BUILDING THE GRID TO NEED

Best Practices for Proactively Developing Distribution Grids to Support Truck and Bus Electrification

Environmental Defense Fund

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“A nationwide buildout of high-power charging infrastructure and an associated expansion of the electric grid will be needed to achieve high levels of electric MHDV deployment.”

EXECUTIVE SUMMARY

Today's medium- and heavy-duty vehicles (MHDVs), from delivery vans to school buses to long-haul tractor-trailers, provide invaluable services in moving people and goods throughout the U.S. while also doing vast damage to public health and the climate with their tailpipe emissions.

Battery-electric vehicles can rewrite this narrative, facilitating commerce while avoiding emitting greenhouse gases and local air pollutants. Policymakers have recognized this, as many states have already advanced policies that will accelerate truck and bus electrification in the coming years. And even in states without such policies, the increasingly competitive economics of electric vehicles and sustainability commitments from public and private fleets are driving a shift away from gas and diesel MHDVs. A nationwide buildout of high-power charging infrastructure and an associated expansion of the electric grid will be needed to achieve high levels of electric MHDV deployment. Because utility regulation in the U.S. is traditionally designed to give investor-owned utilities the opportunity to earn a rate of return when they make investments in their grid, those utilities already have an incentive support load growth from any source, including MHDV electrification. This incentive, however, is balanced by regulators' authority to allow the utility to recover its costs only if those investments were prudently made. This often leaves utilities waiting to expand or upgrade their grids until they receive individual requests from fleets for grid capacity. This reactive process fails to recognize the changing ways in which customers use the grid, and can delay the myriad benefits of MHDV electrification.

REGULATORY REFORMS

Regulators should require regulated utilities to account for projected MHDV electrification in their forecasting, planning, and infrastructure deployments. By aligning utilities' infrastructure planning with projected MHDV electrification, policymakers can ensure utilities have the confidence to make these investments proactively rather than reactively. Regulators can handle approval of most of these investments through existing preapproval processes within rate cases, but because of the rapid development of MHDV electrification and the typical multi-year timeline between rate cases, regulators should also create processes for utilities to seek accelerated approval outside of rate cases.

Recommendation 1: Utility regulators should implement regulatory frameworks, including mechanisms outside of rate cases, that direct utilities to make proactive investments to serve MHDV electrification hot spots without waiting for individual fleets to make load requests.

MITIGATING RISK

These updated project approval processes should include appropriate safeguards against utility overinvestment at customer expense. For example, regulators can require utilities to:

(i) use new data sources that can improve load forecasts, including satellite imagery and vehicle telematics data,

(ii) adapt their grid planning to reflect the tendency of MHDV fleets to cluster in commercial zones and along major travel corridors;

(iii) support deployment of distributed energy resources such as solar PV and battery storage alongside chargers, and

(iv) implement flexible interconnection policies that allow fleets to match their electricity consumption to the capacity limitations of the distribution grid.

These efforts can increase utilities' and regulators' confidence about charging cluster locations, as well as reducing interconnection timelines and long-term system investment needs through lowering fleets' grid capacity requirements.

Recommendation 2: Utility regulators should require utilities to update their grid planning processes to increase confidence that MHDV charging load will materialize when and where expected.

Recommendation 3: State agencies should support utilities by collecting and sharing data that can aid load forecasting for MHDV electrification.

Recommendation 4: Utility regulators should incent and require, as appropriate, the use of non-wires tools to reduce interconnection timelines and costs associated with MHDV charging loads.

As part of their planning, utilities should engage fleets and affected communities to understand their plans, barriers, concerns, and expectations. This engagement can support buy-in from those living near fleet clusters, so communities have an opportunity to share their priorities and experience the direct benefits of this electrification.

Recommendation 5: Policymakers should ensure that affected communities have clear, early opportunities to engage in decisions that will impact the speed and locations of MHDV electrification.

Recommendation 6: Policymakers should create programs that prioritize MHDV electrification in, and maximize the benefits of electrification to, environmental justice communities.

ACCOUNTABILITY AND INCENTIVES

Regulators can also help accelerate interconnections and reduce costs by setting clear targets, metrics, and data reporting requirements, and by backing these requirements with appropriate enforcement mechanisms. A robust reporting regime helps stakeholders identify issues, inform improvements, and measure success. For example, requiring utilities to share information on interconnection timelines, and explain delays, can help regulators identify which aspects of the utility's forecasting, planning and interconnection processes require attention. And if long timelines are driven by factors outside of a utility's control, such as permitting delays, this information can help regulators better collaborate with sister agencies to address these barriers.

Recommendation 7: Regulators should set clear, enforceable targets, metrics, and reporting requirements for utilities' interconnection work.

These measures can be paired with tools that connect utilities' earnings to their achievement of MDHV electrification goals, such as mechanisms that increase or decrease a utility's authorized returns based on its performance in shortening fleet interconnection timelines or reducing interconnection costs. These mechanisms also help mitigate the risk of utility overbuilding by making a utility's earnings less dependent upon the size of its rate base.

Recommendation 8: Regulators should use economic incentives to steer utility improvements in projecting and interconnecting new loads.

COVERING COSTS

Finally, policymakers must consider how to allocate the costs of proactive investments. Analysis shows that MHDV electrification will likely be beneficial for utility ratepayers. Appropriate utility system investments carry a low risk of becoming stranded given the growth of electrified end uses, and the additional revenue from MHDV charging can match or even outpace the long-term cost of system investments needed to support that charging. Policymakers should consider how to allocate these costs among ratepayers, and whether some costs—and the associated risk—can be borne in other ways such as through state or federal programs to minimize ratepayer impacts.

Recommendation 9: Policymakers should consider the regulatory and economic factors driving MHDV electrification, and the MHDV sector's position in the larger energy transition, in assessing the risk of proactive grid investments becoming stranded assets.

Recommendation 10: Policymakers should consider how costs can be shared among individual electrifying fleets, ratepayers more broadly, and other private and public funding sources to deploy grid infrastructure and mitigate the risk to ratepayers.


EV
CHARGE

ACRONYMS

CIAC	CONTRIBUTION AID OF CONSTRUCTION
CPUC	CALIFORNIA PUBLIC UTILITIES COMMISSION
DER	DISTRIBUTED ENERGY RESOURCE
EV	ELECTRIC VEHICLES
GHG	GREENHOUSE GASE
IOU	INVESTOR-OWNED UTILITY
IRA	INFLATION REDUCTION ACT
MHDVS	MEDIUM/HEAVY-DUTY VEHICLES
MW	MEGAWATT
NWA	NON-WIRES ALTERNATIVE
OEM	ORIGINAL EQUIPMENT MANUFACTURER
PIM	PERFORMANCE INCENTIVE MECHANISM
POU	PUBLICLY OWNED UTILITY
ZEV	ZERO-EMISSION VEHICLE

INTRODUCTION

The electrification of medium- and heavy-duty vehicles (MHDVs) will require significant investment to upgrade and expand the distribution grids of the more than three thousand electric utilities in the United States.

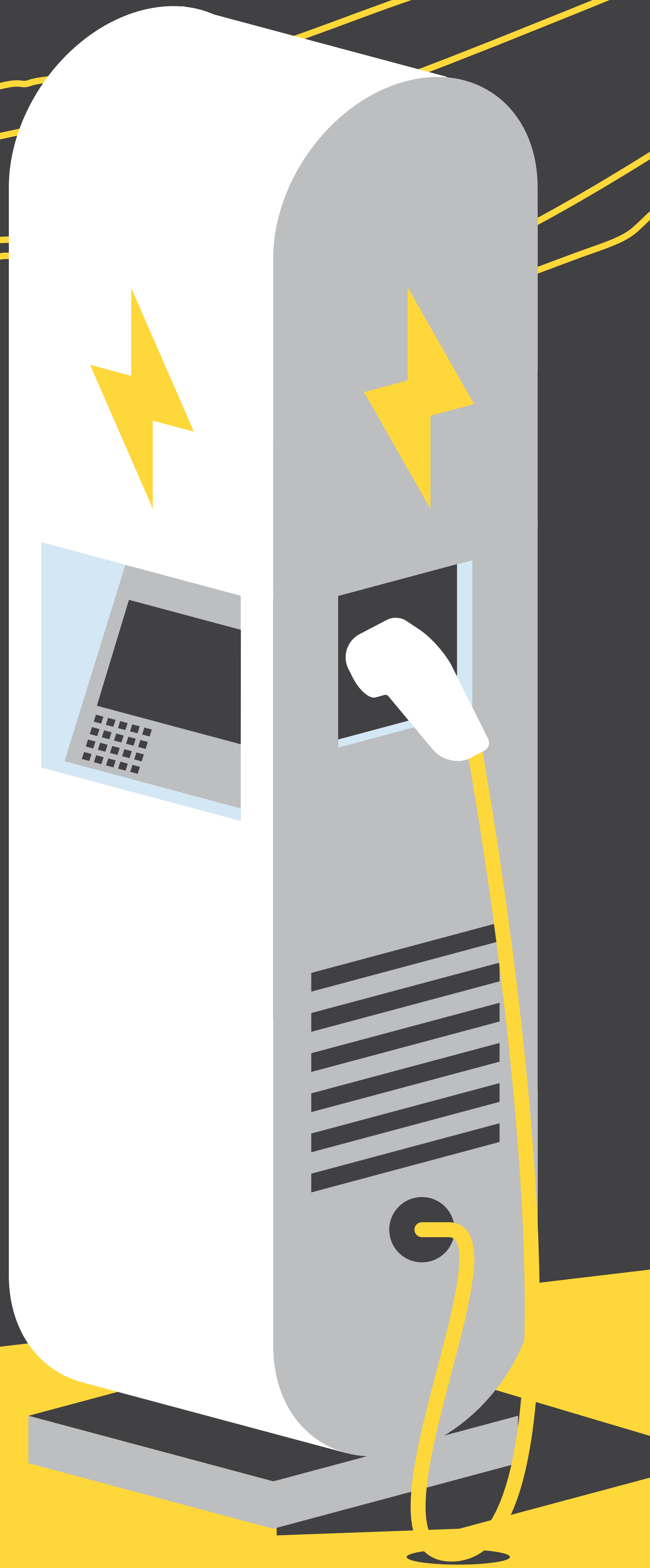
While MHDV electrification will not happen all at once across the country or across market segments, a combination of regulatory and economic factors is accelerating this transition and already contributing measurable load growth on those systems with concentrations of early-electrifying fleets. As this trend continues, timelines to **interconnect chargers** to the grid will likely be a limiting factor for fleet electrification as utilities undertake system work that can stretch several years to prepare their grids for electric MHDV deployments.

This paper attempts to address this need for short interconnection timelines by identifying the issues, and recommending solutions for lawmakers, utility commissions, and utilities, around proactively building out the distribution grids in line with meeting a target of 100% zero-emission MHDV sales in the U.S. by 2035[1]. While focused on investor-owned utilities (IOUs), which serve nearly three-quarters of electricity customers in the U.S., many of these recommendations are also applicable to cooperatives and publicly-owned utilities (POUs), which make up around 95% of the country's electric utilities[2].

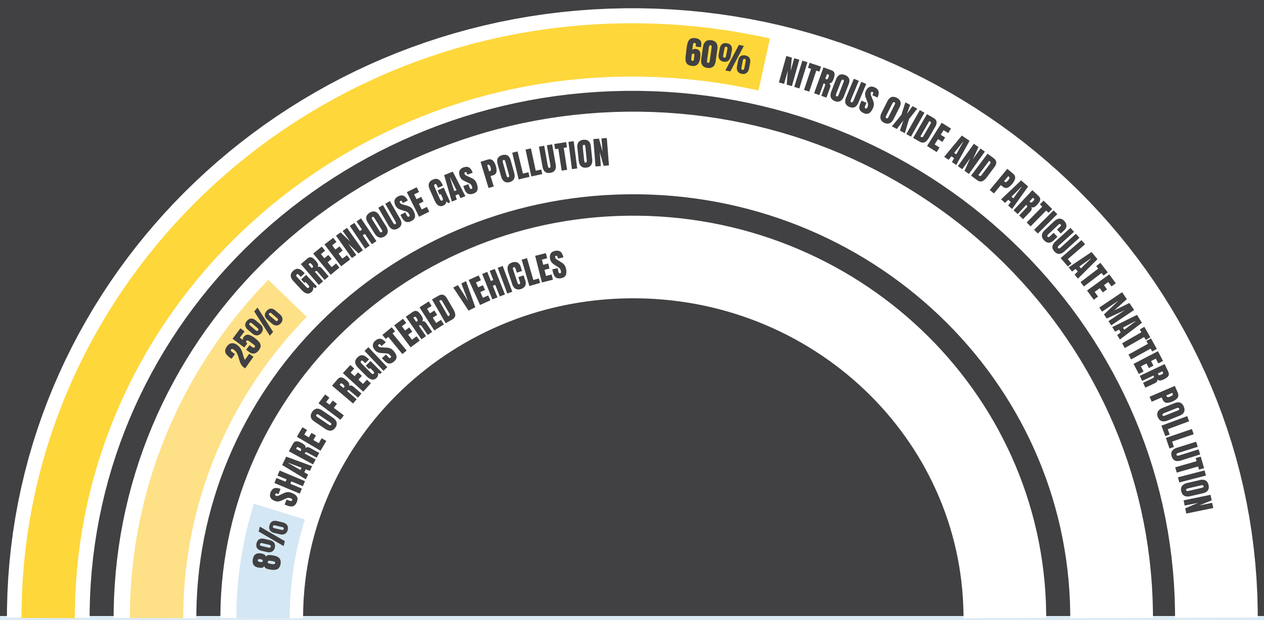
"Interconnection" can refer to both the connection of new generating sources and new load sources to the electric grid. In some jurisdictions, namely California, the connection of new load sources may be referred to as "energization". For the purposes of this paper, we use the term "interconnection" throughout to refer to the connection of new load sources to the electric grid unless otherwise specified.

ULTIMATELY THE QUESTION WE ARE TRYING TO ANSWER IS THIS

What best practices should lawmakers, utility regulators, and utilities implement to ensure that the distribution grid expansion and upgrading needed for widespread MHDV electrification is completed in a timely manner consistent with fleets' needs and federal and state policies, while minimizing costs and other risks to fleets and customers broadly?



THE OUTSIZED IMPACT OF MEDIUM- AND HEAVY-DUTY VEHICLES IN THE TRANSPORTATION SECTOR



THE STATE OF PLAY FOR ELECTRIC MHDVS

Today's MHDVs are responsible for a disproportionate share of both greenhouse gas emissions and local air pollution[3].

These harms are not felt equally, as low-income neighborhoods and communities of color bear a disproportionate share of this pollution[4]. Transitioning to zero-emissions vehicles (ZEVs) can help to mitigate these enormously harmful impacts.

Regulators and fleet operators have begun to recognize and respond to these harms. At the federal and state levels, agencies have advanced, and continue to advance, policies meant to accelerate the deployment of zero-emission MHDVs[5], and have set goals for a full transition away from fossil-fueled MHDVs[6]. Individual fleets are also making their own commitments to electrify, with hundreds of fleets committing to or already ordering hundreds of thousands of zero-emissions MHDVs[7]. Collectively, policies and commitments such as these are expected to significantly increase adoption of zero-emission MHDVs over the coming years, with one study estimating that zero-emission MHDVs in classes 4-8 will grow from less than 1% of the total MHDV stock nationally today, a few thousand vehicles in total, to 10% by 2030, or around 1.1 million vehicles[8]. Electric MHDVs are likely to make up a large majority of these vehicles due to their lower operating costs than other zero-emissions MHDVs[9].

Fleets face several challenges to overcome in adapting to electric MHDVs. Fleet owners and operators face a learning curve to transition away from fossil fuel-powered vehicles, including selecting the appropriate vehicles and chargers, adapting operations and staff training to the vehicles' capabilities and charging needs, and understanding their grid capacity needed for charging and how different charging behavior can minimize those needs and the associated costs. Meeting the charging needs of these fleets will require upgrades to, and expansion of, distribution grids across the country. This transition will happen on different timelines in different states; in the early years in particular it will be concentrated in areas with the greatest amounts of commercial and industrial activity and where regulations obligate a shift to ZEVs. Additionally, most fleets do not make the switch all at once; instead fleets' makeup, and their associated grid capacity needs, will grow over several decades as existing vehicles reach the end of their useful lives and are replaced. Ultimately multiple factors will affect when and where MHDV electrification will happen, and fleet owners, regulators, original equipment manufacturers (OEMs), utilities, and others will all need to play a role in accounting for these variables and preparing the grid accordingly.

> “Ultimately, multiple factors will affect when and where MHDV electrification will happen, and fleet owners, regulators, original equipment manufacturers, utilities and others will all need to play a role in accounting for these variables and preparing the grid accordingly.”

UTILITY BARRIERS TO MHDV ELECTRIFICATION

The scale of the charging need for MHDV electrification is significant, both at the level of the individual vehicle and that of entire sites.

An electric class eight truck can have a battery ten times larger than an average light-duty EV[10] and a MHDV charging hub like a truck stop can have a peak load on the order of twenty megawatts, equivalent to that of a small town[11].

One recent study predicts that by 2030, peak load from MHDV charging will exceed 10 gigawatts with Los Angeles County at the top of the list with 132 megawatts (MW) of peak load[12]. Distribution system improvements will actually need to provide capacity in excess of this coincident peak load, as not all MHDV charging will happen simultaneously and utilities must account for the non-coincident peaks of electrifying fleets across their system charging at different times[13]. The interconnection process to access this capacity is likely to be unfamiliar to most fleet managers and requires working with a new partner, the electric utility, and their regulators to overcome several challenges.

THE RAPID PACE OF ELECTRIFICATION

> **Fleets can often procure vehicles and chargers quickly, sometimes in a matter of months, faster than utilities can complete all but the simplest grid upgrades.**

Fleet electrification can happen much faster than most other sources of electric load, leaving utilities playing catch up. Utilities largely rely on two mechanisms for predicting new electric load: forecasting and load letters. For the load growth spread across their service territory, like new homes and small businesses, utilities tend to rely on forecasting models that take into account economic indicators, population trends, and other similar data to predict system impacts, and then undertake targeted system planning to address those impacts. For customers with loads large enough to independently require grid upgrades, such as a new factory or large apartment building, utilities tend to rely on individual requests from that customer, known as load letters, that detail the grid capacity they need. Because these large facilities typically take years from initial planning to completing construction, utilities usually have enough time to make the necessary grid upgrades by the time the customer is ready for service. Electric MHDVs are fundamentally different. Fleets can often procure vehicles and chargers quickly, sometimes in a matter of months, faster than utilities can complete all but the simplest grid upgrades. Because of this, requiring utilities to wait for individual fleets to reach out with clear grid capacity requests will lengthen the interconnection process as utilities attempt to catch up to each discrete fleet request with the necessary system improvements. It will also lead to more expensive, duplicative grid investments when a utility completes an upgrade to serve a customer's initial load increase, only to have to upgrade that infrastructure again in short order as that customer or others nearby add load.

FLEET CLUSTERING

MHDV fleets are not evenly distributed across states, municipalities, or utility service territories, and instead are concentrated in areas with significant commercial and/or industrial business and along major freight corridors. Although utilities typically know where their current commercial and industrial customers are, that knowledge often doesn't easily translate to an accurate forecast of future MHDV charging load. Many fleets aren't currently large electric customers, and utilities will need to identify these new large customers as well as the clusters of many small fleet loads that will have large aggregate loads. Improving forecasts of MHDV electrification and planning for the resulting charging load will be a crucial component of proactive grid buildout.

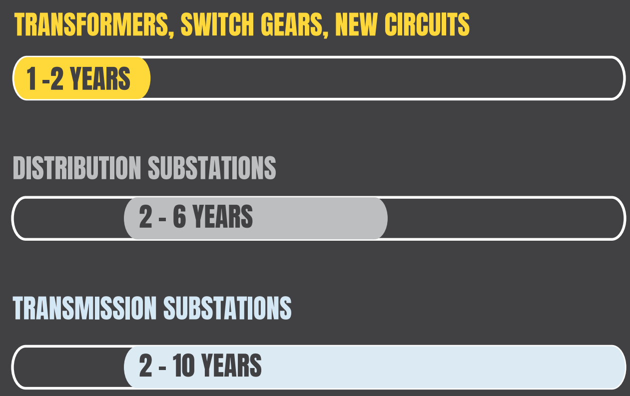
ALIGNMENT WITH REGULATORS

IOUs, which serve nearly three-quarters of all electricity customers in the U.S.[14], are regulated by their state's public utility commission (PUC). Under the traditional utility regulatory framework, IOUs are allowed to recover the cost of investments in their distribution grids, plus a rate of return, for infrastructure investments (such as a new substation or an upgraded feeder) that are both "used and useful" and prudent[15].

This framework works best when load growth is homogeneous and predictable, or is driven by long-lead-time projects. It is more challenging when fleet electrification can result in large new load sources ready to interconnect quickly. Utilities are typically hesitant to begin making investments to upgrade and expand their distribution grids until they are certain of the expected new load those investments would serve, out of fear their regulator will later deem those investments imprudent if the forecasted load does not show up. This means that even when an IOU's grid planners identify a system upgrade they believe is needed to serve forecasted MHDV charging load, the utility may choose to wait until it receives firm commitments from specific fleets. This conservative approach, driven by the lack of certainty that regulators will find proactive investments to be prudent, is an important factor in the long interconnection timelines some MHDV fleets are already experiencing.

GRID UPGRADE TIMELINES

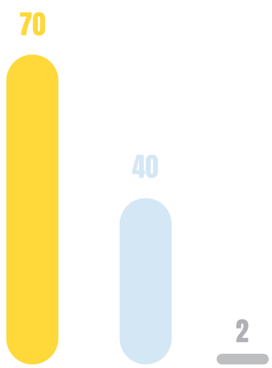
Fleet electrification can trigger a need for several different types of upstream grid upgrades.
The time needed to complete these upgrades can vary widely, with the simplest work doable in a matter of months, and the most complex projects taking upwards of a decade[16]. For example, in its 2022 rate case, Consolidated Edison (Con Edison) requested authorization to construct a new substation in Brooklyn that would enter service no earlier than the summer of 2028 to serve load growth from light-, medium-, and heavy-duty EVs and building electrification[17]. Similarly, in Southern California Edison's latest rate case, the utility identified a variety of system upgrades that will be needed to support California's transportation electrification goals, including the construction of multiple new substations that may take ten or more years to enter service[18].



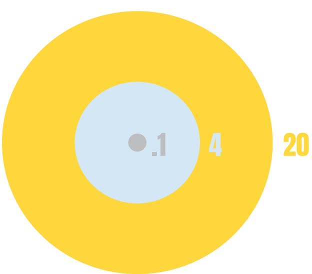
FLEET POWER DEMAND EXAMPLES

HIGHWAY TRUCK STOP	LOGISTICS DEPOT	SMALL BUSINESS
ENERGY USAGE: SMALL CITY	ENERGY USAGE: STADIUM	ENERGY USAGE: 80 HOMES

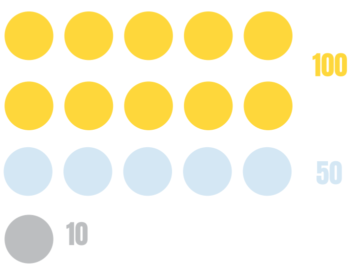
NUMBER OF CHARGERS



PEAK LOAD (MEGAWATTS)



NUMBER OF VEHICLES SERVED



Data Sources: Electric Highways: Accelerating and Optimizing Fast-Charger Deployment for Carbon-Free Transportation
California Heavy-Duty Fleet Electrification Summary Report
United States Energy Information Administration, How much electricity does an American home use

PROACTIVE BUILDING AS A SOLUTION

Preparing the grid for MHDV electrification will require fleets, utilities, utility commissions and other stakeholders to implement a variety of policies and programs to get electric MHDVs the electricity they need.

This whitepaper highlights policies with the potential to minimize interconnection timelines by allowing for proactive grid upgrades. This is paired with discussion of the policies and technologies regulators and utilities can deploy to ensure this new approach to grid development is done in a cost-effective, equitable manner.

AUTHORIZING BUILDING TO NEED

Addressing the challenges of the current utility regulatory framework will require a combination of regulatory improvements that give utilities more flexibility to begin necessary projects to serve coming fleet electrification and the confidence they will be able to recover the costs of those projects, while providing appropriate oversight to ensure that utilities control costs and avoid overbuilding. Depending on the frequency of a utility's rate cases, utility regulators can likely address much of the need for fleet electrification-driven grid upgrades through existing rate cases. To do so, they should require utilities to complete robust transportation electrification forecasting and incorporate this work into their grid planning and investment processes, and they should pair this with a presumption of prudency for investments needed to serve that load. This must also include robust consideration of non-wires alternatives (NWAs) and other cost-mitigation strategies as part of the planning process. A clear directive from a commission to make this work a standard utility practice can give utilities greater confidence that the commission will find those investments to be used, useful, and prudent where they are identified by the improved utility practices. Making this forward-looking work a part of standard utility practice would also mitigate the risk of later disallowances for failure to future-proof investments. That is, if a utility pursued piecemeal upgrades with lower individual project costs but a higher cost than a single upgrade made in line with long-term needs, regulators would be more likely to disallow the excess cost as imprudently incurred.

For the largest MHDV-driven grid needs, such as new substations, utilities would benefit from additional pathways to seek regulatory approval before beginning construction.

1

Utility regulators should implement regulatory frameworks, including mechanisms outside of rate cases, that direct utilities to make proactive investments to serve MHDV electrification hot spots without waiting for individual fleets to make load requests.

While utilities can seek approval for many of these projects within their rate cases, they often go multiple years between these rate cases, and their long-time-horizon load forecasts will never perfectly predict all system needs. Fleet clusters in some areas are seeing load growth from electrification at a pace that is accelerating the need for even these large system investments faster than anticipated by utilities' prior forecasts, to the point where construction should start imminently to avoid delaying fleet interconnections. To address these gaps between rate cases, policymakers should create a separate avenue for utilities to submit requests to their regulator for accelerated review of these identified needs, within appropriate limits, and receive a presumption of prudency and future cost recovery. In order to receive this presumption, utilities should be required to demonstrate their request meets certain criteria such as:

1. **MHDV electrification will trigger a need for the identified upgrade in close proximity to when the upgrade would enter service, even if the utility cannot point to individual customers making the request for capacity.**

2. **Delaying its request is likely to impair the utility's ability to serve these loads in a timely manner.**

3. **The identified upgrade is the least-cost solution, including comparison to NWAs.**

Commissions typically do not require preapproval of individual small projects (such as a discrete transformer upgrade), and utilities are often willing to begin making investments ahead of formal cost recovery approval. To facilitate proactive investment in these projects to support MHDV electrification, policymakers could outline a set of criteria like those suggested above for large projects. But instead of requiring utilities to file this information in advance, they would instead need to keep it on-hand in anticipation of subsequent prudency reviews in the next rate case. The threshold for what projects would fall under these "large" or "small" regulatory pathways could be based on a variety of factors such as the estimated project cost as compared to some flat dollar amount or percentage of the utility's existing rate base, the type of asset at issue, or whether the project would be subject to the commission's existing preapproval process.

With these mechanisms in place, utilities would be in a better position to proactively respond to fleets' grid capacity needs. Many system needs can still be identified through preexisting planning and investment processes by making robust transportation electrification forecasting the standard. For those needs that arise on a faster timeline, large projects would benefit from an accelerated review process, while for small projects utilities could begin work even earlier with subsequent regulatory review. By pairing this structure with appropriate risk mitigation strategies, regulators can balance their obligation to protect customers from imprudent utility investments, their responsibility to allow utilities to meet all customers' electricity needs, and the reality of utilities' hesitancy to pursue grid investments where they are not confident in future cost recovery.

UPDATING FORECASTING AND PLANNING

2

Utility regulators should require utilities to update their grid planning processes to increase confidence that MHDV charging load will materialize when and where expected.

3

State agencies should support utilities by collecting and sharing data that can aid load forecasting for MHDV electrification.

Utilities' traditional forecasting models are not the optimal tool for understanding when and where MHDVs will electrify. Reliable forecasting methodologies are critical both for utilities and their regulators; with more accurate data, utilities can make proactive grid investments to support clusters of fleet electrification without having to wait for load letters, and commissions can more confidently grant cost recovery for those investments without increasing the risk of creating stranded assets. Thankfully, several innovative strategies are already available and seeing increased use to improve utilities' forecasting and planning for MHDV charging load.

First, forecasters have access to improved models for forecasting the timing and location of electric MHDV deployments. This includes propensity models and stock turnover models that are designed around the factors driving MHDV electrification, including total cost of ownership and vehicle retirement rates, rather than relying solely on broad historical data and macroeconomic indicators[19]. These models can better capture the timing of this transition, though may still fall short in capturing its geographic diversity as the relevant data is often based on political boundaries rather than being tied to the geography of the grid.

Utilities would also benefit from greater use of bottom-up forecasting models. While most load forecasts rely on top-down methodologies, which estimate changes in customers' electricity consumption at the level of the service territory and disaggregate those results downward through the distribution system, bottom-up forecasts work in the reverse order by estimating changes in load at the lower levels of the distribution system and aggregating upwards. Top-down forecasts can capture system-wide trends but are poorly equipped to identify system needs driven by highly location-specific trends such as MHDV electrification. Bottom-up forecasts make it easier to capture fleets' tendency to cluster, and allow utilities to target investments to the highest-priority areas.

Given the greater detail in analysis required, bottom-up forecasting has historically been more resource-intensive than top-down forecasting, but it is not infeasible. The grid analytics company Kevala recently developed a statewide bottom-up forecast of load growth in California as part of an ongoing California Public Utility Commission (CPUC) proceeding on distributed energy resource (DER) integration[20]. Utilities may be able to maximize the value of bottom-up forecasting by deploying it to forecast MHDV charging load specifically in commercial and industrial areas and along major freight corridors, and incorporating the results into broader top-down forecasts.

Utilities and regulators can also access new data sources that can show where today's MHDVs are traveling, how far they're driving, and how long they spend at stops.

For example:

- Some utilities, including National Grid and Con Edison in New York, have started to use satellite imagery to map and categorize MHDVs parked at depots within their service territories[21].

- Vehicle telematics data from fleets and OEMs can show where vehicles travel and when and how long they are stopping. Several of the largest MHDV manufacturers in the U.S. are already providing their aggregated telematics data to interested utilities to show where charging hotspots are expected given today's travel patterns[22]. Individual fleets can and should share this information with utilities as well. And ongoing projects like EPRI's ERoadMAP and GridFAST are being developed and deployed to collect and disseminate this data to make it readily deployable by utilities[23].

- State agencies already collect an array of relevant data. Vehicle registration data can be useful for categorizing vehicles by class or use case, allowing utilities to estimate charging needs. Other potential government data sources include state departments of transportation studying freight traffic, departments of education tracking school bus purchasing and operation, and environmental protection agencies collecting data on fleets through regulations like the Advanced Clean Truck Rule[24]. One model for this is California, which requires state agencies to collect and share relevant data like this with utilities to inform their transportation electrification efforts[25].

- Utilities can also ground-truth data with direct outreach to customers such as fleets, truck stops, and warehouses in their territories. This is particularly important for the earliest electrifying fleets and large fleets whose individual electrification is likely to require larger system improvements.

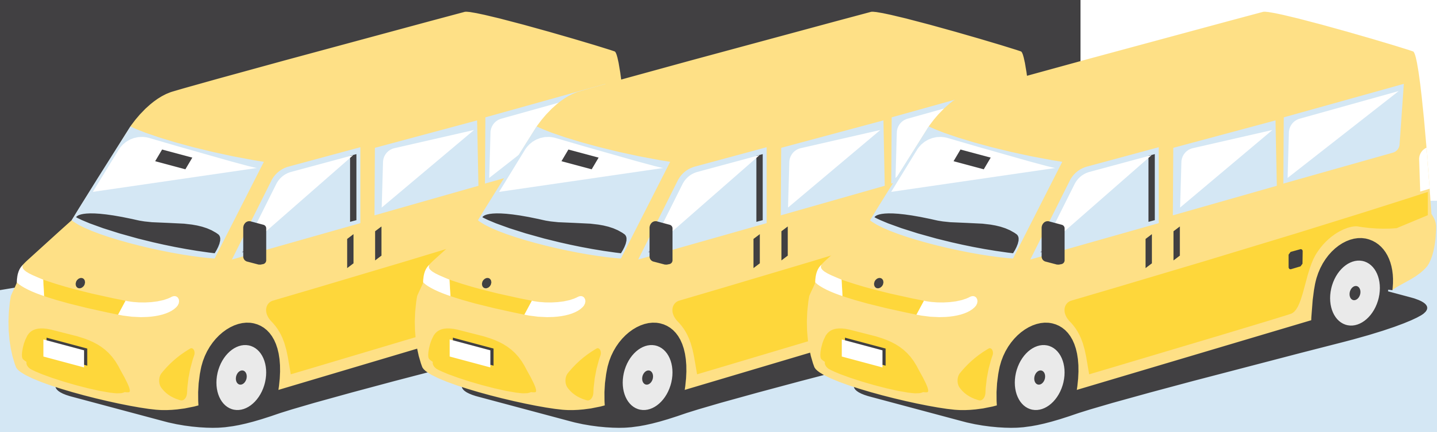
As utilities leverage data sources like these to improve their forecasting and planning work, their regulators should ensure that the inputs, assumptions, and methodologies utilities used are transparent to the commissions and stakeholders. Not all utility data can or should be publicly available, as some can include customers' sensitive business information or information on critical infrastructure. But by making non-sensitive information publicly available, and aggregating data when doing so can alleviate security concerns, regulators would give other stakeholders the opportunity to identify gaps in data and inform improvements to future forecasting and planning.

Collectively, these new data sources, combined with strengthened processes for integrating that data into utilities' forecasting and grid planning efforts, are well-positioned to improve utilities' accuracy when it comes to preparing for MHDV electrification. More widespread use of these tools can benefit utilities and customers alike by identifying grid upgrade needs earlier, giving utilities the lead time needed to make those upgrades by the time load sources like MHDV chargers are ready to interconnect, and mitigating the risk that these investments are made at the wrong location, scale, or timeline.

CALIFORNIA'S AB 2700

Transportation Electrification: Electrical Distribution Grid Upgrades

Signed into law by Governor Newsom in September 2022, AB 2700 in California directs the California Energy Commission to annually compile data already being collected by state agencies that can inform grid planning for electrification, including fleet sizes, types, and locations. This data must then be shared with the relevant utilities, which must use that data to inform their grid forecasting, planning, and construction work to meet the state's transportation electrification goals.



ACCOUNTING FOR INNOVATIVE TECHNOLOGIES AND POLICIES

4

Utility regulators should incent and require, as appropriate, the use of non-wires tools to reduce interconnection timelines and costs associated with MHDV charging loads.

Alongside improving utilities' processes for identifying load growth and corresponding grid needs, regulators can help reduce customer costs and interconnection timelines by requiring robust consideration of technologies and processes that can mitigate or obviate the need for system upgrades to serve new loads. These tools include flexible interconnection, distributed energy resources (DERs), and third-party construction.

Created as a tool for speeding interconnection of new distributed generation, namely wind and solar[26], flexible interconnection also has significant potential as an interim solution to speed up MHDV interconnection timelines, and a long-term tool for optimizing grid capacity needs. At its most basic, flexible interconnection involves managing a customer's net load or generation to avoid or minimize needed grid upgrades. In the context of fleet electrification, this could include setting caps on a fleet's maximum allowable demand from the grid below the cumulative nameplate capacity of its chargers, setting demand caps that are time-variant (i.e., higher caps during off-peak periods and lower caps during peaks), or dynamically setting caps based on real-time grid conditions. These solutions vary in their flexibility, complexity and value to customers and the grid, but they all provide benefits to both the participating customer, who can interconnect at least a portion of their load earlier than they would otherwise be able to, and ratepayers broadly, as more efficient use of existing grid infrastructure spreads delivery costs over a broader customer base. A variety of strategies already exist for dynamic curtailment of generating DERs[27], and some utilities already experiencing excessive interconnection timelines are studying how they can use flexible interconnection, without relying on involuntary curtailment, in the transportation electrification space.

Alongside flexible interconnection, co-locating DERs like solar, battery storage, and automated load management systems with MHDV charging sites can create enormous value for fleets while minimizing grid upgrade costs. When customers install DERs to avoid otherwise necessary grid upgrades, those customers should receive the same financial support they would have if they waited for the grid upgrade, a policy that has already been proposed by staff at the New Jersey Board of Public Utilities[28]. Such a policy effectively creates an NWA incentive for MHDV charging, as DERs are treated as equivalent to system upgrades where they can meet the same needs—potentially much quicker than through traditional system upgrades. Where regulators direct utilities to implement DER and other NWA policies for charging infrastructure, like that proposed in New Jersey, they should pair this with requirements that the utility build out grid upgrades in line with the expected net load, rather than the unmitigated load, to maximize the system benefits. They will need to balance this requirement, however, with long-term grid investments to serve all customers, as many fleet clusters will still require some system upgrades even where DERs are widely deployed.

Lastly, where utilities' internal limitations may lead to long interconnection timelines, commissions should consider allowing customers in certain circumstances to directly contract with third parties to complete system expansion work needed to energize their chargers. For service facilities—those utility-side facilities that provide service to a single customer such as transformers, transformer vaults, and service lines—this is already common practice for large commercial and industrial customers taking high-voltage service. For infrastructure further upstream that could serve multiple customers, including feeders and substations, such third-party construction of grid infrastructure raises more complex questions of who should own, and recover the costs of, such infrastructure. Regulators considering this as a solution would need to consider the impact of this change on current utility operations and the existing utility regulatory structure, and the extent to which third-party construction would address the existing barriers to shortening interconnection timelines.

ENSURING COMMUNITY ENGAGEMENT

Proactively preparing the grid for MHDV electrification should involve working with not only the fleets that will be electrifying, but also the communities where those fleets will be charging and operating. Today's diesel- and gas-powered trucks and buses are a major source of harm to public health through their local air pollution and GHG emissions, harm that is disproportionately felt by residents of low-income communities and communities of color[29]. As a result, these communities have a lot to gain from the transition to electric MHDVs if investment is appropriately structured to prioritize impacted areas. But MHDVs can also impact communities in several ways separate from their fuel source—including noise, traffic, and land use impacts—and the transition to electric MHDVs is an opportunity for policymakers to consider not just grid impacts but also these broader community impacts of the new zero-emission MHDV sector.

Early and sustained engagement with impacted communities is also important for mitigating risks associated with proactive grid investment. This includes soliciting community feedback both on high-level policies and utility-specific plans, as well as ensuring communities are kept informed as these plans are implemented. Clear policies regarding community engagement also recognize that utilities and their regulators are not simply passively responding to customers' request with their grid expansion policies, but can play an active role in guiding where and when MHDV electrification occurs. For example, policymakers may prioritize incentives for different types of MHDV charging—depot, destination, or on-route—where communities identify that charging can maximize community benefits. Additionally, a community group could work directly with their local utility and state agency staff to identify priority areas for electric MHDV deployment while avoiding bringing new traffic into overburdened areas. Policymakers should also recognize the economic and public health costs of further delaying this work with ineffective engagement, and ensure their efforts meet communities' needs while allowing necessary work to proceed efficiently. Ultimately the community is best-positioned to know what harms they are experiencing, and this local knowledge should be just as important to utilities as knowledge of grid conditions when planning for MHDV charging.

5

Policymakers should ensure that affected communities have clear, early opportunities to engage in decisions that will impact the speed and locations of MHDV electrification.

6

Policymakers should create programs that prioritize MHDV electrification in, and maximize the benefits of electrification to, environmental justice communities.

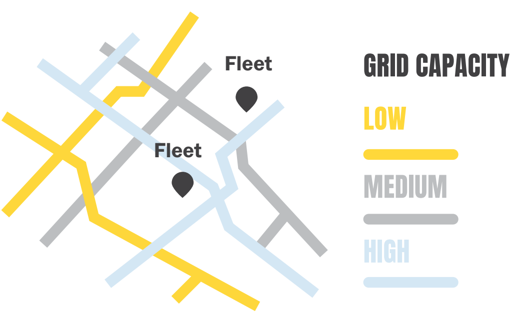
ACCOUNTABILITY AND INCENTIVES FOR UTILITIES

7

Regulators should set clear, enforceable targets, metrics, and reporting requirements for utilities' interconnection work.

CAPACITY MAPPING

While most often used to inform the deployment of DERs intended to feed power back into the grid like solar PV, a "hosting capacity map" can also be a map that tracks where capacity exists to serve new sources of load such as EV charging. This may also be referred to as a "**load-serving capacity map.**"



SB 410
POWERING UP CALIFORNIANS ACT

Signed into law in October 2023, SB 410 seeks to accelerate interconnection for new and upgraded EV charging sites and depots. Among other things, the law requires the CPUC to establish average and maximum interconnection timeline targets for the utilities, and requires the utilities to track and regularly report their timelines along with explanations for delays when timelines are exceeded. The law also obligates the utilities to address those failures, including ensuring they have adequate staffing and equipment available, and have the necessary forecasting and planning policies in place.

UTILITY TRANSPARENCY AND ACCOUNTABILITY

Alongside the tools regulators can require utilities use to maximize the likelihood that MHDV charging load will develop as forecasted, and to minimize the cost of resulting system upgrades, they also need policies in place to steer utility behavior towards those beneficial outcomes. A key first step of this accountability is creating data transparency that allows regulators and other stakeholders to have a clear picture of what a utility is, and is not, accomplishing.

One form of this is public hosting capacity mapping. These maps and the hosting capacity analysis that informs them provide insight into where the distribution grid can accommodate DERs and loads, and where upgrades would be needed to allow for new interconnections. Utilities should update their maps regularly—at least quarterly where possible—and indicate where there are requests for capacity that aren't yet reflected in the maps, so DER developers and fleet operators have an up-to-date picture of where electrification is feasible in the near-term to inform their fleet electrification plans. Similarly, greater geographic granularity would help fleet operators better understand where electrification is generally possible in their neighborhood or at their specific facility.

Hosting capacity maps are just one way utilities can serve as information centers for all those taking part in the energy transition, including MHDV fleets. If utilities embrace this role, fleets could work through their utility to identify other fleets nearby to coordinate electrification plans with to share costs and jointly benefit from system upgrades. Such a model is only possible, however, if the utility is responsible for regularly sharing information about their systems, and fleets are reliable in sharing their data and plans with their utility, something they are unlikely to do without clear regulatory mandates.

Regulators should also require utilities to track and publicly report interconnection timelines for EV chargers. This information is important for understanding whether current policies and programs are meeting fleets' needs as they deploy charging infrastructure. One such model can be found in SB 410, a new law in California that directs the CPUC to create reporting requirements on when and why utilities failed to meet interconnection targets[30]. Such a policy does not create a direct financial incentive or disincentive for the utilities, but better informs and empowers the commission to address shortcomings. It can also help identify barriers to faster interconnection that are outside of the utility's control, such as supply chain constraints[31].

Finally, in the event IOUs are unable to meet interconnection timeline goals, policymakers should consider alternatives to provide timely service to fleets. Many of the tools and technologies that can complement utilities' interconnection efforts such as DERs and third-party construction can also shrink the role of the utility in serving electric MHDV fleet customers, either as stopgap measures or long-term solutions. Where unreasonable interconnection timelines are the result of utility shortcomings, rather than regulatory barriers that limit utilities from taking proactive measures to serve fleets, regulators should consider how they can allow and encourage fleet customers to use these tools to minimize utility responsibilities.

8

Regulators should use economic incentives to steer utility improvements in projecting and interconnecting new loads.

CON EDISON TRANSPORTATION INTERCONNECTION TIMELINE PIM

Approved by the New York Public Service Commission in July 2023, Con Edison's Interconnection PIM is designed to incentivize the utility to speed interconnection of transportation electrification projects over 300 kilowatts in load. Con Edison is incentivized to improve their average timeline for interconnection for six categories of new and upgraded service connections and associated upstream system improvements, measured off of their average timeline for these categories of work between 2019 and 2022.

INCENTIVIZING UTILITIES TO ACCELERATE INTERCONNECTION

Paired with reporting requirements and goals for MHDV electrification, financial incentives can have a measurable impact on utility behavior. For IOUs operating under the traditional regulatory structure where they can recovery their costs plus a rate of return for prudent investments in physical infrastructure, the energy transition has the potential to be quite profitable because of the need for significant investment in their distribution grids. Multiple studies have shown it will take tens of billions of dollars to prepare distribution grid across the country for the energy transition, including MHDV electrification[32], a significant though not extraordinary figure when compared to the nearly $60 billion IOUs are expected to invest in their distribution systems in 2023[33].

Despite this potential value, IOUs are typically risk-averse companies that avoid putting money into serving a new kind of load if they aren't confident they will be granted recovery on that investment. Given this, redesigned incentives and accountability mechanisms may be useful for ensuring this work is done expeditiously while preventing utilities from "gold plating" the grid by investing above and beyond what is actually needed as a way to grow profits.

One such tool several states have already implemented is performance incentive mechanisms (PIMs), which tie a portion of an IOUs' profits to their achievement of certain pre-determined metrics. This means that utilities are no longer solely incentivized to pursue new infrastructure investments that are most likely to receive regulatory approval, but rather can be pushed towards any number of policy goals depending on the approved PIMs, such as minimizing GHG emissions from light-duty vehicles, maximizing managed charging of EVs, and minimizing interconnection timelines for EV chargers[34]. PIMs also have the benefit of being able to work as both an incentive or disincentive for IOUs, with successful efforts resulting in increases to their authorized returns on equity, and unsuccessful efforts decreasing those authorized returns, though the potential incentives and disincentives need not be symmetrical.

Developing appropriate metrics and targets for the application of PIMs can be a contentious process. This may be particularly true when the behavior regulators seek to incentivize may be new to utilities and their customers, as is the case with MHDV electrification and charger interconnection, and there may be little preexisting data to inform the development of metrics and targets. Regulators must carefully tailor PIMs to balance the need for incentives to be large enough to change behavior, small enough to avoid unreasonable enrichment or punishment, achievable enough to be actionable, and challenging enough to not simply create guaranteed profits. Regulators must also recognize where utilities already have a strong incentive to speed interconnection profits through adding to their rate base; piling incentives on top of one another may spur utility action, but it may not be an optimal use of customer funds.

AVOIDING THE STRANDED ASSET TRAP

In the utility regulatory context, stranded assets are utility assets that become unused before the utility is able to recover the full cost of those assets.

For example, a utility may build a new coal-fired power plant expecting it to be operational for forty years and to recover the cost of that plant over that lifespan, but for economic or regulatory reasons it may instead shut the plan down after only thirty years. The cost of the plant the utility was unable to recover in the subsequent ten years is now a stranded asset, and regulators must decide whether customers will still pay for that asset despite it not being used and useful, or whether utility shareholders must cover these costs, potentially harming the utility's financial health in ways that can increase long-term costs for customers.

Utility commissions are always wary of allowing a utility to overbuild and create "gold plated" assets that add to their rate base but provide only a small fraction of potential benefits to customers, or become entirely stranded. Given this, they may raise concerns that proactively building out the distribution grid to serve expected electrification of MHDV fleets and other end uses may create stranded asset risks if the expected load does not materialize. But there are significant differences between additional distribution grid capacity driven by MHDV electrification load and the utility assets traditionally thought of as at-risk of becoming stranded assets.

Ultimately, regulations and economics are driving the need for more, not less, grid capacity, and the distribution grid is in a fundamentally different position than the fossil fuel infrastructure at risk of becoming stranded assets today and in the future. It remains true that utility regulators should be vigilant against utilities overinvesting in infrastructure with their bottom lines in mind, and the risk of stranded assets is not zero. But the factors accelerating MHDV electrification, and the risk mitigating strategies available to regulators including improved forecasting and planning, innovative technologies, and diversified financing can increase confidence that loads will materialize as expected and decrease concerns over stranded asset risks.

9

Policymakers should consider the regulatory and economic factors driving MHDV electrification, and the MHDV sector's position in the larger energy transition, in assessing the risk of proactive grid investments becoming stranded assets.

COVERING COSTS AND AVOIDING STRANDED ASSETS

REGULATORY DIRECTIONS

For some utility assets at risk of becoming stranded as part of the energy transition—coal-fired power plants and natural gas distribution lines, for example—regulations are often a driving factor in shortening their useful lives. Environmental regulators, rather than utility commissions, may implement policies that make operations more costly, introduce new regulatory hurdles, or shift consumer behavior in a way that reduces the need for the asset. In contrast, regulatory and economic factors are driving the shift away from diesel-powered MHDVs and towards EVs. State regulations like the Advanced Clean Trucks and Advanced Clean Fleets rules and voluntary agreements like the memoranda of understanding on zero-emission MHDVs are accelerating MHDV electrification in those states moving fastest on this issue[35]. And even in states without these policies, the significant federal funding available for deploying electric MHDVs[36], and the expected economic advantages of electric MHDVs[37], are shifting fleets towards electrification. These factors increase, rather than decrease, the need for distribution system investments and reduce stranded asset risk.

GEOGRAPHIC FLEXIBILITY OF MHDV FLEETS

Even where utilities inadvertently overbuild capacity in expectation of MHDV electrification, that excess capacity is unlikely to become a stranded cost because the excess capacity will attract fleets to develop charging infrastructure in that area. Utility service territories and specific zones within those territories with excess distribution grid capacity where fleets can see shorter interconnection timelines are likely to be in high demand as the number of fleets looking to electrify grows. New York has already experienced this with its light-duty EV make-ready program, where the beginning of the program saw charging station developers prioritizing sites with fewer grid upgrade needs[38]. Not all fleets will be willing or able to relocate to areas with this excess capacity. But as businesses expand, site leases expire, and new businesses open, many fleets will have some flexibility when choosing depot locations, and easy access to excess grid capacity will grow as an influencing factor in their site selection. Policymakers may also consider how this excess capacity may be a tool for economic development, encouraging greater deployment of quieter, cleaner business in targeted areas.

DIVERSITY OF ELECTRIFYING END USES

Even in the unlikely event that the scale or speed of MHDV electrification falls below regulators' and utilities' expectations, load growth from other end use electrification is separately driving demand for new distribution grid capacity. Public charging for light-duty EVs, building electrification for space and water heating, and electrification of industrial processes are all experiencing their own growth and will need their own grid capacity. By diversifying the types of customers expected to benefit from an upsized distribution grid, utilities minimize the risk of overbuilding for any one type of customer and help to avoid stranded assets.

DIVERSIFYING HOW COSTS ARE COVERED

10

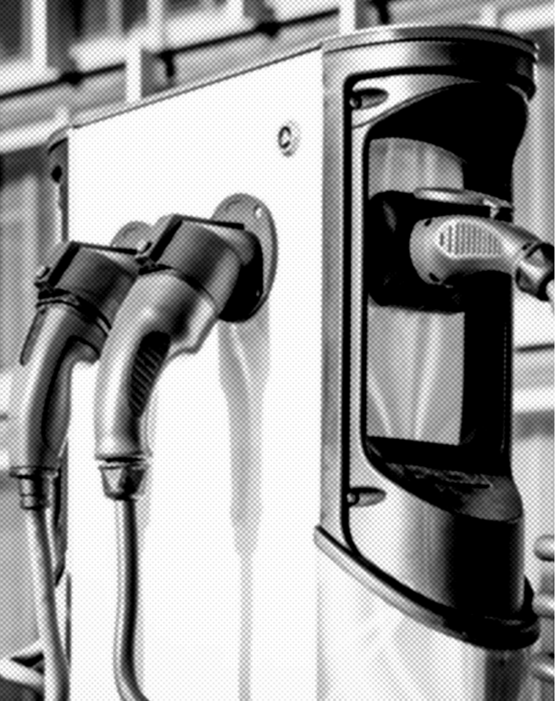
Policymakers should consider how costs can be shared among individual electrifying fleets, ratepayers more broadly, and other private and public funding sources to deploy grid infrastructure and mitigate the risk to ratepayers.

Determining who will pay for the grid upgrades necessary to support transportation electrification will inevitably be a source of competing views, and the importance of this determination will only increase as the scale of upgrade needs grows. Because this need is being driven not just by transportation by several overlapping changes to how electricity is generated, moved, and consumed, a mixture of cost allocation strategies and revenue streams will likely be necessary to fund the work without overburdening any single group of customers.

In the long run, the new delivery service revenue utilities collect from electrified fleets can cover a significant portion of necessary system upgrade costs. A recent study focusing on two service territories in New York found that the additional delivery service revenue collected from MHDV charging customers can equal or exceed the cost of investments needed to serve those new customers[39]. When fleets engage in managed charging, the study found they would decrease both their individual charging costs and the total cost of grid upgrades, and would generate net positive revenue in every year of the study period[40]. A similar analysis by the California Public Advocates Office found that electrification, including that of light-, medium- and heavy-duty vehicles, can put downward pressure on rates[41]. One caveat to this conclusion is that these studies did not consider the increased near-term costs of utilities futureproofing investments, and regulators may need to decide how to allocate these additional near term costs, as well the resulting long-term savings. Policymakers have several options when making this decision, including using their existing cost allocation methods, creating a separate customer class for MHDV charging customers, or allocating costs more broadly in light of the broader benefits of facilitating MHDV electrification[42].

In areas without programs that provide make-ready incentives to electrifying fleets for grid upgrade costs and socialize those costs among customers, fleets today need to rely on the existing paradigm of line extension and contribution in aid of construction (CIAC) policies. The specifics of these policies vary across utilities, but they generally provide coverage of a portion of the cost of grid upgrades needed to serve new load while the customer must pay for the remaining share. This process can result in early-electrifying fleets paying for system upgrades that ultimately serve multiple customers. Requiring a customer to cover a portion of make-ready costs in some circumstances, particularly a share of the make-ready costs on the customer side of the meter, can ensure fleets are committed to electrification and minimize risk to ratepayers. But policymakers may choose to socialize a greater share of these costs to accelerate MHDV deployment in line with policy goals, such as pollution reduction in environmental justice communities. And by allowing for proactive grid development and not relying on individual customers to provide CIAC payments for utility-side costs, regulators can avoid the disincentive for first movers while still relying on their preferred cost allocation methodology to appropriately assign the cost of system upgrades to customers.

Some fleet customers, particularly the largest, most well-capitalized ones, may be willing to cover the full cost of system upgrades needed to serve their chargers even above their typical CIAC share because the opportunity cost of delayed interconnection exceeds the cost of that work[43]. Prioritizing projects serving these self-funded fleets may free up scarce funds for projects to serve other customers, but allowing wealthier fleets to shorten



> The federal government is also well-positioned to use its financial capacity to serve as a backstop for grid upgrade costs in the unlikely event forecasted MHDV load does not materialize to avoid harmful customer impacts.

their interconnection timelines by avoiding reliance on ratepayer funds and jumping ahead of other customers in the project queue raises potential equity concerns. Where fleets are willing and able to pay a third party to do the work rather than the utility, that can be a path towards speeding up those projects without delaying the work needed by small fleets. But for those fleets reliant on the utility to complete system work, prioritization should be based on the readiness of the fleet, the urgency of the need, and the emissions reduction potential in pollution-burdened communities of prioritizing that work over work elsewhere on the system, rather than the financial capacity of the fleet.

Finally, different solutions may be needed for the many small POUs and co-ops that may have a smaller rate base to absorb these costs. These utilities also lack the profit motive that creates an incentive to add to their rate base, and are generally not structured in a way that they would be influenced by PIMs. Though they represent a small share of customers from a national perspective, these utilities and their customers should not be left behind in this transition. Additional funding streams from state and federal budgets may be needed where relying on customer funds is insufficient for the scale of the need or would result in excessive increases in customers' electric bills. The Infrastructure Investments and Jobs Act and Inflation Reduction Act (IRA) both contained funding streams that could be used for MHDV charging and grid infrastructure, including the Greenhouse Gas Reduction Fund, the National Electric Vehicle Infrastructure program, and the Charging and Fueling Infrastructure Grant program[44]. More targeted funding would be appropriate to support IOUs, POUs and co-ops' transportation electrification projects, which are currently ineligible for the additional funding the IRA appropriated for decarbonization projects by rural electric co-ops[45]. The federal government is also well-positioned to use its financial capacity to serve as a backstop for grid upgrade costs in the unlikely event forecasted MHDV load does not materialize to avoid harmful customer impacts. Lending capacity already exists for rural utilities through the Department of Agriculture's Electrical Infrastructure Loan & Loan Guarantee program[46], and analogous financing opportunities may exist through the Department of Energy (DOE) Loan Program Office's loan guarantees[47], or the DOE's authorized role as an anchor customer for interregional transmission lines[48]. This funding may be particularly useful at bridging the gap between the need for funding to undertake grid upgrade work that may begin several years before fleets have electrified and are using that new grid capacity.

Spreading the costs of grid upgrades among several entities helps to mitigate risk to any one group and increases the total amount of capital available to support this work. Effectively implementing such a funding model would require efforts to minimize the transactional costs of using multiple funding sources. If they aren't well-integrated, customers won't benefit from them even if the on-paper cost is attractive. Policymakers should also consider whether utilities are best positionedx to assist customers with securing outside grants and financing given their existing relationships with customers, or if this responsibility is better housed within state agencies such as economic development agencies. Regardless of the structure, if funding streams can be efficiently combined fleet customers can minimize the cost of their electrification efforts, smoothing the transition.

CONCLUSION

Enabling sufficient grid capacity for charging, including by allowing and encouraging utilities to proactively invest in their distribution grids, is essential to supporting a speedy deployment of electric trucks and buses.

This will not, however, require policymakers to be especially groundbreaking in their decisions, as mechanisms already exist to shift utility behavior in the necessary direction. By modifying utility regulatory mechanisms, policymakers can be confident utilities are actively identifying and completing system improvements needed to support the MHDV transition. By deploying all available data sources and technologies, and engaging early with all stakeholders, they can lower the cost and maximize the benefits of the needed investments. And by leveraging new financing tools, they can mitigate the risk of driving up electricity costs for customers. Collectively, these changes would allow utilities to make prudent, forward-looking investments in their systems to facilitate the energy transition to the benefit of customers and society as a whole.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[32] See Resource Innovation, NYSERDA, Transportation Electrification Distribution System Impact Study, at ES-2 (May 2022), (estimating that distribution system upgrades to serve transportation electrification in New York through 2050 would cost between $1.4 billion and $ 26.8 billion); Kevala, supra note 20 (estimating that distribution system upgrades for the California's three major IOUs to serve EVs, building electrification, and distributed solar and storage will cost up to $50 billion through 2035); See California Public Advocates Office, Distribution Grid Electrification Model Fact Sheet, at 1 (Aug. 2023), (estimating distribution upgrade costs of $26 billion through 2035 in California in order to meet the state's transportation electrification goals assuming greater off-peak charging than the Kevala study).
[33] Edison Electric Institute, Industry Capital Expenditures.
[34] Case 22-E-0064, Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulations of Consolidated Edison Company of New York, Inc. for Electric Service, Order Adopting Terms of Joint Proposal and Establishing Electric and Gas Rate Plans with Additional Requirements, at 146. For a more detailed explanation of the mechanics of the PIM, see Case 22-E-0064, Proceeding on Motion of the Commission as to the Rates, Charges, Rules and Regulations of Consolidated Edison Company of New York, Inc. for Electric Service, Appendix 22: Earnings Adjustment Mechanisms.
[35] See supra note 5.
[36] See Jason Mathers & Pamela MacDougall, EDF, Four things fleet leaders should know about America's grid and zero-emission trucks (Nov. 8, 2023),(identifying billions of dollars in federal grants and tax incentives for electric trucks and charging infrastructure deployment).
[37] See Jason Mathers, EDF, 4 ways protective, greenhouse gas standards can benefit heavy-duty fleets (Oct. 11, 2023), (noting that electric MHDVs can have lower operating costs than those reliant on fossil fuels).
[38] See Case 18-E-0138, Proceeding on Motion of the Commission Regarding Electric Vehicle Supply Equipment and Infrastructure, Presentation by the Joint Utilities of New York: EV Make-Ready Program (MRP) Midpoint Review Technical Conference, at 9 (Nov. 18, 2022).
[39] Lucy Metz et al., Synapse Energy Economics, Distribution System Investments to Enable medium- and Heavy-Duty Vehicle Electrification, at ii (Apr. 14, 2023),
[40] Id.
[41] California Public Advocates Office, supra note 32, at 2.
[42] See Case 18-E-0138, Proceeding on Motion of the Commission Regarding Electric Vehicle Supply Equipment and Infrastructure, Order Establishing Electric Vehicle Infrastructure Make-Ready Program and Other Programs, at 78-80 (July 16, 2020). Describing the cost allocation of New York's IOU's EV charging programs.
[43] Pamela MacDougall, Aravind Kaila & Troy Musgrave, Solving the charging challenge for commercial electric fleets, EVS36 Symposium (2023).
[44] See EPA, GREENHOUSE GAS REDUCTION FUND; UNITED STATES FEDERAL HIGHWAY ADMINISTRATION, NATIONAL ELECTRIC VEHICLE INFRASTRUCTURE FORMULA PROGRAM; UNITED STATES FEDERAL HIGHWAY ADMINISTRATION, CHARGING AND FUELING INFRASTRUCTURE DISCRETIONARY GRANT PROGRAM.
[45] UNITED STATES DEPARTMENT OF AGRICULTURE, EMPOWERING RURAL AMERICA PROGRAM (NEW ERA).
[46] UNITED STATES DEPARTMENT OF AGRICULTURE, ELECTRICAL INFRASTRUCTURE LOAN & LOAN GUARANTEE PROGRAM.
[47] UNITED STATES DEPARTMENT OF ENERGY LOAN PROGRAM OFFICE, TITLE 17 CLEAN ENERGY FINANCING PROGRAM.
[48] UNITED STATES DEPARTMENT OF ENERGY GRID DEPLOYMENT OFFICE, TRANSMISSION FACILITATION PROGRAM.

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