Funding Transportation Electrification in California

The Public Advocates Office Position Paper

November 17, 2022

CONTENT

ACRONYMS

BTM	Behind-the-meter
CARB	California Air Resources Board
CEC	California Energy Commission
CPUC	California Public Utilities Commission
DCFC	Direct current fast charger
DRIVE	Development of Rates and Infrastructure for Vehicle Electrification
ESJ	Environmental and Social Justice
EV	Electric vehicle
FY	Fiscal year
GHG	Greenhouse Gas
HD(V)	Heavy-duty (vehicle)
IOU	Investor-owned utility
LCFS	Low Carbon Fuel Standard
LD(V)	Light-duty (vehicle)
MD(V)	Medium-duty (vehicle)
MMT	Million Metric Ton
OIR	Order instituting rulemaking
PG&E	Pacific Gas and Electric
PM	Particulate matter
POC	People of color
SCE	Southern California Edison
SDG&E	San Diego Gas & Electric
T&D	Transmission and distribution
TE	Transportation electrification
TOU	Time-of-use
TNC	Transportation Network Company
TTM	To-the-meter

1 OVERVIEW – WHAT COULD HAMPER THE GROWTH OF TRANSPORTATION ELECTRIFICATION?

Electric rates are too high

Electricity in California is twice as expensive as other western and mountain states in the United States, see Figure 1.[1] Electricity rates of California's largest investor-owned utilities have also been rising at least twice as fast as inflation.[2] Utility costs are a higher percentage of expenditures for lower-income households.[3] As such, rising rates puts disproportional financial pressure on low-income households.

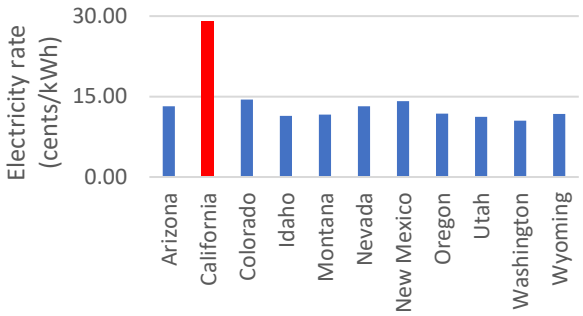

Figure 1. Average residential electric rates in June 2022 for western and mountain states.

Transportation emissions are too high

Transportation sector tailpipe emissions account for over 40% of California's GHG emissions, as seen in Figure 2.[4] This percentage increases to 50% considering lifecycle impacts such as oil refining and vehicle manufacturing.[5] Therefore, reducing transportation emissions by electrification is paramount to achieving the state's GHG reduction goals.

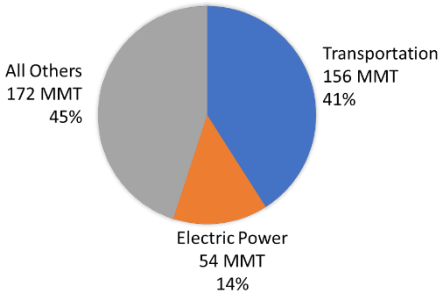

Figure 2. 2021 California GHG emission by sector (MMT of CO2e).

Transportation electrification will cost billions

To be on track to meet California's emission targets, CARB anticipates that the transportation sector will need to reduce annual emissions from 156 MMT in 2021 by roughly half, to 86 MMT in 2030.[6] This transition will likely require

[1] Energy Information Administration Average Price of Electricity to Ultimate Customers. Accessed at: https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_5_6_a

[2] CPUC Rates En-Banc on February, 24, 2021. PDF page. 3 of slides: https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/en-banc/rates-en-banc_panel-1_updated.pdf

[3] CPUC 2019 Annual Affordability Report. Figure 20 in p. 39. Accessed: https://www.cpuc.ca.gov/-/media/cpuc-website/industries-and-topics/reports/2019-annual-affordability-report.pdf.

[4] CARB Draft 2022 Scoping Plan AB 32 GHG Inventory Sectors Modeling Data Spreadsheet. Accessed at: https://ww2.arb.ca.gov/sites/default/files/2022-05/2022-draft-sp-PATHWAYS-data-E3.xlsx

[5] CARB LCFS Basics, slide 4. Accessed at: https://ww2.arb.ca.gov/sites/default/files/2020-09/basics-notes.pdf

[6] CARB Draft 2022 Scoping Plan AB 32 GHG Inventory Sectors Modeling Data Spreadsheet.

significant investment in transportation electrification. So it is important for the funding to be used effectively and equitably.[7]

2 RECOMMENDATIONS

The funding needed for transportation electrification should be better understood.
The magnitude of the funding needed to electrify the transportation sector is currently unclear. The CEC, CARB and CPUC (Joint Agencies) should initiate an interagency process and host a series of workshops to determine how much, where and when investment is needed in the electric grid to support expansive transportation electrification. We recommend the Joint Agencies focus on the cost of to-the-meter (TTM) and behind-the-meter (BTM) infrastructure, i.e., transformers, electric meter, electrical panel upgrades, conduits and wiring, and EV chargers. The cost of transmission and distribution (T&D) infrastructure, i.e., power lines, poles, and substations, can be reasonably recovered via properly designed retail electric rates.

Ratepayers should not fund transportation electrification infrastructure.
Ratepayer funding of transportation electrification is regressive and inequitable. Low-income households in California already pay a larger portion of their household income for energy. Increasing electric rates to fund the state's GHG reduction initiatives, therefore, places a disproportionate burden on low-income families. This is also counterproductive as this increases the cost of fueling electric vehicles, which in turn reduces the incentive to purchase electric vehicles.

Funding sources other than electric rates should be explored further.
State initiatives should be funded by the state, not ratepayers. The State of California set a goal to reduce transportation emissions by codifying CARB's Advanced Clean Cars II regulation. This regulation requires all new passenger cars, trucks and SUVs sold in California to be zero emissions by 2035.[8] The state's general fund[9] and greenhouse gas reduction fund should support the implementation of this regulation.

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[7] Cal Advocates estimates in Section 4.2 of this document that TE will accumulate a cost of $30.8 billion in TTM and BTM upgrades by 2030. This includes BTM infrastructure (electrical panels, conduit, wiring, EV charger) and TTM (transformer, meter), not upstream T&D infrastructure (lines, poles and substation).

[8] CARB, "California moves to accelerate to 100% new zero-emission vehicle sales by 2035". Accessed at: https://ww2.arb.ca.gov/news/california-moves-accelerate-100-new-zero-emission-vehicle-sales-2035

[9] LA Times, "California surplus expected to hit unprecedented $97 billion under Newsom's budget plan" Accessed at: https://www.latimes.com/california/story/2022-05-13/california-budget-surplus-swells-to-97-billion-under-newsom-new-plan

Another option is to look towards the private sector to fund the charging infrastructure. For example, those who are installing EV chargers, and benefiting from them, should pay for them instead of shifting the cost to other ratepayers.

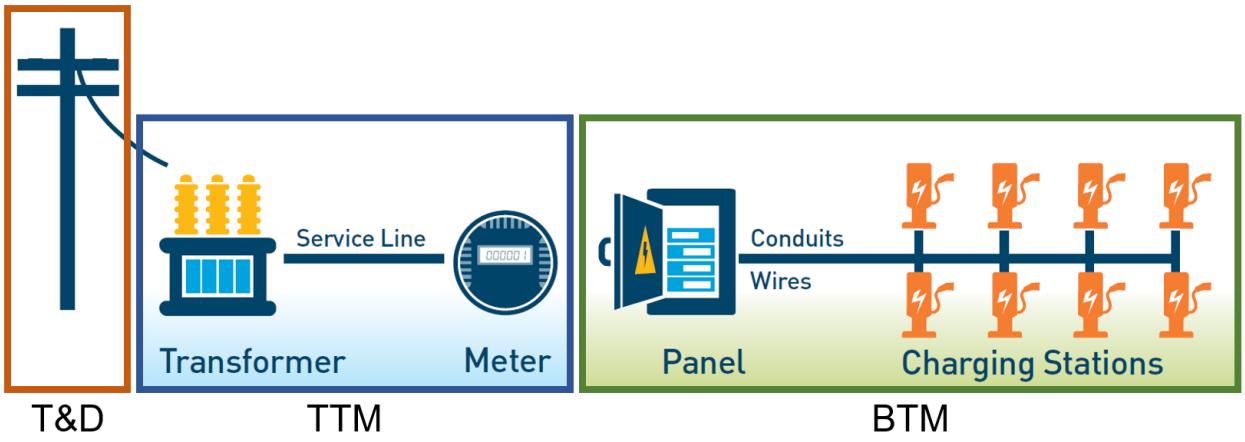
Finally, there may be other innovative ways to fund transportation electrification infrastructure that do not contribute to inequity, which should be explored further.

3 BACKGROUND

3.1 Note on Terminology

This position paper covers alternative funding for BTM and TTM infrastructure, but not T&D infrastructure (see Figure 3). The cost of BTM infrastructure is not typically paid for by utility ratepayers. The cost of TTM TE infrastructure is paid for by ratepayers, pursuant to Electric Rule 15, 16 and 29 (for PG&E and SCE) or 45 (for SDG&E). The cost of T&D upgrades is covered by the increased energy demand and revenue from EVs, which is consistent with the cost-causation principle and a reasonable and fair approach to cost recovery. Therefore, there is no need to alter the funding structure for T&D infrastructure.

Figure 3. Categories of TE infrastructure.[10]



Within this paper, we discuss several categories of TE funding sources:

- Private sector funding – Money from entities such as EV charging companies, EV manufacturers, and investors.
- State funding – Money from income tax (general fund), cap-and-trade revenue, carbon tax, bonds.
- Ratepayer funding – Money from utility rates.
- Public funding – Both state and ratepayer funding.

[10] Adapted from Pacific Gas and Electric. (2022). *Electric Vehicle Infrastructure Rule 29.*

3.2 Procedural Background

In 2020, CPUC staff issued a Draft TE Framework to align the IOUs' TE programs with the changing EV market.[11] The Draft TE Framework discussed alternative funding mechanisms and public-private partnerships as a means of reducing ratepayer funding for TE over time as the EV market matures.[12]

On February 25, 2022, CPUC staff issued a proposal in the DRIVE OIR. Despite consideration of alternative funding mechanisms in the 2020 Draft TE Framework and concerns on rate affordability, CPUC staff proposed an additional $1 billion in ratepayer funding for TE programs from 2025 to 2029.[13] This is in addition to the $1.8 billion that the CPUC previously authorized to fund TE programs (of which $1.5 billion was unspent as of April 2022), and in addition to the authorized cost recovery of all TTM TE infrastructure needed to accommodate TE.[14] A Proposed Decision on October 14, 2022 proposes to adopt the staff proposal's $1 billion in ratepayer funding for TE programs from 2025-2029.[15]

3.3 Looking to the Future

Pursuant to the CPUC's and Legislature's direction, electricity ratepayers have funded many of the TE programs so far. The CPUC authorized the IOUs to take a "critical role in the transportation sector," and has expanded the IOUs' role in TE by allowing the IOUs to own BTM TE infrastructure.[16] The IOUs' recovery from ratepayers of the $1.8 billion[17] in TE costs is expected to increase electricity rates by a total of 1%, roughly

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[11] *Transportation Electrification Framework – Energy Division Staff Proposal* (Draft TE Framework), filed February 3, 2020. Accessed at: https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M326/K281/326281940.PDF

[12] Draft TE Framework, Sections 9.3 and 10.1.

[13] *Energy Division Staff Proposal to Establish Transportation Electrification Funding Cycles and Statewide Behind-the-Meter Program* (Staff Proposal), p. 7. Filed February 25, 2022. Accessed at: https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M453/K952/453952700.PDF

[14] Per Assembly Bill 841 (Ting, 2020), Electric Rule 29 requires IOUs to build TTM TE infrastructure for separately metered EV chargers and recover those costs during general rate cases.

[15] *Proposed Decision on Transportation Electrification Policy and Investment*, p. Ordering Paragraph 4. Filed October 14, 2022.

[16] D.14-12-079, *Phase I Decision Establishing Policy to Expand the Utilities' Role in Development of Electric Vehicle Infrastructure*, filed December 18, 2014, issued in Rulemaking (R.) 13-11-007, *Order Instituting Rulemaking to Consider Alterative-Fueled Vehicle Programs, Tariffs, and Policies*, p. 1.

[17] Staff Proposal, p. 4.

equal to $20/year.[18] This increase when added to all other rate increases will place further financial stress on customers, particularly low-income Californians.[19]

Looking to the future, Cal Advocates estimates that an additional $16.5 billion is needed by 2030 for TE-related BTM and TTM infrastructure, beyond what is currently committed from the public sector and expected from the private sector.[20] This amount of funding requires long-term planning among government agencies, automakers and utilities, and discussions with stakeholders on how it should be paid for. This position paper presents ideas to kickstart that process.

4 APPROACHES TO FUNDING TRANSPORTATION ELECTRIFICATION

4.1 Guiding Principles

To balance the competing needs and interests of stakeholders, Cal Advocates proposes three guiding principles for transportation electrification:

1. Transportation electrification should be environmentally and socially just.
    a) Transportation electrification should be accessible to all.
    b) Transportation electrification should ensure equity among customers.
    c) Transportation electrification should not lead to increased electric rates.
2. Transportation electrification should support California's energy and sustainable land-use policies, including, but not limited to, executive order N-79-20 and SB 32 (Global Warming Solutions Act of 2016).
3. Transportation electrification should rely minimally on state and ratepayer funding.

The remainder of this section describes actions that would contribute to achieving these principles.

4.2 Transportation electrification should be environmentally and socially just.

Equitable transportation electrification can mitigate three key environmental and social injustices among different socio-economic groups in California:

1. Unequal burdens caused by vehicle pollution primarily faced by Black and Hispanic communities.
2. Inequitable access to electrified transportation.

[18] Cal Advocates estimates removing $1.8 billion in funding can avoid a 1% increase in electric rates.

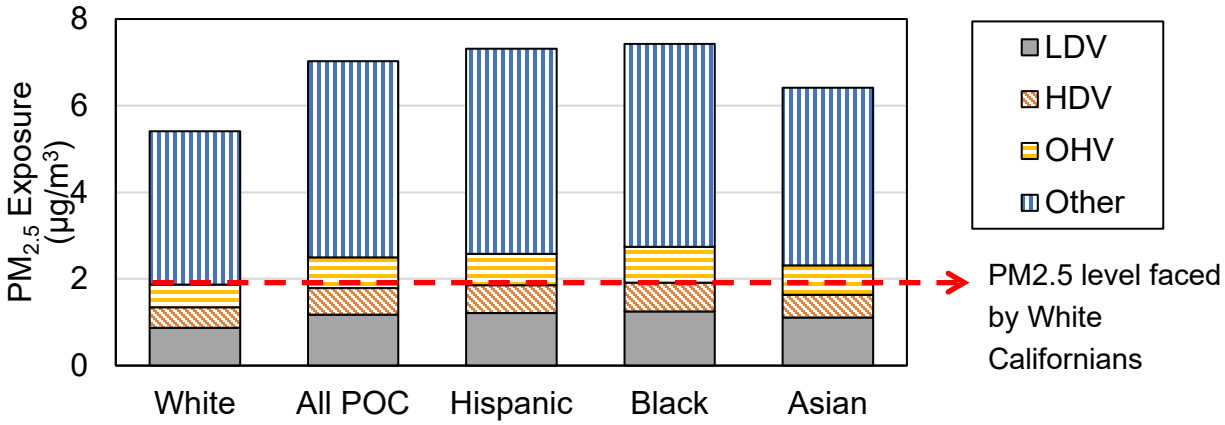
[19] CPUC 2019 Annual Affordability Report, p. 42.

[20] Cal Advocates roughly estimates in Section 4.2 of this document that there is a funding gap of $16.5 billion for transportation electrification infrastructure by 2030.

3. Disparate impacts of rising electricity rates caused by utility spending, including utility spending on TE.

One of the air pollution metrics that illustrates racial disparities in pollution exposure is PM2.5. PM2.5 is a fine air particle that is produced by combustion of gasoline or diesel fuel and can be inhaled and absorbed into the bloodstream. Exposure to PM2.5 can affect a person's lungs and heart, increasing risks of heart attacks and asthma attacks.[21] As illustrated in Figure 4, LDV, HDV and OHV (Off-Highway Vehicles, e.g. construction equipment) each cause a disproportionate negative impact on POC.[22] For POC in general, removing the disparity of PM2.5 exposure due to vehicle emissions removes one third to one half of the total disparity in PM2.5 exposure.

Figure 3. Source contributions to PM2.5 exposure by racial group in California.[23] Vehicles = LDV+HDV+OHV; other = all other sources.



Reduced inequity across racial groupings is important, but that is not the whole story. Equity across all socio-economic groups must also be considered. A metric that can be used as a reference is the CalEnviroScreen score. This composite score reflects pollution and socio-economic burdens for each census tract in California.[24] This tool can help identify census tracts in which TE will provide significant equity benefits. This approach is consistent with the CPUC's ESJ Action Plan 2.0, which acknowledges that race-based

[21] EPA, "How does PM Affect Human Health?". Accessed at: https://www3.epa.gov/region1/airquality/pm-human-health.html

[22] Tessum, Christopher & Paolella, David & Chambliss, Sarah & Apte, Joshua & Hill, Jason & Marshall, Julian. (2021). *PM 2.5 polluters disproportionately and systemically affect people of color in the United States*. Science Advances. 7, pp. 1-2. 10.1126/sciadv.abf4491.

[23] Tessum et al. (2021), supplemental data file s2.

[24] Office of Environmental and Health Hazard Assessment. *About Cal EnviroScreen*. Accessed at https://oehha.ca.gov/calenviroscreen/about-calenviroscreen.

inequities "often align" with inequities more broadly.[25] Tracking air-quality impacts across communities, moreover, is one of the CPUC's ESJ Action Items.[26] Cal Advocates supports systematically using CalEnviroScreen scores to target TE at the most underserved communities.

a) Transportation electrification should be accessible to all.

TE access is currently inequitable in California. Black and Hispanic neighborhoods are half as likely as other racial groups to have access to publicly-funded EV charging stations in California.[27] Therefore, current public policy is exacerbating the disparity in TE access and failing to lower barriers for these communities to own EVs. To help address this inequity, EV charger deployment must promote equity.

As illustrated in Figure 5, lower EV adoption in low-income and disadvantaged communities could result in lower use of, and revenue from, chargers in those areas. Since private sector installations are driven by the potential to generate revenue from the chargers, lower potential revenue means the private sector is less likely to install more chargers. This further slows EV adoption, as a lack of chargers disincentivizes EV purchases. Since this is a feedback loop, a difference in investment across social groups or neighborhoods will exacerbate existing inequities in EV adoption. Mitigating this negative feedback loop requires increasing funding in underserved areas, a priority that aligns with the CPUC's ESJ Goals.[28]

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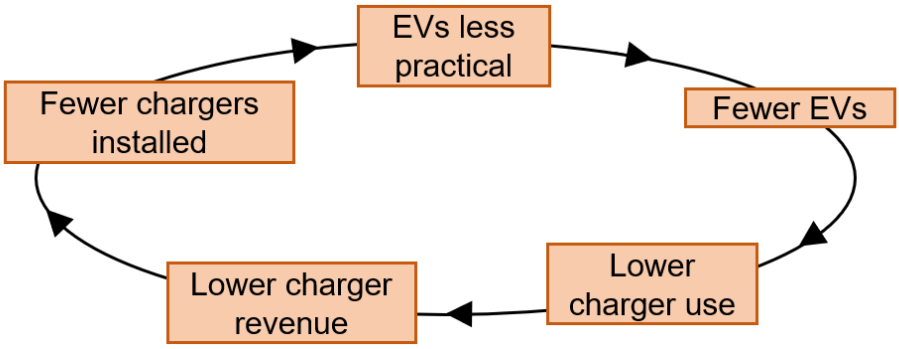
[25] CPUC. (2022). *Environmental & Social Justice Action Plan Version 2.0* (ESJ Action Plan), p.3. Accessed at https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/news-and-outreach/documents/news-office/key-issues/esj/esj-action-plan-v2jw.pdf.

[26] ESJ Action Plan, p. 32 (Action Item 2.2.3).

[27] Hsu, Chih-Wei & Fingerman, Kevin. (2020). *Public electric vehicle charger access disparities across race and income in California.* Transport Policy, Table 3, pp. 64-65. Accessed at: https://doi.org/10.1016/j.tranpol.2020.10.003

[28] ESJ Action Plan, pp. 24, 38.

Figure 4. Fewer initial EVs could lead to perpetual low EV adoption.



Making TE accessible to all also requires access to affordable EV charging. High-priced electricity will make owning an EV more expensive on an ongoing basis, which could put EVs out of reach for low-income Californians. Therefore, California needs to keep electric rates for EV charging low.

The CPUCs' ESJ Action Plan 2.0 Goal 2 recommends prioritization of ESJ and underserved communities for TE infrastructure investments and will help to ensure increased utilization of charging infrastructure from these communities in the future.[29] Prioritization of TE investment in underserved communities is important, as well as considering who should pay for it. As described in the next section, ratepayer funding would further hurt these communities.

b) Transportation electrification should ensure equity among customers.

Lower income households spend a far greater proportion of their income on electricity. At the median income levels across the state, almost all families spend less than 5% of their income on electric bills. In contrast, at the 20th percentile of income levels, many families spend 10-15% of their income on electric bills.[30] Relying on ratepayer funding for state initiatives like TE , therefore, is regressive and could lead to unjust outcomes because it further increases the utility cost burden on low-income households. However, if TE costs remain the responsibility of ratepayers, there is a way to design electric rates

[29] ESJ Action Plan, Action Item 2.5.5, p. 37.

[30] CPUC 2019 Annual Affordability Report. Figure 20 in p. 39. Affordability ratio is defined as "the percent of income that is spent on each type of essential utility service after housing and the remaining essential utility services are considered." Looking at the distribution of household affordability ratios (AR) for families at the 20th percentile of income levels (AR20), many households spend up to 10-15% of their income on utilities. In contrast, at the 50th percentile of income levels (AR50), very few households spend more than 5% of their income on utilities.

such that equity is ensured among EV owners and non-EV owners, such that one customer group does not over subsidize another.

Electric rates should be designed such that the cost of infrastructure upgrades needed for TE is covered by the incremental revenues collected from EV customers. This approach upholds the cost causation principle wherein benefitting customers pay for the utility's cost to serve them. Aligning rates with cost causation principles prevents EV adoption from driving up electric rates for those who do not own EVs, thereby ensuring equity among all customers.

Widespread EV charging at rates below the marginal costs places upward pressure on rates. Under such discounted rates, EV customers impose more costs on the utility than what they pay through their bills. Rates should not be set below the marginal costs price floor during any TOU period.[31] EV TOU rates should at minimum, feature prices that reflect the marginal costs in each TOU period.[32]

Some current EV charging rates do not cover marginal costs, so EV customers on these rates are subsidized by customers who do not own EVs. For instance, SDG&E's residential EV-TOU-5 rate has a "super off-peak" rate that exclude transmission costs and under-collect distribution costs.[33] Cal Advocates staff analysis revealed that a large EV customer in coastal areas who adopt the EV-TOU-5 rate are subsidized almost $600 per year by other customers.[34] On the other hand, SDG&E's pending TOU-ELEC rate recovers an appropriate level (i.e. at least more than marginal costs) of costs in each TOU period. Compared to the EV-TOU-5 rate, the TOU-ELEC rate, reduces the subsidy for the same large coastal customer described above from $600 to $95. Other customers in the TOU-ELEC rate may pay up to $300 per year more than their incremental cost of

[31] The marginal costs price floor is the sum of marginal costs and non bypassable charges multiplied by a customer load profile (actual usage). The analysis is typically performed on an annual basis.

[32] TOU rates feature pre-set prices which are time variant, under the theory that procuring electricity at certain times has a higher cost than at other times. Variation may be throughout hours of the day and months of the year. For example, rates may be higher from 4pm to 9pm, and may be higher in summer than winter.

[33] SDG&E EV-TOU-5 rate does not charge transmission or distribution cost in the "Super Off-Peak" rate. Accessed at: https://www.sdge.com/sites/default/files/regulatory/3-1-21%20Schedule%20EV-TOU-5%20Total%20Rates%20Table.pdf

[34] Cal Advocates staff analysis showed that an average large coastal residential customer may pay $105 less in annual electric bill after adding an EV to its home electric load and switching from the standard residential TOU rate of TOU-DR-1 to EV-TOU-5, whereas the cost for SDG&E to serve the customer is $471 more. This implies a "Contribution to Margin" of -$576 for this customer, which would have to be subsidized by other customers.

service,[35] which can contribute towards paying for TE infrastructure upgrades and reduce rates for all customers, which will further incentivize electrification. The TOU-ELEC rate is therefore more equitable because it has a smaller risk of shifting costs to non-EV customers than the EV-TOU-5 rate.

Some rates currently feature artificially high peak to off peak price differentials to encourage adoption of EVs. Such non-cost-based prices may reduce a customer's contribution to margin if TE infrastructure cost recovery is allocated unequally between different TOU periods. Therefore, in the long run, TE infrastructure cost recovery should be assigned proportionally based on marginal costs during each TOU period. Any deviations from marginal costs should be gradually phased out so that rates eventually reflect the full cost of service, which will provide the revenue needed to fund infrastructure upgrades, reduce cross subsidization and ensure equity between customer groups.

c) Transportation electrification should not lead to increased electric rates.

To-date, TTM infrastructure has been funded exclusively through rates. TTM costs for EV charging infrastructure have equated to approximately 30% of overall costs,[36] with BTM infrastructure accounting for the remaining 70%.[37] Including the cost of TTM infrastructure in rates for light duty vehicles alone increases the cost of EV charging by about $0.025/kWh between 2022 and 2030.[38]

Continuing to recover these TTM costs through rates could hinder EVs in achieving cost-parity with conventional vehicles and could slow their uptake, particularly among low-income Californians. Even if the cost of BTM infrastructure is removed from rates in its entirety as the market gains self-dependence, TTM costs will remain a burden to

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[35] Cal Advocates staff analysis showed that the negative "Contribution to Margin" in SDG&E territory is drastically reduced or turned to positive for all residential customer types (coastal/inland, large/small) if they use the "TOU-ELEC" rate. An average Inland small residential customers would have a "Contribution to Margin" value of $307 on TOU-ELEC compared to -$122 on EV-TOU-5.

[36] A.21-10-010, Application of PG&E for the Approval of the Electric Vehicle Charge 2 Program, Cal Advocates' Opening Testimony, pp. 1-7, 1-8. Accessed at: https://docs.cpuc.ca.gov/PublishedDocs/SupDoc/A2110010/5219/493823405.pdf

[37] Most TTM upgrade costs are attributed to residential EV charging in single family homes, not IOU programs. These upgrades trigger D.21-12-033, *Decision Extending the Interim Policy on Common treatment for excess Plug-In Electric Vehicle Charging Costs*, which stipulate that costs on the utility side of the meter attributed to EV charging will be recovered through rates.

[38] Assuming LD EVs consume 28.5 TWh/year and that $5 billion in ratepayer funded TTM infrastructure is repaid over 10 years at a ratepayer cost of $7.3 billion. MD/HD charging consumption data is largely unavailable as deployment in these sectors is nascent, however, Cal Advocates' internal analysis shows TTM costs for MD/HD charging infrastructure is $5 billion through 2030.

ratepayers, especially those who are low-income and will likely not enjoy the benefits of EV ownership (while also subsidizing those who do).

Cal Advocates proposes that TTM costs should be recovered alongside BTM infrastructure – outside of rates – through alternative funding mechanisms discussed in Section 6.

As the cost of TE looms, California's policymakers must assess how much TE-associated infrastructure can be funded by TE rates without hindering EV deployment, especially among low-income Californians. Funding T&D, TTM, and BTM infrastructure outside of electricity rates would lead to lower electric rates for everyone but may require high levels of state funding. Conversely, funding all three categories through rates would lead to high rates, discourage electrification, and would fail to leverage potential private-sector funding. In practice, most of the uncertainty is in funding for TTM infrastructure, because T&D infrastructure is typically ratepayer funded and BTM infrastructure is seldom ratepayer funded.

4.3 Transportation electrification should support California's climate policies.

Transportation is responsible for 40-50% of California's GHG emissions and is therefore an important sector to decarbonize.[39] California's existing policies provide a pathway to decarbonization in service of the state's climate goals. This transportation electrification proposal supports these policies and goals.

CARB's Advanced Clean Cars II regulation requires all new LD EVs sold in California to be zero-emissions by 2035.[40] CARB is also developing the Advanced Clean Fleets regulation for MD/HD vehicles to be zero-emission by 2045.[41] According to the CEC, California will need to build more than 1.3 million EV chargers by 2030[42] to support the 8-million LD and 180,000 MD/HD EVs that CARB expects needs to be adopted to meet the state's emission reduction goals.[43] These chargers will come at a cost of

[39] CARB (2022). *Draft 2022 Scoping Plan Update,* pp. 147. Accessed at https://ww2.arb.ca.gov/sites/default/files/2022-05/2022-draft-sp.pdf

[40] CARB (August 25, 2022), *California moves to accelerate to 100% new zero-emission vehicle sales by 2035.* Accessed at https://ww2.arb.ca.gov/news/california-moves-accelerate-100-new-zero-emission-vehicle-sales-2035

[41] CARB Advanced Clean Fleets. Accessed at: https://ww2.arb.ca.gov/our-work/programs/advanced-clean-fleets

[42] Charging Infrastructure Assessment, p. ii.

[43] CARB 2020 Mobile Source Strategy, p. 94. Accessed at: https://ww2.arb.ca.gov/sites/default/files/2021-09/Proposed_2020_Mobile_Source_Strategy.pdf

approximately $30.8 billion in total (summing up the "Total BTM cost" and "Total TTM costs" in Table 1). The values in Table 1 are rough order-of-magnitude estimates intended for illustrative purposes only. Section 6 establishes the steps to determine more accurate estimates.

Table 1. Estimated public charging port needs and funding for LDs and MD/HD EVs.[44]

	8 million LD EV	180,000 MD/HD EV	Total
Total ports needed	1,162,000	157,000	1,319,000
Additional ports needed	1,083,000	157,000	1,240,000
Total BTM cost ($B)	$12.0	$8.7	$20.7
Total TTM cost ($B)	$5.0	$5.1	$10.1
Private-sector willingness-to-pay ($B)	$6.1	$3.4	$9.5
Unspent public funding ($B)	$2.2	$2.6	$4.8
Anticipated funding gap ($B)	$8.7	$7.8	**$16.5**

Note: All costs are related to the additional ports beyond those already installed. Unspent funding includes funding from the approved 2021-2022 budget and ratepayer funding.

After estimating customer willingness to pay[45] and considering California's already committed state and ratepayer funding, we found that there's a funding gap of roughly $16.5 billion. Note that this funding gap does not consider T&D upgrades (which should be recovered by increased volumetric sales from TE), or home charging infrastructure costs.

4.4 Transportation electrification should rely minimally on public funding.

The purpose of public funding is to enable the state to meet its decarbonization and equity goals.[46, 47] The public sector should, therefore, only fund TE to the extent that the private sector does not deploy TE infrastructure at a rate consistent with California's decarbonization goals and in locations consistent with the state's equity priorities.

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[44] LDV needs from CEC AB 2127 EV Charging Infrastructure Assessment (2021), pp. 34,41. MD/HDV needs from CEC. (2021) *2021-23 Investment Plan Update for the Clean Transportation Program,* pp. 35-36, 49-50, accessed at https://www.energy.ca.gov/filebrowser/download/3785. We use unit cost estimates of $10,000/$4,000 for L2 charger BTM/TTM; $50,000/$29,000 for 50-kW DCFC, and $106,000/$61,000 for 350-kW DCFC.

[45] Willingness to pay is estimated as 53% of BTM cost of a level 2 charger and 39% of BTM cost of a DCFC based upon [1-(Rebates Issued)/(Project Costs)] in the CALeVIP program. *California Electric Vehicle Infrastructure Project (CALeVIP) Cost Data*. Accessed at https://www.energy.ca.gov/programs-and-topics/programs/clean-transportation-program/california-electric-vehicle.

[46] CEC AB 2127 Report, Electric Vehicle Charging Infrastructure (2021), pp. 1,6,7.

[47] CEC SB 1000 Report, Electric Vehicle Charging Infrastructure Deployment Assessment (2020), pp. 1-2, 6-8.

Inadequate public funding could stall TE or continue inequitable access to TE. Conversely, excessive public funding could crowd out private investment, slowing electrification and overspending public funds that could be better spent elsewhere.

To better estimate the public sector funding need, we must better understand what portion of the cost of public chargers can be funded by the private sector, including EV manufacturers, site owners, vehicle owners, and EV charging businesses. Half of the total cost of BTM infrastructure is for relatively expensive DCFCs (on a per-unit basis), which may have more challenged economics. Cal Advocates estimates that the private sector is willing to pay $9.5 billion out of a total of $30.8 billion in total funding need,[48] but we will need a more precise estimate to account for factors such as spatial variation.

As hastening EV deployment and learning-by-doing in charger installations improve private-sector economics, the need for public funding will diminish. Public funding should, therefore, have a planned offramp to provide the private sector with the right long-term signal and to avoid over-funding TE in the future. Ultimately, transportation electrification should support a transition to a self-sustainable EV and charger markets wherein EVs have achieved cost-parity or better with gasoline and diesel vehicles, and EV charging stations (like gas stations) are financially viable businesses.

5 ALTERNATIVE FUNDING SOURCES

Cal Advocates estimates that California will need to spend an additional $16.5 billion beyond the funding proposed in the FY 2022-2023 budget on BTM and TTM charging infrastructure ($6.4 billion in BTM, $10.1 billion in TTM). Funding should not burden ratepayers in form on increased rates. As explained above, increasing rates to fund TE is regressive because it disproportionately burdens low-income customers.

In the new workstream described in Section 6, the Joint Agencies should consider other sources of funds such as state funds and private sector funding.

5.1 State Funds

California currently funds TE outside of electric rates by allocating funds through the state budget (some of which are collected in the Greenhouse Gas Reduction Fund from cap-and-trade allowance auction revenues), through the LCFS,[49] and through private

[48] Willingness to pay is estimated as 53% of BTM cost of a level 2 charger and 39% of BTM cost of a DCFC based upon [1-(Rebates Issued)/(Project Costs)] in the CALeVIP program. *CALeVIP Cost Data*. Accessed at https://www.energy.ca.gov/programs-and-topics/programs/clean-transportation-program/california-electric-vehicle.

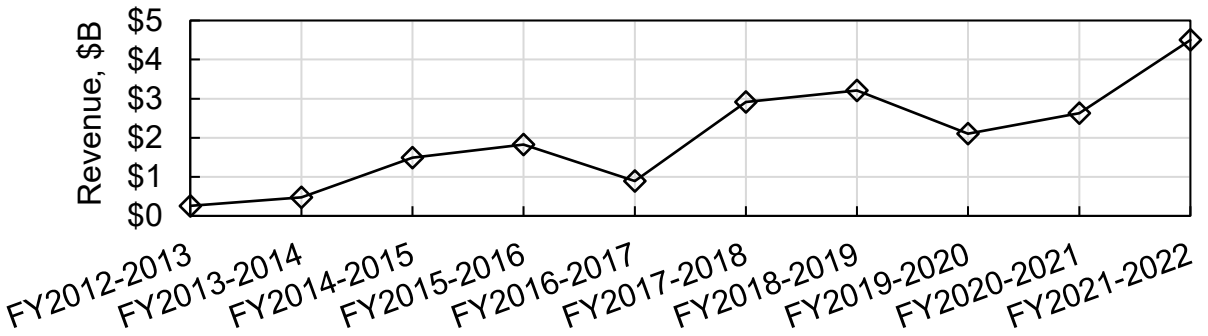
[49] California's LCFS requires fossil fuel sellers to buy credits produced by low-carbon fuel producers. This provides funding for all low-carbon fuels, including electricity used in transportation.

organizations like Electrify America. Expanding the usage of these funding sources will reduce electric rates and increase access to TE from all customers including low-income Californians.

California's state budgets from FYs 2021-2022 and 2022-2023 approved $10 billion in TE spend from 2021-2026. This includes $3.4 billion in charging infrastructure for all vehicle classes.[50] [51] [52] The state budget for TE is currently supported by federal funding, Proposition 98[53] funding, and California's General Fund and the Greenhouse Gas Reduction Fund.

As illustrated by Figure 6, revenue from the cap-and-trade allowance auction has increased recently, due to increasing allowance prices (since May 2022). This increased revenue enhances California's ability to use cap-and-trade auction revenues (which can be used to support programs which reduce greenhouse gas emissions) to fund TE programs.

Figure 5. California cap-and-trade allowance auction revenues.[54, 55]



The cap-and-trade allowance auction generated an average of $2.7 billion ($2.1 to $3.2 billion) in proceeds to California in FYs 2017-2018 through 2020-2021, and $4.5 billion

[50] State of California. (2021). *Climate Change*, pp. 109-110. Accessed at: https://www.ebudget.ca.gov/2021-22/pdf/Enacted/BudgetSummary/ClimateChange.pdf

[51] State of California. (2022). *Climate Change*, pp. 82-83. Accessed at: https://www.ebudget.ca.gov/2022-23/pdf/BudgetSummary/ClimateChange.pdf.

[52] CEC presentation on 1/13/2022 on Governor's 2022-23 Budget, funding for ZEV Infrastructure.

[53] Proposition 98 earmarks a certain percentage of California's state budget for education. This can fund electrification of school buses.

[54] California Air Resources Board. (2022). *Summary of Proceeds to California and Consigning Entities.* Accessed at https://ww2.arb.ca.gov/sites/default/files/2020-09/proceeds_summary.pdf.

[55] California utilities also receive proceeds which are excluded from these totals.

in FY 2021-2022. The additional $1.8 billion annually could provide majority of the public-sector funding needed for BTM and TTM charging infrastructure in California.[56]

5.2 Private Sector Financing

Automakers of Tesla[57] and Rivian[58], and charging companies such as Chargepoint,[59] Electrify America[60] and EVgo,[61] are all building charging networks across the country. Even car rental companies like Hertz are building their own EV chargers.[62] In addition, the 2022 CALGreen Standards[63] effective January 1, 2023, requires a certain percentage of parking spots in a garage in a new building to have EV chargers. All new residential buildings and some commercial buildings such as grocery, retail and warehouses will be required to have EV charging infrastructure. All of this signals that the private sector will increasingly fund TE infrastructure.

CPUC Commissioners Shiroma and Houck have called for creative financing solutions to attract private capital into the TE investment space.[64] To ensure financial sustainability and eliminate public sector subsidies in the long run, we should explore methods for the private sector to contribute to and finance TE infrastructure. Any private sector financing should occur in such a way that it does not exacerbate the inequities faced in the TE space currently.

6 DETERMINING NECESSARY FUNDING

Relying on ratepayers to fund BTM and TTM infrastructure is inequitable and premature until the capacity to rely on private-sector and state funds is fully understood and realized.

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[56] $1.8 billion for each of the 9 years of 2022-2030 totals to $16.2 billion, just about the same as the total BTM and TTM funding gap of $16.5 billion.

[57] Tesla Superchargers, https://www.tesla.com/supercharger

[58] Rivian Adventure Network, https://rivian.com/experience/charging

[59] Chargepoint map, https://na.chargepoint.com/charge_point

[60] Electrify America map, https://www.electrifyamerica.com/locate-charger/

[61] EVgo map, https://www.evgo.com/find-a-charger/

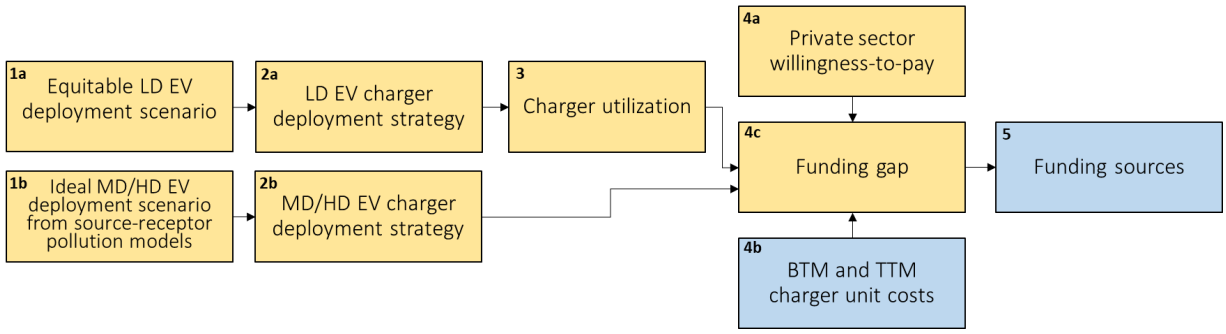
[62] Hertz press release on September 27, 2022, https://newsroom.hertz.com/news-releases/news-release-details/hertz-bp-collaborate-accelerate-ev-charging-north-america

[63] 2022 CALGreen Code Section 4.106.4 (Residential) or Section 5.106.5.3 (Nonresidential).

[64] Commissioner comments in TE En-Banc on October 13, 2021. Specifically: "We can get more creative with financing these opportunities and get away from using rate-based funding." – Commissioner Houck. "The financing OIR … scoped in TE infrastructure. We have brought in the treasurer's office, from GO-Biz, IBank and other banking institutions to help us look at what kind of financing opportunities there might be." - Commissioner Shiroma. Recording accessed at: https://www.adminmonitor.com/ca/cpuc/en_banc/202110132/

As described above, the Staff Proposal proposes an additional $1 billion in ratepayer funding for TE programs from 2025 through 2029. Cal Advocates proposes that rather than establish a funding amount now, the CEC, CARB, and CPUC should initiate a joint agency process to determine how much, when and where funding is needed, as well as the most appropriate mechanisms for sourcing that funding. The Joint Agencies should create a working group to further develop and ultimately lead the study process depicted in Figure 7. This is a study to develop a TE infrastructure deployment plan and budget. An expanded version of Figure 7 is provided in the Appendix, which shows studies outside of the scope of this work but still relevant to it.

Figure 6. Potential scope for a study to determine how much TE funding is needed and where. Each box represents a distinct step in the study process. Arrows indicate data output from one process feeds as input to another process. Studies depicted in yellow are geospatial studies; studies shown in blue (BTM charger unit costs and total budget) are not.



The left side of Figure 7 depicts the steps in the study to establish the ideal and equitable EV charger deployment plan for TE. In steps **1a** and **2a**, LD EV charger deployment should be based on equitable access. In steps **1b** and **2b**, MD/HD EV deployment should be based on equitable pollution burdens.[65] MD/HD EV deployment would skip step **3** because their deployment in this sector will be driven by business needs for charging rather than charging revenue. These two studies (LD EV charger deployment and MD/HD EV charger deployment) should involve stakeholder engagement, especially from ESJ and underserved communities. Stakeholder input is necessary to ensure that stakeholders can participate in decisions that impact their access to clean transportation

[65] The vehicle deployment plans underpinning the need for chargers are treated as exogenous; the number of vehicles deployed is assumed sufficient to meet the targets laid out in N-79-20. Equity should be considered in regulations and subsidies for LD EVs.

and clean air. The CPUC's ESJ Action Items should identify the need for community input on the important topics of EV ownership, charger access, or electric rates.[66]

The two studies of charger deployment (LD and MD/HD EV charger deployment) should inform an analysis of private-sector willingness to pay (step **4a**) based upon charger revenues in the LD sector and business value in the MD/HD/OH sector. Finally, total charger costs (step **4b**) can be combined with private sector willingness-to-pay[67] to determine the funding gap (step **4c**).

Once the Joint Agencies determine the public funding gap, they can also determine which funding source is the most effective and equitable way to utilize. Cal Advocates recommends using the sources identified in Section 5 of this paper.

[66] ESJ Action Plan, p. 45 (action item 5.3.2).

[67] In the MD/HD/OH EV sectors, willingness-to-pay for EV chargers will likely depend upon vehicle subsidies because commercial and industrial customers will view EVs and chargers as a single investment.

APPENDIX

Figure 7 depicts the scope of a preliminary study that could be used to develop a budget for TE in California. There are additional analytical needs at the periphery of this study. For example, an incentive design is needed to achieve the EV deployment scenarios envisioned, and charger deployment and utilization will impact transmission and distribution upgrade costs, and ultimately EV rates.

Figure 8 below expands upon Figure 7 by showing key peripheral studies in grey to place the studies envisioned in this proposal into the TE context in California. The process identified in Figure 8 is more complicated, but the gist is simple: Vehicle incentives feed into deployment scenarios, and charger deployments impact BTM, TTM and T&D upgrade needs and ultimately EV rate design.

Figure 7. Our TE studies placed into the context of TE development in California. Each box represents a distinct step in the study process. Arrows indicate data output from one process feeding as input to another process. Studies shown in yellow are geospatial studies; studies shown in blue (BTM charger unit costs and total funding needed) are not. Studies shown in grey indicate peripheral studies which are outside the scope but related to this work.