

Consolidation of Electrical Service Guidelines to Accelerate Fleet Electrification and Green Supply Chain in California

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Abstract— The transition to clean and green energy is inevitable just like the changes in global climate, the former being the consequence of the latter. Time is of essence here. The U.S. Government is also pushing the speedier adoption of electric vehicles (EVs) all across the country to handle the menace of emission. Urged by ambitious policies and propelled by generous investments in clean energy, California is leading the way to fleet electrification. The accelerated electrification of fleet in California, demands consolidation of electrical service guidelines, an important impediment to speedier transition. Replacement of fleet vehicles with similar vehicles that are significantly low on emission mark an important milestone for meeting the stringent emission targets set by the state. Though local in implementation, this program has global ramifications due to its capacity to aid other regions transition to vehicle electrification to meet such worldwide emission targets, as commitments made under the Paris Climate Agreement. This article identifies the obstacles to fleet electrification and recommends ways to consolidate electrical service guideline that can expedite the fleet electrification in California, a state that is a leader in green logistics, and hence promote green supply chain.

Keywords— *Electrification, fleet, electric vehicle, EV, consolidation, electrical service, electrical service guidelines, standardization.*

1. Introduction

The threat of global warming and climate change are very real and these phenomena are happening faster than expected. In 2018, Yangyang Xu, Veerabhadran Ramanathan and David G. Victor, warned in their article “Global Warming Will

Happen Faster Than We Think” in the journal Nature, about this [1]. During the past 19 months there have been 18 instances where global temperatures hit or went past the internationally agreed warming boundary of 1.5° Celsius [2, 3]. Even the natural cooling effect of the ocean current La Niña proved ineffective. It is evident that factors affect the climate cycle are not natural. Researchers and scholars attribute the temperature rise and global warming to the persistent and sustained accumulation of greenhouse gases (GHG) released into the atmosphere by human activities, especially the fossil fuel combustion caused majorly by industries and transports [4]. The damage might not be reversible but further deterioration can definitely be avoided [5]. Electrification has emerged as one of the most feasible solutions for handling the situation.

Electrification refers to the process of replacement of fossil fuel using technologies with the ones that use electricity as a source of energy [6, 7]. Fossil fuels (such as oil, coal and natural gas) are conventional sources of energy, limited in terms of availability, fast depleting and causes serious environmental damages due to emission of GHG and other pollutants. Almost every person is now aware of the gravity of climate change and global warming [8]. Needless to say, the fast deteriorating and troubling issues of climate change has coerced the modern world to turn towards lesser damaging sources of energy such as electricity

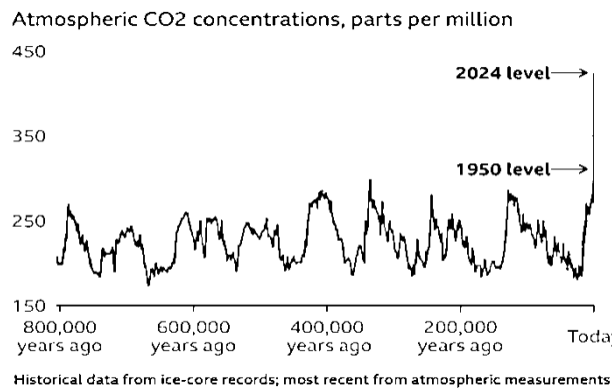


Figure 1: CO2 Levels are at Record High in 800,000 years [9]

1.2 Need for Electrification in the USA

Besides the impending need to take a positive step towards bringing down global temperature, there are other important factors that are driving the fleet electrification in the USA. These include environmental sustainability, cost savings, and the global impetus towards a cleaner transportation system which is expected to be more sustainable. Electrification of fleets has become a crucial step in USA's strive towards reduction in GHG emissions by half by 2030 and meeting its climate change goals of net zero by 2050. In addition to this, electric vehicles or EVs tender lesser running costs, enhanced reliability, alongside contributing to the nation's public health through the reduction in air pollution, specifically in vulnerable communities [11]. California has emerged as the global leader in developing policies that can battle climate change. The volume of carbon reduction is enormous and it requires wide scale changes covering all economic sectors. While it is necessary that the entire state undergoes a transition to ensure decrease emission, the transportation sector takes the front seat due to its contribution to pollution which is the highest amongst all sectors [12].

1.3 Fleet Electrification

Public vehicle fleets, include everything from city buses and school transport to garbage trucks and vehicles used by the law enforcement department and constitutes a major share of the U.S. on-roads traffic [11] most of which run on fossil fuels using the Internal combustion engine (ICE) technology. ICE vehicles are responsible for at least 30% of the GHG emissions in the USA [13]. Carbon Monoxide or CO is released from burning and combustion of

fossil fuels and vehicle emissions can be considered to be the largest source of carbon monoxides comprising 56% of CO released nationwide and up to 95% released in the cities across the U.S. [14, 15]. 45% of Nitrogen oxides, that cause respiratory problems and other health issues and are responsible for formation of smog, acid rain, and ground-level ozone, can also cause, is emitted by the transportation sector [16].

Majority of the policy-makers believe electrification of the vehicle fleet to be the key to reducing greenhouse gas emissions, air pollution in the neighborhood and dependence on fossil fuel [17]. Governments at national, local, and state levels have established ambitious targets aimed at extensive adoption of electric vehicles (EVs) for the complete phasing out of internal combustion engines (ICEs). In general, fleet vehicles give higher average mileage than any other similar vehicles. This is why the replacement of these fleet vehicles with electric vehicles that have low if not zero emissions is considered to be an important landmark in achieving emissions targets that have been growing progressively more stringent [18, 19].

This article focuses on the electrification of the fleet in the U.S. state of California, a leader in green logistics. While this transition to electric vehicles (EVs) is a localized phenomenon that is most intrinsically linked to helping California achieve its progressively tighter emission standards [19], the consequences would be far reaching and global due to the fact that it can act as a demonstration that will aid other regions transition to electricity-run fleet and achieve global emissions targets, such as the emission level commitments that have been made under the Paris Climate Agreement [20]. The policies and procedures adopted by the state are aimed at encouraging EV adoption by both public and private vehicles including commercial fleets, and even drayage trucks that form an important part of business logistics, thus making green supply chain a reality.

2. Literature Review

California has a significant role to play when it comes to contribution towards vehicle pollution, specifically in the context of emission of greenhouse gases, pollutants causing smog formation, as also diesel particulate matter. The transportation sector in California contributes to almost 50% of the state's

GHG emissions, about 80% of nitrogen oxide pollution, and nearly 90% of pollution caused by diesel particulate matter [9, 21]. The California

Energy Commission makes a yearly investment of \$100 million approximately for making the state's transportation sector cleaner [21].

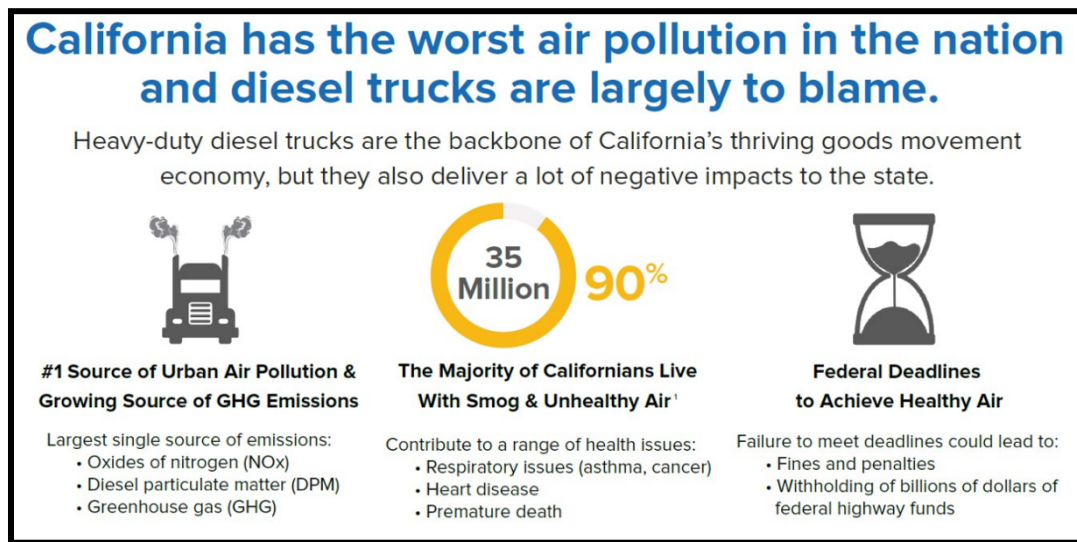


Figure 2: California Air Pollution [22]

Ambitious goals have been set by California for transition to a cleaner environment through electrification and greenhouse gas reduction.

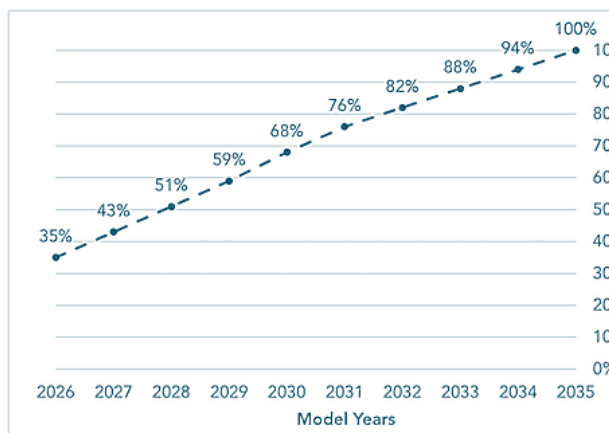


Figure 3: Projected electric vehicle market share in CA [23]

Following are examples of four of such declared targets:

- **Assembly Bill 1082 (AB 108):** Directs the CPUC to promote commercial fleet electrification, including through technical assistance [24].
- **Executive Order B-48-18:** Establishes targets for the deployment of electric vehicle infrastructure, aiming for 250,000 electric vehicle

chargers by 2025 [25]. It includes deployment of 10,000 DC fast chargers, which forms part of the larger and more comprehensive goal of having 5,000,000 zero-emission vehicles plying the Californian roads by 2030 [26].

- **Senate Bill 44 (SB 44):** Focuses on enhancing the development of zero-emission vehicle infrastructure. The aim is the simplification of the legal challenges that are likely to arise under the California Environmental Quality Act (CEQA). This streamlined review is not precisely about EV infrastructure, but has the potential to accelerate the development of EV-related projects and expedite the development of EV charging stations by increasing their manageableness within the process of environmental review [27].

- **California Air Resources Board (CARB) Regulations:** Regulations directly mandate the adoption of electric trucks/commercial vehicles. Particularly, the **Advanced Clean Fleets (ACF)** regulation makes the transition to zero-emission vehicles necessary for the fleets, and the **Advanced Clean Trucks (ACT)** regulation makes it mandatory for the truck manufacturers to enhance the sales of their zero-emission trucks, targeting for 100% electrification by 2045 [28]. CARB's **Advanced Clean Cars II** regulation, the **Advanced Clean Trucks** regulation, and the **Advanced Clean Fleets** regulation support the state's ZEV vehicle

sales goals [26]. The Advanced Clean Cars II regulations are expected to swiftly curtail the emissions caused by the use of light-duty passenger car, pickup truck and SUVs starting with 2026 as the model year through 2035 [23].

California came into limelight in 2020 when it became the global pioneer in prohibiting the sale of new cars in the state that are powered by gasoline 2035 [29]. This mandate was the reason why over 15 million plug-in electric passenger vehicles are on the road in California [30, 31]. 2023 saw zero emission vehicles (ZEVs) constituting 25% of California's new vehicle sales, amounting to nearly 445,000 vehicles [29].

2.2 Fleet Electrification in California

California can save at least 7,000 lives by 2050, while significantly cutting down smog and climate pollution, and save thousands of dollars for the new car buyers through the adoption of clean car standards [32]. Fleet electrification while cleaning the environment will also save money. California is leading the decarbonization of heavy transport [33]. Fleet operators have the capacity to lead this transition to electrification of transportation and reduction of greenhouse gas (GHG) emissions at a significant scale [34].

Fleet vehicles in the state of California are eligible for a number of incentives which includes the state-run Clean Vehicle Rebate Program that offers a rebate of up to \$7,000 per vehicle and up to 30 rebates per fleet per year, and an array of local programs that are provided through the air districts and utilities. Recent executive order N-79-20 also applies to California fleets which has made it mandatory for every in-state vehicle sale to be directed towards achieving zero-emission by 2035 [35]. California is taking steps to ensure that, by 2035, 100% of its new light-duty vehicle sales, including Plug-In Electric Vehicles or PEVs, are zero-emission.

The state has also made substantial investment in developing EV charging infrastructure – a key factor influencing EV adoption, with plans to bring on board 90,000 chargers by 2025 [36]. Often referred to as “Level 3” chargers, direct current (DC) chargers are fast chargers that recharge EV batteries to 80% within 20 minutes to an hour and are hence particularly important and essential for large scale public adoption of EVs [37]. Level 2 chargers charge EV batteries much slower compared DC fast

chargers but are still speedier compared to a standard wall outlet. They are also important for EV adoption. The state of California has provided a significant volume of fund for facilitating and accelerating the pace of transition to EV through the installation of charging infrastructure for electric vehicles. For instance, the California Energy Commission (CEC) has made an investment of \$2.9 billion for building 80,000 charging stations [38]. This move targets particularly the low-income and disadvantaged communities who face substantially higher pollution burdens [39].

Not just globally, but in the U.S. too the electrification of fleet of government and commercial vehicle is gathering a lot of traction, on the back of such factors as steady decline in battery costs, development and expansion of charging infrastructure, increasing government incentives, and speedier adoption of sustainability goals. The pace of changeover to electric vehicles in government and commercial fleets is picking up speed, and projections indicate a substantial upsurge in adoption of electric vehicles by 2030 [40]. Centralized fleet purchasing increases the feasibility and efficiency of electrifying a large number of vehicles significantly due to the involvement of a smaller number of decision-makers [41].

In order to achieve these set targets, changeover to EVs has become necessary for the commercial fleet operators all across the state. Eight pilot projects have been proposed for EV charging by four of the state's electric investor-owned utilities. The approval of these pilots and their subsequent implementation are part of the efforts made by California Public Utilities Commission in the direction of achieving widespread transportation electrification goals as also the clean energy targets of the Senate Bill 350 and Assembly Bills 1082 and 1083 [42].

The expansion of the Zero Emission Vehicles market is heavily dependent on a robust network of charging stations not only in the residential complex or premises but also along public roadways. Public accessibility of charging stations in conjunction with appropriate outreach and incentives for purchase, are crucial to ensuring equitable access to ZEVs [43, 44]. Availability of charging infrastructure on a wide scale is indispensable for boosting consumer confidence vehicle electrification as it ensures that every vehicle can access and use a charging station

as and when required [45]. Following are the

common challenges for EV adoption.

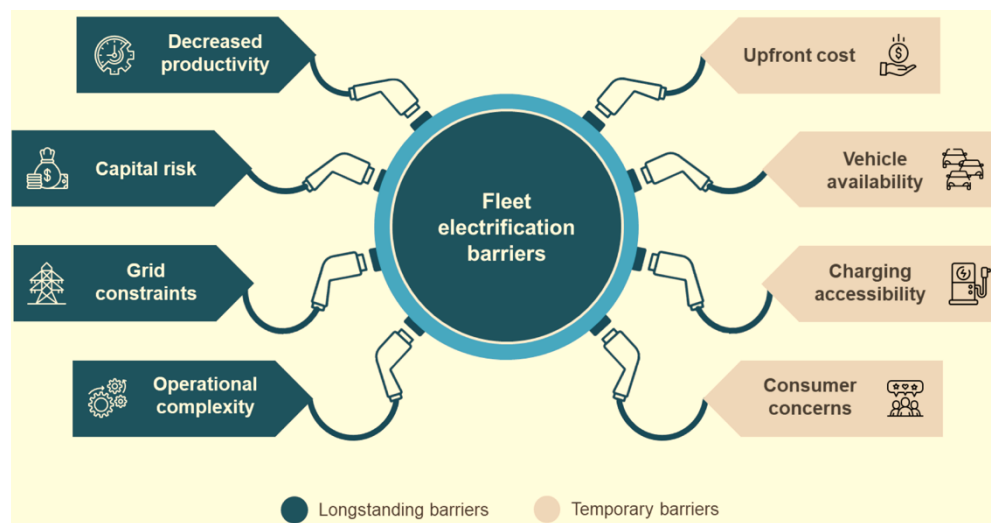


Figure 4: Key Challenges for Mass Commercial Fleet EV Adoption [46]

Consolidation of electrical service guidelines is crucial to expediting electrification of fleet in California. It encompasses rationalization and simplification of processes for availing utilities needed to be accessed while working with electrified fleets, ensuring effective upgradation of grid to offer a seamless experience for the operators of such fleet. The consolidation also entails creation of devoted fleet electrification contacts and merging of the various different EV programs under a single team, to avoid confusion, spreading of misinformation or inadequate information.

3. Challenges for Fleet Operators

Uncertainties & Ambiguities: While transitioning to electric vehicles (EVs), fleet operators in California meet a number of obstacles and challenges, that include elevated initial direct costs, restricted number of EV models, and the requirement for adequate and appropriate charging infrastructure. [47]. Other key concerns and challenges include range anxiety and the duration for getting the EV batteries adequately charged. The transition is further complicated by issues such as dearth of adequately trained and skilled technicians and service facilities that are rightly equipped to handle and work on electric vehicles, as well as uncertainty about the long-term resale value of EVs that the EV users can garner at the time of disposal [48]. Ambiguity around the resale value of EVs makes the decision-making processes of the fleet managers very complex. Such aspects as rates of vehicle depreciation and market demand for old

secondhand electric vehicles need to be assessed with care so as to generate effective plans for fleet investments [47].

Compliance for Charging Infrastructure: For the fleet operators in California, EV transition poses additional challenges that pertain to electrical service guidelines, that specifically relate to the accessibility and dependability of the state's charging infrastructure. Compliance with federal and state regulations, comprehension of rules and regulations pertaining to charging infrastructure, and leveraging available incentives and grants, are by far, some of the most harrowing challenges that the fleet operators in California witness during fleet electrification [49]. California mandated the use and sale of zero-emission vehicles (ZEVs) which require meticulous planning along with collaboration among the fleet operators, infrastructure providers, and utilities in order to make sure that the state possesses adequate charging capabilities.

Fleets which fail to comply with CARB regulations are most likely to face substantial monetary consequences, monetary penalties and may, in all probabilities, lose their capacity to operate within the state's jurisdictions [50]. However, January of 2025 witnessed, CARB withdrawing its request to the Environmental Protection Agency (EPA) for a waiver of preemption of the Clean Air Act (CAA) of California's Advanced Clean Fleets (ACF) regulation. In conjunction with the withdrawal, CARB also announced that it will refrain from enforcing those portions of the ACF

that needs a federal waiver, and includes the portions that apply to high-priority and drayage fleets [51]. This has created a lot of uncertainties relating to the future of the regulatory space pertaining to fleet electrification [52]. Uncertainties most definitely slow down progression.

Inconsistent Standards: Some of the key hurdles for fleet operators in California's fleet transition to EVs are the conflicts and irregularities in standards, specifically related to compliance deadlines and charging infrastructure, which create complications and obstacles for businesses. The state's Advanced Clean Fleets (ACF) rule makes a phased transition to ZEV mandatory, but has specified various deadlines for various fleet based on types and sizes, which has the potential to create a lot of confusion among the fleet operators [53]. ACF Regulation affect fleets of 50 trucks or more, even where they are based out of state, if they travel to California. Other states do promise to follow California but may have differing deadlines. However, for truck fleet operators who work across states - within and outside California, it becomes a challenging situation [54]. Moving back-and-forth between state-level and federal EV mandates are most likely to lead to compliance difficulties and uncertainties for both the manufacturers and the consumers. Confusion may arise among fleet operators regarding which specific rules to follow, and in what sequence and they could even see conflicting deadlines alongside conflicting emissions targets depending upon where they are located, and face the risk of plan disruptions in case and where the federal law overrides state policies such as the 2035 ban by California [55]. Presently, the utilities operate under various service guidelines that govern various requirements for novel customer connections. For instance, the set of infrastructure and utility design plan required under PG&E are different from the requirements under SCE and SDG&E, despite the fact that they all share territory borders through the state [56, 57]. Such inconsistencies push the fleet operators into a realm where they have to navigate a landscape covered by complex mesh of hurdles created by the differing regulatory requirements which, in turn, increases not just the time but also the costs involved in fleet electrification.

Increased Costs: Redundant investments in manpower and infrastructure are common outcomes of the lack of standardization of rules and

requirements. Fleet operators are faced with the challenge of have to adapting to a range of standards and regulations pertaining to electrical capacity prerequisites and conditions, approval procedures for installation, and standards of charging infrastructure, which invariably push up the general cost of fleet electrification. Such factors as expenses on EV batteries, the need for customization to conform to specific service requirements, and the necessity to have adequate charging infrastructure in place can push up the upfront outlay significantly [46]. Organizations operating fleets are most likely to bear the brunt of the impact, as conversion to electric vehicle fleets will, in all probabilities, necessitate adjustments to the manner in which their businesses operate. This does not entail just one-time cost escalation but also a rise in ongoing operational expenses. Cost escalation is inevitable and so is the impact on operations; but it has become imperative for the fleet operators to identify the best ways to transition to ZEVs that would lead to minimum cost escalation and will have the least adverse impact on current operations [58].

Delays in Implementation: Guideline differences and discrepancies create confusion among the fleet operators. Seeking clarity, comprehending the complex regulatory requirements and negotiating ambiguous and contradicting directives invariably lead to delays in seeking and receiving the necessary approvals, which in turn further stalls the fleet electrification projects. Fleet operators have to face multiple processes to conform to the standards set by different utility providers which lead to their experiencing significant project timelines. This adversely affects their capability to successfully reach regulatory deadlines. Jurisdictions vary widely so far as the type of permit required is concerned, and range from absence of any permit requirement to permits that require a comprehensive review of fleet electrification plans. Applications need to be submitted in varied formats and following different levels of details required to be furnished at the time of filing which frequently leads to multiple rounds of comments and subsequent re-filing after incorporating all the amendments suggested. Installers also complain about vastly divergent timeframes for comparable projects, which can range from a few weeks to even a year [59].

Allowing rooms for delays and uncertainties not just slows down installation of individual projects but also result in significant cost escalations for the

installers and fleet operators. Data available from Electrify America, a company which is in the business of installing public charging stations, indicates that, in 2019, on average it took 75 business days, in California, for businesses to receive permits as compared to the national average of 44 days, even with comprehensive zoning review and multiple rounds of comments and counter filing which are considered to be the top two causes of delay in implementation. Costs exceeded the Electrify America national average by at least 24%, which, at least in parts, is the outcome of the delays in granting permits [29]. Obtaining permits in California for EV charging infrastructure in 2024, took 79 days on an average which is 30% longer than that duration of receiving a permit in other states and contributes to significant rise in the cost of construction [60]. The delay is evident from the new car registration statistics. A little over 25% of all the new car registrations in California in 2024 were EVs, as against 25% recorded in 2023. The flat sales are preceded by few years of rapid growth. The sales still fall significantly short of the state's declared target of 35% [59].

Operational Inefficiencies: Where the service guidelines are not streamlined, operational inefficiencies emerge, as it becomes necessary for the fleet operators to train their staff and adjust the operational procedures that they follow, in order to ensure compliance with diverse standards. Different guidelines also indicate a potential increase in the cost of compliance. Diverse service guidelines often require different operational procedures. It is imperative for the fleet operators to modify equipment usage, alter their workflows, and even change or upgrade their safety protocols to avoid facing non-compliance issue a minimize delays [61]. The differences in standards and regulations implemented in different areas or apply to different types of vehicles, has made it necessary for the fleet operators to train their staff about the multiplicity of compliance rules and procedures and adapt their operational workflows so as to comply, resulting in heightened costs and magnified chances of errors [62]. Such fragmentation dents and weakens the potential benefits of transition to EV fleet and amplifies the complexity of management of process of transition to electrified fleet. A big drawback is that while fleets are allowed to qualify for and claim the federal tax credit for Plug-in Electric Vehicles (PEVs), a number of public fleets do not have to bear any federal tax liability, hence the credit

amount cannot be applied [60] and hence recovery of the expenditure at least in parts is not possible.

4. Recommendation: Consolidate Electrical Service Guidelines

EV adoption and fleet electrification is a necessity and the process of changeover has already commenced. Any major change will always have hurdles and so does this process of transition. It faces several regulatory and infrastructural hurdles as discussed in the foregoing paragraphs. To address these issues, the following measures are recommended:

1. **Conduct a Comprehensive Review:** The California Public Utilities Commission (CPUC) should initiate a review of the electrical service guidelines offered by the major electric utilities in California, PG&E, SCE, and SDG&E to ensure that they are aligned with the common state objective of fleet electrification. It is essential for this review to assess the existing standards, identify areas of where the rules and regulation are either overlapping or are completely dissimilar and to the extent of contradiction, and determine best practices that could be standardized. Several of the vehicles that belong to the fleet travel cross country. California-based fleets, particularly large trucking fleets, commonly go cross-country. These fleets are frequently operated over-the-road, delivering goods across long distances, and in different states across the country. The EV standards must have to conform to or at least be compatible with the standards set in other states. Hence a comparative review is an absolute necessity. Also initial fleet assessments and product development is necessary to improving familiarity of the fleet operators with the EV technology and determining if an EV could meet the operating needs of their existing vehicles.

2. **Develop a Single State-Wide Standard:** The state of California is aiming for 100% zero-emission vehicles in the medium and heavy-duty vehicles of the fleet by 2045. Some deadlines are sooner, such as 2035 for drayage trucks; and is moving in the direction of streamlining regulatory requirements which includes aligning regulations with infrastructure development and financial incentives. Within the state itself there are various standards for various vehicles. The state must adopt a uniform standard and reduce the confusion among the fleet operators. The findings of the

review mentioned in the preceding point can be effectively utilized to develop and formulate a single, state-wide standard for fleet electrification. It is essential for this standard to encompass:

○ *Infrastructure requirements:*

Standardized infrastructure is essential for California's fleet electrification as it will ensure a smooth transition besides offering an equitable access for all fleets including heavy, medium, and light duty vehicles, to fueling and charging facilities. This standardization is the key to achieving competence, reliability, and more extensive adoption of ZEVs across California. For instance, standardizing utility metering cabinets by setting up consistent measurements and proportions, configurations, and materials for such enclosures ensures ease of maintenance, safety and interoperability. This standardization also simplifies installation and benefits utilities through cost reductions, and improvements in the efficiency of their metering systems taken as a whole.

○ *Project approval processes:* The complexities and ambiguities that lead to delayed project approval act as a major deterrent to meeting fleet electrification deadlines. By standardizing the project approval process, it is possible to streamline and expedite the process of granting permits, reduce timelines, and ensure uniformity across the state. This, ultimately, will provide higher accessibility and better efficiency to fleet electrification. It would be of immense help to have a centralized authority for purchasing and policy-making with respect to the electrification of the state fleet. This will reduce a lot of ambiguities in the system, increase its reliability, and ensure effective and timely enforcement and implementation of the ZEV purchasing policies and mandates.

○ *Charging station installation incentives:* Charging stations form the backbone of the EV infrastructural set up. However, high upfront costs, low land rentals discourage people to come forward for setting up charging stations or simply charging points at their commercial or residential premises. Offering pecuniary incentives can encourage the installation of charging stations

3. **Engage Stakeholders:** The best way to consolidate electrical service guidelines and to accelerate fleet electrification is to get the stake

holders involved. Stakeholders are the ones who are affected by the transition and hence trying to solve the issues they face and taking care of their requirements would mean finding solutions for easy and faster adoption. Involving the key stakeholders, such as the commercial fleet operators, the original equipment manufacturers (OEMs), utility companies, and operations and maintenance professionals is necessary for the development of a unified standard. They can provide valuable inputs that are necessary and indispensable for creation of a uniform and streamlined guideline that will be not just practical, but also extremely effective, in supporting of fleet electrification goals. Also creating a learning management system for helping employees get educated about electric vehicles and understand the process and prepare for the electrification of their fleet.

4. **Implement Transition Support:** The state needs to provide comprehensive support to utilities and fleet operators during the transition to the new standard. This support could include training programs, technical assistance, and financial incentives to encourage early adoption and compliance. Ease of access to flexible financing options, which includes lease financing, low-interest loans, and customized payment plans, can help fleet operators in easy acquisition of electric vehicles. Grants need to be made available to help utilities and fleet operators create and maintain the necessary charging and fueling infrastructure without shouldering heavy financial obligations. The state should take initiatives to educate the fleet owners about ways and means to avail of Federal tax credit programs and utilize it to their advantage during the entire transition process and thereafter to ease the financial burden of transition to EVs.

5. **Monitor and Adjust:** The success of any project depends on the careful monitoring post execution and identification of glitches and possible areas of concern and subsequent adjustment of policies, procedures and physical assets to ensure that the changeover occurs smoothly and broadly in line with the stated objectives and within the stated timeline. Not all policies would be successful and would need adjustments to suite the needs of the stake holders. It is, therefore, necessary to establish a framework for ongoing monitoring and adjustment of the

- [Online]. Available: [https://decarbonization.visualcapitalist.com/tracking-us-electrification-by-sector/#:~:text=Electrification%20refers%20to%20the%20process,Energy%20Information%20Administration%20\(EIA\)..](https://decarbonization.visualcapitalist.com/tracking-us-electrification-by-sector/#:~:text=Electrification%20refers%20to%20the%20process,Energy%20Information%20Administration%20(EIA)..) [Accessed 01 May 2025].
- [7] IEA, "What is electrification?," 11 Jul 2023. [Online]. Available: <https://www.iea.org/energy-system/electricity/electrification>. [Accessed 01 May 2025].
- [8] S. Chandra, "Driving Towards a Sustainable Future: Optimizing Electric Vehicle Utilization in Last-Mile Supply Chain Operations," *Int. J. Sup. Chain. Mgt*, vol. 13, no. 4, pp. 21-33, 2024.
- [9] COLTURA, "Pollution From Vehicles," 2025. [Online]. Available: <https://coltura.org/vehicle-pollution/>. [Accessed 28 Mar 2025].
- [10] P. Kumawat, "Impact of Electric Vehicles on the Future ECommerce Landscape: Challenges & Advantages," *Int. J. Sup. Chain. Mgt*, vol. 13, no. 6, pp. 46-54, 2024.
- [11] J. Womble and L. Bird, "Ways the US Can Electrify Its Public Fleets, from City Buses to Garbage Trucks | World Resource Institute - Insights," 12 Oct 2023. [Online]. Available: <https://www.wri.org/insights/us-public-fleet-electrification/#:~:text=As%20the%20United%20States%20works,impacted%20by%20pollution%20from%20transportation..> [Accessed 29 Apr 2025].
- [12] A. Jenn and J. Highleyman, "Distribution grid impacts of electric vehicles: A California case study," *iScience*, vol. 25, no. 1, pp. 1-17, 2022.
- [13] US Environmental Protection Agency, "Sources of Greenhouse Gas Emissions," 31 Mar 2025. [Online]. Available: <https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions>. [Accessed 30 Apr 2025].
- [14] Coltura, "Pollution From Vehicles," 2025. [Online]. Available: <https://coltura.org/vehicle-pollution/#:~:text=Across%20the%20U.S.%2C%20vehicle%20emissions,the%20pollutants%20that%20cause%20smog..> [Accessed 03 May 2025].
- [15] US EPA, "Basic Information about Carbon Monoxide (CO) Outdoor Air Pollution," 21 Jun 2024. [Online]. Available: <https://www.epa.gov/co-pollution/basic-information-about-carbon-monoxide-co-outdoor-air-pollution>. [Accessed 03 May 2025].
- [16] US EPA, "Smog, Soot, and Other Air Pollution from Transportation | United States Environmental Protection Agency (US EPA)," 04 Apr 2025. [Online]. Available: <https://www.epa.gov/transportation-air-pollution-and-climate-change/smog-soot-and-other-air-pollution-transportation/#:~:text=Pollutants%20that%20contribute%20to%20poor,VOCs%20emissions%20in%20the%20U.S..> [Accessed 03 May 2025].
- [17] E. Muehlegger and D. S. Rapson, "Subsidizing low- and middle-income adoption of electric vehicles: Quasi-experimental evidence from California," *Journal of Public Economics*, vol. 216, 2022.
- [18] M. Batool, M. A. Mudassir, S. Kousar and M. A. Makarem, "Carbon Capture by Hybrid Separation," *Encyclopedia of Renewable Energy, Sustainability and the Environment*, vol. 4, pp. 935-942, 2024.
- [19] C. Sugihara and S. Hardman, "Electrifying California fleets: Investigating light-duty vehicle purchase decisions," *Transportation Research Interdisciplinary Perspectives*, vol. 13, pp. 1-12, 2022.
- [20] C. E. D. Leva and S. Vaughan, "The Paris Agreement's New Article 6 Rules - The promise and challenge of carbon market and non-market approaches : International Institute of Sustainable Development (IISD)," 13 Dec 2021. [Online]. Available: <https://www.iisd.org/articles/paris-agreement-article-6-rules>. [Accessed 03 May 2025].
- [21] California Energy Commission, "Transforming Transportation," 2025. [Online]. Available: <https://www.energy.ca.gov/about/core-responsibility-fact-sheets/transforming-transportation>. [Accessed 02 May 2025].
- [22] California Renewable Transportation Alliance, "Cleaner Air," 2025. [Online]. Available: <https://ca-rta.org/renewable-transportation-fuels/clean-air/>. [Accessed 03 May 2025].

- [23] CARB, "Latest Update - Amendments to Advanced Clean Cars II," 2024. [Online]. Available: <https://ww2.arb.ca.gov/our-work/programs/advanced-clean-cars-program/advanced-clean-cars-ii>. [Accessed 03 May 2025].
- [24] Cadmus Group & Energetics Inc. , "Standard Review Projects and AB 1082/1083 Pilots - Evaluation Year 2023 (Year3)," Nov 2024. [Online]. Available: <https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/sb-350-te/srp-ab10821083-2023-evaluation-report112024.pdf>. [Accessed 04 May 2025].
- [25] California Energy Commission, "Assembly Bill 2127 Electric Vehicle Charging Infrastructure Assessment (Staff Report)," 07 Jan 2021. [Online]. Available: https://biotech.law.lsu.edu/blog/document_ew_04-1.pdf. [Accessed 04 May 2025].
- [26] L. Baroody, "Plugging Local Governments into Resources to Advance Transportation Electrification | Civic Well," 14 Mar 2024. [Online]. Available: [https://civicwell.org/civic-news/currents-plugging-local-governments-into-resources-to-advance-transportation-electrification-14/#:~:text=California%20has%20an%20ambitious%20goal%20of%205,hydrogen%20stations%20by%202025%20\(Executive%20Order%20B%2D48%2D18\)](https://civicwell.org/civic-news/currents-plugging-local-governments-into-resources-to-advance-transportation-electrification-14/#:~:text=California%20has%20an%20ambitious%20goal%20of%205,hydrogen%20stations%20by%202025%20(Executive%20Order%20B%2D48%2D18)). [Accessed 04 May 2025].
- [27] California Senate Bill 44, "Bill Text: CA SB44 | 2021-2022 | Regular Session | Chaptered | LegiScan," 07 Oct 2021. [Online]. Available: <https://legiscan.com/CA/text/SB44/id/2436321>. [Accessed 04 May 2025].
- [28] Covenant Logistics Group, "CARB Regulations Will Continue Impacting the Trucking Industry," 20 Sep 2023. [Online]. Available: <https://www.covenantlogistics.com/articles/carb-regulations-will-continue-impacting-the-trucking-industry#:~:text=The%20regulation%20requires%20that%20manufacturers%20sell%20a,by%20these%20manufacturers%20are%20zero%2D emission%20by%202045..> [Accessed 03 May 2025].
- [29] E. Conrad, P. Hehmeyer and B. Cain, "Overcoming roadblocks to California's public EV charging infrastructure," Feb 2024. [Online]. Available: <https://siepr.stanford.edu/publications/policy-brief/overcoming-roadblocks-californias-public-ev-charging-infrastructure>. [Accessed 05 May 2025].
- [30] N. Lopez, "California phases out new gas cars - so what's next for electric cars? Cal Matters | Cal Matters," 25 Aug 2022. [Online]. Available: <https://calmatters.org/environment/2022/08/electric-cars-california-to-phase-out-gas-cars/>. [Accessed 06 May 2025].
- [31] A. Davis, T. Hoang, T. Lopez, J. Lu, T. Nguyen, B. Nolt, L. Rillera, D. Schell and M. Wofford, "Assembly Bill 2127 Electric Vehicle Charging Infrastructure Second Assessment Staff Draft Report. CEC-600-2023-048, California Energy Commission.," 2023. [Online]. Available: <https://www.energy.ca.gov/publications/2023/second-assembly-bill-ab-2127-electric-vehicle-charging-infrastructure-assessment>. [Accessed 06 May 2025].
- [32] A. Henderson, "New Study Finds California's Zero-Emission Cars Standards Could Save Lives, Reduce Pollution, Save Californians Money | Environmental Defence Fund," 04 May 2021. [Online]. Available: <https://www.edf.org/media/new-study-finds-californias-zero-emission-cars-standards-could-save-lives-reduce-pollution>. [Accessed 03 Mar 2025].
- [33] G. Westhoff, A. Kahn, Nocona Sanders, D. Mullaney and D. Kapur, "How electric truck fleets can save money with smarter charging, solar power, and batteries | Mission Possible Partnership," 31 Jan 2025. [Online]. Available: <https://www.missionpossiblepartnership.org/hubs/how-electric-truck-fleets-can-save-money-with-smarter-charging-solar-power-and-batteries/#:~:text=In%20California%2C%20solar%20energy%20is,when%20partnered%20with%20battery%20storage..> [Accessed 03 May 2025].
- [34] California Trucking Association, "The Road to Fleet Electrification," 09 Sep 2019. [Online]. Available: <https://www.ceres.org/download/2c463e18-7518-4f6f-86f1-6567a0bd4a1d>. [Accessed 28 Apr 2025].

- [35] Executive Dept. State of California, "EXECUTIVE ORDER N-79-20," Sep 2020. [Online]. Available: <https://www.gov.ca.gov/wp-content/uploads/2020/09/9.23.20-EO-N-79-20-Climat.pdf>. [Accessed 03 May 2025].
- [36] California Air Resources Board, "California moves to accelerate to 100% new zero-emission vehicle sales by 2035," 25 Aug 2022. [Online]. Available: <https://ww2.arb.ca.gov/news/california-moves-accelerate-100-new-zero-emission-vehicle-sales-2035#:~:text=The%20rule%20establishes%20a%20year%2Dby%2Dyear%20roadmap%20so,zero%2Dmission%20vehicles%2C%20including%20plug%2Din%20hybrid%20electric%20vehicles.&t>. [Accessed 05 May 2025].
- [37] United States Department of Transportation, "Charger Types and Speeds," 2024. [Online]. Available: <https://www.transportation.gov/rural/ev/toolkit/ev-basics/charging-speeds>. [Accessed 05 May 2025].
- [38] ICCT research, "Charging infrastructure policies | ZEV Transition Council," 20 Nov 2024. [Online]. Available: [https://zevtc.org/tracking-progress/charging-infrastructure-policies/#:~:text=California%20Energy%20Commission%20\(CEC\)%20announced,of%20Heavy%20Industries%20announced%20Rs..](https://zevtc.org/tracking-progress/charging-infrastructure-policies/#:~:text=California%20Energy%20Commission%20(CEC)%20announced,of%20Heavy%20Industries%20announced%20Rs..) [Accessed 05 May 2025].
- [39] Office of Governor Gavin Newsom, State of California, "Charging Ahead: California Doubling the Number of EV Chargers in the State With \$3 Billion Investment," 14 Dec 2022. [Online]. Available: <https://www.gov.ca.gov/2022/12/14/charging-ahead-california-doubling-the-number-of-ev-chargers-in-the-state-with-3-billion-investment/>. [Accessed 06 May 2025].
- [40] CHARGED, "Electrification gaining momentum in fleet vehicle industry," 19 Apr 2024. [Online]. Available: <https://chargedevs.com/whitepapers/electrification-on-gaining-momentum-in-fleet-vehicle-industry/#:~:text=The%20electrification%20of%20commercial%20vehicles,rapidly%20in%20the%20coming%20decade..> [Accessed 05 May 2025].
- [41] Green Light Labs, Inc., "Accelerating Fleet Electrification in California - FINAL PROJECT REPORT," California Energy Commission's (CEC). Publication Number: CEC-500-2024-046. , San Jose, CA, 2024.
- [42] Government Of California, "DECISION ON THE TRANSPORTATION ELECTRIFICATION PILOTS FOR SCHOOLS AND PARKS PURSUANT TO ASSUMBLY BILLS 1082 AND 1083," 10 Apr 2019. [Online]. Available: <https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M319/K350/319350862.PDF>. [Accessed 03 May 2025].
- [43] P. Slowik, "EXPANDING ZERO-EMISSION MOBILITY EQUITY AND ACCESS - WORKSHOP REPORT," ZEV Alliance & The International Council on Green Transportation, 2019.
- [44] E. Elkind, T. Lamm, K. Segal and G. Damon, "Driving Equity: Policy Solutions to Accelerate Electric Vehicle Adoption in Low-Income Communities - Policy Report," Berkeley Law Center for Law, Energy & the Environment and UCLA School of Law Emmett Institute on Climate Change & the Environment., 2022.
- [45] H. Hickerson and H. Goldsmith, Electric Vehicle Charging Station Permitting Guidebook, 2nd Edition ed., Californis Governor's Office of Business and Economic Development., 2023.
- [46] EVBoosters, "Fleet Electrification: Challenges and Considerations," 04 Oct 2023. [Online]. Available: <https://evboosters.com/ev-charging-news/fleet-electrification-challenges-and-considerations/>. [Accessed 08 May 2025].
- [47] P. Monteiro, "Navigating the Transition: Opportunities and Challenges for Fleet Managers Switching to Electric Vehicles | AnyLine," 06 May 2024. [Online]. Available: <https://anyline.com/news/opportunities-and-challenges-for-fleet-managers-switching-to-electric-vehicles>. [Accessed 06 May 2025].
- [48] N. Virmani, V. Agarwal, K. Karuppiah, S. Agarwal, R. D. Raut and S. K. Paul, "Mitigating barriers to adopting electric vehicles in an emerging economy context,"

- Journal of Cleaner Production, Vols. 414, 137557, 2023.
- [49] Zorp.One, "Navigating Regulations in EV Fleet Management," 15 Jun 2023. [Online]. Available: <https://www.zorp.one/blog/navigating-regulations-in-ev-fleet-management#:~:text=In%20this%20article%2C%20we'll%20explore%20the%20most,the%20fundamentals%20of%20managing%20an%20electric%20vehicle.> [Accessed 05 May 2025].
- [50] J. B. Hunt, "Navigating Advanced Clean Fleets and CARB Compliance," 13 Dec 2023. [Online]. Available: https://www.google.com/search?q=compliance+issues+in+fleet+transition+in+california+usa&sca_esv=b5b85f1110a5fb0d&ei=wG4baIvDCLHkseMPmK_06AQ&oq=compliance+issues+in+fleet+transition+in+California&gs_lp=Egxnd3Mtd2l6LXNlcniM2NvbXBsaWFuY2UgaXNzdWVzIGluIGZsZW. [Accessed 07 May 2025].
- [51] M. Foster, "Advanced Clean Fleets Regulations No Longer in Force for Most Fleet Operators and Owners," 25 Feb 2025. [Online]. Available: <https://www.mofo.com/resources/insights/250225-advanced-clean-fleets-regulations-no-longer-in-force.> [Accessed 07 May 2025].
- [52] Sidley, "California Withdraws EPA Waiver Request for Advanced Clean Fleets Regulations," 17 Jan 2025. [Online]. Available: <https://www.sidley.com/en/insights/newsupdates/2025/01/california-withdraws-epa-waiver-request-for-advanced-clean-fleets-regulations.> [Accessed 07 May 2025].
- [53] CARB, "Advanced Clean Fleets Regulation - Internal Combustion Engine Purchase Requirements," 03 Jul 2024. [Online]. Available: <http://ww2.arb.ca.gov/resources/fact-sheets/advanced-clean-fleets-regulation-internal-combustion-engine-purchase#:~:text=High%20Priority%20Fleets%20that%20comply%20with%20the,their%20minimum%20useful%20life%20mileage%20thresholds%20are.> [Accessed 06 May 2025].
- [54] M. L. Grasse and S. V. Winter, "Environmental, Land Use & Natural Resources Advisory: California's Advanced Clean Fleets Regulation Under Attack | Alston & Bird," 23 Jun 2024. [Online]. Available: <https://www.alston.com/en/insights/publications/2024/06/california-clean-fleets-regulation-under-attack.> [Accessed 07 May 2025].
- [55] EVE Mobility, "How California's EV Debate Impacts Midwest Fleet Electrification," 02 May 2025. [Online]. Available: <https://www.eve-mobility.io/post/what-california-s-emissions-fight-means-for-midwest-fleets#:~:text=While%20California%20says%20the%20rules%20are%20essential,they're%20unrealistic%20under%20current%20EV%20market%20conditions.&text=state%20EV%20mandates%20.> [Accessed 05 May 2025].
- [56] Office of Energy Infrastructure Safety, Govt. of California, "BEFORE THE PUBLIC UTILITIES COMMISSION," 16 Dec 2022. [Online]. Available: <https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M500/K013/500013812.PDF.> [Accessed 09 May 2025].
- [57] California Public Utilities Commission, "2024 Senate Bill 695 Report," 01 Jul 2024. [Online]. Available: https://www.google.com/search?q=PG%26E+has+different+infrastructure+and+utility+design+plan+requirements+compared+to+SCE+and+SDG%26E%2C+even+though+they+all+border+each+other%E2%80%99s+territories+through+the+state.+&sca_esv=b5b85f1110a5fb0d&ei=424baMejF6. [Accessed 10 May 2025].
- [58] Milad Arouni, "What California's Zero-Emission Moves Could Mean for Fleet Operators | Burns & McDonnell," 29 Aug 2024. [Online]. Available: <https://blog.burnsmcd.com/what-californias-zero-emission-moves-could-mean-for-fleet-operators#:~:text=Organizations%20operating%20fleets%20will%20bear,adverse%20impact%20on%20current%20operations..> [Accessed 05 May 2025].
- [59] A. Lazo, "California's surge in EV sales has stalled — so what happens to its landmark mandate? | Cal Matters," 06 Feb 2025. [Online]. Available: <https://calmatters.org/environment/climate-change/2025/02/electric-car-sales-stall-california/#:~:text=About%20a%20quarter%20%E2%80%94%2025.3%25%20%E2%80%94,below%20the%20state's%2035%25%20target..> [Accessed 05 May 2025].

- [60] BEI Construction, "The challenges facing California's EV charging initiative," 29 Jul 2024. [Online]. Available: <https://beiconstruction.com/the-challenges-facing-californias-ev-charging-initiative/#:~:text=Permitting%20delays%E2%80%94%94These%20not%20only,costlier%20than%20in%20other%20states..> [Accessed 10 May 2025].
- [61] Fynd, "Top Challenges Faced By Fleet Management And Fleet Managers (2025 Guide)," 15 Nov 2024. [Online]. Available: <https://www.fynd.com/blog/fleet-management-challenges>. [Accessed 07 May 2025].
- [62] WorkTrek, "10 Standards Maintenance Professionals Should Be Aware Of," 15 Nov 2024. [Online]. Available: <https://worktrek.com/blog/standards-for-maintenance-professionals/>. [Accessed 07 May 2025].