is in pilot and/or active adoption by several US transit agencies. Likewise, overhead pantograph charging is increasingly favored as a way to automate high-speed charging for electric transit buses. This diversity of charging technologies and formats offers fleets a wider spectrum of technology options to minimize risk of operator error and maximize convenience and efficacy.

C. CHARGE MANAGEMENT

Charge management is a critical part of the charging infrastructure and vehicle electrification ecosystem, directly adjacent to the work of charging station manufacturers and infrastructure developers, OEMs, and independent analyst/consulting firms. It provides sophisticated fleet block analyses, which seeks to optimize the number of charging stations, thereby lowering capital costs; makes charging more efficient (algorithms that incorporate tariffs, demand charges, time-of-day use as well as vehicle idle time and scheduling); and reduces operating expenses, so the overall capital and operating approach is as efficient as possible. Some charge management stakeholders with more direct involvement in power markets see the opportunity to apply the commodity risk skill-set of electricity rates management to this part of the electrification ecosystem, as well.

While the charge management function or service is mostly seen as being provided by either independent firms with a specialization (and specialized, proprietary software) in this area, or an analogous function provided by the charging station manufacturer, certain large fuels management firms are developing this capability, as well. In this respect, it is as a hedge toward the future of vehicle transport from ICE to electric, rather than as an extension of expertise with the electric infrastructure itself.

Similar to the innovation seen in charging infrastructure, and building off of these developments, there is also innovation in charge management. Some examples include:

- Electric bus manufacturer and EVSE supplier Proterra recently announced a charging solution designed to enable the electrification of large-scale vehicle fleets. Developed in partnership with Power Electronics, this new service offers a customizable fleet charging solution that can be configured at a broad range of power levels, and utilizing interoperable, universal charging technology.[51]
- With a focus on Vehicle-to-Grid (V2G), Nuvve offers patented V2G technology that optimizes electric vehicle charging, facilitates "two-way" charging (from vehicle to the grid and vice versa), lowers the total cost of ownership for EVs, and supports the introduction of renewable energy sources such as wind and solar as an alternative to fossil fuel power plants.[52]
- Amply Power builds fully automated charging systems with real-time energy-flow management technology, optimized for lowest electricity cost, while delivering a per-electric-mile-driven EV charging service to fleets. Amply has developed the Dollar per Gallon-equivalent (DPGe) metric, which enables a direct comparison of electric costs for EVs to a gallon-of-gas equivalent. Amply's approach is scalable, enabling growth from a pilot project to full transition. [53]

51 Proterra (2020). "Proterra | Electric Vehicle Technology Manufacturer. Retrieved from: https://www.proterra.com

52 Nuvve (2020). Home-NUVVE Corp. Retrieved from: https://nuvve.com

53 AMPLY Power (2020). Fleet Charging Simplified. Retrieved from: https://www.amplypower.com

III

III. FINANCING LANDSCAPE FOR COMMERCIAL FLEET ELECTRIFICATION

The level of interest of the financial community in commercial fleet electrification is very high, not only because of the ESG factors mentioned in Section I.B.3 above. From commercial banks to equity investors, finance companies and venture capitalists, there are a number of additional factors at work here.

- Natural Adjacency: Commercial fleet electrification is seen as a natural adjacency to already-established franchises in renewable energy, clean energy, battery storage, etc.
- Rapidly Growing Market: Some financiers see that commercial adoption of electric vehicles will go faster than on the passenger side; its current positive growth path simply has yet to move into an accelerated mode. As such, it is seen as an emerging and distinct asset class.
- TCO/Positive Economics: The emphasis on the demonstrable TCO/economic case that can be seen in certain but increasing duty cycles, and which – as mentioned previously - makes fleet electrification attractive to the corporate CFO, is as well a very positive factor for investors and lenders.
- Extension of Transport Sector: Those financial institutions that are currently invested in the Transportation sector, either in financing gas and diesel vehicles or in infrastructure such as toll roads, ports and airports, also see it as an extension of – or the future of – their businesses.
- Integral to Combat Climate Change: All stakeholders in the transportation sector know of its significant contribution to pollution in general and GHG emissions in particular. Therefore, financiers (as well as many others) see commercial fleet electrification as a key category to be solved to successfully combat climate change and improve air quality, and thus embrace this sector's very clear fit within their ESG targets.

Despite these positive factors, there has been very little actual transaction execution from financial institutions – lenders, in particular, other than certain categories that will be discussed herein. The reason for this paucity of financing has to do primarily with the extensive range of risks in commercial fleet electrification, with very few obvious mitigants. Some of the many risks are described here.

- Residual Value: For conventional gas or diesel vehicles, of all types, the useful life is very well known as a result of literally millions of cars, trucks and buses on the road. Based on this deep well of documented performance, lenders and investors are very comfortable providing liquidity

and low-cost capital into this sector, and know with great confidence the value of the collateral that they can look to in the event of non-payment. The same cannot be said for electric vehicles in any category, and so efficient financing cannot be applied: financiers simply do not know the value of the vehicles over time, and that is an unacceptable risk. A corollary to this is fundamental operational risk, in that without that deep data base of on-road vehicles, it is risky making long-term projections of performance, wear-and-tear and degradation, repairs, replacements, etc., as well as all of the costs associated thereto.

- Technology: The pace of technological change is rapid in the EV sector overall. As a result, financiers see significant risk in obsolescence, fearing that they will end up with stranded or worthless assets that have been overtaken by tomorrow's better products.
- Utilization/Consumption: As mentioned previously, public charging infrastructure is difficult to finance because utilization, and therefore the charging revenue stream, is too unpredictable. That risk is mitigated in commercial charging facilities through the long-term service contract with the host depot or fleet operator.
- Program Implementation and Execution: The decision to electrify a commercial fleet is not just one of replacing diesel vehicles with comparable electric models, and then adding in chargers. Rather, it comes within a company-wide effort at transformation toward sustainability and carbon reduction. As such, an electrification program is evaluated within a company-wide context, from procurement processes, accounting systems, human resources, and organizational structure, and more. Therefore, from a financier's perspective, financing "only" charging infrastructure or "only" a company's new electric trucks effectively translates to taking on the risk of not only implementation of the electrification program, but successful transformation of the company itself.

A. FINANCING PARTIES

The financial community consists of many distinct subcategories of capital providers, each with its own range of target returns and general terms and conditions, as well as a distinct approach to risk tolerance and mitigation. Amongst those subgroups with an active interest in commercial fleet electrification are the following, described in greater detail below and summarized at a high level in Table 1.

Table 1. A comparison of relevant financing parties

TYPE OF INSTITUTION	FINANCIAL INSTRUMENT	TRANSACTION SIZE	RISK TOLERANCE	TARGET RETURN
Commercial Banks	Debt	● ● ●	●	●
FinCos	Debt	●	● ●	● ●
Green Banks	Debt	●	●	● ●
Green Bonds	Bonds	● ● ●	●	●
Microlenders	Debt	●	● ●	● ●
Equity Investors	Equity	● ● ●	● ● ●	● ●

KEY			
●	<$10 million	● Low	● LIBOR+200-300bp
● ●	$10-$50 million	● ● Moderate	● ● LIBOR+301-500bp
● ● ●	>$50 million	● ● ● Flexible	● ● ● >12% IRR

1. COMMERCIAL BANKS AND OTHER SENIOR LONG-TERM DEBT PROVIDERS

Commercial banks play an invaluable role in the financial ecosystem, in that they can leverage their customers' deposits to create liquidity at a very attractive interest rate for the general economy. However, because of their regulatory charter, banks do not take principal risk; this means that they provide liquidity into projects or to customers who have high credit quality and therefore display little risk that the bank will not get its principal back, over some observable period of time (while banks do not take principal risk, they do take term risk). Because of this low-risk approach, banks' cost of capital is relatively low, and so their potential inclusion into any EV financing brings the benefit of that low rate into the overall cost of capital.

As has been discussed, the entire vehicle electrification sector poses a range of risks, such that there is significant principal risk to a commercial lender. This does not mean that banks are not actively engaged in assessing the sector, including commercial fleet electrification in particular. However, for US-chartered commercial banks, including foreign banks operating under US banking licenses, any financing must include tangible forms of credit support that cut across all of the risks we have already discussed, including residual value, utilization/revenue, vehicle and charging infrastructure performance, and so on. Consequently, sponsor credit, track record, and role in any project are very important considerations.

Because banks do see EVs as an upcoming asset class, there is much internal effort to coordinate between the Project Finance units, who rely on heavily structured and contracted arrangements for non-recourse financing, and corporate bankers, who do balance sheet financing, to find financially viable solutions

around clean transportation. Both groups see the need for project sponsors and stakeholders to put more of their balance sheet at risk to support transactions (residual value being a key risk, among many); however, as some stakeholders are weak credits on their own, 3rd party credit support may also be necessary. Unfortunately, this gets away from creating the most cost-effective capital stack.

Lenders do see this asset class as a potential opportunity to re-capture some premium credit margin. In this, they cite the earlier days of renewable (mostly wind and solar) projects, where there was the "newness" factor that justified higher credit spreads. As renewable projects proliferated and proved the viability and resiliency of the credit structure, more financing parties entered the sector and drove down credit spreads. Fleet electrification is hoped and expected to reach financeability soon, these lenders say, but will need to pay more robust credit spreads for the early transactions.

It does not appear that the traditional commercial bank vehicle lenders are particularly eager to dive into electrification finance: their ICE-based business is effectively de-risked and commoditized, which brings very efficient and low-cost financing. And for reasons already cited, financing electrification brings numerous risks, many of which – such as residual value - have yet to see efficient and financeable mitigants. In direct contrast to "first-mover advantage," it appears that this group will be happy to be the "third mover," once first movers innovate a financing model and second movers develop a track-record for this financing mold so they can more confidently participate.

Several European-based commercial banks, with project finance-type businesses both in the US and around the world, point to their participation in electrification projects, for example municipal bus transit systems, in other countries. However, there was effectively a government guaranty to the lenders, who therefore took none of project-specific risks (residual value, performance, ridership, etc.). As such, these were highly leveraged transactions, underwritten to very narrow debt service coverage ratios (range of 1.05-1.20X), and at very low credit spreads.

There is also the aspect of transaction size: banks are generally organized to underwrite relatively large transactions which, depending on the type of commercial bank, can range from $25 million to multiples of $100 million. Transactions that would combine the purchase of electric vehicles plus charging infrastructure, incorporating all of the tangible credit supports, have yet to reach such size and scale.

Senior lenders, in another approach to mitigating risk, would hope to see large industrial corporates with strategic interests in this sector playing a direct role, alongside the newer names of electric OEMs and charge infrastructure developers. For example, it was cited that lenders would take significant comfort in their underwriting process if industrials such as ABB, Schneider Electric, Engie, EnelX, Samsung, LG, etc. were equity investors in, and co-sponsors of, charge infrastructure projects or large electric vehicle procurements.

2. FINANCE COMPANIES ("FinCos")

These companies play an important part in the financing ecosystem, providing funding – albeit somewhat expensive – to companies (usually small-to-medium sized enterprises, or "SMEs") that do not

qualify for loans from large commercial banks. In fleet electrification, FinCos can provide a customized solution for industrial EVs (such as forklifts, yard equipment, etc.). Because of the risks, this is very "hands on" lending: credit spreads are quite robust for the FinCo, because the customer base usually does not have a published debt credit rating; likely in excess of 500 basis points. Debt coverages are tight, not higher than 1.20-1.25X. FinCo's utilize capital leases, which puts the asset on the borrower's books, so the FinCo takes no residual value risk. The FinCo maintains collateral protection through a security interest in the asset.

3. GREEN BANKS

Green Banks are quasi-public entities established to undertake smaller transactions aligned with states' clean energy agendas. These transactions often seek to facilitate business model development as clean energy sectors work to achieve commercial scale. However, Green Banks are not a monolith and the focus areas, investment objectives, and market strategies differ across the relatively scarce institutions in place today, some of which are described below.

NY Green Bank (NYGB): NYGB is an agency of New York State Energy Research and Development Authority (NYSERDA) and is organized along the lines of a commercial bank to make loans on market terms (and does not provide subsidized loans, grants or incentives), but with a NY State focus and a broad clean energy mandate. The bank has been actively engaged with electrification stakeholders, throughout the EV supply chain, including OEMs, as well as EV charging infrastructure developers, fleet operators, state electric utilities, and other strategic and financial investors and lenders.[54]

Based upon its extensive market outreach, NYGB has developed five financing frameworks, with the objective of supporting the State's overall goals to reduce GHG emissions from the transportation sector:

1. Financing OEM EV production costs
2. Financing OEM EV fleet lease arrangements
3. Financing customer EV fleet purchases
4. Financing OEM battery lease arrangements
5. Financing EV charging infrastructure

NYGB emphasizes, however, that it can be flexible within these frameworks and/or adopt additional approaches, as circumstances require.[55] One additional element of NYGB's approach bears mentioning, which is that the bank will invest the time to underwrite small projects, if it sees that there is potential for scalability. In this manner, NYGB is willing to demonstrate viability of electrification business models and financing structures, in order to show commercial lenders a path toward full-scale underwriting as

54 New York Green Bank, a Division of NYSERDA (2020). NY Green Bank. Retrieved from: https://greenbank.ny.gov

55 Gurman, R.O. (2019). Environmental Law in New York, Volume 30 No. 12. NY Green Bank Capital to Support New York State Vehicle Electrification. Retrieved from: https://greenbank.ny.gov/-/media/greenbanknew/files/news-2019-12-NYGB-New-York-Lead-Robert-Gurman.pdf

such financings grow and scale.

California's "IBank": The California Infrastructure and Economic Development Bank (IBank) was created in 1994 to provide low-cost financing to a wide range of infrastructure projects, which have included EV charging stations.[56] Within the IBank is the California Lending for Energy and Environmental Needs (CLEEN) program which includes, among other programs, lending for clean transportation projects across EVs, as well as hybrid electric vehicles and alternative fuel vehicles. Earlier this year, the Governor's Office of Business and Economic Development proposed establishing a new Climate Catalyst Revolving Loan Fund to provide low-interest loans across California's climate agenda, including zero-emission vehicles.[57]

Connecticut Green Bank: There are no specific EV financing programs at the CT Green Bank at this stage, although it is hoped that their rolling RFP for innovative capital solutions would prompt some EV-related submissions. Most of the activity driving electrification is at the state's agencies, developing programs for electrification over time, including, for example, the CT Department of Energy and Environmental Protection's (DEEP) Electric Vehicle Roadmap policy document, released in April 2020. The Roadmap is "a comprehensive strategy for accelerating the deployment of electric vehicles (EVs) through policies and regulatory tools addressing transportation equity, purchasing incentives, consumer education, charging infrastructure expansion, consumer protection, integration of EVs into the electric grid, utility investment, and utility rate design."[58]

4. GREEN BONDS

As mentioned previously, there has been spectacular growth in the issuance of "green" bonds. However, their usefulness for commercial fleet electrification is currently of limited value. This is because these debt instruments are typically marketed to investors seeking high-quality borrowers and credits (backed by the issuer's balance sheet or similar high-quality credit support instrument), and as such are issued in fairly large transactions. As already discussed, commercial fleet electrification transactions struggle both to create a high-quality credit structure, and are rarely of such a size as to qualify in the green bonds category.

5. MICROLENDERS

These funds are organized to advance any number of public and societal objectives by targeting smaller loans to smaller entities lacking access to some of the conventional lending institutions and credit

56 California Infrastructure and Economic Development Bank (2020). California Infrastructure and Economic Development Bank(IBANK). Retrieved from: https://ibank.ca.gov/

57 State of California (2019). Budget Change Proposal , Climate Catalyst Fund. Retrieved from: https://esd.dof.ca.gov/Documents/bcp/2021/FY2021_ORG0509_BCP3557.pdf

58 Connecticut Department of Energy and Environmental Conservation (2020). Electric Vehicle Roadmap for Connecticut. Retrieved from: http://www.dpuc.state.ct.us/DEEPEnergy.nsf/c6c6d525f7cdd1168525797d0047c5bf/f7ed4932eec438d0852585520001c81b/$FILE/EV%20Roadmap%20for%20Connecticut.pdf

facilities described above. Smaller truck fleets are characteristically capital-constrained and may lack the creditworthiness and transaction sizes required for other types of lending. Microlending may offer a more compatible solution for capital needs of small truck fleets, and indeed social and environmental justice imperatives are driving tremendous interest among microlenders in truck electrification.

For microlenders, financing barriers for ZECV projects that may be overcome by larger intermediaries pose a more difficult challenge. The higher upfront cost of ZECVs poses a significant barrier to loans for smaller truck fleets, as the potential for operational and maintenance savings over time to offset the upfront incremental cost is not yet sufficiently substantiated by an empirical track-record. Microlenders cannot easily add this extra amount to their loans, even if the borrower could cover a proportionate share of the added cost, because the lack of an established secondary market for electric trucks prevents determination of a clear residual value. This in turn inhibits a lender's ability to rely on the vehicle itself for collateral.

Further, the characteristic size of small truck fleets, frequently in the 2-10 vehicles range, makes charging infrastructure, as an added cost and operational adoption factor, simply prohibitive: small fleet operators, who have expressed difficulty in financing the delta between ICE and ZE vehicles, cannot access capital for yet the additional costs of charging infrastructure.

6. EQUITY INVESTORS

As opposed to lenders, investors seek cashflow and/or capital appreciation, but all based on taking direct risk in the success (or failure) of the enterprise after the lender has been paid. This category includes infrastructure funds, private equity funds, foundations and family offices, commercial investment arms of financial firms and/or strategic industrials, managers of large pools of capital on behalf of limited partners (LPs) such as pensions, insurance companies, etc.

Investors, like lenders, are extremely enthusiastic about the commercial fleet electrification sector, but see numerous obstacles:

- Transaction Size: Similar to commercial banks, many investors have very high minimums, which are not necessary compatible with the size of most ZECV transactions; there are not many transactions that exceed $50 million in total size. In contrast, several equity interviewees indicated their own investment would need to be at least $50-150 million (a few investors stated $1 billion as their minimum), with an implied total transaction size of 50-100% more.
    - Many investors indicated that the per-transaction minimum guideline could be relaxed to the $10-50 million range for attractive initial underwritings, if there was clear line of sight to future size and scale for additional capital deployment.
    - Other investors with very high minimums did acknowledge that the public relations value of doing an initial electrification deal—even of a relatively small ticket size—would receive a favorable internal response.
- Target Returns: Most respondents were understandably guarded or vague in this key area. Although

case-dependent, to the extent that transactions can be carefully structured and de-risked and demonstrate immediate and predictable cashflow, most equity investors seek transactions with a projected internal rate of return (IRR) of at least 8-9% on a pre-tax basis. The high end of target returns amongst equity interviewees was generally "high mid-teens," but this was still with only a measured level of revenue uncertainty. Investors also use a cash multiple metric, seeking an absolute return on invested cash in the range of 1.5-2.0X (somewhat dependent on investment hold period). Some investors look to achieve a significant premium on exit, through their direct contribution toward value enhancement over time. However, the pace of change—technology, performance, risks, markets, etc.—in such a rapidly evolving sector makes premium expectations themselves quite risky.

  - The emphasis on ESG and impact investing does not affect investors' yield targets, which are still a function of the risks, credit quality and structure of the transaction itself, separate from its "green" credentials.
  - Of note, one industry stakeholder does not see private equity and infrastructure funds as an appropriate source of capital for electrification because their cost of capital (as reflected in their target returns) is too high for the margins and free cash flow that this sector is able to generate at this stage in its development. This obstacle may be partly ameliorated when commercial banks start to finance projects, thereby bringing their lower cost of capital into the cost of capital calculation.

- Residual Value Risk: As opposed to commercial banks, equity investors appear to be willing to take a studied look at residual value risk. Equity takes more risk, in general, than lenders, and can be flexible in projecting how vehicle residual value may materialize in the future, despite the lack of tangible data that lenders require as part of their analysis across all potential risk factors. However, residual value would not be factored as a significant component of base-case return, but rather could be seen as enhancing upside potential.
- Contracted vs. Uncontracted (Merchant) Revenues: The level of contracted vs. uncontracted revenues is directly related to target returns. As such, commercial projects are highly attractive to developers, and will garner the lower range of target returns from investors, as the depot or fleet operator can provide a high level of certainty to revenues through a long-term service contract. While investors, similar to lenders, appreciate the cash flow certainty of contracted revenues, some investors will look to the merchant or non-contracted potential for additional revenues, subject to a detailed analysis of the underlying markets and other circumstances around such metrics and overall impact on both upside benefits as well as downside risk.
- Investors cited numerous additional risks, including:
  - Rapid pace of technological change makes long-term investment horizons more difficult to navigate;
  - Regulatory environments vary greatly across US jurisdictions, impeding scale;
  - Investors' exit timeframes don't always match the business model;
  - Identifying who "runs the show" between the developer, investor and a syndicate of investors

is always a fraught issue;

- Investors mostly prefer deploying capital into projects that have achieved operational status; limited funds may be invested at the development and construction stage as well, but only if the equity investor has strong confidence in the developer and has a clear line of sight to a robust, investable project pipeline; and
- Uncertainty as to how tax equity—such a prevalent capital source in renewable energy—will fit in commercial fleet electrification.

B. FINANCIAL PRODUCTS AND FINANCING FRAMEWORKS

Despite the lack of actual financings executed in support of commercial fleet electrification, lenders and investors cited the full range of financial products as being assessed for adaptability here. Among the more frequently cited products are the following:

1. CAPITAL LEASE

This product usually applies to an investment grade credit; 2-4% interest rate; 8-10 years term. Although government entities, such as municipal transit agencies and public school districts, traditionally purchase their vehicles through capital budgets (including via federal and state funding programs), financial pressures caused by the coronavirus pandemic have led many to consider new procurements via a capital lease, thereby converting that upfront capital outlay into annual operating expense via a capital lease and third-party financing. This is an attractive approach for the lender, not only because the counterparty is of good credit quality, but also because the lease is fully amortizing, and therefore the purchaser takes the residual value risk.

2. OPERATING LEASE

In this case, the financing party takes some risk; i.e., a well-established residual value for most ICE models (passenger, commercial, service/trucks, etc.). As previously mentioned, there is no depth of data for residual value of EVs of any kind, so OEMs or the fleet sponsor must step up for this risk, which only transfers that risk quantum—from the lender's perspective—to a potentially less favorable credit (given the universe of EV-only OEMs). Some investors are considering EV-related operating leases under highly structured terms and conditions and taking a calculated risk on residual value; others will not touch it.

3. BATTERY COST AND DISCRETE FINANCING

From a financing perspective, the cost and residual value of the battery is a big part of the equation. As previously mentioned, the battery alone accounts for 25-50% of an electric vehicle's cost, although the prices of batteries are expected to continue their rapid decline. Electric bus manufacturer Proterra

has partnered with Mitsui USA to develop a financing product specifically for the battery component of electric transit buses,[59] and others are seeking to replicate this approach. The objective is to remove the battery packs from the upfront cost, thereby making the acquisition price tag roughly comparable with a diesel bus; repayment of the separate 12-year battery financing comes via operating and maintenance savings of the new electric bus over time. And, quite importantly, Proterra-Mitsui guaranty battery performance, including a mid-life replacement, and take the residual value risk on the battery, eliminating that concern from the bus owner and, potentially, any financing placed on the rest of the vehicle. From their side, Proterra has designed its battery packs for second-life utilization and efficient repurposing to future applications. Other OEMs and partners are evaluating similar financing approaches.

4. CHARGING/INFRASTRUCTURE/ELECTRIFICATION-AS-A-SERVICE

As previously mentioned, much effort is being invested in developing a financial product around dedicated commercial charging infrastructure, based on the CaaS business model that a sponsor (charging infrastructure developer) provides to a host (fleet operator). In a commercial fleet depot setting, this approach bears great promise for cost-effective financing because the fleet operator, assuming it is a credit-worthy entity, forms the basis for the financing decision. Its vehicle operations are predictable and consistent, and therefore so are its precise charging requirements. The sponsor (charging infrastructure developer) can design the infrastructure around the specific operations profile, and a well-defined capital budget developed for procurement and installation of that infrastructure. The expectation is that this will be a long-term (minimum 7 years) service arrangement, with mutually-agreed periodic payments calculated to cover the sponsor's operating expenses (charging costs, operation and maintenance costs, labor, etc.) and associated financing costs (principal, interest, and an appropriate equity return) involved for the infrastructure capital budget. Variations of the "as-a-service" model may feature infrastructure (IaaS), mileage, power, electrons, or even a full turnkey fleet electrification service package, including procurement and ownership of the vehicles themselves (EaaS) (Figure 9)

Longer term, there is anticipation for a shared commercial charging infrastructure model, whereby several commercial and/or municipal fleets develop protocols to share a common

"As-a-Service" Model Variants

Charging-as-a-Service (CaaS) is a turnkey EV charging offering in which a developer installs, owns, and maintains all charging equipment and infrastructure and provides the charging service to the fleet operator for a specified term and for a fixed fee. This eliminates the cost of charging infrastructure as a capital expense for a fleet, instead transferring it to a fleet's operating budget, which should have extra flexibility owing to reduced vehicle operating and maintenance costs. Services frequently bundled in a CaaS transaction include:

- EV charging infrastructure
- Fleet charge management software
- Utility bill management (e.g., demand charge management)

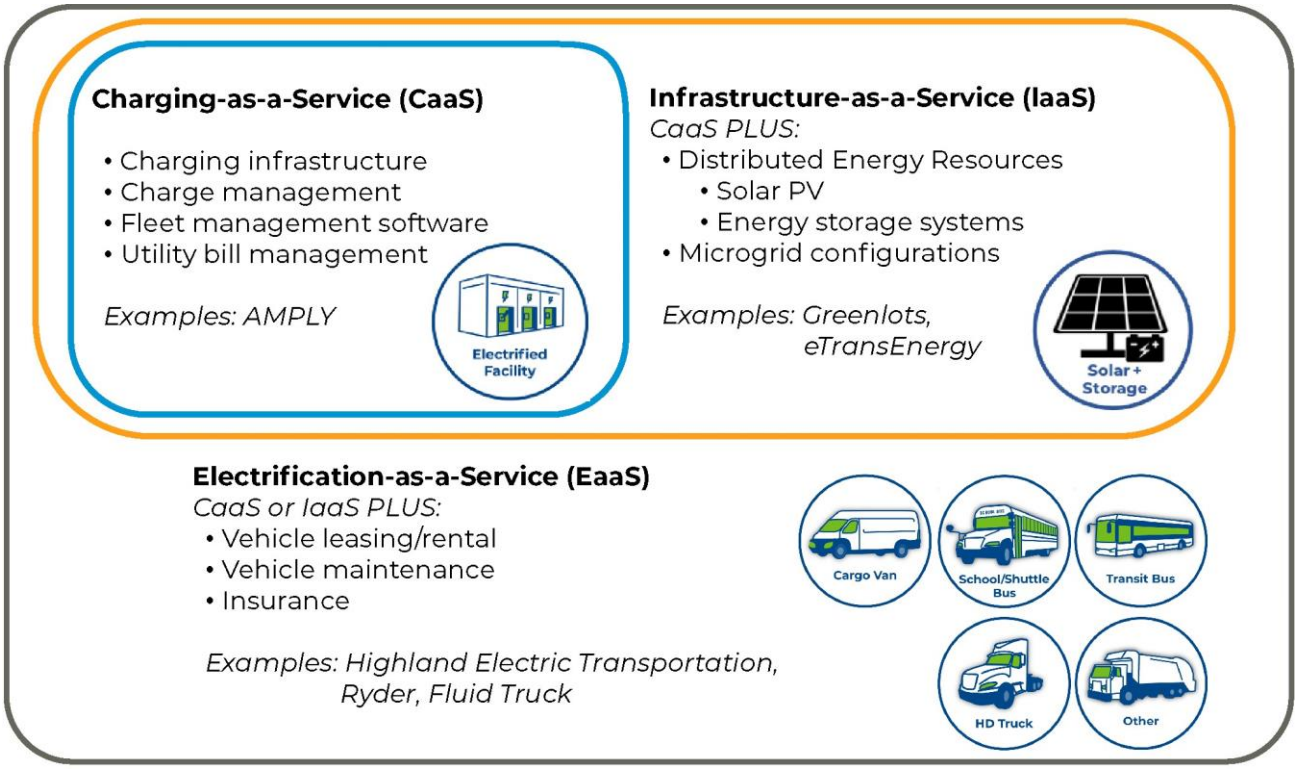
Infrastructure-as-a-Service (IaaS) encompasses the elements of CaaS with the addition of distributed energy resources, such as solar PV systems and/or stationary energy storage systems, and possibly configured as a microgrid to enhance energy resiliency.

Electrification-as-a-Service (EaaS) refers to a full-service arrangement that bundles electric vehicle procurement and operation into the same fixed-fee arrangement with charging infrastructure and potential additional energy infrastructure. This model resembles traditional vehicle leasing in many respects but with the addition of enabling infrastructure specific to an electric vehicle project.

59 Proterra (2019). Proterra And Mitsui & Co., Ltd. Create $200 Million Credit Facility To Scale Proterra Battery Leasing Program. Retrieved from: https://www.proterra.com/press-release/proterra-and-mitsui-co-ltd-create-200-million-credit-facility-to-scale-proterra-battery-leasing-program

infrastructure charging hub. This could also apply to infrastructure locations such as airports, marine ports, or terminals, each of which would feature several disparate EV fleets sharing a more cost-effective centralized charging infrastructure installation. This has the obvious advantage of driving higher utilization for a common depot investment; however numerous obstacles—including responsibility for operations and maintenance, and payment obligations—must be overcome before this is seen as a viable and financeable charging infrastructure model.

Figure 9. "As-a-Service" Model Descriptions and Relationships



Corporate Capital

In addition to the foregoing observations on financing products and frameworks for fleet electrification, corporate capital is increasingly being activated for various points along the vehicle electrification value chain. This capital generally assumes the form of corporate equity, mostly from public market investors, venture capital or strategic (industrial) investors.

- **SPACs and PIPEs**: A special purpose acquisition company (SPAC) is a company formed to raise capital through an initial public offering (IPO) for the purpose of acquiring another company sometime in the future; it has no business operations of its own. Simultaneously, and in order to raise the bulk of the capital, the investment banker/underwriter will commence with a private investment in a public equity (PIPE), which is the buying of shares of publicly traded stock – i.e., the SPAC. Large institutional investors, many of whom have active ESG and impact investing mandates and/or appetites, as well as interest in deploying large sums of capital as efficiently as possible, are attracted to SPACs/PIPEs.
    - SPACs and PIPEs have played prominently in recent EV-related capital raises, including Lordstown Motors, Workhorse, Hyliion, Nikola, Nuvve Corp., ChargePoint and Romeo Systems Inc.
    - Consistent with the ESG driver, public market institutional investors are playing a significant role in these financings: funds managed by the likes of BlackRock, Neuberger Berman, Fidelity Management, Baillie Gifford, Wellington Management Company, and Federated Hermes Kaufmann have been cited as taking part in several recent EV-related SPAC transactions.
    - OEMs are also participating directly in EV SPACs, such as General Motors' $75 million investment into the Lordstown Motors transaction.[a]
    - Romeo Systems, an EV battery technology developer, raised $384 million in a SPAC transaction announced on October 5, 2020. Beyond the significant interest of institutional investors were strategic partners including Borg Warner, Republic Services, and The Heritage Group.[b]
- **Venture Capital (VC) Investors:** This is early-stage investing, after a start-up has raised initial "friends and family" capital, but before institutional investors (e.g., strategic/industrial) get seriously involved. This is very high-risk/high-return capital, and traditional loan financings—at a reasonable cost of capital—do not play a part at this stage. In the electrification sector, VCs play more of a role on the technology and product development level, such as intellectual property, batteries, software, or electrification components. Their target companies are still developing their technology/product/manufacturing process. VC investors generally have an active interest or other investments in electrification or adjacent sectors, leveraging their technical expertise, industry knowledge, etc. Investors who have been interested in "Energy-as-a-Service" see electrification's CaaS as an adjacency, with more straightforward economics, and better investment security. VCs come in early, and then strategic investors (i.e., industry stakeholders, broadly defined) come into future rounds. VC investments can range from less than $1 million to multiples of $10 million.
- **Mergers & Acquisitions (M&A):** In recent years, EV charging solutions providers Greenlots and EVgo have been acquired by strategic investor Shell and private equity firm LS Power, respectively.[c]
- **Direct Investments:**
    - Rivian raised $700 million of capital in a round led by Amazon and an additional $500 million investment from Ford, in advance of having a commercially available product.[d]
    - In January 2020, strategic investors Hyundai and Kia invested €100 million in Arrival at a valuation of approximately $3 billion, and in October 2020, institutional investor BlackRock added a $118 million investment as this UK-based company launches its expansion into the United States.[e]

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[a] LaReau, Jamie L. (2020). Detroit Free Press. GM Invests in Lordstown Motors Merger that Will Make it Publicly Traded. Retrieved from: https://www.freep.com/story/money/cars/general-motors/2020/08/03/gm-invest-ev-maker-lordstown-motors/5571007002/

[b] Reuters (2020). EV battery maker Romeo Systems to go public through a $1.33 billion SPAC deal. Retrieved from: https://www.reuters.com/article/us-romeo-systems-m-a-rmg-acquisition/ev-battery-maker-romeo-systems-to-go-public-through-a-1-33-billion-spac-deal-idUSKBN26Q1PM

[c] Greenlots (2019). Greenlots announces acquisition by Shell, one of the world's leading energy providers. Retrieved from: https://greenlots.com/greenlots-announces-acquisition-by-shell-one-of-the-worlds-leading-energy-providers/; LS Power (2019). LS Power Announces Acquisition of EVgo. https://www.lspower.com/ls-power-announces-acquisition-of-evgo/

[d] Eavis, Peter (2019). Rivian Gets $1.3 Billion Investment in Electric Truck Venture. Retrieved from: https://www.nytimes.com/2019/12/23/business/rivian-truck-investment.html

[e] Frangoul, Anmar (2020). CNBC. JP Morgan values UK electric car start-up at $3.3 billion after Hyundai and Kia invest. Retrieved from: https://www.cnbc.com/2020/01/16/uk-electric-vehicle-start-up-arrival-values-itself-at-3point3-billion.html; Ohnsman, Alan (2020). Forbes. Arrival's Electric Vehicle Vision Gets $118 Million Boost From BlackRock. Retrieved from: https://www.forbes.com/sites/alanohnsman/2020/10/14/arrivals-electric-vehicle-vision-gets-118-million-infusion-from-blackrock/#6a7426211ee6

Corporate Capital (continued)

- Redwood Materials recently raised $40 million to fund its efforts to develop a battery recycling process to supply the electric vehicle market; publicly disclosed investors include Capricorn Investment Group and Breakthrough Energy Ventures, the environmental-focused fund launched by Bill Gates that includes Amazon founder and former CEO Jeff Bezos as a board member.[f]
- Even prior to its announcement of an IPO, ChargePoint counted among its strategic investors Daimler, BMW, Siemens AG, Chevron Corp., and the investor-owned utility American Electric Power Co.[g]
- As of March 2, 2021, Tesla's market capitalization ($686.44 billion on $31.5 billion in revenues for 2020) far surpassed those of several established auto giants, including General Motors ($77.97 billion market capitalization on $115.8 billion in 12-month revenues ending 9/30/20), Toyota ($242.42 billion on $275.4 billion in 2020 revenues), and Ford ($49.04 billion on $130.9 billion in 12-months revenue ending 9/30/20). On November 16, 2020, S&P Dow Jones Indices announced that Tesla will be added to the S&P 500 index. The top public shareholders of Tesla stock include some familiar names to this sector: Vanguard Group, Baillie Gifford, BlackRock, and Fidelity Management (each with less than 5% of total shares).
- In February 2021, Highland Electric Transportation, a provider of turnkey fleet solutions delivering the latest in zero-emission technologies to school districts and fleet managers, raised $253 million of corporate equity to accelerate its growth. The financing was led by Vision Ridge Partners with participation by Fontinalis Partners and existing investors. Highland reduces the complexity of going electric by providing customers a full-service solution for electric buses that it owns, powers, and maintains.[h]

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[f] Korosec, Kirsten (2020). TechCrunch. Amazon's first five climate fund investments include Tesla co-founder JB Straubel's startup Redwood Materials. Retrieved from: https://techcrunch.com/2020/09/17/amazons-first-five-climate-fund-investments-include-redwood-materials-rivian/

[g] ChargePoint (2020). ChargePoint, Inc. to Become Public Company, Advancing EV Charging Network's Reach Across North America and Europe. Retrieved from: https://www.chargepoint.com/about/news/chargepoint-inc-become-public-company/; https://www.chargepoint.com/about/news/chargepoint-secures-additional-127-million-funding/

[h] BusinessWire (2021). Highland Electric Transportation Raises $253 Million from Vision Ridge Partners, Fontinalis Partners, and Existing Investors. Retrieved from: https://www.businesswire.com/news/home/20210216005946/en/Highland-Electric-Transportation-Raises-253-Million-from-Vision-Ridge-Partners-Fontinalis-Partners-and-Existing-Investors

IV

IV. ROLE OF INDUSTRY STAKEHOLDERS

A. MANUFACTURERS

Traditional (diesel and gasoline) OEMs have always provided financing options to their customers, and zero-emission OEMs acknowledge the financing needs of their customers due to the upfront cost differential relative to comparable diesel models. However, the analytics are completely different for EVs than for diesels, from TCO to sources, costs and terms of potential financing. In other words, customers "need to do their homework," and electric OEMs see their role in providing guidance and, potentially, finance solutions, as an integral element to their success.

Some OEMs are developing financing products to facilitate EV sales, where the basic formula is to finance the upfront cost differential between electric and diesel, with such financing then serviced through projected operating savings. Fleet operators see OEM/vendor finance as a critical step toward larger-scale adoption. For instance, electric bus and truck manufacturer BYD has teamed with Generate Capital to launch a $200 million electric transit bus leasing program in 2018.[60] Generate is also assessing this financing model for rideshare and last-mile logistics.

One drawback, from the OEM's perspective, is that some financing structures being developed require the OEM to retain the residual value risk of the battery. From a capital perspective, keeping this liability on its balance sheet is not efficient, as it drains resources from expanding the fundamental business of vehicle production. Back-to-back risk arrangements with the battery manufacturer itself are being developed to address this problem, and liquid secondary markets for batteries and battery values will also ameliorate this problem for the OEM.

As previously mentioned, battery costs are projected to continue their downward trajectory (see Figure 10). In addition, batteries can be swapped out in mid-life of the vehicle (approximately 6 years for the battery vs. approximately 12 years for the vehicle), with economically viable "second-life" applications for the swapped-out battery (this is part of the operating thesis of the Mitsui-Proterra approach described inSection III.B.3 above), and technology to provide battery life of 12 years or greater is on the horizon.

60 Lunden, I. (2018). TechCrunch. BYD and Generate Capital launch $200M electric bus leasing JV in the US. Retrieved from: https://techcrunch.com/2018/07/11/byd-and-generate-capital-launch-200m-electric-bus-leasing-jv-in-the-us

The "Million-Mile" Battery

Perhaps the EV battery-equivalent to the Holy Grail is the "million-mile" battery, which targets a battery that will last a million miles or more (through multiple charging sessions) before it loses charging strength to power an electric vehicle. This equates to multiplying the number of charges a battery can take by approximately four, giving it greater durability than the underlying vehicle itself. Which then leads to the potential to retain batteries as a discrete asset, and swap them into newer vehicles; or use this extended life and ability to swap to power long-haul trucks or buses, or even automated vehicles. Tesla has indicated its ambitions toward this goal, and Chinese battery manufacturer Contemporary Amperex Technology Ltd. ("CATL") told Bloomberg in June 2020 that it has a battery pack ready for electric vehicles that will last as much as 1.2 million miles, although scant additional public details have been released.[a]

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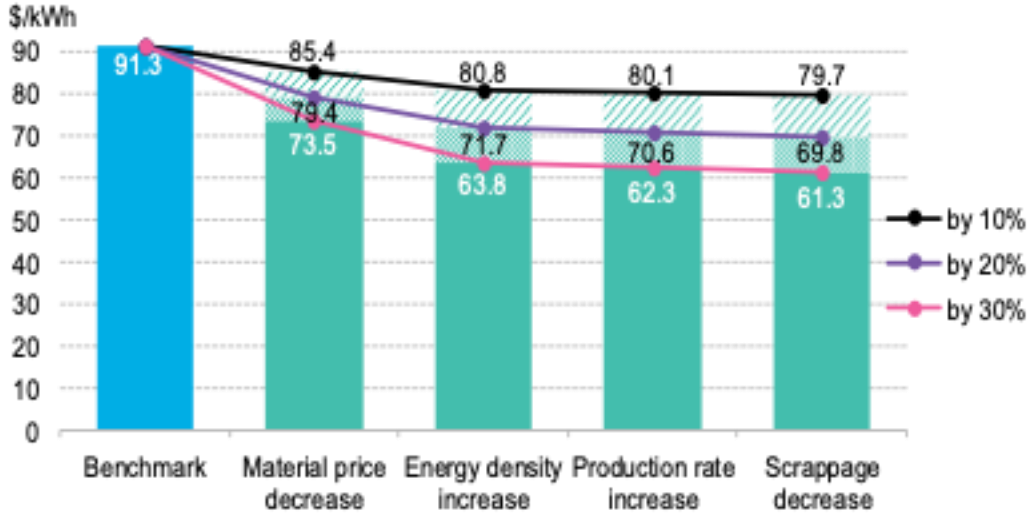
[a] Liu, J., Zhang, C., Ritchie, M., Stringer, D. (2020). Bloomberg News. A Million-Mile Battery From China Could Power Your Electric Ca. Retrieved from: https://www.bloomberg.com/news/articles/2020-06-07/a-million-mile-battery-from-china-could-power-your-electric-car

Figure 10. Battery cell cost reduction outlook (BNEF EVO 2020, Figure 223)



Second-Life Battery Innovations

Examples of the second-life battery ecosystem are plentiful, including:

- The Heritage Group, a leader in environmental and recycling services, which has made a strategic investment in Romeo Systems Inc., an EV battery technology developer for commercial vehicle applications. Heritage is partnering with Romeo specifically to support the development of a battery re-use and recycle facility for Romeo's batteries near or at their end-of-life use.[a]
- Transit bus manufacturer New Flyer recently announced a partnership with Li-Cycle, North America's largest lithium-ion battery recycling company, on a pilot that converted 45 end-of-life lithium-ion battery modules into a mixture of lithium, nickel, cobalt and copper to produce critical, battery-grade materials from recycled sources, as well as other recycled materials that can be returned to the economy.[b]
- Nevada-based Redwood Materials is developing a battery recycling process to supply the electric vehicle market. The company was founded by former Tesla executive JB Straubel, who was involved with developing battery technology for the car manufacturer. According to a recent profile in the Wall Street Journal, Redwood is "honing its processes by working on batteries from consumer electronics such as cellphones, which are smaller and easier to handle compared with the large packs that come from cars."[c]
- The California Energy Commission (CEC) Electric Program Investment Charge (EPIC) has provided $2-3 million to three California startups to advance their proof-of-concept work on second life EV battery applications. Two of those companies, RePurpose Energy and Smartville Energy, have their origins out of research in the University of California system and, along with ReJoule, have developed technologies and applications that seek to redeploy EV batteries safely and efficiently into second-life energy storage applications.[d]

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[a] The Heritage Group (2020). HG Ventures Makes $4 Million Investment in Romeo Systems. Retrieved from: https://thgrp.com/hg-ventures-makes-4-million-investment-in-romeo-systems/

[b] Cision PR Newswire (2021). Li-Cycle and New Flyer Team Up to Complete Heavy-Duty Battery Recycling Pilot. Retrieved from: https://www.prnewswire.com/news-releases/li-cycle-and-new-flyer-team-up-to-complete-heavy-duty-battery-recycling-pilot-301205224.html

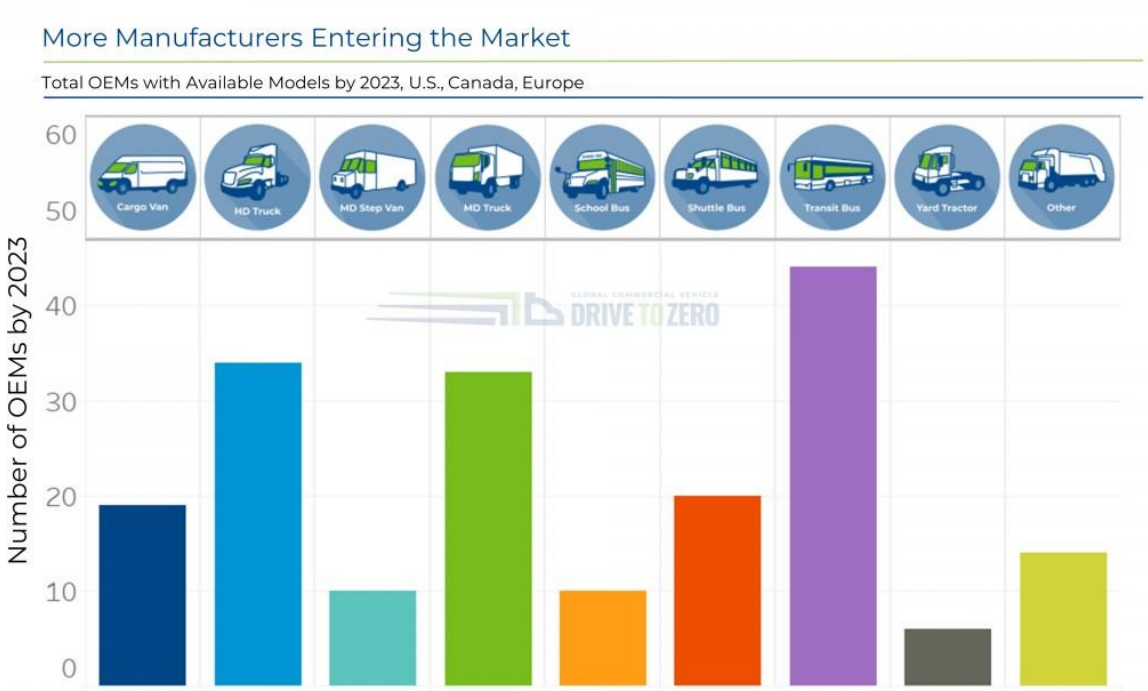
[c] Higgins, Tim (2020). Wall Street Journal. One of the Brains Behind Tesla May Have a New Way to Make Electric Cars Cheaper. Retrieved from: https://www.wsj.com/articles/one-of-the-brains-behind-tesla-found-a-new-way-to-make-electric-cars-cheaper-11598673630

[d] Pyper, Julia (2020). Green Tech Media. Second Life: Carmakers and Storage Startups Get Serious About Reusing Batteries. Retrieved from: https://www.greentechmedia.com/articles/read/car-makers-and-startups-get-serious-about-reusing-batteries

B. FLEET OPERATORS

Across commercial vehicle applications, and consistent with CALSTART's Beachhead Strategy, certain fleet types such as transit and last-mile delivery have duty cycles wherein electrification is already cost-competitive. Because of the diversity of commercial fleet applications, and the relative youth of commercial fleet electrification, however, a major concern of fleet operators has been the supply/availability of electric vehicles. While the depth of OEMs involved in actual MHD electric vehicle production and with fully road- and performance-tested deployments is relatively thin to date, that picture is changing rapidly (see Figure 11).

Figure 11. Number of manufacturers with commercially available ZECV products in the US, Canada, and Europe by 2023 across vehicle platform (CALSTART's Zero-Emission Technology Inventory)



In cases where the fleet customer is not the actual vehicle operator, as in the case of leasing companies, the customer may consider some form of utilization guaranty. Such an arrangement provides a minimum level of certainty as to utilization of the underlying electric trucks, creating a floor economic case around which a financing structure can be built. This clearly shifts the risk of vehicle financing, at least partly, to the customer or lessee, and therefore holds potential for wider application.

The very nature of the fleet business model—operating polluting vehicles that are very visible to a critical public—in the current environmentally-conscious context, is leading many operators to consider electrification to varying degrees. Across the US (and around the globe), Requests for Proposals (RFPs), pilots of varying degrees, and early-stage electrification transition programs are under way. A few prominent examples are described below:

- Municipal transit agencies are leading the way in terms of fleet electrification, both in terms of length of track-record, number of deployments, and diversity of fleet participants; currently more than 250 transit operators in the US are operating (or have placed orders for) a total of 2790 zero-emission buses as of December 2020, with more than 1000 of those buses already in service.[61]
- Port Authority of New York and New Jersey (PANYNJ) has fully transitioned the 36 intra-airport buses it operates at its JFK, LGA and Newark airports to all-electric Proterra buses, amassing the largest airport electric bus fleet on the East coast.[62]

61 Silver, F., Jackson, J., and Lee, B. (2019). CALSTART. Zeroing in on ZEBs. Retrieved from: https://calstart.org/zeroing-in-on-zebs

62 Higgs, L. (2020). NJ.com. Port Authority amasses largest airport electric bus fleet on East Coast. Retrieved from: https://www.nj.com/news/2020/10/port-authority-amasses-largest-airport-electric-bus-fleet-on-east-coast.html

- The Twin Rivers Unified School District, home to more than 25,000 students just outside Sacramento, CA, has the largest electric school bus fleet in the nation (40 buses), including buses from multiple electric bus manufacturers.[63]
- IKEA is developing a program to provide 100% zero-emission residential delivery worldwide by 2025, beginning with its New York City, Los Angeles, Amsterdam, Paris, and Shanghai markets.[64] To integrate ZECVs across its network of third-party logistics (3PL) providers, which in turn largely hire independent owner-operators as fulfilment contractors, IKEA has partnered with Fluid Truck, a national truck rental platform, to provide competitive short-term rental pricing for ZECVs.[65]
- The United States Postal Service (USPS) in February 2021 awarded Oshkosh Defense with an Indefinite Delivery, Indefinite Quantity contract to produce 50,000 – 165,000 next-generation delivery vehicles (NGDVs).[66] The U.S. Postmaster General identified 10 percent of the initial fleet will be ZEVs due to limited initial finances, but diesel-powered vehicles will be eligible for electric retrofits.[67] As a response to the plan to run the majority of NGDVs on diesel, environmentally-concerned lawmakers have proposed additional funding to purchase ZEVs.

C. PUBLIC INFRASTRUCTURE OPERATORS

Government authorities operate airports, marine ports, terminals, and so on, at which multiple operators run many types of vehicles and motorized equipment. In some cases, the authority owns some or all of the rolling assets, but in many cases, private operators run the vehicles. In this latter case, the public authority acts as a facilitator toward electrification, and can influence the on-premises service operators through incentives, reduced fees & preferential treatment toward EV adopters. The San Pedro Bay Ports Clean Air Action Plan, discussed in the Introduction, is likely the most influential example to date of a port authority, as one layer of government, exerting such influence over private operators.[68] Even in these instances, however, financing is a big hurdle, because private operators are being directed toward electrification but do not necessarily have the ability or resources to finance such a transition.

Public infrastructure operators also face very complex issues with respect to charging infrastructure, such as the following questions:

63 Twin Rivers Unified School District (2020). EV Buses. Retrieved from: https://www.twinriversusd.org/Students--Families/Transportation-Services/Electric-Vehicles-/index.html

64 Ingka Group, IKEA (2020). Zero emissions for home deliveries. Retrieved from: https://about.ikea.com/en/sustainability/becoming-climate-positive/zero-emissions-for-home-deliveries

65 WorkTruck (2020). Fluid Truck Orders 600 Lightning Electric Trucks & Vans. Retrieved from: https://www.worktruckonline.com/10127584/fluid-truck-orders-600-lightning-electric-trucks-vans

66 United States Postal Service (2021). U.S. Postal Service Awards Contract to Launch Multi-Billion-Dollar Modernization of Postal Delivery Vehicle Fleet. Retrieved from: https://about.usps.com/newsroom/national-releases/2021/0223-multi-billion-dollar-modernization-of-postal-delivery-vehicle-fleet.htm

67 Shepardson, D. (2021). Reuters. U.S. Postal chief commits to 10% of new delivery fleet as electric vehicles. Retrieved from: https://www.reuters.com/article/us-usa-postal-service-vehicles-idUSKBN2AO2LI

68 Supra note 17

- Does the public authority undertake this on behalf of the private operators?
- How to design across so many different duty cycles and usage patterns?
- Where to put the chargers, especially across sometimes expansive real estate (for instance, Kennedy Airport, in Queens, NYC, is almost 5,000 acres)?
- How to price such a service across multiple customer categories?

Or, conversely:

- Should government mandate that the individual companies electrify?
- In which case, how to coordinate with companies?
- Or some hybrid of shared electric charging infrastructure?

Across all of these questions, planning, financing and execution are incredibly complex.

D. "ONE-STOP-SHOP" DEVELOPERS

A business model category is emerging which provides a single point of contact for a fleet in its electrification efforts, beyond only providing the CaaS/IaaS product. Reflecting the dynamism and innovation seen in all other corners of the electrification sector, these "one-stop-shops" are being formed by combinations of financial investors and/or fund managers, unregulated subsidiaries of investor-owned utilities, industrials (EV and non-EV OEMs and supply chain) and others. The objective in these partnerships is to provide the full value chain of functions, in order to credibly market and then successfully execute the one-stop-shop offering. This full-service approach, Electrification-as-a-Service (EaaS), includes not only technical skills and operational services, but also financial resources, vehicle procurement and ownership (and, it is assumed, profit extraction), as well life-cycle management capability (including battery disposition/recycling).

A "one-stop-shop" project developer offers a comprehensive electrification plan to a fleet operator in exchange for a single bundled periodic payment from the operator to the developer. Such an electrification plan could entail any number of the following service elements:

- Duty cycle; block and route analysis
- Charge infrastructure technology, design (including depot layout) and procurement
- Managing any interface with local distribution utility, including make-ready investment and bill payment/management
- Solar + storage features, as applicable
- Vehicle-to-grid functionality and optimization, as applicable
- Charge management system and electrical energy optimization and procurement
- Vehicle procurement to the operator's precise specifications, and ownership of such vehicles –

leased to the operator under a long-term services agreement

- Staging/phasing of the electrification transition, as necessary
- Managing and obtaining any incentive, grant or credit programs, at state/local/federal levels
- Financing of the entire electrification enterprise

Such a program must pencil out to a positive TCO compared to the operator's current ICE/diesel fleet, and would be documented via a comprehensive, long term (minimum 7-10 years) contract defining all roles, responsibilities and liabilities and penalties. The economics need to cover a cost-efficient capital stack, above the electrification program's operating and management expenses, including debt service at a reasonably set market credit spread and coverage ratio, plus distributable cash flow to provide a return of equity and an appropriate return on equity.

For its part, the developer needs to demonstrate the capability and expertise to execute across these disparate tasks, and as efficiently and cost-effectively as possible. Of equal importance, the developer needs to have access to low-cost capital—both debt and equity—to drive the economics into favorable territory for the customer. But if all of the EaaS pieces come together properly, the one-stop-shop developer has created size and scale, and a sound operating and credit project profile, to attract such low-cost capital.

V

V. EMERGING MARKET SOLUTIONS, AND POLICY RECOMMENDATIONS TO ADDRESS KEY FINANCING BARRIERS

A. KEY BARRIERS

A recent report by Environmental Defense Fund (EDF), M.J. Bradley & Associates, and Vivid Economics, "Financing the Transition – Unlocking Capital to Electrify Bus & Truck Fleets," has developed a "total cost of electrification" (TCE) framework to holistically characterize barriers associated with commercial fleet electrification, including "soft costs" such as permitting, technological evolution and user acceptance (see Figure 12).[69] The TCE framework augments more traditional TCO-based assessment by reflecting additional factors such as risks, uncertainties and frictions associated with a fleet transition.

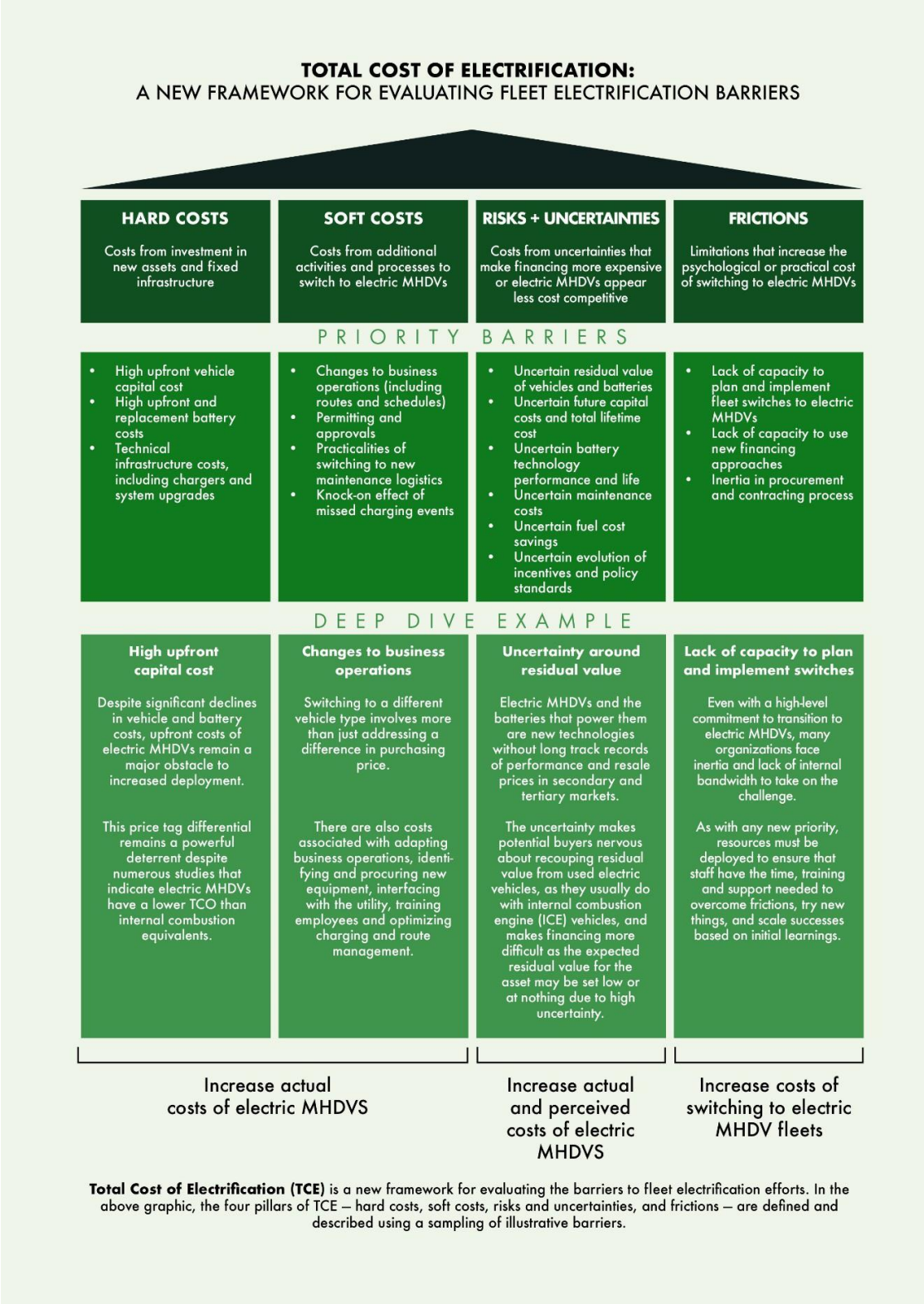
Through the course of the stakeholder interviews conducted to inform this paper, we have repeatedly cited several specific factors that have particularly inhibited development of robust financing of commercial fleet electrification, including some of those highlighted within the TCE framework. Among those viewed as most foundational are:

- Residual value: This is the unknown quantity of value left in an EV at the end of any period, such as the term of a financing of that vehicle.
- High upfront cost: EVs can be 100% more expensive than comparable ICE models or more, on top of which is to be added associated charging infrastructure.
- Lack of model availability: Fleet operators cited the lack of commercial EVs for their specific requirements. Stakeholders cited specific categories, such as refrigeration or long-haul models, as well as the inability to obtain customizable options without incurring excessive additional costs. Geography certainly plays a role, as states with more accommodating electrification policies are seeing more ZECV availability. Further, at present there is no readily accessible ZECV dealer network, where showroom models can be viewed directly by potential buyers.
- Technology risk: The pace of change is fast and accelerating, bringing both much-needed

69 EDF, MJ Bradley & Associates, and Vivid Economics (2020). Financing the Transition: Unlocking Capital to Electrify Trucks and Buses. Retrieved from https://www.edf.org/sites/default/files/documents/EDF_Financing_The_Transition.pdf

improvements in EVs, in terms of performance and reduced costs, but also potential for rapid obsolescence.

Figure 12. Total cost of electrification framework for evaluating barriers to fleet electrification (EDF, MJ Bradley & Associates, Vivid Economics)



Total Cost of Electrification (TCE) is a new framework for evaluating the barriers to fleet electrification efforts. In the above graphic, the four pillars of TCE – hard costs, soft costs, risks and uncertainties, and frictions – are defined and described using a sampling of illustrative barriers.

- Local utility resistance: The level of cooperation from local utilities varies greatly, although electrification is one of the few market growth opportunities for them. Some utilities seek to capitalize on this trend, setting both their regulated and unregulated businesses to provide support and/or play an active part in the electrification transition, while utilities and their regulators in many other service jurisdictions have been slow to adapt or support this trend.
- Unsupportive rate design: Although electrification is effectively a new revenue source for local utilities, demand charges and lack of commercially effective tariff structures result in unnecessarily high electric rates. Further, fleet operators are unaccustomed to negotiating this aspect of their business, and see it as complex and full of risk. It is this complexity that creates the opportunities for developers, such as the "one-stop-shop" sponsors mentioned previously, to step in and manage the utility and tariff interface for commercial fleet operators.

In the following sections we describe emerging market solutions that can help to ease financing conditions for commercial fleet electrification in coming years, as well as policy recommendations to further accelerate fleet electrification in the near-term and thereby activate and leverage greater amounts of private capital in the medium-to-long term.

B. EMERGING FINANCIAL AND COMMERCIAL SOLUTIONS

The ZECV market is developing solutions directly from and for the financial community, in parallel with commercial and technology advancements.

Financial

- Equity investors are assessing ways to take on residual value risk and isolating it from vehicle operators, primarily by developing tools to mitigate such risk, including closer cooperation with OEMs and battery manufacturers.
- Developers are looking to package charging infrastructure with vehicle ownership (through long-term leasing of the vehicles to operators), thereby increasing transaction size to attract lenders and investors. To the extent that successful implementation of such a project is with a corporate fleet operator, who then looks to electrify additional depots, then replication and scale will be additional attractive factors to the financiers. Commercial banks are developing credit and risk management tools, and credit policies, specifically for fleet electrification. Continued innovation in monetizing the future operating and maintenance cost savings, and packaging such into a financial product.
- There is emerging innovation in financial products specifically for this sector, such as a lender "sleeving" the OEM's vendor-finance product, whereby a traditional automotive lender provides the direct loan to the customer, but the credit risk is ultimately borne by the OEM, and thereby lowering the overall cost of capital, and developing an instrument enabling lending against LCFS credits or other environmental attributes. In this way, EV OEMs are mimicking traditional OEMs with a financing arm to facilitate customer sales.
- To date, tax equity—which is an integral component to the renewables financing market—has not

played a noticeable role. However, it is likely that with growth in financing volume, strategies that maximize tax efficiency will make their way into the equation.

- Continued involvement by green banks and the expansion of such entities across more American states (or perhaps the creation of a national green bank) can provide proof-of-concept for financial products developed specifically to advance commercial fleet electrification.[70]

Commercial

- OEMs, battery manufacturers and one-stop-shop EaaS developers are crafting innovative approaches to insulate fleet operators from residual value risk. It is certainly the case that more stakeholders are interested in replicating the Proterra-Mitsui battery-finance model; such expansion of participants can lead to competition and, hopefully, lower upfront costs and more favorable terms and conditions to commercial EV purchasers. Integral to this are the advent, expansion and transparency of second- and third-life battery markets, as previously discussed.
- Over time and with accelerated deployment of EVs, a deep data base of residual values will materialize. As this data proliferates, it is likely that a secondary market for used electric commercial vehicles can develop, which will serve to lower the high upfront cost, another significant barrier to commercial fleet electrification. This will then put lower-cost ZECVs within reach of a greater pool of owners and operators, particularly smaller fleets.
- Continued innovation of business models, contractual frameworks ("PPA-like" contracts), larger projects that include quantities of vehicles to create attractive transaction sizes, a development that is sure to be well received by the financial community.
- Corporate commitments to fleet electrification continue to grow, which will lead to both confidence by OEMs to invest in scaling-up their manufacturing capacity – and on through the supply chain, as well as pipelines of repeatable and replicable projects; the latter a development that is sure to be well received by the financial community.
- Accelerated investment by strategic and public market investors directly into industry stakeholders, from OEMs and on through the supply chain, will provide these companies with the financial resources to invest in both R&D and scaled-up production capacity, leading to better, less expensive, and higher-performing products. This will produce more favorable TCO calculations across an expanding universe of commercial electric vehicles and duty cycles.
- As industry stakeholders refine their product offerings, partnerships through the supply chain and the commercial EV sector serve to reduce and/or mitigate risks. As risks are dispersed throughout the ecosystem to those parties best suited to manage those risks, overall production and product costs will come down, reinforcing the trend toward more favorable TCO calculations.
- Utility regulators are addressing the specific needs of electrification in policy papers and rate cases, although this is still inconsistent across the US. We have cited that several states—California, New

70 More information about US green banks can be found in "Green Banks in the United States," the 2020 annual report found at the website of the American Green Bank Consortium (https://greenbankconsortium.org/); for an excellent discussion of the state of green banks both in the US and globally, please refer to the recently published "State of Green Banks 2020." (https://rmi.org/insight/state-of-green-banks-2020/).

York, and Oregon, to name a few—are creating regulatory frameworks that will encourage and/or incentivize their local utilities to be more accommodating and participatory in the electrification transition.

Technology

It is readily apparent that technological advancements will continue to drive growth across all aspects of electrification. It is clear that OEMs and stakeholders throughout the vehicle electrification supply chain are seeing how the macro drivers are influencing fleet operators and financiers, as well as increasing and broadening policy support such as fleet standards & mandates. These all send a very strong signal to manufacturers to invest more into R&D, which will facilitate even greater technological innovation and improvements, and lead to enhanced performance/declining costs throughout the supply chain. By way of only a most recent example, InoBat, a European-based battery manufacturer recently announced the world's "first intelligent battery cell … to meet the highest performance, safety and cost needs of electric vehicles."[71]

It is certainly to be expected that, not only will there be more availability of electric models across more vehicle classes, including expansion of industrial electric offerings, but that TCO convergence will advance across more duty cycles and specific use cases. For example, in October 2020 Amazon unveiled its Rivian-developed electric delivery truck, which will have 10,000 vehicles on the road by 2022, and will reach 100,000 in operation by 2030.[72] In parallel, we will likely see enhanced sophistication of charge management tools and analytics.

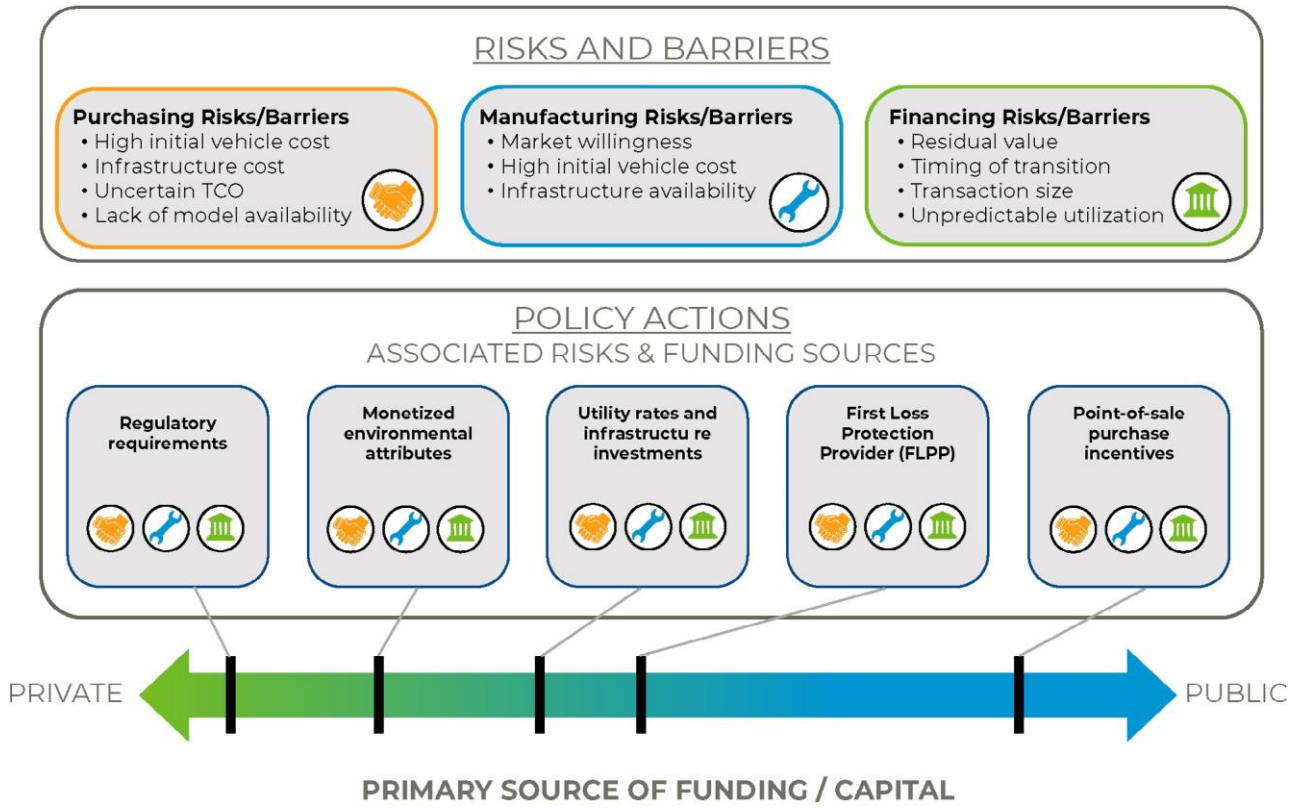
C. POLICY RECOMMENDATIONS TO ADDRESS KEY FINANCING BARRIERS

As detailed in Section I.B.2, there is extensive public policy support for electrification in general, and commercial fleet electrification in particular. There are numerous policies that either mandate the transition to commercial EVs or incentivize fleets to purchase EVs, and as such are complementary to the financial, commercial and technological advances already mentioned. Collectively, and when deployed more uniformly throughout the country, they can help to drive down the upfront ZECV cost toward parity with ICE vehicles, and therefore make commercial ZEVs more financeable—and as such, more affordable in the very near future. Figure 13 summarizes the above-described risks and barriers and a number of policy interventions that can support and ultimately give way to enhanced private ZECV financing activity.

71 Billington, J. (2020). Electric & Hybrid Vehicle Technology International. 'World's first intelligent electric vehicle battery' unveiled. Retrieved from: https://www.electrichybridvehicletechnology.com/news/battery-technology/worlds-first-intelligent-electric-vehicle-battery-unveiled.html

72 Hawkins, A.J. (2020). The Verge. Amazon unveils its new electric delivery vans built by Rivian, Retrieved from: https://www.theverge.com/2020/10/8/21507495/amazon-electric-delivery-van-rivian-date-specs

Figure 13. Comparison of Policy Actions with Associated Risks and Barriers



1. MITIGATE RESIDUAL VALUE RISK THROUGH FIRST LOSS PROTECTION

There are no known policies that specifically address the key risk to financing commercial fleet electrification, as cited by low-cost commercial lenders and the other types of financiers discussed above: residual value risk. We have mentioned emerging market-driven solutions, such as the Proterra-Mitsui and BYD-Generate financing models, which attempt to mitigate the fleet operator's residual value risk. However, these approaches are still expensive from a financing standpoint, and do not bring in commercial lenders directly into the capital stack, although over time they may do so. What is needed, therefore, is a policy, or a policy-supported financial product, that works directly to mitigate residual value risk to low-cost commercial lenders.

This may be accomplished through applying the financial-product concept of "first loss protection" to ZECV financing. First loss protection, a well-known financial product in the securitization and insurance industries, insulates lenders from a pre-defined amount of financial loss due to a specified risk, providing a level of mitigation against—in this case—residual value risk, thus enhancing the creditworthiness of a loan transaction. We propose here that a program should be created, perhaps at the federal level through the DOE's Loan Programs Office, or possibly through various states' Green Banks, with the sponsoring agency referred to as FLPPs, or First Loss Protection Providers. In such a program the FLPP would maintain a position in vehicle financing that is focused on taking a specified first amount of

residual value risk. In financing a fleet of ZECVs by commercial lenders, as well as the FLPP and equity capital, the FLPP's first loss protection on residual risk would provide comfort to banks and other senior lenders that at least a portion of this risk is being allocated to a specific—and credible—financing party. While all parties to the transaction (the customer, financiers and the FLPP) need to "do their homework" on what such residual value risk entails, such a position by the FLPP in the risk calculus could entice senior lenders to bring their low-cost capital into the financing equation.

This is not to imply that FLPPs take unstudied or undue risks in this process. Rather, they need to conduct extensive due diligence across technology, equipment performance, mileage and duty-cycle projections, and numerous other commercial aspects, in order to arrive at the appropriate measure of first loss protection in such transactions. Properly pricing such risk is also an important element in this equation, although an important assumption here is that a government FLPP would be somewhat accommodating on such pricing, as well as the numerous intricacies of security, collateral & documentation. But with such diligence and thorough underwriting, positive results can in time convince the financing markets that these residual value risks are quantifiable, manageable and, therefore, acceptable as risks to be taken up directly by commercial lenders themselves.

In addition, reinforcing the residual value of ZECVs will have the added benefit of supporting development of a robust secondary market by enhancing liquidity, as early adopters gain certainty about how and when to sell a used vehicle. This in turn will enable LMI and SME fleets to have more choice of ZE options within the venues through which they typically purchase trucks—the used market.

2. DIRECT PUBLIC FUNDING TOWARD ZECV PURCHASES IN THE NEAR TERM

With ZECV purchases better supported with a structural measure such as first loss protection, the next most important element is to facilitate adoption by directing public dollars—at various levels of government—to close the financing gap for ZECVs in the near term. A coordinated set of purchase incentive programs, ideally with federal and state incentives leveraging one another, would gr1adually reduce assistance as ZECV technology progresses down the technology cost curve and a greater share of ZECV transactions can fall within financing parameters of the intermediaries discussed above. Such an approach relies on government to catalyze financing but transitions this load to the private sector in the span of just a few years.

- Federal purchase incentives for ZECVs: The CALSTART-organized National Zero-Emission Truck (ZET) Coalition has called for the creation of new $2+ billion, five-year federal incentive for ZECV acquisition. A new federal direct incentive[73] for the purchase of ZECVs has the potential to provide immediate job and economic stimulus to an important and growing segment of the U.S. commercial vehicle industry, its supply chain, and its manufacturing workforce. While new ZET technologies are expected to ramp up globally as market opportunities mature, in the United States, incentives for the purchase of zero-emission trucks are needed to help alleviate the upfront costs of

73 House Select Committee on the Climate Crisis (2020). "Solving the Climate Crisis", pp. 122-3. Retrieved from: https://climatecrisis.house.gov/sites/climatecrisis.house.gov/files/Climate%20Crisis%20Action%20Plan.pdf

advanced truck technologies and create a robust, sustainable zero-emission truck market. There is currently no ZECV tax incentive, rebate, or other direct incentive at the federal level. To date, state programs offering a point-of-sale incentive – based on offsetting the incremental cost between the conventional vehicle and the zero-emission truck – have seen tremendous success in helping fleets to quickly and efficiently deploy ZETs by buying down the upfront cost of the truck and providing a reliable policy mechanism to incentivize ZET integration into commercial and public fleets.[74] Congress could follow this model by creating a federal direct incentive for ZETs administered at the point-of-sale. Further, the mechanism could be advanced through budget reconciliation if it is structured as an upfront grant in-lieu of investment tax credit for eligible truck purchases. Among the Coalition's other recommendations include incentivizing ZECV infrastructure through a combination of financial and tax incentives; and supporting RD&D for ZECVs by an additional $250 million per year over five years.[75]

- State incentives: Continued and expanded funding of voucher incentive programs, across more states and specifically designed to promote ZECV adoption, should be implemented. With VW Settlement dollars largely already allocated, funds would need to come from newly budgeted programs or reallocated from existing revenue-generating programs like RGGI, as New Jersey and Massachusetts are planning to do.

  In addition, such programs should be incorporated into the various multi-state efforts (Multi-State ZEV Task Force, TCI-P). In addition, numerous stakeholders report significant difficulty in deciphering the requirements, processing paperwork, and cumbersome process for claiming the funds. Finally, scrappage requirements need to be made more flexible, which should also incorporate exchange-like features whereby a voucher applicant can access another operator's fleet for a diesel vehicle to scrap; as well as a metric for the exchange of value between the voucher recipient and the operator contributing the old truck needs to be developed.

  Critically, funding programs must also be designed to explicitly integrate LMI/SME fleets that historically have not participated in clean truck funding programs. Such provisions should, inter alia, cover 100-125% of the EV-diesel cost differential (rather than the usual 80-90% coverage) and have the scrappage requirement waived entirely, while supporting ZECV deployments among LMI and SME fleets with greater hands-on assistance for financing and infrastructure deployment.

However, with many states' Volkswagen Settlement funding quickly becoming fully subscribed in many instances, there is great uncertainty regarding how states can leverage existing revenue sources to capitalize the types of programs described above. Accordingly, states must identify other means of creating aligned revenues that can be prioritized for this purpose.

- Create additional funding streams for state-level vehicle incentives: Cap-and-Invest programs have

74 Welch, D., and Mandel, B. (2019). CALSTART. Voucher Incentive Programs: A Tool for Clean Commercial Vehicle Deployment, pp. 17-24. Retrieved from: https://calstart.org/voucher-incentive-programs-a-tool-for-clean-commercial-vehicle-deployment-2019

75 CALSTART (2020). National Zero-Emission Truck Coalition Statement of Principles. Retrieved from: https://calstart.org/zet-statement-of-principles-6-17-20

been used in California (in an economy-wide program to cap carbon emissions) and the Northeast's RGGI power sector cap-and-trade scheme. Cap-and-Invest programs generally have as their objective to set a declining cap on emissions from a specific set of polluting resources, such as power plants or combustion vehicles, with emissions allowances that must be procured to cover emissions and thereby bringing the prices of polluting resources more in line with their true social costs. Revenues from the auctioned pollution allowances are then redirected toward complementary activities such as research, policies, and/or investments in cleaner technology solutions and associated infrastructure.

TCI-P, the regional transportation Cap-and-Invest market structure proposed across twelve Northeast and Mid-Atlantic jurisdictions, offers promise for providing self-sustaining, medium-term, public-sector funding for, inter alia, improved public transit and expanded use of electric vehicles.[76] As the TCI-P framework advances to implementation in 2021-2022, it will help to accelerate the drive toward TCO parity for EVs relative to ICE vehicles. Participating jurisdictions will have an unprecedented opportunity to create harmonized programs that reinvest auction revenues into the electrification transition, in the form of, for example, expanded public commercial charging infrastructure, or expanded voucher incentive programs.

Low-carbon fuel standards, or clean fuel standards, are superficially like Cap-and-Invest/trade schemes in the sense of being "polluter-pays" mechanisms that can raise large sums of revenues, which can then be funneled toward clean transportation priorities. However, rather than setting a declining pollution limit, fuel standards set a declining standard for the carbon intensity of fuels sold for use in a jurisdiction. Fuel standard policies are in place in California and Oregon already, with similar mechanisms in exploratory stages in New York and Washington State.

- Monetize environmental attributes from market mechanisms: California's LCFS program[77] creates a steady stream of income for owners/operators of zero-emission vehicles, potentially worth up to $150,000 over a ten-year vehicle life, depending on the battery size and duty cycle of the vehicle. Credits are earned as vehicles are charged with electricity, or fueled with hydrogen, as both fuel sources have a much lower carbon-intensity than regular diesel or gasoline. CALSTART has been working with other partners (NRDC and the Silicon Valley Leadership Group) to establish a state-run LCFS loan program in California that would enable fleet owners to secure loans for the upfront capital needed based on the LCFS credits that fleets can earn over time. Currently, most fleets generally lack a means to monetize the future stream of LCFS value and bring it up-front. Bringing the term value of LCFS credits forward into a financial product could dramatically lower up-front costs for electric vehicles. These loans would either come directly from a state financing authority (such as California's Pollution Control Financing Authority or Infrastructure Bank (IBank)),[78] or via state-backed private loans, where the state bank would provide a loan-loss guarantee to reduce the

76 Transportation and Climate Initiative (2020). FACT SHEET: Cap-and-Invest as a Tool to Reduce Pollution. Retrieved from: https://www.transportationandclimate.org/fact-sheet-cap-and-invest-tool-reduce-pollution

77 California Air Resources Board (2021). Low Carbon Fuel Standard. Retrieved from: https://ww2.arb.ca.gov/our-work/programs/low-carbon-fuel-standard

78 The California Pollution Control Financing Authority, run by the California Treasurer's Office, includes a program called California Capital Access Program (CalCAP), which is designed to encourage banks and other financial institutions to make loans to small businesses that have difficulty obtaining financing. Currently the program funds loans to small truck fleets, and could be expanded to run this LCFS loan program. California's iBank is also a program of the State Treasurer's Office and is focused on financing GHG reduction projects.

risk borne by private financers. In the CALSTART/ NRDC proposed program design, fleets would consign their LCFS credits to the lender, and loans, plus interest, would then be paid back via the sale of those credits in the LCFS market. CALSTART expects that either with direct public loans, or with publicly backed loans, interest rates could be kept low (below 5 or 6 percent). CALSTART is working to ensure that this loan program would focus on making loans to small and medium-sized fleets. This innovative approach should be adopted in California and then mirrored by other states that have currently adopted—or are pursuing—a LCFS policy as well. Such loans make it much easier for small fleets to access the value of an LCFS and can motivate faster and more ambitious ZEV adoption by fleets of all sizes.

3. REINFORCE ZECV DEPLOYMENTS WITH INFRASTRUCTURE AND INNOVATION GRANTS

Of course, successful ZECV deployment is more than a question of the vehicles themselves, but also of the interactions of those vehicles with energy systems—that is, their charging infrastructure and charge management techniques. As such, a comprehensive policy approach will shore up ZECV deployments by ensuring that utilities have the financial and process know-how to configure a fleet's infrastructure, and will also stay ahead of the curve by funding innovative early-stage projects that seek to pilot or demonstrate new technologies and business models. Such programs will extra financing to make ZECV projects more financeable—in the case of utilities, mobilizing ratepayer capital with a healthy rate of return—and provide critical empirical data to validate the next wave of ZECV deployments to firm up additional project types for financiers.

- Infrastructure investments, incentives and financing: Regulators should adopt complementary policies to enable local utilities to easily execute on make-ready investments, adopt accommodating tariff structures and reduced demand charges, and clarification of ownership boundaries across charging infrastructure, etc. Regulatory approvals cited above in California and New York for utility make-ready infrastructure programs that explicitly support ZECV deployments are a logical starting point, but these programs must be supported with sound rate design innovations that can reflect a utility's cost of service to commercial fleets while providing fleets with a usable option to save money relative to diesel if they can shift charging to low-cost periods.
- Prizes and competitions: A direct contributor toward innovative solutions would be the creation of competitions and prizes directly related to fleet electrification, at either state or federal levels. Such programs can particularly target proof-of-concept for earlier-stage ZECV technologies (e.g., long-haul) or business models (e.g., infrastructure-as-a-service) to expedite commercialization of promising solutions. As mentioned, the NYS PSC recently announced the Clean Medium- and Heavy-Duty Vehicle Innovation Prize, with a focus on reducing harmful air pollution in frontline communities; and soliciting innovative and high impact approaches that enable access to clean transportation services for disadvantaged and underserved communities. The Clean MHD Vehicle Innovation Prize category will offer grand prize awards totaling $16 million, part of an $80 million Clean Transportation Prize Program that NYSERDA is sponsoring.

4. PROVIDE CLEAR MARKET DIRECTION THROUGH REGULATIONS

Finally, with a proactive and supportive policy ecosystem in place, jurisdictions can confidently set clear market signals through a range of regulations. These market mandates work in concert with policy to make sure that the transformation to mass-market adoption of ZECVs can be financeable by private entities.

- Corresponding manufacturer and fleet requirements: Financing institutions need to see a guarantee that this market is going to grow and scale, which will increase their comfort in financing commercial EVs. Regulations in the form of sales or purchase mandates are critical to develop ZECV markets at an accelerated pace. These targets create a built-in sales pipeline, so that financiers know that there is a scalable market. This can be seen, for example in California, where, as previously mentioned, the recently passed ACT regulation has set electric truck sales targets for manufacturers. Many stakeholders view the forthcoming "fleet rule" as a necessary companion that will make the ACT regulation attainable without exacting a disproportionate toll on manufacturers.[79] California's Innovative Clean Transit regulation is a current example of a fleet procurement requirement, albeit one for a smaller subset of the on-road ZECV fleet and one that is controlled by comparatively few actors.[80]
- Public fleet procurement streamlining / bulk purchasing: Many states, including California, New York, Massachusetts and Illinois, are looking to craft state-wide procurements of electric vehicles, mostly revolving around transit buses, but also at the fleet level for the many state and local agencies and government entities that operate tens or hundreds of passenger vehicles, service trucks and the like. In fact, according to the National Conference of State Legislatures ("NCSL"), "Twenty-eight states have hybrid or electric vehicle fleet requirements, acquisition goals, or a stated preference for the state's government to purchase hybrid or electric vehicles."[81] The objective of these bulk procurements is to create volume and scale, and thus drive upfront costs down. These procurements, as well, serve as a very important market signal to OEMs and the supply chain that the risk to scale-up on the manufacturing side can be mitigated. And a robust order book, in turn, will enable lending at cost-effective levels, further reducing costs to the upfront acquisition equation.

79 California Air Resources Board (2021). Advanced Clean Fleets. Retrieved from: https://ww2.arb.ca.gov/our-work/programs/advanced-clean-fleets

80 Supra note 20

81 Hartman, K., and Shields, L. (2021). National Conference of State Legislatures. State Policies Promoting Hybrid and Electric Vehicles. Retrieved from: https://www.ncsl.org/research/energy/state-electric-vehicle-incentives-state-chart.aspx

VI

VI. CONCLUSIONS

Commercial fleet electrification is accelerating rapidly in the United States, driven by a fortunate convergence of advances in OEM commitments to product manufacturing, technology, commercial innovation, and policy support. Each of these factors is serving to expand the availability of commercial vehicle types & industrial uses, drive down both upfront and operating costs, and make commercial vehicles more affordable and accessible to fleet operators across a growing range of applications and duty cycles. In parallel with this, investments in electrification stakeholders are vibrant in the public capital markets, and also in select private investments-mostly by strategic & industrial investors. The Biden administration, as well as Congressional leaders in both chambers, appear to be very supportive of advancing zero-emission vehicle policies, and therefore, many in the industry are hopeful that significant federal funding and incentives will emerge in the next two years.

However, financing, particularly from commercial lenders with their attractive low-cost capital, is not keeping pace. In particular, the range of risks faced in financing commercial electric fleets are too broad and deep for lenders to accept, without cost-prohibitive guarantees, and/or credit or balance sheet support, which is not readily available to most potential electrification adopters. To address the most-frequently cited barrier, residual value risk, we have proposed herein development of a first loss protection instrument, to be offered by some federal or state instrumentality, who we designate as first loss protection provider, or "FLPP." Such an instrument could be incorporated into the capital stack, and signal to commercial lenders that at least a portion of the residual value risk is being covered, thereby accelerating their participation in ZECV financings.

However, for all of the foregoing advances, penetration of commercial electrification into the LMI demographic and SME category is almost non-existent. Acquisition costs are too high, incentive programs have unachievable conditions, and low-cost financing—which is accessible for LMI and SME operators for diesel trucks—simply is not available. This paper has identified emerging solutions that are addressing this market failure, which include commercial, financial and technology advancements. These are supported by policies at various levels of government that work in the same direction (see Figure 13).

All of these factors will continue to drive compelling economics for corporate CFOs to evaluate, as they calculate the favorable costs of fleet electrification, as compared to diesel. Hopefully, commercial banks will find their way into the financing equation, as well, making the economics even better, and the transition to fleet electrification even faster.