# FINANCING THE TRANSITION

## UNLOCKING CAPITAL TO ELECTRIFY TRUCK AND BUS FLEETS

**ABOUT THIS REPORT**

Published in November 2020, this report, "Financing the Transition: Unlocking Capital to Electrify Truck and Bus Fleets" was co-developed and written by Environmental Defense Fund, M.J. Bradley & Associates and Vivid Economics.

It is a companion to a detailed online research portal developed on the same topic.

To develop the findings, we interviewed 32 representatives from transit, trucking and school bus fleet operators; public and private finance professionals; and electric vehicle market and public policy experts. This report reflects the analysis and judgment of the authors only and does not necessarily reflect the views of the various interviewees and reviewers.


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Environmental Defense Fund (EDF) is a global 501(c)3 not-for-profit organization dedicated to protecting the environmental rights of all people, including the right to clean air, clean water, healthy food and flourishing ecosystems. Guided by science, we work to create practical solutions that win lasting political, economic and social support because they are nonpartisan, cost-effective and fair. Our Energy Program's Finance group works to unlock and accelerate clean energy markets. We engage public and private actors to design and deploy innovative policies and financing that accelerate capital flows into sectors and technologies critical to the clean energy transition.

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M.J. Bradley & Associates provides strategic and technical advisory services to address critical energy and environmental matters including energy policy, regulatory compliance, emission markets, energy efficiency, renewable energy and advanced technologies. Our multi-national client base includes electric and natural gas utilities, major transportation fleet operators, clean technology firms, environmental groups and government agencies. Our seasoned team brings a multi-sector perspective, informed expertise and creative solutions to each client, capitalizing on extensive experience in energy markets, environmental policy, law, engineering, economics and business.

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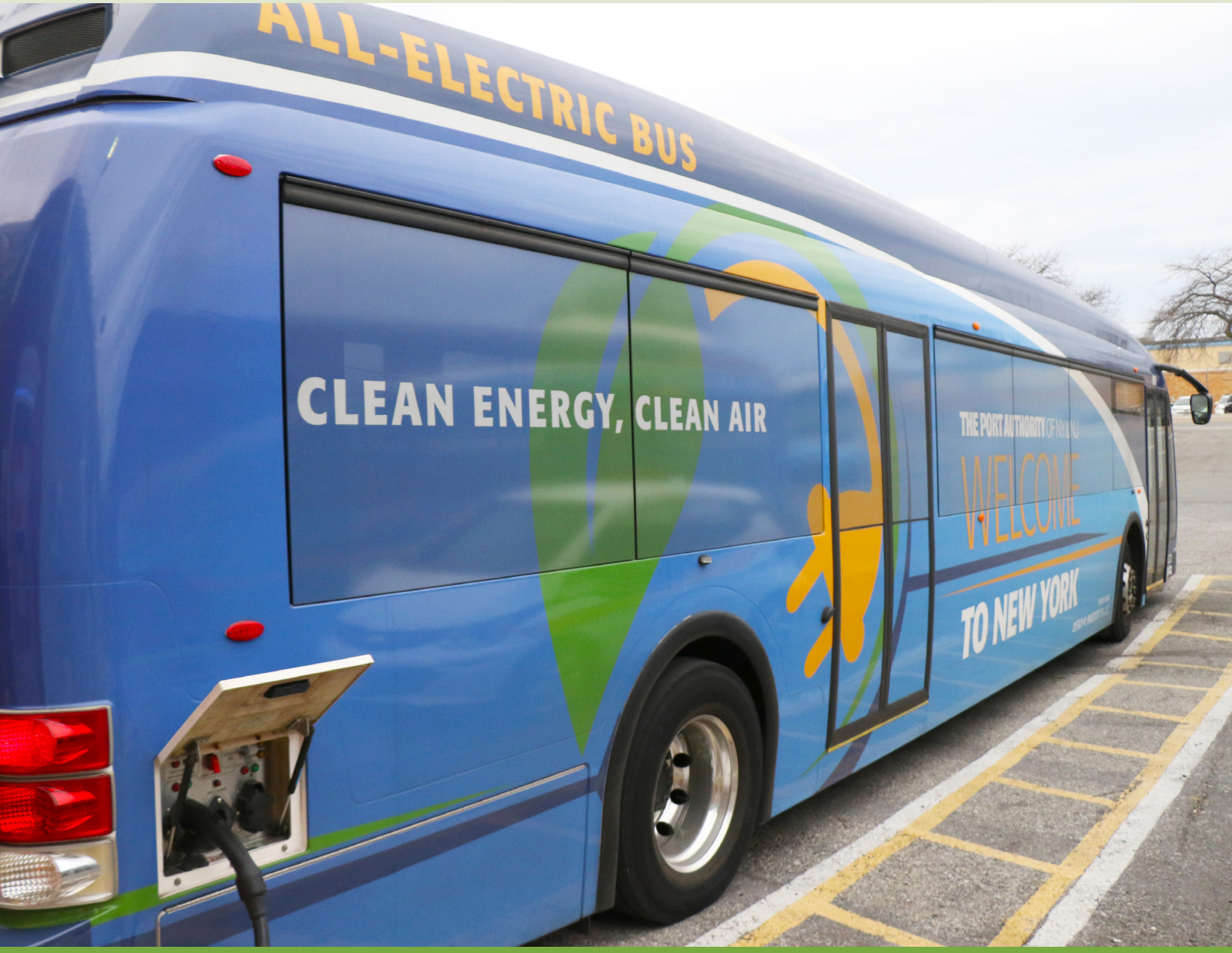
Vivid Economics is a strategic economic consultancy that specializes in the policy-commerce interface and resource- and environment-intensive sectors. Our work addresses the public interest to enhance our clients' interests and the public good. Vivid Economics supports accelerated green and sustainable investment through understanding and communicating investment barriers, designing approaches and financing instruments, and supporting broader reforms and new institutions to enable green investment. We advise local and national government, public bodies and investors on the private returns and public impact from investment strategies and assets.

# CONTENTS


ALL-ELECTRIC BUS
CLEAN ENERGY, CLEAN AIR
WELCOME
TO NEW YORK

# FOREWORD

*"The opportunity for cleaner fleets, cleaner cities and cleaner investments is before us."*

We've all seen the signs in hotel rooms urging us to hang up towels to save the planet. According to researchers, that sign is much less effective than a sign that asks you to join other guests who hang up their towels.

This mirrors what we've learned about clean energy. In the case of fleet electrification, we have long assumed that fleet owners will invest in a solution that will save the planet or save them money. But, just like understanding what's needed to move hotel room occupants to act, getting to "Yes" on any fleet electrification initiative demands that we first have to understand both the barriers that stand in the way and the tools that can overcome those barriers.

The time is right for taking on this challenge in the transportation sector. Electric trucks and buses are gearing up for mass deployment. The technology is proven. Critical stakeholders, from policymakers to fleet owners to utilities to financiers are ready to move forward. There is an urgent need to reduce transportation emissions in communities that suffer a disproportionate burden from air pollution. At the same time, a record amount of capital is being deployed through impact investing and other means to drive societal outcomes. However, just because all of these pieces are in place, a market will not spontaneously materialize. Several remaining barriers stand in the way of animating the vast sums of private capital necessary to catalyze the transition to a zero-emission national fleet.

This report and the companion research portal examine these barriers and provide recommendations on how to more effectively leverage public dollars and engage private capital than what has been tried in years past. As this report demonstrates, achieving the environmental, health and financial benefits of this emerging technology will require thinking in new ways about when and how to deploy public and private resources. It will also require more collaboration between policymakers, fleet owners, utilities and financiers, facilitated by a common framework that these parties can use to understand the full range of challenges and the means by which to move forward.

The framework presented in this report is the Total Cost of Electrification (TCE). It builds upon and augments the traditional Total Cost of Ownership (TCO), which has long been a core metric for fleets. Fleet electrification as understood through TCE includes hard costs, soft costs, risks, uncertainties and frictions that are difficult to capture in a traditional TCO analysis. These factors, though, can serve to slow or even block fleet transition efforts. TCE brings these challenges into the discussion, providing a common language that also helps highlight opportunities to overcome them.

This report matches the most significant barriers to existing and emerging financing approaches and non-financial support tools that can mitigate, eliminate and/or shift the costs, risks and frictions that hold back fleet transitions. Using this "toolkit" will help policymakers and other stakeholders design and deploy solutions that can unleash private capital in electrification markets.

However, frameworks and tools will not spark an electric transformation on their own. It will take people, working in collaboration with one another, to make the transition happen. The financial sector must move off of the sidelines and directly engage with players across the industry to communicate the risk-return needs that will ultimately allow private capital to engage at scale.

The opportunity for cleaner fleets, cleaner cities and cleaner investments is before us. With the convergence of climate change, environmental justice and post-COVID recovery, the importance and urgency of jumpstarting fleet electrification have never been greater. We are at a critical juncture to enable the enormous potential of a high-growth, green jobs industry that can create unprecedented economic and national security benefits. Now is the right time to rebuild better by building clean.

With this report, we now have a framework, a toolkit and a path toward collaborative action to catalyze markets and realize our collective ambitions. So let's hang up those towels and get to work.

**Richard Kauffman**

Chairman, New York State Energy Research and Development Authority (NYSERDA)

Chair of the Board of Directors, Generate Capital

Adjunct Senior Research Scholar, Columbia Center on Global Energy Policy

# EXECUTIVE SUMMARY

The medium- and heavy-duty vehicle (MHDV) market – which includes everything from semi-trucks and delivery vans, to city buses and garbage trucks – is on the cusp of an electric transformation. Done right, this shift will deliver massive societal and economic benefits, including improved public health, reduced climate pollution, lowered life cycle costs and net increases in clean energy investment.

To ensure and accelerate the transition, we must move beyond the set of traditional mechanisms that have been used to assist one-to-one replacements of trucks and buses, such as grant programs providing basic buy-down payments. A new generation of solutions will be needed to electrify America's fleet and achieve a zero-emissions future by 2050. These solutions must deploy limited public monies in a manner that will unlock private capital at an unprecedented scale.

This shift will require understanding and developing innovative financing approaches and non-financial support tools that overcome key hard and soft costs, risks and uncertainties, and market frictions. The summation of these barriers represents the Total Cost of Electrification (TCE), a new analytical framework that expands upon traditional analyses associated with fleet investment.

Interviews with over 30 representatives across the nation from transit, trucking and school bus fleet operators; national and international public and private finance professionals; and electric vehicle market and public policy experts indicate that an array of complementary solutions are needed to overcome the highest-priority barriers at the federal, state and local levels. Further, they must be tailored to overcome challenges specific to fleet types, geographies and goals. These solutions form a TCE Toolkit of different financing approaches and supporting tools that can be deployed by policymakers, fleet owners, utilities and financiers to address different costs and barriers to investment.

**"A new generation of solutions will be needed to electrify America's fleet and achieve a zero-emissions future by 2050."**

A new generation of public policies and programs capable of transitioning truck and bus fleets to zero-emissions can be built by leveraging tools identified in the TCE Toolkit. Additionally, interviews uncovered three design principles to guide stakeholders forward.

Progress will require a new level of collaboration among all stakeholders including policymakers, fleet owners, utilities, financiers, vehicle manufacturers and communities overburdened by air pollution.

Together, these parties can develop and implement the solutions suitable for distinct fleet types and geographies designed with a comprehensive understanding of the barriers standing in the way of action. These programs, in turn, will accelerate the turnover of truck and bus fleets to zero-emission vehicles in the coming decade.

# TOTAL COST OF ELECTRIFICATION (TCE) TOOLKIT

## FLEET INVESTMENT BARRIERS

| HARD COSTS | SOFT COSTS | RISKS + UNCERTAINTIES | FRICTIONS |
|---|---|---|---|
| Costs from investment in new assets and fixed infrastructure | Costs from additional activities and processes to switch to electric MHDVs | Costs from uncertainties that make financing more expensive or electric MHDVs appear less cost competitive | Limitations that increase the psychological or practical cost of switching to electric MHDVs |

## TCE TOOLKIT

| | | | |
|---|---|---|---|
| Public-backed "soft" loans | Operational expenditure grants | Asset residual value guarantees | Non-financial grants (e.g. in-kind support) |
| Interest rate incentives | Performance guarantees | Political risk guarantees | Policy reform for new approaches |
| Equity investments | Operational leasing | Financial risk guarantees | Technical assistance for using financing |
| Financial grants | "Wet" (all inclusive) leasing | Building secondary markets for vehicles and batteries | Guidance on financing compliance with regulations |
| Commercial bonds | Lease-purchase agreements | Battery health programs | Clean vehicle standards |
| Green bonds | On-bill financing | | |
| Municipal bonds | | | |
| Aggregation / Warehousing | | | |

## LEGEND

Capital instruments | Risk reduction instruments | Cost smoothing instruments | Technical support | Policy action

# DESIGN PRINCIPLES FOR FLEET ELECTRIFICATION PROGRAMS

1

**Deploy** public money where it's needed the most and where it will have the most impact.

2

Actively **enable** private investment and financing options.

3

**Target** the full set of barriers relevant to your electric fleet transition including costs, uncertainties, risks and frictions.

# INTRODUCTION


Zero-emission technologies have arrived for the MHDV market. Communities suffering from diesel pollution, policymakers, fleet owners, utilities, financiers and vehicle manufacturers all recognize the potential of these new, clean trucks and buses. However, for these vehicles to deliver on their promise, their numbers need to grow in the national fleet in addition to on the showroom floor. Financing remains a significant challenge to widespread adoption and deployment in public and private fleets across the United States.

The traditional public and private mechanisms that have been developed to assist the purchase of cleaner trucks and buses are often mismatched with the highest-priority needs for fleet transitions. Nationwide, most existing programs were designed for one-to-one replacements of older internal combustion trucks with new, less-polluting ones. These programs have been limited in their ability to support new infrastructure or address the additional costs, risks, uncertainties and frictions that arise when shifting vehicle technology. Further, fleet owners often find existing grant programs to be administratively difficult and costly to navigate, given constraints such as reporting and vehicle scrappage requirements. The end result is a lost opportunity to replace more internal combustion vehicles with zero-emission ones.

The opportunity at hand is to transition truck and bus fleets to zero-emission vehicles — a deployment of new technology and infrastructure similar in scope to that which has been built up over more than a century to support the use of fossil fuels. To achieve this transition, we need a new generation of financing approaches and non-financial support tools that are as innovative and widely-adopted as the vehicles themselves.

There is much at stake in getting new approaches and tools right. Over the next decade, billions of dollars of capital will be required to transition to zero-emissions fleets of medium- and heavy-duty vehicles – with a vast majority of investment going to electrification. All stakeholders can gain through reduced pollution and lower lifecycle costs. Developing these new solutions, though, will require that the full range of fleet barriers be understood and addressed.

Many fleet electrification barriers are known and accounted for in traditional TCO calculations. These include vehicle upfront costs, which are a well-recognized challenge. However, various softer costs, risks, uncertainties and market frictions like those that stem from emerging technologies, local permitting and changes to operational patterns need to be considered too. While falling outside of a traditional TCO analysis, these are very real costs that stakeholders can begin to account for under a framework of TCE.

We believe that solutions and fleet electrification programs designed to account for TCE will be effective in spurring adoption of electric trucks and buses and will emerge through focused collaboration among stakeholders. EDF and others can help to foster dialogue. At the conclusion of this document we provide principles and engagement questions to support such collaboration.

# THE MARKET OPPORTUNITY FOR MEDIUM- AND HEAVY-DUTY ELECTRIC FLEETS

MHDVs are excellent candidates for electrification. If the sector can be unlocked, electric MHDVs could flip the impact from this problematic industry into a top solution for society to slow climate change, create jobs, and improve the environment and quality of life in communities over the next decade.

The market opportunity for this transition is enormous. Every day, more than 14 million buses and large trucks carry commuters, packages, raw materials and other critical cargo that fuel the U.S. economy.[1] These vehicles, usually powered by diesel engines, are among the dirtiest vehicles on the road and will be the leading source of growth in transportation climate pollution over the next 30 years.[2] Total deployment of electric MHDVs today remains a small fraction of overall buses and trucks on the road. But technology continues to rapidly improve as demand soars. Experts estimate that by 2030, electrified trucks could grow into a $47 billion global sector.[3] This opportunity, paired with the accelerating global demand for socially responsible investments, points to a powerful tipping point for transforming transportation and establishing a new asset class that can deliver substantial financial, social and environmental returns for forward-thinking investors.

The truck industry is gearing up for this transition. Manufacturers are investing billions of dollars to ready zero-emission trucks for the market.[4] Daimler – the top producer of freight trucks in the United States – has committed to stop selling internal combustion trucks in main markets by 2039.[5] Fleets are embracing these vehicles, too. In 2019, Amazon ordered 100,000 electric trucks from EV start-up Rivian.[6] Pepsi, Anheuser-Busch, J.B. Hunt and others are now piloting trucks, to name a few examples. Businesses that rely on transportation in their supply chains but don't own their own vehicles have significant unmet demand for clean shipping. New contractual and financial models that aggregate demand for electric MHDVs will create new investment opportunities to accelerate adoption. Over the next few years, the number of electric truck models on the market is expected to grow significantly, and the number of medium- and heavy-duty electric vehicle deliveries will double.[7,8]

Policymakers are pushing for a timely transition. In June 2020, 15 U.S. states committed to a 2030 goal for 30% of trucks, buses and vans sold in these states to be zero-emission vehicles.[9] In September 2020, California's governor issued an executive order requiring state agencies to develop programs that achieve a statewide transition to zero-emission trucks by 2045 as feasible, including a requirement that key segments transition to 100% Zero Emission Vehicles (ZEVs) by 2035.[10] These states – which represent more than a third of the total U.S. MHDV fleet[11] – are already committing to thousands of electrified vehicles at the city level. In fact, public sector fleets across the U.S., including refuse, transit and school buses are already going "all-electric" in cities like New York, Los Angeles, Houston, Honolulu and elsewhere.

## MARKET OPPORTUNITY

**$47 BILLION** Global market opportunity for electric trucks by 2030 [12]

**27x GROWTH** Potential increase of electric trucks on U.S. roads by 2025 [13]

**$1.5 BILLION** U.S. market opportunity for electric buses by 2024 [14]

# TOTAL COST OF ELECTRIFICATION: A BARRIERS FRAMEWORK

Making the switch to an electric fleet requires much more than simply deciding to switch. It requires a comprehensive assessment of the barriers that must be overcome to make the transition. The TCE is a framework for this assessment.

**"TCE can provide fleet owners with increased confidence to commit to, and successfully realize, fleet electrification efforts."**

The TCE framework builds upon and complements traditional TCO analyses. TCE highlights the need to be inclusive of the hard and soft costs, risks, uncertainties and frictions associated with a fleet transition. These often fall outside of a traditional TCO analysis. By bringing transparency to the range of issues that may be encountered, TCE can provide fleet owners with increased confidence to commit to, and successfully realize, fleet electrification efforts.

Further, when the full range of costs, risks, uncertainties and frictions are thoroughly inventoried, understood and evaluated, an array of tools available to policymakers and other stakeholders to overcome those barriers becomes apparent.

With that said, TCE is not a panacea and remains an evolving framework as more is understood about the particular needs and challenges faced by individual fleets. We already anticipate that certain underlying business model challenges may not be fully captured. However, by engaging with this framework, it is expected that stakeholders will continuously identify areas for improvement and offer recommendations so that it can evolve and become increasingly useful to the sector.

On the next page, the TCE framework is shown. A more detailed exploration of TCE and the range of barriers it captures can be found on our companion research portal.

## TOTAL COST OF ELECTRIFICATION:
A NEW FRAMEWORK FOR EVALUATING FLEET ELECTRIFICATION BARRIERS

| HARD COSTS | SOFT COSTS | RISKS + UNCERTAINTIES | FRICTIONS |
|---|---|---|---|
| Costs from investment in new assets and fixed infrastructure | Costs from additional activities and processes to switch to electric MHDVs | Costs from uncertainties that make financing more expensive or electric MHDVs appear less cost competitive | Limitations that increase the psychological or practical cost of switching to electric MHDVs |

### PRIORITY BARRIERS

| | | | |
|---|---|---|---|
| • High upfront vehicle capital cost<br>• High upfront and replacement battery costs<br>• Technical infrastructure costs, including chargers and system upgrades | • Changes to business operations (including routes and schedules)<br>• Permitting and approvals<br>• Practicalities of switching to new maintenance logistics<br>• Knock-on effect of missed charging events | • Uncertain residual value of vehicles and batteries<br>• Uncertain future capital costs and total lifetime cost<br>• Uncertain battery technology performance and life<br>• Uncertain maintenance costs<br>• Uncertain fuel cost savings<br>• Uncertain evolution of incentives and policy standards | • Lack of capacity to plan and implement fleet switches to electric MHDVs<br>• Lack of capacity to use new financing approaches<br>• Inertia in procurement and contracting process |

### DEEP DIVE EXAMPLE

| High upfront capital cost | Changes to business operations | Uncertainty around residual value | Lack of capacity to plan and implement switches |
|---|---|---|---|
| Despite significant declines in vehicle and battery costs, upfront costs of electric MHDVs remain a major obstacle to increased deployment.<br><br>This price tag differential remains a powerful deterrent despite numerous studies that indicate electric MHDVs have a lower TCO than internal combustion equivalents. | Switching to a different vehicle type involves more than just addressing a difference in purchasing price.<br><br>There are also costs associated with adapting business operations, identifying and procuring new equipment, interfacing with the utility, training employees and optimizing charging and route management. | Electric MHDVs and the batteries that power them are new technologies without long track records of performance and resale prices in secondary and tertiary markets.<br><br>The uncertainty makes potential buyers nervous about recouping residual value from used electric vehicles, as they usually do with internal combustion engine (ICE) vehicles, and makes financing more difficult as the expected residual value for the asset may be set low or at nothing due to high uncertainty. | Even with a high-level commitment to transition to electric MHDVs, many organizations face inertia and lack of internal bandwidth to take on the challenge.<br><br>As with any new priority, resources must be deployed to ensure that staff have the time, training and support needed to overcome frictions, try new things, and scale successes based on initial learnings. |

| Increase actual costs of electric MHDVS | Increase actual and perceived costs of electric MHDVS | Increase costs of switching to electric MHDV fleets |
|---|---|---|

**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.

# DEVELOPING SOLUTIONS TO BARRIERS: THE TCE TOOLKIT

The TCE framework provides a new way to differentiate the barriers facing distinct fleet types. By using TCE, the range of costs, risks, uncertainties and frictions that must be overcome can be revealed and considered with greater clarity – and associated solutions can be developed to address them.

On the following pages, we introduce the TCE Toolkit, a first-of-its kind catalogue of financing approaches and non-financial support tools available to help electrify MHDV fleets.

To help navigate the toolkit, we offer five overarching categories of solutions. Financing approaches include capital instruments, risk reduction instruments and cost smoothing instruments, while non-financial support tools include technical support and policy actions.

Details on these solutions can be found on the companion research portal for this report, including an analysis of the comparative strengths of these solutions and the particular challenges they are best suited to address in various fleets types and geographies.


**THE TOTAL COST OF ELECTRIFICATION (TCE) TOOLKIT:**
CATEGORIES OF FINANCING APPROACHES AND NON-FINANCIAL SUPPORT TOOLS

| | | |
|---|---|---|
| FINANCING APPROACHES | CAPITAL INSTRUMENTS | Financing instruments that increase access to capital or other resources and/or reduce the cost of capital |
| | RISK REDUCTION INSTRUMENTS | Financing instruments that reduce exposure to risk or uncertainty |
| | COST SMOOTHING INSTRUMENTS | Financing instruments that reduce and smooth upfront and/or recurrent costs |
| NON-FINANCIAL SUPPORT TOOLS | TECHNICAL SUPPORT | Support for technical management of electric MHDVs and technical assistance for financing approaches |
| | POLICY ACTION | Policy measures to enable financing and encourage fleet transitions |


Photo Courtesy: Damlier

## **THE TCE TOOLKIT:** OVERVIEW OF SELECT APPROACHES AND TOOLS

| HARD COSTS | SOFT COSTS | RISKS + UNCERTAINTIES | FRICTIONS |
|---|---|---|---|
| Public-backed "soft" loans | Operational expenditure grants | Asset residual value guarantees | Non-financial grants (e.g. in-kind support) |
| Interest rate reductions | Performance guarantees | Political risk guarantees | Policy reform for new approaches |
| Equity investments | Operational leasing | Financial risk guarantees | Technical assistance for using financing |
| Financial grants | "Wet" (all inclusive) leasing | Building secondary markets for vehicles and batteries | Guidance on financing compliance with regulations |
| Commercial bonds | Lease-purchase agreements | Battery health programs | Clean vehicle standards |
| Green bonds | On-bill financing | | |
| Municipal bonds | | | |
| Aggregation / Warehousing | | | |

LEGEND

Capital instruments | Risk reduction instruments | Cost smoothing instruments | Technical support | Policy action

# KEY TERMS AND SOLUTIONS

## CAPITAL INSTRUMENTS

### PUBLIC-BACKED "SOFT" LOANS

Public-backed "soft" loans are loans with low interest rates, longer maturity, reduced collateral requirements, grace periods or subordinated debt that can support MHDV fleet electrification investments not suitable for commercial-term borrowing. These were used by the Inter-American Development Bank for Bogota's e-bus rapid transit system, allowing for the purchase of e-buses with significantly higher purchase prices than traditional diesel buses.

### INTEREST RATE REDUCTIONS

Interest rate reductions can incentivize the uptake of MHDV fleet electrification investments. These may be provided by public or private lenders with public "buy down" of interest rates. The Wyoming Business Ready Community Program uses this approach for public infrastructure development that benefits the business community.

### EQUITY INVESTMENTS

Equity investments can support an MHDV fleet electrification enterprise or project, spur the establishment and growth of businesses, and signal investability to the broader financial sector.

### FINANCIAL GRANTS

Financial grants are direct transfers to fleets or owners that reduce the purchase price of new vehicles and/or infrastructure by covering part of the capital cost of new assets. Direct grants have been used frequently in the past but exhaust public capital quickly, and so are best used in a targeted way to prioritize deployments in overburdened communities and support investment when other financing approaches are not available or practical.

### COMMERCIAL BONDS

Commercial bonds are debt instruments issued by private businesses engaged in MHDV fleet electrification that entitle creditors to interest "coupon" payments. These can help businesses raise capital to finance large upfront costs for corporate projects.

### GREEN BONDS

Green bonds are public or commercial bonds that generate capital to fund high upfront costs where proceeds are earmarked for environmental projects, including MHDV fleet electrification. The "green" credentials of these instruments can attract heightened interest from investors and could lead to lower interest payments.

### MUNICIPAL BONDS

Municipal bonds are debt instruments issued by public entities engaged in MHDV fleet electrification that entitle creditors to interest "coupon" payments. These can enable public entities to raise capital to finance large upfront costs for municipal projects.

### AGGREGATION / WAREHOUSING

Aggregation / Warehousing involves bundling together smaller MHDV fleet electrification investments to attract investors looking for larger opportunities. This approach can transform one-off, non-traded assets into standardized, tradable assets and has been used in other clean economy sectors (e.g., renewable energy, energy efficiency) to catalyze the flow of capital at scale.

### OPERATIONAL EXPENDITURE GRANTS

Operational expenditure grants include cash grants, rebates or reimbursements for operational costs connected to electric MHDV fleets, such as electricity and maintenance. These can help to reduce ongoing costs for fleet owners and operators.

### NON-FINANCIAL GRANTS

Non-financial grants are transfers of non-financial assets or support (such as land, infrastructure, maintenance, training, etc.) to reduce upfront or ongoing costs for electric MHDV fleet owners and operators.

## RISK REDUCTION INSTRUMENTS

### PERFORMANCE GUARANTEES

Performance guarantees, or government-backed guarantees, reduce investment risk by protecting electric MHDV purchasers from under-performance of vehicles or batteries.

### ASSET RESIDUAL VALUE GUARANTEES

Asset residual value guarantees protect investors or purchasers against future low residual or resale value of electric MHDVs by specifying a guaranteed minimum value, through direct purchase or making up price differentials.

### POLITICAL RISK GUARANTEES

Political risk guarantees protect investors or purchasers of electric MHDVs against losses due to a specified set of political risks – such as changes in climate, vehicle or fuel regulations or policies – to reduce investment risk.

### FINANCIAL RISK GUARANTEES

Financial risk guarantees protect investors in electric MHDV fleets against losses due to debt servicing defaults on the part of the borrower for any reason, including under performance of assets. The Title 17 Federal Loan Guarantees for Renewable Energy Projects and Energy Efficient Projects is a framework that addresses projects of similar size and scope as large transportation-related infrastructure and vehicle purchases.[15]

## COST SMOOTHING INSTRUMENTS

### OPERATIONAL LEASING

Operational leasing, where the electric MHDV fleet operator rents both the vehicle and battery from the manufacturer or an intermediary, reduces upfront purchase costs and the risk from uncertain residual values of assets.

### "WET" (ALL INCLUSIVE) LEASING

"Wet" (all inclusive) leasing is a leasing model where the lessor provides the vehicle,

battery, maintenance, and, in some cases, the insurance and operational staff, to the electric MHDV fleet operator. This reduces upfront purchase costs, risk from uncertain residual values of assets and the need to invest in maintenance or the training of staff.

### LEASE-PURCHASE AGREEMENTS

Lease-purchase agreements, where the electric MHDV fleet operator rents vehicles and batteries with the option to buy upon termination of the contract, reduces upfront purchase costs and risks from uncertain residual values of assets, while preserving the exclusive option to purchase assets at the end of the lease.

### ON-BILL FINANCING

On-bill financing allows electric MHDV fleet operators to finance a share of the upfront costs and repay this over time on their utility bill. This reduces upfront purchase costs, links repayments to standing relationships, and provides a new guaranteed revenue source to utilities. The Pay-As-You-Save (PAYS) model is a specific case of on-bill financing.

## TECHNICAL SUPPORT

### BUILDING SECONDARY MARKETS

Building secondary markets for vehicles and batteries, through commitments to purchase assets or the provision of other incentives for the private sector, would reduce uncertainty and risk around residual values of assets.

### BATTERY HEALTH PROGRAMS

Battery health programs that monitor electric MHDV battery performance, rectify performance issues, and/or replace faulty or under-performing batteries, reduce uncertainty and risk around battery performance and residual values of assets.

### TECHNICAL ASSISTANCE

Technical assistance for public and private fleet owners would enable easier uptake of new financing approaches that support electric MHDV fleet transitions.

### GUIDANCE ON FINANCING

Guidance on financing compliance with regulations is particularly important when combining financing approaches or funding sources in new ways.

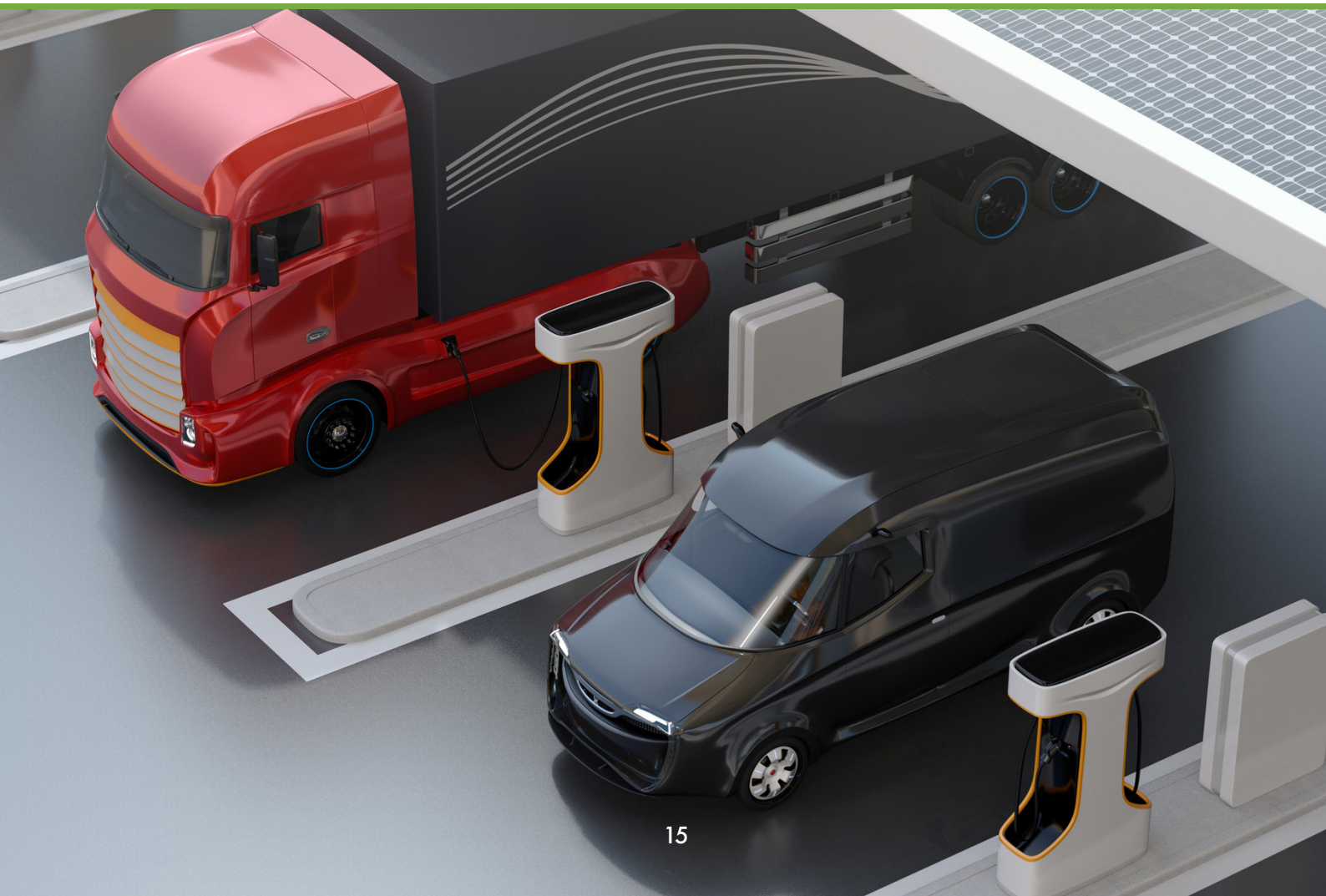
## POLICY ACTION

### POLICY REFORM FOR NEW APPROACHES

Policy reform for new approaches could enable easier uptake of new financing approaches that support electric MHDV fleet transitions. Examples include reforms and policies that allow electric vehicles to acquire additional value through their operation as grid assets via bi-directional charging and discharge, or to acquire monetizable emissions credits that can be used within financing agreements, and adjustments to accounting or investment rules to enable the use and combination of new financing approaches.

### CLEAN VEHICLE STANDARDS

Programs such as emission standards for new vehicles or fleet performance standards can be used to incentivize or accelerate fleet transitions.



# DESIGN PRINCIPLES FOR FLEET ELECTRIFICATION PROGRAMS

Throughout the interview process that informed this report, learnings were synthesized to arrive at a common set of principles to guide the development of fleet electrification programs that leverage public resources and stimulate private investment in electric MHDV fleets.

While these principles are not meant to cover the full range of considerations that should be addressed by policymakers, fleet owners, utilities and financiers, they offer a foundation to compare and adopt a portfolio of options sourced from the TCE toolkit. In particular, these three design principles are meant to elicit a focus on both financing approaches and non-financial support tools, and maximize the impact of public and private investment toward fleet electrification goals.

To further explain these principles, here are two examples of how they could be used to achieve a big impact in two important fleet types – drayage trucks and school buses.

**Drayage trucks**, involved in short distance freight shipping, historically have resulted in disproportionately high amounts of pollution in and near ports and other logistics centers, including on roads servicing those facilities. Due to the high average age, idle time and emission rate of drayage trucks, the heavy concentration of these vehicles contributes to negative air quality impacts in communities near ports. In addition to emissions that contribute to poor air quality, these vehicles are also important sources of greenhouse gas emissions.

As a result, policymakers are increasingly prioritizing drayage truck fleet electrification. For example, many ports in California – including Los Angeles, Long Beach and San Pedro – are targeting ambitious drayage truck electrification goals.[16]

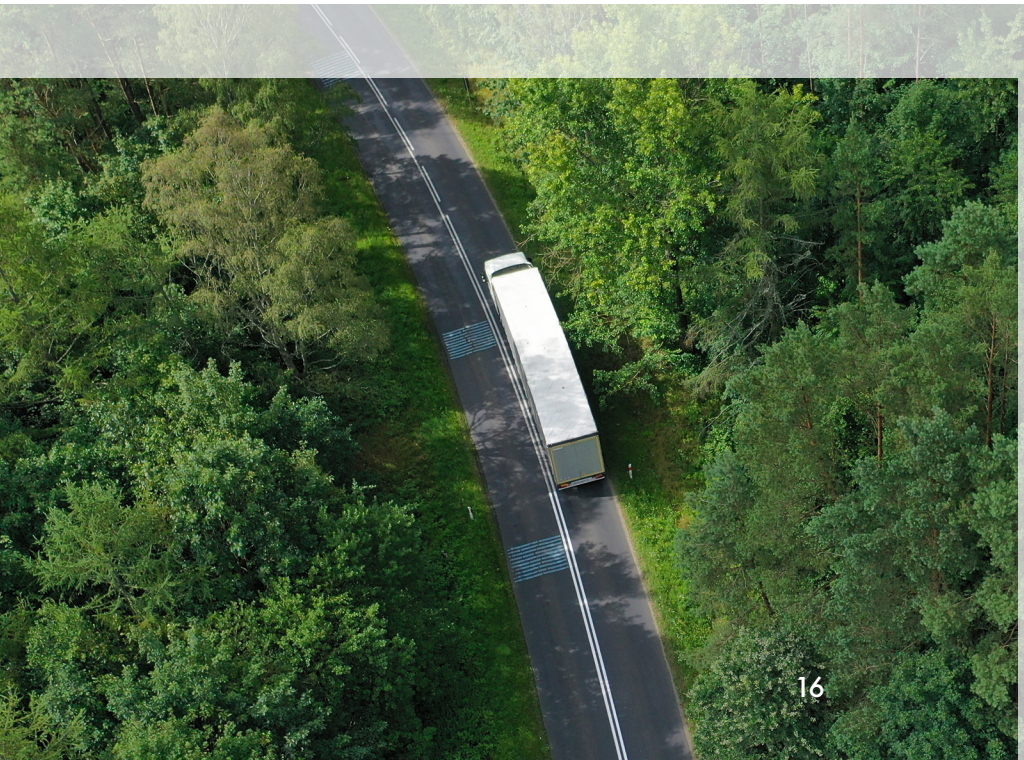
For stakeholders working to electrify drayage fleets, consider the following:

**Principle #1:** Public finance can support accelerated action on drayage trucks by targeting fleets associated with the greatest harm or facing the biggest cost barriers to electric MHDV investment. Small operators that may be poorly capitalized or face challenges with limited access to charging infrastructure could benefit from grant programs, soft loans or vehicle scrappage programs – though the impact of grant schemes may be limited as many drivers buy vehicles on secondary markets.

**Principle #2:** Many drayage fleets will be able to finance investments fully themselves, but may need support getting started with new financing approaches, such as battery leasing or on-bill financing to address upfront investment cost challenges.

**Principle #3:** Public actors can also help drayage fleets overcome key uncertainties and frictions, including uncertain battery technology performance and battery life, and the lack of capacity to use new financing approaches, through the use of risk reduction instruments like guarantees and through technical assistance for financing instrument design.

1. **Deploy** public money where it's needed the most and where it will have the most impact.
2. Actively **enable** private investment and financing options.
3. **Target** the full set of barriers relevant to your electric fleet transition, including costs, uncertainties, risks and frictions.




**Diesel school buses** have substantial negative health impacts from exhaust fumes, especially for children, who are uniquely vulnerable to pollution.

While school buses are seen as ripe for electrification – given the potential high health and climate benefits – they face several barriers, particularly justifying high upfront investment costs given limited annual use (particularly during summer months) and limited access to capital markets for the third of school bus fleets that are privately owned.[17]

For stakeholders working to electrify school bus fleets, consider the following:

**Principle #1:** Public finance can support accelerated action on school buses for both municipally- and privately-owned fleets by targeting legacy fleets, as many states do not have a mandated maximum school bus age, and by offering financial grant programs and "soft" and low-interest loans that lower high upfront costs.

**Principle #2:** Innovation in private financing approaches can also support accelerated school bus fleet electrification, for example through using vehicle-to-grid approaches to create additional revenue streams by allowing greater asset utilization during daily or prolonged downtimes, as being trialed by Dominion Energy in Virginia.[18]

**Principle #3:** Stakeholders can also bring to bear technical assistance support to help school bus fleets overcome key uncertainties and frictions such as inexperience with novel financing approaches and operational requirements.

# COLLABORATIVE ACTION TO JUMPSTART THE TRANSITION

**"Real progress requires more than frameworks and toolkits. To bring these static documents to life, leaders from government, business and finance must break out of sectoral silos and open themselves up to thinking differently."**

This report offers a new framework for evaluating the range of barriers currently limiting the flow of private market capital into medium- and heavy-duty fleet electrification efforts across the United States, as well as a toolkit to help overcome these barriers. Together, they offer a foundation for initiating collaborative action to jumpstart the transition. They provide a common language for key stakeholders – including policymakers, fleet owners, utilities and financiers – to communicate with one another about challenges, beyond upfront capital costs, and begin designing targeted solutions that can accelerate the electric transformation.

Real progress requires more than frameworks and toolkits. To bring these static documents to life, leaders from government, business and finance must break out of sectoral silos and open themselves up to thinking differently. This requires an exploration of how barriers and solutions are interlinked, and the initiation of collaborative processes and dialogues where parties sit down together with a goal of forging solutions that take into account multiple interests. Most importantly, this dialogue must authentically engage and be shaped by the communities that will be directly impacted by decisions around electrification efforts.

While it is impossible to be prescriptive about the format and nature of collaboration processes that should take place in a particular fleet or geography to enable investment, here are a set of five engagement questions are offered here to aid dialogue between key stakeholders.

**1. What type of fleet is the target of the effort, or the most important to electrify first and why?** Will electrifying this fleet maximize climate, environmental justice and job creation benefits?

**2. What are the critical barriers to electrifying that type of fleet?** What does a full TCE analysis reveal about hard costs, soft costs, risks and uncertainties, and frictions?

**3. Who is missing at the table?** Based on electrification priorities and the TCE analysis, who needs to work together to develop impactful and cross-cutting solutions? Are the relevant experts and stakeholders, including representatives of the community, at the table?

**4. What approaches and tools might be well-positioned to help overcome the critical barriers?** Where will public support have the biggest bang for its buck? Should any current programs be reassessed?

**5. How will success be measured?** What metrics are most appropriate to evaluate that barriers are being overcome and outcomes achieved? How will impact be assessed?

Now is the time to roll up our sleeves and collaborate to build and deploy new financing approaches that will accelerate the adoption of electric trucks and buses. The need is urgent, the vehicles are here, fleets are ready, and the long-term business case is compelling. Policymakers and market participants have the tools to act.

**Let's get to work financing the transition.**

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# FINANCING THE TRANSITION

## UNLOCKING CAPITAL TO ELECTRIFY TRUCK AND BUS FLEETS


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