STATE OF MINNESOTA
BEFORE THE PUBLIC UTILITIES COMMISSION

Katie Sieben	Chair
Joseph Sullivan	Vice-Chair
Valerie Means	Commissioner
Matt Schuerger	Commissioner
John Tuma	Commissioner

In the Matter of an Inquiry into Xcel Energy Investments that May Assist in Minnesota's Economic Recovery from the COVID-19 Pandemic

DOCKET NO. E-002/M-20-745

COMMENTS OF THE OFFICE OF THE ATTORNEY GENERAL

INTRODUCTION

The Office of the Attorney General—Residential Utilities Division ("OAG") respectfully submits the following Comments in response to the petition of Xcel Energy ("Xcel" or "the Company") for approval of electric vehicle ("EV") programs as part of its COVID-19 economic recovery investments. Xcel's petition includes, among other proposals, a request for approval of $150 million in customer rebates for the purchase of light-duty EVs and electric buses.

Electrifying the transportation sector will be critical to Minnesota's—and the nation's—response to climate change, and the OAG is supportive of efforts to increase EV adoption and reduce emissions. But the Company's specific proposal here—to spend ratepayer money on EV rebates—is not a good way to increase EV adoption. It is not authorized by Minnesota law, is unlikely to significantly move the needle on EV adoption, and—in the case of light-duty EVs—would contribute to economic disparities among the Company's ratepayers. Moreover, Xcel's own cost–benefit analysis shows that ratepayers and society would be better off if the Company does not offer rebates. For these reasons, the Commission should not approve the rebate program that Xcel has proposed here. If, however, the Commission approves rebates in some form, it should scale back the program to protect ratepayers.

BACKGROUND

In May 2020, the Commission requested information about potential utility investments that could assist in Minnesota's recovery from the COVID-19 pandemic.[1]

In September 2020, Xcel filed a number of proposals in response to the Commission's request, including several related to transportation electrification:

- Rebates for the purchase of light-duty EVs and electric buses,
- Public fast-charging stations,
- Accelerating Xcel Energy fleet electrification, and
- Expanding existing EV fleet pilot service[2]

I. XCEL'S EV REBATE PROPOSALS

Xcel requests approval to spend up to $50 million on light-duty EV rebates and $100 million on rebates for electric transit buses and school buses.[3]

With regard to light-duty EVs, Xcel proposes to offer its residential and commercial customers rebates to purchase new or used vehicles with a price of up to $50,000.[4] The rebate amounts would decline over time and would be offered on a first-come, first-served basis until funding is exhausted. Table 1 from Xcel's filing[5] shows the schedule of proposed light-duty rebates:

Table 1: Light-Duty EV Rebates by Year

	2021	2022	2023	2024	2025
New Light-Duty EVs	$2,500	$2,500	$2,500	$2,000	$1,500
Used Light-Duty EVs	$1,250	$1,250	$1,250	$1,000	$750

[1] *In the Matter of an Inquiry into Utility Investments that May Assist in Minnesota's Economic Recovery from the COVID-19 Pandemic*, Docket No. E,G-999/CI-20-492, Notice of Reporting Required by Utilities (May 20, 2020).
[2] *In the Matter of Xcel Energy's Petition for Approval of Electric Vehicle Programs as part of its COVID-19 Pandemic Economic Recovery Investments*, Docket No. E-002/M-20-745, Xcel Response and Petition at 15–18 (Sept. 25, 2020) (hereinafter "Xcel Petition").
[3] Xcel Petition, attach. C at 7.
[4] *Id.*, attach. C at 3.
[5] *Id.*, attach. C at 8.

With regard to electric buses, Xcel proposes to offer rebates for the purchase of transit buses and school buses, with $65 million of the total $100 million bus-rebate budget earmarked for Metro Transit.[6] The rebates for transit buses would start at $1 million, declining over time. School bus rebates would start at $325,000 or $275,000, depending on whether the bus had vehicle-to-grid ("V2G") capability, and would also decline over time. Table 2 from Xcel's filing[7] shows the schedule of proposed rebates for electric buses:

Table 2: Electric Transit Bus and School Bus Rebates by Year

	2021	2022	2023	2024	2025
Transit Buses	$1,000,000	$1,000,000	$750,000	$500,000	$250,000
School Buses (V2G)	$325,000	$325,000	$325,000	$300,000	$275,000
School Buses (non-V2G)	$275,000	$275,000	$275,000	$250,000	$225,000

II. Rebate Cost–Benefit Analysis

Xcel hired Energy and Environmental Economics, Inc. ("E3") to prepare a cost–benefit analysis of its rebate proposals.[8] E3's report examines the cost-effectiveness of each category of EV rebate from the ratepayer, participant, and societal perspectives. The OAG's analysis focuses on the ratepayer and societal perspectives because they are most relevant to an assessment of whether the rebates are in the public interest.

E3 first modeled the costs and benefits of EV charging over the 2020–2030 timeframe under status quo, or "base case," assumptions. Under base-case assumptions, E3 found that increased adoption of light-duty EVs would result in a $339 million net present value ("NPV") from the ratepayer perspective and $366 million from the societal perspective, while heavy-duty EVs would yield a $21 million NPV for ratepayers and $82 million for society.[9]

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[6] *Id.* at 16–17.
[7] *Id.*, attach. C at 9.
[8] *See* Xcel Cost–Benefit Analysis Filing, attach. A (Jan. 11, 2021) (hereinafter "E3 Report").
[9] E3 Report at 11.

After modeling the base case, E3 then tested the impact of Xcel's rebate proposals on the base-case results. E3 found that Xcel's light-duty rebate proposal would yield an NPV of $411 million for ratepayers—$72 million greater than under the light-duty base case—and $335 million for society—$31 million less than under the base case.[10] For electric buses, E3 found that Xcel's rebate proposal had an NPV of -$51 million from the ratepayer perspective—$72 million less than the NPV of heavy-duty EV charging under the base case—and -$35 million from society's perspective—or $117 million less than under the base case.[11]

In an August 6, 2021 supplemental filing, Xcel provided new E3 analysis that showed substantially decreased NPVs for the light-duty rebate proposal. The updated analysis examined two scenarios: one that capped rebates at the proposed $50 million budget ("constrained scenario") and a second that assumed that the program would run through 2025 with no constraint on program budget ("unconstrained scenario").[12] Under the constrained rebate scenario, the ratepayer NPV is $335 million—$4 million less than under the base case—and the societal NPV is $340 million—$26 million less than under the base case.[13] Under the unconstrained scenario, the ratepayer NPV is only $308 million—$31 million less than under the base case—and the societal NPV is $332 million—$34 million less than under the base case.[14]

Table 1 from the E3 Report shows the NPVs for each scenario discussed above, as well as the other scenarios E3 modeled:

[10] *Id.* at 12.
[11] *Id.*
[12] Xcel Supplemental Filing, attach. A at 45 (Aug. 6, 2021) (hereinafter "Revised E3 Report"). The lack of a budgeting constraint resulted in $177 million being paid out in rebates over the 2021–2025 period, rather than $50 million.
[13] *Id.* at 12.
[14] *Id.*

Table 1. Total Net Present Value (NPV) for all vehicles adopted between 2020 – 2030 in ($ Million)

Case	Ratepayer	Driver	Societal
Personal LDV – managed charging	$339	$26	$366
Parcel Trucks (MDV) – managed charging	$0.6	$45	$50
Transit Buses (HDV) – managed charging	$21	$44	$82
Total Base Case Impacts	**$361**	**$116**	**$497**
EV Programs and Sensitivities			
Personal LDV – Unmanaged charging	$346	-$10	$336
Personal LDV – High DCFC, managed charging	$346	$41	$391
Personal LDV – Unconstrained rebate program, managed charging	$308	$144	$332
Personal LDV – Constrained rebate program, managed charging	$335	$65	$340
Transit Bus Rebate Program, managed charging[2]	-$51	$14	-$35

III. Accounting Treatment

Xcel requests that the Commission allow it to include the cost of EV rebates in rate base as a regulatory asset and to amortize cost recovery over ten years.[15] As part of this accounting treatment, the Company proposes to charge ratepayers its approved rate of return on the regulatory asset, just as if the rebates were an investment used to provide electric service.[16]

ANALYSIS

The Commission should not grant approval of Xcel's requested rebate program, and in particular, rebates for light-duty EVs, for at least three reasons. First, EV rebates are not utility service, and Minnesota law does not contemplate the Commission approving something that is not utility service. Second, offering rebates for the purchase of light-duty EVs would tend to magnify economic disparities among Xcel's ratepayers without having much of an impact on EV adoption.

[15] Xcel Petition, attach. C at 10.
[16] *Id.*

And third, Xcel's cost–benefit analysis suggests that rebates are not an efficient way to spur EV adoption. If, however, the Commission approves EV rebates in some form, it should modify Xcel's proposal as outlined in the final section of these Comments.

I. Minnesota Law Does Not Give the Commission Authority to Approve Ratepayer-Funded EV Rebates.

The Commission possesses only those powers vested in it by the Legislature.[17] Any reasonable doubt as to the existence of a particular power in the Commission should be resolved against the exercise of that power.[18] "While express statutory authority need not be given a cramped reading, any enlargement of express powers by implication must be fairly drawn and fairly evident from the agency objectives and powers expressly given by the legislature."[19]

The purpose of the Public Utilities Act[20] is to regulate public utilities "in order to provide the retail consumers of natural gas and electric service in this state with adequate and reliable services at reasonable rates."[21] "Service" means "natural, manufactured, or mixed gas and electricity" or "the installation, removal, or repair of equipment or facilities for delivering or measuring such gas and electricity."[22] "Rates" are "every compensation, charge, fare, toll, tariff, rental, and classification, or any of them, demanded, observed, charged, or collected by any public utility for any service . . . ."[23]

Providing rebates to incentivize the purchase of a particular type of car is not utility service. It does not involve "the installation, removal, or repair of equipment or facilities for delivering or measuring . . . electricity." And even if the proposed EV rebates were for utility "service," they

[17] *In re Minn. Power*, 545 N.W.2d 49, 51 (Minn. App. 1996) (quoting *Great N. Ry. v. Public Serv. Comm'n*, 169 N.W.2d 732, 735 (1969)).
[18] *Id.*
[19] *Id.* (quoting *Peoples Natural Gas Co. v. Minn. Pub. Utils. Comm'n*, 369 N.W.2d 530, 534 (Minn. 1985)).
[20] H.F. 1835, 68th Leg., Reg. Sess., 1974 Minn. Laws 890–919 (codified at Minn. Stat. ch. 216B).
[21] Minn. Stat. § 216B.01.
[22] Minn. Stat. § 216B.02, subd. 6.
[23] *Id.*, subd. 5.

would not be appropriate for rate-base treatment because they are not "utility property" used and useful in rendering service to the public.[24] Thus, they should be treated as operating expenses rather than utility infrastructure as Xcel proposes.

Xcel's own filings in this docket demonstrate that EV purchase rebates are not utility service. In a March 8 supplemental filing, Xcel acknowledged that no tariff is needed for the rebate program because it does not involve energy rates: "The Company does not believe a tariff is necessary for the rebate program. There will not be specific energy rates dedicated to this program, and the program requirements will be explicitly stated in the program applications that potential customers will have to complete."[25] Xcel thus acknowledges that rebates will not involve "rates" for utility service over which the Commission has jurisdiction. And the Commission should therefore decline to approve them.

For the foregoing reasons, the proposed rebate program does not involve "service" or "rates" over which the Commission has authority. But even if the Commission finds that it does have authority to approve Xcel's proposal, it should not approve EV rebates for the reasons explained in the following sections.

II. RATEPAYER-FUNDED REBATES FOR LIGHT-DUTY EVS WOULD REINFORCE ECONOMIC DISPARITIES AMONG XCEL'S CUSTOMERS WITHOUT SIGNIFICANTLY STIMULATING THE DEMAND FOR, OR THE SUPPLY OF, EVS.

Beyond the legal issues with Xcel's EV rebate proposal, there is a further problem with light-duty EV rebates: They are likely to amplify existing disparities in Xcel's service area without significantly impacting EV adoption. Therefore, even if the Commission finds that the rebates are within its authority, it should not approve Xcel's proposal.

[24] Minn. Stat. § 216B.16, subd. 6.
[25] Docket No. E-002/M-20-745, Xcel Supp. Filing at 2 (Mar. 8, 2021).

A. The Proposed Light-Duty EV Rebates Are Likely to Reinforce Disparities.

By approving EV rebates, the Commission would be adding to Xcel's customers' energy burden. This would have the greatest impact on low-income customers, who experience an energy burden nearly four times the state average.[26] Low-income customers, moreover, are disproportionately people of color.[27] For example, in the Twin Cities area, where much of Xcel's customer base resides, the median black family earns $38,178 a year, which is less than half of the median white family income of $84,459 a year.[28]

Meanwhile, the customers most likely to use the rebates would be those that need them the least. To take advantage of Xcel's proposed rebates, a residential customer would need the financial means to acquire a vehicle that costs up to $50,000 and have a place to charge it. In other words, the rebates are likely to be used predominantly by well-off customers: those who own their home, are financially stable, and can afford an expensive purchase. Low-income and minority customers are less likely to be able to purchase an expensive vehicle—or, indeed, to have access to any vehicle at all.[29] And rebates provided to commercial customers, too, are likely to disproportionately benefit white business owners, because they own a larger percentage of Minnesota's businesses than their overall percentage of the state population.[30]

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[26] *See* U.S. Department of Energy, Low-Income Energy Affordability Data (LEAD) Tool, https://www.energy.gov/eere/slsc/maps/lead-tool (last visited July 28, 2021).

[27] *See* Minnesota Department of Health, People in Poverty in Minnesota, https://data.web health.state.mn.us/poverty_basic (last visited July 28, 2021) (showing that Minnesotans who identify as American Indian/Indigenous or Black/African American face poverty rates of nearly thirty percent, compared to just seven percent for those who identify as white).

[28] Greg Rosalsky, *Minneapolis Ranks Near the Bottom for Racial Equality*, NPR, June 2, 2020, *available at* https://www.npr.org/sections/money/2020/06/02/867195676/minneapolis-ranks-near-the-bottom-for-racial-equality.

[29] *See* National Equity Atlas, Car Access – Minnesota, https://nationalequityatlas.org/indicators/Car_access#/?geo=02000000000027000 (last visited July 28, 2021) (stating that black and Native American households in Minnesota are the least likely to have access to a vehicle).

[30] Minnesota Department of Employment and Economic Development, Minnesota Economic Disparities by Race and Origin at 4 (June 2020), *available at* https://mn.gov/deed/assets/061020_MN_disparities_final_tcm1045-435939.pdf.

For these reasons, Xcel's proposed rebates are likely to benefit the fortunate few at the expense of less fortunate ratepayers, including the most financially vulnerable residents of the Company's service area. Notably, this is different than taxpayer-funded rebates, which are funded through progressive tax rates and low-interest government debt, as opposed to Xcel's rate of return. And, for the reasons discussed below, the rebates are unlikely to have a significant impact on EV adoption compared to other available solutions.

B. Ratepayer-Funded Rebates Are Unlikely to Significantly Impact Light-Duty EV Adoption.

Xcel's proposed rebates are unlikely to significantly stimulate demand for, or the supply of, light-duty electric vehicles. Demand for EVs is already high,[31] and significant federal incentives are already available for those purchasing them.[32] Congress, moreover, is currently considering even higher tax incentives that would bring the maximum incentive for a single EV purchase from $7,500 to $12,500.[33] And the Infrastructure Investment and Jobs Act that the U.S. Senate recently passed provides substantial support for transportation-electrification infrastructure, including at least $68 million allocated to Minnesota.[34] In light of the significant existing demand and incentives for EVs and the additional support for EVs under consideration, it is unlikely that Xcel's ratepayer-funded incentives will do much to alter the equation.

Even if Xcel's proposed rebates had a measurable impact on the demand for EVs, this impact would likely be overwhelmed by supply-related factors. A global shortage of

[31] *See, e.g.*, Paul Eisenstein, *Tesla Reports $1 Billion in Profit, with Sales Almost Doubling in the Last Quarter*, NBC NEWS, July 26, 2021, *available at* https://www.nbcnews.com/business/autos/tesla-reports-1-billion-profit-sales-almost-doubling-last-quarter-n1275071.

[32] U.S. Department of Energy and U.S. Environmental Protection Agency, Federal Tax Credits for New All-Electric and Plug-in Hybrid Vehicles, https://www.fueleconomy.gov/feg/taxevb.shtml (last visited July 28, 2021).

[33] David Shepardson, *U.S. Senate Panel Advances EV Tax Credit of up to $12,500*, REUTERS, May 27, 2021, *available at* https://www.reuters.com/world/us/us-senate-panel-advances-ev-tax-credit-up-12500-2021-05-27/.

[34] WhiteHouse.gov, Fact Sheet: The Infrastructure Investment and Jobs Act Will Deliver for Minnesota, https://www.whitehouse.gov/wp-content/uploads/2021/08/MINNESOTA_Infrastructure-Investment-and-Jobs-Act-State-Fact-Sheet.pdf (last visited Aug. 12, 2021).

semiconductors is expected to dampen the supply of EVs in 2021–2023, while a shortage of batteries is expected to continue to limit supply in 2022–2029.[35] Car companies are taking steps to address this shortage, investing billions of dollars to improve their EV production capacity.[36] The State of Minnesota, moreover, by establishing a clean cars standard, has helped ensure that more of whatever supply of EVs is produced will be sold in this state.[37]

In light of the high demand for EVs, the above-noted supply issues, and the significant steps that have already been taken to boost both the supply of and the demand for EVs, it is unlikely that Xcel's proposed rebates would have a measurable impact on either. Instead, the rebates are likely to simply contribute to the existing economic disparities in Xcel's service territory by giving discounts to high-income customers that are funded by all. The Commission should therefore decline to approve them.

III. XCEL'S REBATE COST–BENEFIT ANALYSIS SUGGESTS THAT RATEPAYERS AND SOCIETY WOULD BE BETTER OFF IF EV ADOPTION WERE ALLOWED TO OCCUR AT ITS OWN PACE.

Under the right circumstances, increased use of EVs can yield benefits both for society and for Xcel's ratepayers. These benefits, however, are diffuse and hinge on a number of contingencies and assumptions, including: (1) that the rebates induce EV adoption that wouldn't otherwise have happened, (2) that EVs displace conventional vehicles, (3) that the electricity used to charge EVs continues to become less carbon-intense, and (4) that increased EV demand does not force costly

[35] Neil Winton, *Battery Scarcity Could Dwarf Chip Shortage Impact On Global Auto Sales*, FORBES, July 27, 2021, *available at* https://www.forbes.com/sites/neilwinton/2021/07/27/battery-scarcity-will-dwarf-chip-shortage-impact-on-global-auto-sales-report/.

[36] Michael Wayland, *GM Ups Spending on EVs and Autonomous Vehicles by 30 Percent to $35 Billion by 2025 on Higher Profits*, CNBC, June 16, 2021, *available at* https://www.cnbc.com/2021/06/16/gm-ups-spending-on-evs-and-autonomous-vehicles-to-35-billion-by-2025 html (noting that GM plans to increase spending on electric and autonomous vehicles to $35 billion through 2025 and that Ford also recently increased its EV spending to more than $30 billion by 2025); *see also In the Matter of Xcel Energy's Petition for Approval of Electric Vehicle Pilot Programs*, Docket No. E-002/M-18-643, Department Reply Comments at 2 (July 12, 2021) (listing various carmakers' commitments to invest in EVs).

[37] *See* Press Release, Office of Minnesota Governor Tim Walz, Governor Walz Celebrates Minnesota Becoming a Clean Cars State (July 26, 2021), *available at* https://mn.gov/governor/news/?id=1055-491262.

system upgrades that drive rate increases.[38] Accordingly, the Commission has required utilities to analyze the costs and benefits of their EV-related proposals.[39]

Xcel's cost–benefit analysis in this case shows a negative NPV for electric-bus rebates from the ratepayer and societal perspectives.[40] And while the Company's analysis does show a positive net benefit for light-duty EV rebates, the NPV to ratepayers and society is much lower than what would occur absent rebates.[41] This is because EV adoption is already projected to increase significantly in future years, which means that many of the benefits of increased EV charging—such as increased utility revenues and decreased pollution—are forecasted to materialize even if no rebates are offered. And while Xcel predicts that rebates would increase the number of EV adoptions, the incremental benefits from those additional adoptions do not offset the cost of providing rebates.[42]

Not only does Xcel's own analysis find that offering rebates yields a lower NPV than doing nothing, but even that lower NPV is likely overstated because the Company fails to account for the impact of free ridership. In general terms, free ridership occurs when some members of society benefit from a shared resource without paying for it.[43] In the present context, free ridership would occur if customers receive rebates for vehicles that they would have acquired without the incentive. In those instances, the rebate cannot be said to have caused an EV adoption. And if the rebate did

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[38] *See In the Matter of a Commission Inquiry into Electric Vehicle Charging and Infrastructure*, Docket No. E-999/CI-17-879, Order Making Findings and Requiring Filings at 1 (Feb. 1, 2019) (hereinafter "Order Making Findings") ("EVs have the potential to benefit Minnesota in numerous ways, but could also adversely impact the electric system if their integration is not planned.").

[39] *See id.* at 7–8 (stating that parties bringing forward EV proposals "can submit a formal cost–benefit analysis that attempts to quantify various costs and benefits to determine whether the benefits outweigh the costs, or vice versa").

[40] *See supra* p. 4.

[41] *See supra* pp. 4–5.

[42] *See* Revised E3 Report at 17.

[43] Investopedia, Free Rider Problem, https://www.investopedia.com/terms/f/free_rider_problem.asp (last visited July 29, 2021).

not cause the adoption, the additional revenue from charging that EV should not be included in the cost–benefit analysis.

In this case, E3 used a "two stage Bass diffusion approach" to forecast the increase in EV adoption that would result from Xcel's rebates.[44] E3's methodology, however, did not account for any level of free ridership.[45] Put differently, E3's methodology assumes that every person who uses a ratepayer-funded rebate would not have purchased an EV if Xcel's rebate were not available. This cannot be true, since EVs are already in high demand. The OAG asked Xcel to recalculate the NPV of the rebate program assuming varying levels of free ridership.[46] The Company, however, declined to provide these alternative calculations.[47] Because Xcel failed to account for free ridership, the Commission should give its cost–benefit analysis limited weight in evaluating its EV rebate proposals. And even Xcel's overly favorable methodology shows that the NPV is lower when rebates are offered. For these reasons, the Commission should not approve Xcel's rebate proposals.

IV. If the Commission Approves Rebates, It Should Modify Xcel's Proposal to Protect Ratepayers.

For the reasons discussed above, the Commission should not approve Xcel's proposed EV rebates. If, however, the Commission approves rebates in some form, it should modify Xcel's proposal in at least two ways. First, the Commission should require the Company to expense the rebates rather than account for them as a capital asset. Second, the Commission should reduce the light-duty rebate budget from $50 million to $5 million and the electric-bus rebate budget from $100 million to $10 million. These recommendations are explained below.

[44] E3 Report at 45.
[45] *See* Xcel's response to Department IR No. 1(f) (attached hereto as Exhibit A).
[46] *See* Xcel response to OAG IR No. 14 (asking the Company to calculate the net benefit of the program assuming that one rebate causes 1 EV adoption or 0.5 EV adoptions).
[47] *Id.*

First, the Commission should require Xcel to expense rebate costs. As discussed earlier in these Comments, rebates are properly accounted for as operating expenses rather than capital assets. This is because rebates are not "utility property."[48] Rather, rebates are in the nature of operating expenses and, if approved, should be accounted for as such. There is an additional reason that EV rebates should not be capitalized: Doing so would increase the total costs paid by ratepayers because of the rate of return that Xcel receives on capital assets. Xcel argues that capitalizing the rebates is appropriate because expensing the full amount immediately would lead to "rate shock."[49] But the Company presents the Commission with a false dilemma. Capitalization is not the only way to mitigate the rate impacts of EV rebates. The Commission should instead require the Company to expense its rebate budget over a period of several years rather than immediately. This would better protect ratepayers by smoothing rates without the need for interest payments to Xcel's shareholders.

The second modification that the Commission should make to Xcel's proposed rebates is to reduce the total budget for light-duty rebates to $5 million and the budget for electric-bus rebates to $10 million. This would significantly limit the ratepayer impact of the proposal by reducing its scale to that of a pilot program. Reducing the rebate budget would also be consistent with a recent decision by the Colorado Public Utilities Commission ("PUC") regarding Xcel's Colorado transportation electrification plan.[50] Xcel had originally proposed a $30 million light-duty EV rebate program as part of this plan, but the Colorado PUC ultimately approved a budget of only $5 million, finding insufficient support in the record for a program of the scale proposed by the

[48] Minn. Stat. § 216B.16, subd. 6.
[49] Xcel Response and Petition, attach. C at 10.
[50] *See In the Matter of the Application of Public Service Company of Colorado for Approval of Its 2021–2023 Transportation Electrification Plan*, Docket No. 20A-0204E, Commission Decision Granting Application with Modifications (Dec. 23, 2020).

Company.[51] Similarly, in this case, the Commission should only approve EV rebates on a small scale to limit rate impacts and gain experience with EV rebates before considering whether to expand the program.

CONCLUSION

For the foregoing reasons, the Commission should not approve Xcel's proposed EV rebates. If, however, the Commission approves rebates in some form, it should require Xcel to expense the costs and scale back the size of the program to protect ratepayers.

Dated: August 26, 2021

Respectfully submitted,

KEITH ELLISON
Attorney General
State of Minnesota

/s/ **Peter G. Scholtz**
PETER G. SCHOLTZ
Assistant Attorney General
Atty. Reg. No. 0389936

445 Minnesota Street, Suite 1400
St. Paul, Minnesota 55101-2131
(651) 757-1473 (Voice)
(651) 296-9663 (Fax)
peter.scholtz@ag.state.mn.us

ATTORNEYS FOR OFFICE OF
THE ATTORNEY GENERAL—
RESIDENTIAL UTILITIES DIVISION

[51] *Id.* at 33–34.

EXHIBIT A

☐ **Not Public Document – Not For Public Disclosure**
☐ **Public Document – Not Public Data Has Been Excised**
☒ **Public Document**

Xcel Energy		Information Request No. 1
Docket No.:	E002/M-20-745	
Response To:	Minnesota Department of Commerce	
Requestor:	Christopher T. Davis	
Date Received:	October 7, 2020	

Question:
Topic: Electric Vehicle Purchase Rebates
Reference(s): Pages 15-18, and Attachment C, pages 2-13

a. What percent of fossil fuel consumption do Plug-in Hybrid Electric Vehicles (PHEVs) reduce? Has Xcel considered providing a smaller rebate for PHEVs as compared to Battery Electric Vehicles (BEVs)?
b. Please explain how Xcel determined the rebates for new and used light-duty EVs. How do these rebate levels compare to EV rebates in other states? Is Xcel aware if other states provide rebates for PHEVs?
c. Order Point 6a from the Commission's February 1, 2019 Order in Docket 17-879 found that at a minimum "Any EV-related proposals that involve significant investments for which the utility is seeking or will seek cost recovery should include a cost-benefit analysis that shows the expected costs along with the expected ratepayer, system and societal benefits associated with the proposal." Xcel stated that it has budgeted up to $150 million for the Electric Vehicle Purchase Rebates. Has Xcel conducted a ratepayer impact and societal cost-effectiveness tests for new and used light-duty EV rebates in Minnesota? Please provide a cost-benefit analysis from the ratepayer and societal test perspectives that shows the expected costs along with the expected ratepayer, system and societal benefits associated with the proposal.
d. In Attachment C, page 12 of 35, Xcel refers to how studies conducted by Energy and Environmental Economics (E3) on behalf of Xcel Energy electric utilities in Colorado and New Mexico that the cost to serve incremental EV charging are less than the new revenues produced, which can help create downward pressure on customer rates in the future.
    i. For personal light-duty vehicles, did the E3 study evaluate PHEVs and BEVs?

ii. Please provide copies of the E3 studies and point out where the studies came to the following conclusions:
   a. For Xcel Colorado, personal light-duty EV over its lifetime found net ratepayer benefits in excess of $3,700.
   B For Xcel Colorado, commercial light-duty EV over its lifetime of about $13,000.
   c. For Xcel Colorado, electric transit buses can provide approximately $89,000 over their lives.

e. What are the expected new Minnesota revenues for each light-duty EV that would be rebated under this program? What are the expected Minnesota incremental costs of serving a new EV customer?
f. Has Xcel estimated the free ridership that may occur when providing a rebate for a new EV? Has Xcel estimated the free ridership that may occur when providing a rebate for a used EV?
g. Has Xcel investigated the size of the market for used EVs in its service territory and whether the sellers of used EVs have difficulty locating buyers of used EVs?
h. Does Xcel have concerns that providing rebates to EV purchasers will result in large subsidies to potentially higher income customers?
i. Has Xcel considered designing a tiered-rebate structure for light-duty vehicles, with lower rebates provided to higher income customers?
j. Has Xcel considered providing lower rebates to PHEVs than Battery Electric Vehicles (BEVs)?
k. Please explain how Xcel determined the rebates for transit buses, and school buses with and without VG2? Is Xcel aware of utilities or other entities providing rebates for any of the same three types of buses? If yes, how do Xcel's proposed rebate levels compare to EV bus rebates in other states?
l. What are the incremental costs between a standard bus and an electric bus, for the three categories of buses? How much of the incremental costs will Xcel's proposed rebates cover?
m. What are the expected new Minnesota revenues for each type of EV bus that Xcel intends to rebate? What are the expected incremental Minnesota costs of serving a new bus EV customer?

<u>Response:</u>

a. The Company has not conducted an analysis on percent of fossil fuel consumption that PHEVs reduce. That said, there is existing research literature on the amount of driving that PHEV drivers typically do while using electricity as fuel rather than gasoline. For example, in an Electric Power Research Institute (EPRI) study that focused on Salt River Project customers with electric vehicles[1], Chevrolet Volt plug-in hybrid drivers operated approximately 83 percent of the time on battery power.

In terms of considering a smaller rebate for PHEVs, the Company did consider that option, but chose not to due to several factors, including our desire to keep things simple for customers and make it easier for automakers and dealerships to market the rebate in order to encourage participation, the modest difference in kWh usage for PHEVs relative to battery electric vehicles (BEVs), and forecasts that PHEVs are likely to represent a smaller portion of market share moving forward.

b. The Company chose rebates based on incentive levels in other states, including the Company's Colorado service territory. Today, Colorado's state tax credit is $4,000, but will be stepping down to $2,500 in 2021. The Company also assumed that the incremental costs for EVs compared to gasoline-powered vehicles will be declining and, as a result, has proposed lowering the rebate levels over time. For the rebates for used vehicles, the Company has assumed the costs of the vehicles and the incremental costs would be significantly less than for new vehicles and has proposed offering a rebate at roughly half the cost of the rebate for new vehicles.

These rebates for light-duty vehicles are in line with state tax credit and rebate programs in other states:

Colorado	$2,500-$4,000
New Jersey	$400 - $5,000*
California	$1,000-$4,500**

*Based on mileage range of electric battery
**Includes vehicles with fuel cells

Other states take varying approaches for incentives for PHEVs. For instance, in Colorado, the same level of incentive is offered for BEVs and PHEVs while New Jersey's incentive is based on the mileage range of the battery. California, meanwhile, offers a specific rebate level for PHEVs.

c. See the Company's response to Citizens Utility Board (CUB) Information Request No. 11 included as Attachment D, subparts c-d.

d. i) Yes, though the study evaluated BEVs and PHEVs together rather than separately.

[1] EPRI, 2018. Electric Vehicle Driving, Charging, and Load Shape Analysis: A Deep Dive Into Where, When, and How Much Salt River Project (SRP) Electric Vehicle Customers Charge.

ii) See Attachment A for the Colorado study and Attachment B for the New Mexico Study. The study conclusions for (a) are on p. 41 of the Colorado study, (b) are on p. 50, and (c) are on p. 53.

e. The expected annual revenue for a rebated EV on a time-varying rate is $314.76. The annual expected incremental cost is $144.60. Please see Attachment C for the revenue and cost detail.

f. No, the Company has not estimated free ridership or spillover (i.e., customers who are motivated by the rebate to make a vehicle purchase but end up not using the rebate). However, the goal of the rebate program is to accelerate EV adoption in Minnesota, and although there may be some free ridership as a result of this rebate program, we believe that any free rider effects will be more than offset by the likely market transformation, emissions, and electric customer benefits from the rebates and overall acceleration of the EV market.

g. The EV market has been evolving quickly, and we expect that the used EV market will continue to change over the next few years. Several BEVs with longer battery range, such as the Chevrolet Bolt and the Tesla Model 3, will be available in larger quantities on the used markets as the initial lease terms end. The proposed rebate for used EVs could potentially increase demand, leading to used vehicles being imported into the state of Minnesota and creating environmental benefits while also increasing access for drivers who may not be able to pay for a new vehicle.

h. The Company has designed these rebates with fairness and equity in mind, including an MSRP cap and a rebate for used vehicles as well as rebates for buses so that a broader swath of customers can access the benefits of transportation electrification.

i. Yes, however, the Company does not collect or validate income information from its customers and therefore chose an MSRP cap instead of lowered rebates for higher income customers. In addition to aligning with our normal practices, the Company believes this approach makes it easier for dealers and automakers to market the rebate program, and avoids problems associated with requests for drivers' income information that could discourage participation.

j. See response to subpart a. The Company has sought to provide a balance between simplicity in order to raise awareness and encourage participation and fairness and equity considerations. It could be possible to design the incentives differently than the Company's proposal—including but not limited to basing the rebates on vehicle type (e.g., plug-in hybrids, battery electric), size of battery, or weight of vehicle, among other things—but the Company has sought to provide an incentive to accelerate adoption of electric vehicles that is generally simple and easy for customers to understand and automakers and dealerships to market while being mindful of fairness and equity.

k. See the Company's response to CUB Information Request No. 11 included as Attachment D, subpart a. for how the Company determined the rebate levels. There are several utility and state programs, largely funded by VW Settlement, that seek to reduce the upfront costs and accelerate adoption.

   As discussed in our response to CUB, the school bus rebate is intended to match Minnesota Pollution Control Agency's (MPCA) support. Other programs that provide support, including Dominion Energy's, seek to offset the incremental costs of electric school buses, which is similar to the Company's proposed approach.

   The proposed rebate levels for electric transit buses stem from conversations with Metro Transit and the desire to strike an appropriate balance between strong upfront incentives to encourage economic recovery and electrification and declining rebates over time as the market develops in order to reduce the costs of the program. There are other programs for electric transit buses too, including MPCA's and Colorado Department of Transportation's (CO DOT). In MPCA's case, the budget for phase 2 for heavy-duty electric vehicle and electric equipment grants is roughly $7 million, and the Company understands that the agency is still determining the support as part of the grant program which is planned to begin taking applications in Spring 2021. In Colorado, the grant program for electric buses is based on either an amount equivalent to 80% of the cost of a new diesel replacement bus or an amount equivalent to 110% of the incremental cost (over the cost to purchase a diesel bus) of a new zero emission bus.

l. See the Company's response to CUB Information Request No. 11 included as Attachment D, subpart a.

m. The Company has not estimated Minnesota revenues and incremental costs for electric buses. For a discussion of cost-benefit analysis, see the Company's response to CUB Information Request No. 11 included as Attachment D, subpart c-d.

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Preparer:	Mathias Bell	Nick Paluck
Title:	Principal Performance and Strategy Consultant (Electric Transportation)	Rate Consultant
Department:	Customer and Innovation	Regulatory Analysis
Telephone:	612.321.3260	612.330.2905
Date:	October 19, 2020	October 19, 2020

EXHIBIT A

Benefit-Cost Analysis of Transportation Electrification in the Xcel Energy Colorado Service Territory

May 2020

Energy+Environmental Economics

EXHIBIT A

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Benefit-Cost Analysis of Transportation Electrification in the Xcel Energy Colorado Service Territory

May 2020

Energy and Environmental Economics, Inc.
44 Montgomery Street, Suite 1500
San Francisco, CA 94104
415.391.5100
www.ethree.com

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Executive Summary

Study Aims and Methodology

Energy and Environmental Economics, Inc. (E3) modeled the economic and electric grid impacts of plug-in electric vehicle (PEV) adoption in Xcel Energy's Colorado service territory. This work aims to inform Xcel Energy, policymakers, and other stakeholders on the impacts of a pathway for PEV adoption in Xcel Energy's Colorado territory that aligns with the state Electric Vehicle Plan target of 940,000 PEV's by 2030.

E3 employed its EVGrid model to capture key interactions between drivers, vehicles, chargers, utility costs, incentives, and gasoline costs. In this study, we consider the impacts of PEV adoption from 2020 to 2030 and costs and benefits are analyzed from ratepayer, driver, and societal perspectives that are captured through three utility cost tests:

+ Ratepayer Impact Measure (RIM): the costs and benefits to all Xcel Energy Colorado ratepayers – will average utility rates increase or decrease?
+ Participant Cost Test (PCT): the costs and benefits to the vehicle driver or fleet owner – is the total cost of ownership higher or lower for the driver?
+ Societal Cost Test (SCT): the costs and benefits to Colorado State – do EVs provide net benefits for the state as a whole?

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Vehicle Types and Scenarios

The study explored how costs and benefits vary under different vehicle types, charging control, charging infrastructure deployment, and utility program scenarios. The base case for each vehicle type studied and the four sensitivity cases are summarized below:

- **Personal Light-Duty Vehicle (LDV) base case:** This case calculates the costs and benefits arising from personal light duty PEV drivers. We simulate 4 different PEV types and assume charging is unmanaged in the base case.
- **Commercial LDV:** This case attempts to model the impacts of PEV adoption for rideshare drivers in Colorado. Charging is also unmanaged in the base case.
- **Transit Buses:** Transit buses are assumed to only charge at their bus depot location where each bus has access to a fast charger. Charge management occurs to minimize electricity bills.
- **School Buses:** School buses are modelled very similarly to transit buses assuming they only charge at their depot location and that charging is managed. School buses do not drive during holidays and only a fraction drive during weekends.
- **Personal LDV managed charging sensitivity:** In this scenario, charging is performed to minimize electricity bills. In addition, for residential charging it is assumed that additional charge management is performed to manage peak loads.
- **Personal LDV high DCFC sensitivity:** This scenario tests the impact of doubling the number of public DCFCs deployed across Xcel Energy Colorado territory. The scenario assumes adoption is increased by 20% relative to the personal LDV base case due to increased consumer awareness and lower range anxiety.

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- **Personal LDV socializing charger costs sensitivity:** This sensitivity case assumes that Xcel Energy contributes 50% towards all charging infrastructure costs behind the customer meter.
- **Commercial LDV expensive public charging rate sensitivity:** Under the base scenario we assume commercial LDV drivers pay the utility tariff rate for all public charging (the S-EV tariff). This scenario instead uses the upper end of today's fees for charging in pubic (currently around $0.55/kWh) to understand how this affects the economics of PEV ownership.

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Base Case Results

Overall, this study finds that under the base scenarios for all vehicle types *ratepayers stand to benefit by nearly $1.07 billion* in net present value from PEV adoption between 2020 and 2030. *Drivers or fleet owners would benefit by $358 million* in lower total cost of ownership and *Colorado would benefit by $1.51 billion* from avoided gasoline, reduced O&M, emission reductions, and federal and state tax credits. Table 1 summarizes the total Net Present Value (NPV) of all cases. These values represent the total costs and benefits over each vehicles' 12-year lifetime, summed for every vehicle adopted from 2020 to 2030 and discounted using Xcel Energy's weighted average cost of capital.[1]

Table 1. Total Net Present Value (NPV) for all vehicles adopted between 2020 – 2030 in ($ Million)

Case	RIM	PCT	SCT
Personal LDV - base case	$1,018	$326	$1,426
Commercial LDV	$16	$29	$42
School Buses	$7	($27)	($19)
Transit Buses	$27	$30	$59
Sensitivities			
Personal LDV - managed charging	$1,054	$555	$1,533
Personal LDV - high DCFC	$1,193	$577	$1,571
Personal LDV - 50% socialization	$703	$641	$1,426
Com LDV - expensive public charging rates	$16	($41)	$42

[1] Note that the costs and benefit streams that contribute to the NPV values calculated extend out to 2042 since all vehicles adopted in the last year of the study period, 2030, would continue to provide costs and benefits over their full lifetime which is assumed to be 12 years.

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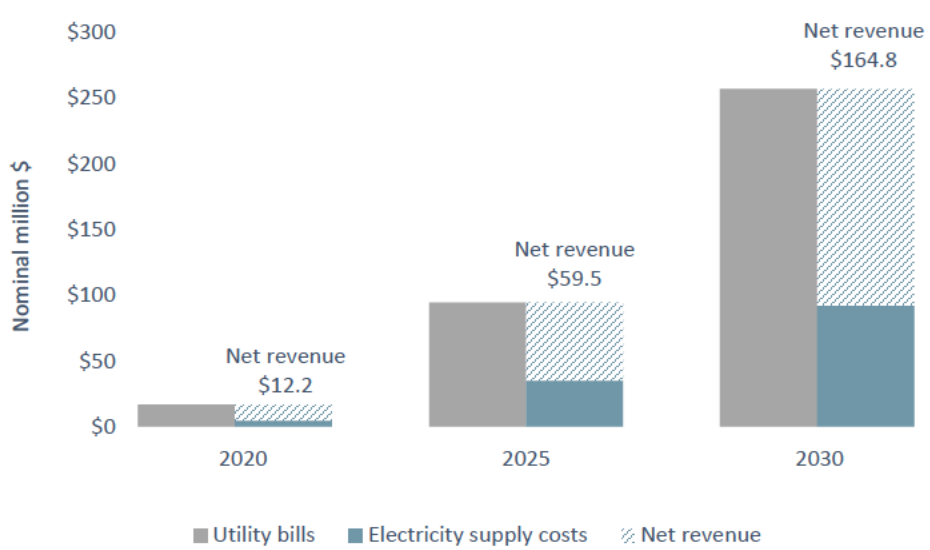
The aggregate impact on Xcel Energy's Colorado ratepayers under the base case scenario is summarized in Figure 1, and shows that by 2030 revenue collected from tariffs is over $257 million or an average of $0.12/kWh (in 2030 nominal dollars) which exceeds the total cost to serve PEV charging load at $92 million ($0.04/kWh). Under all vehicle types and every case explored ratepayers benefit substantially from PEV adoption.

Figure 1. Annual utility net revenue from transportation electrification ($ nominal)



Driver or fleet owner benefits, as reported in the vehicle results sections on a per vehicle basis, show that for nearly all cases PEVs are cheaper in total cost of ownership than ICE vehicles. This is primarily from reduced gasoline or diesel consumption and reduced O&M. Over the vehicle lifetime, these savings outweigh the higher upfront cost of PEVs, the charger installation costs, battery replacements, and charging costs. Drivers also benefit from tax credits at the federal and state level.

The societal benefits to Coloradans in Xcel Energy territory amount to nearly $1.51 billion for all PEVs adopted between 2020 and 2030 over each vehicles' lifetime. The benefits from avoided gasoline and O&M costs (referred to as eVMT savings) and emission savings far exceed the charging infrastructure, electric supply, and incremental vehicle costs in all but the school bus cases. Note that the societal cost benefit results presented in this study do not include other indirect benefits such as the energy security value from lower reliance on fossil fuels and monetized health impacts of reduced criteria pollutants (although emission values are reported).

For all vehicle types and scenarios explored in this study, the CO_2 emissions from electricity generation to meet charging load were lower than the emissions from gasoline or diesel combustion. Total CO_2 emission reduction for all PEVs adopted between 2020 and 2030 sum to 11.7 million metric tons (MMTons) over vehicle lifetimes, with annual CO_2 emission savings peaking in 2030 at 1.1 MMTons /year. Other pollutants were also included in the analysis: emissions from NO_x were found to decrease with PEV adoption by 3,242 metric tons while SO_2 emissions are projected to *increase* by 1,151 metric tons relative to the adoption of new ICE vehicles.

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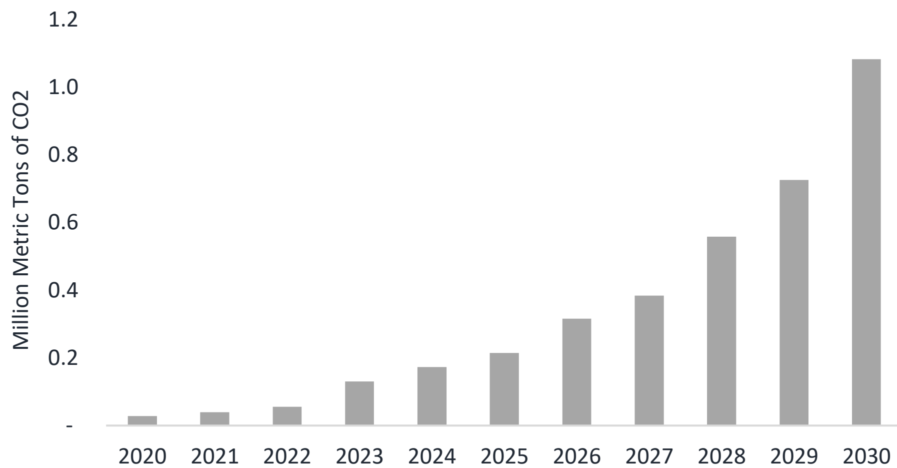
Figure 2. Annual avoided CO_2 emissions from all vehicle types



Sensitivity Case Results

Additional key findings from sensitivity cases include:

- The managed charging sensitivity demonstrates the large benefits that could be obtained from managed charging to minimize utility bills, which increases drivers' bill savings by 70% and ratepayer benefits by a total of $36 million.
- Doubling DCFC deployment in Colorado could increase ratepayer benefits by $175 million *if* PEV adoption is increased by 20%, however PEV adoption impacts of DCFC deployment remain highly uncertain.
- Ratepayers would still benefit by an NPV of $703 million if Xcel Energy paid for 50% of residential charging infrastructure costs behind the meter and driver net benefits would nearly double. This does not include any increase in adoption from reducing upfront costs for drivers.

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- Rideshare electrification could *cost* the average rideshare driver a total of $34,048 over the vehicle's lifetime if the cost of charging in public remains the same as it is today. If rideshare drivers were to pay for public charging at Xcel Energy's commercial tariff (S-EV) rate or if access to charging at home were increased, particularly at multi-unit dwellings, this could reduce lifetime costs by up to $77,000 per vehicle which would make PEV adoption a substantial net *benefit* for rideshare drivers.[2]

[2] Average values per vehicle are calculated by taking the final NPV result for all vehicles adopted between 2020 – 2030 and dividing it by the total number of vehicles adopted during this period.

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1 Study Aims

Colorado is one of the leading states advancing transportation electrification in the US and has enacted various regulations, laws, and incentives in recent years. The first Colorado Electric Vehicle Plan published in 2018 set the goal of reaching 940,000 EVs on the road by 2030 and in August 2019 Colorado became the eleventh state in the US to adopt ZEV standards. This study evaluates the costs and benefits of PEV adoption aligned with this target in Xcel Energy's Colorado territory (U.S. Department of Energy, 2020; Colorado Energy Office, 2020). Specifically, this study aims to support Xcel Energy, policymakers, and other stakeholders in understanding:

+ the costs and benefits of plug-in electric vehicle (PEV) adoption, from a ratepayer, driver, and broader societal perspective,
+ the potential value of systems or programs that manage the timing of PEV charging,
+ potential carbon dioxide reductions from electrified transportation, and
+ potential impacts of electric vehicles on utility planning, specifically electricity consumption and planning loads.

2 Methodology

2.1 Cost-Benefit Overview

To perform a Benefit Cost Analysis (BCA) of transportation electrification in Xcel Energy's Colorado service territory, E3 compared the costs and benefits accrued over the lifetime of each PEV adopted against an equivalent Internal Combustion Engine (ICE) vehicle. Whether a particular value stream is a cost or a benefit depends on the perspective taken. E3 performed BCAs from the perspective of EV owners (drivers), other utility customers, and Colorado as a whole. Each perspective offers distinct insights that help describe the overall impact of EV adoption in Xcel Energy's Colorado territory and inform development of policy and programs. The three perspectives are as follows:

+ Ratepayer Impact Measure (RIM): the costs and benefits to all Xcel Energy Colorado ratepayers – will average utility rates increase or decrease?
+ Participant Cost Test (PCT): the costs and benefits to the vehicle driver or fleet owner in the case of buses – is the total cost of ownership higher or lower for the driver?
+ Societal Cost Test (SCT): the costs and benefits to Colorado State – do EVs provide net benefits for the state?

Table 2 provides and overview of the various costs and benefits analyzed under each perspective:

Table 2. Cost and benefits associated with each cost test perspective

Cost/Benefit Component	PCT	SCT	RIM
Incremental EV cost	Cost	Cost	
Federal & State EV tax credit	Benefit		
EV O&M savings	Benefit	Benefit	
Fuel savings	Benefit	Benefit	
Electricity Supply Costs for EV charging		Cost	Cost
Charging infrastructure cost	Cost	Cost	
Electricity Bill for EV charging	Cost		Benefit
Emission savings		Benefit	

2.2 Modelling methodology

E3's EVGrid model performs BCAs from each of the perspectives described above and uses various input streams that are described in detail in the Inputs and Assumptions section. The model calculates the net present value of EV adoption relative to gasoline vehicles across a region of interest. Accurate forecasting of electricity supply costs and electricity bills depends strongly on the hourly load shape from PEV charging. Charging load shapes in turn vary substantially across the driver population and depend on several factors such as vehicle type, charging access, cost of charging and many others.

To model charging behavior E3 has developed a bottom-up modelling approach that simulates driving and charging of thousands of PEV drivers. Driving behavior is captured using travel survey data and converted to 15-minute driving patterns though a Markov-Chain Monte Carlo method. The driving population is characterized by drivers' access to charging and the type of EV they drive. For personal Light-Duty Vehicle (LDV) cases there are 4 PEV types and 6 charging access types, resulting in 24 combinations or customer types. Potential charging locations are categorized into residential, workplace, and public areas and drivers choose where and when to charge by minimizing their charging cost through linear optimization subject to various constraints. This generates a normalized load shape for each customer type which are then scaled by portion drivers representing that customer type. The final load shape therefore captures the diversity of driving behavior, charging access, and PEV adoption across the driving population.

In addition, charging sessions can then be further managed to minimize peak loads or demand charges at each location through a heuristic cost minimizing method. This modelling framework enables PEV charging load shapes to be generated under various scenarios for Vehicle-Grid Integration (VGI), charging infrastructure deployment, and adoption scenarios. PEV charging load shapes output from EVGrid's load shape module have been benchmarked and calibrated using real OEM charging session data.

2.3 Modelling Scenarios

This study calculates the lifetime costs and benefits for every PEV adopted between 2020 – 2030. Personal LDV, Commercial LDV (rideshare drivers), transit bus, and school bus vehicle types were modelled encompassing a majority of future PEV adoption in Xcel Energy's Colorado territory. There were also sensitivities conducted for the LDV cases, which E3 expects will make up 99% of

PEV adoption and 95% of forecasted PEV charging load by 2030. Each case is described below:

- **Personal LDV base case:** This case calculates the costs and benefits arising from personal light duty PEV drivers. We simulate four different PEV types and assume charging is unmanaged or uncontrolled. Drivers are still sensitive to the average cost of charging in each location and choose where to charge based on this cost, but when they arrive at a location that they plan to charge in they immediately plug-in and the vehicle is charged at the maximum rate until the battery is full or the vehicle leaves the charging premises.
- **Commercial LDV:** This case attempts to model rideshare drivers in Colorado. These drivers own their vehicle, some have access to charging at home, but most rely on public charging infrastructure. Charging is unmanaged in this case.
- **Transit Buses:** Transit buses are modelled as only charging at their bus depot location where each bus has access to a fast charger. It is assumed electric transit buses are only assigned shorter routes where daily mileage is less than the vehicle range. Charge management minimizes demand and energy charges.
- **School Buses:** Similar to transit buses, school buses are assumed to only charge at their depot location. School buses do not drive during holidays and only a fraction drive during weekends. Charing is also assumed to be managed.

A number of sensitivities were explored for the LDV cases to evaluate different electrification scenarios:

- **Personal LDV managed charging:** In this scenario, charging is performed to minimize the driver's cost of charging. Charging is managed on a 15-minute basis to minimize energy and demand charges. In addition, for residential charging it is assumed that additional charge management is performed by Xcel Energy to mitigate the impact of rebound peaks when the off-peak TOU period begins. This is performed by a combination of cascading charging start times over a 45-minute interval and peak 'flattening' where charging is further staggered throughout the period the vehicle is parked.

+ **Personal LDV high DCFC:** This scenario tests the impact of doubling the number of public DCFCs deployed across Xcel Energy's Colorado territory. The scenario assumes adoption is increased by 20% relative to the personal LDV case to account for the indirect network effects of reducing range anxiety and increasing consumer awareness from having a denser DCFC network.
+ **Personal LDV socializing charger costs:** Here it is assumed that Xcel Energy contributes 50% towards all charging infrastructure costs behind the customer meter. This case is a simple reallocation of costs. No impact on adoption or charging shape and no additional utility rate base or return on equity is assumed.
+ **Commercial LDV expensive public charging rates:** Under the base scenario we assume commercial LDV drivers pay the utility tariff rate for all public charging (the S-EV tariff). This scenario instead uses the upper end of today's fees for charging in pubic (currently around $0.55/kWh) to understand how this affects the economics of PEV ownership.

3 Inputs and Assumptions

3.1 Driving and Charging Behavior

To simulate PEV driving and charging behavior the team utilized thousands of vehicle trips from detailed trip datasets. For the personal LDV case, trip data was extracted from the 2017 National Household Travel Survey (NHTS) (Federal Highway Administration, 2017), for commercial LDV case the Chicago Taxi trip database (City of Chicago, 2020) was used, and for both bus cases the NREL Fleet DNA database (NREL, 2019) was used. Each dataset was cleaned, filtered for the specific vehicle of interest, and where possible filtered for Colorado trips only. The origin and destination locations were categorized and the mileage was adjusted slightly to align with Colorado specific annual VMT sources as shown in Table 3.

Table 3. Annual VMT for each vehicle class

PEV category	Annual VMT
Personal LDVs	12,861[3]
Commercial LDVs	58,689[4]
Transit buses	42,500[5]
School buses	12,792[6]

[3] Colorado personal LDV mileage from the National Transportation Statistics 2017 (Bureau of Transportation Statistics, 2018)
[4] Taken from the Chicago Taxi trip database (City of Chicago, 2020) and mileage adjusted for Colorado taxi deadhead hours and trip lengths using Colorado specific rideshare data (Henao, 2017)
[5] Colorado specific transit VMT from (Federal Transit Administration, 2019)
[6] Taken from (U.S. Department of Energy, 2020; NREL, 2019)

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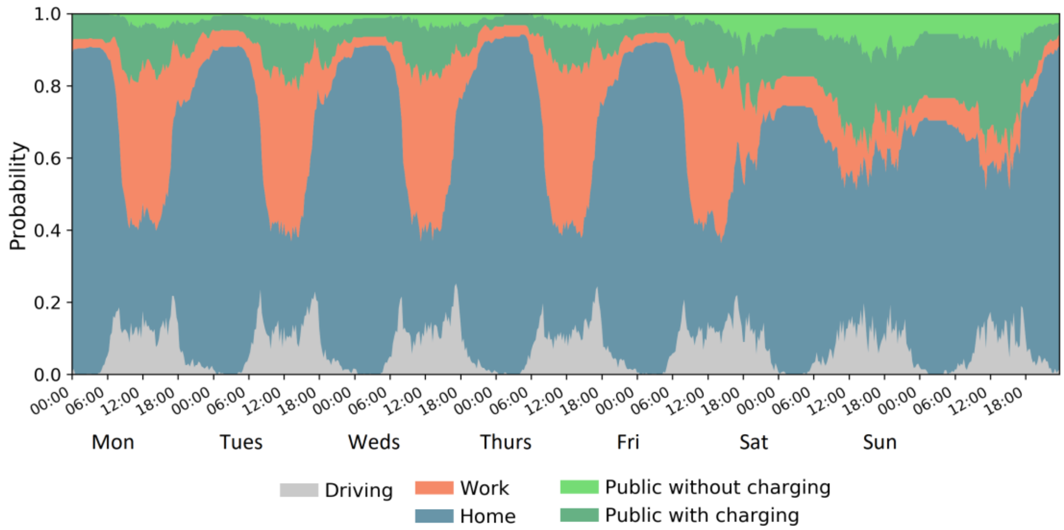
A random sample of trips is then drawn from the dataset covering 500 driver days to construct driving profiles through a Markov-Chain Monte Carlo approach. An example weekly driving pattern for a group of drivers is shown in Figure 3.

Figure 3. A weekly driving profile generated for personal LDV drivers using 2017 NHTS data and the Markov Chain methodology



Drivers who had travel days that could not be completed using the EV and charging access options assigned to them were deemed to have 'unserved driving energy' and were dropped from the sample to generate the final aggregated charging loads. This implies that drivers with driving patterns where they cannot complete their travel day with the EV and charging access they were assigned would not purchase this EV type and would not therefore contribute to the final load. A minimum dwell time of 15 mins was set for charging, if the driver was parked at a destination for less time than this time, no charging was assumed to occur.

Due to the computational intensity of simulating driving and charging behavior only a winter and summer week in 2025 was simulated, the resulting load shapes were scaled based on PEV adoption and interpolated for adoption forecast between 2020 – 2030.

3.2 EV Adoption

EV adoption assumptions in this analysis are based on forecasts by Xcel Energy's EV strategy team for Colorado territory. Personal LDVs are expected to grow cumulatively to 451,342 vehicles in Xcel Energy's territory in 2030, capturing a market share of 17% as visualized in Table 4Table 4. The total market for LDVs is expected to grow 1.1% per year, following assumptions by the FHWA on growth of VMT in the US (FHWA, 2019). In the high DCFC case, E3 estimates a slightly higher adoption curve of EVs assuming driver's range anxiety declines with more fast charging possibilities. Conservative assumptions in literature describe how a 100% increase in DCFC stock results in 20% increase in EV adoption (Li, et al., 2016).

Commercial LDV population was extrapolated based on employment statistics of drivers and chauffeurs in Colorado and adjusted for an update that included ride-hailing drivers (U.S. Bureau of Labor Statistics, 2018). The team estimated 2,740 commercial LDVs in 2020 in Xcel Energy's Colorado territory and 3,288 in 2030. EVs are forecasted to grow from 204 vehicles in 2020, following the announcement by Lyft to introduce 200 electric vehicles in 2020, to 1,644 vehicles in 2030 (Paul & Chuang, 2019). Based on a "clean mile" target proposed to SB 1014 in California (Anon., 2018), the team assumes the share of electric taxis would grow to 50% in 2030 in Colorado.

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For buses, we follow the growth rate of Xcel Energy's EV forecast assumptions for Heavy Duty Vehicles. This results in a gradual increase toward 520 electric transit buses in 2030 in Xcel Energy territory, corresponding to a market share of around 68%. For school buses, we assume 575 electric buses on the road in 2030, corresponding to a market share of around 24%.

Table 4. Overview of EV adoption per vehicle category

PEV category	Total Vehicles*	2020 PEV	2025 PEV	2030 PEV
Personal LDVs	2.68 million	30,450	169,211	451,342
Personal LDVs – high DCFC	2.68 million	36,540	203,065	541,611
Commercial LDVs	3,288	205	863	1,644
Transit buses	760	22	70	520
School buses	2,389	25	77	575

*Total Vehicles in Xcel Energy's Colorado territory in 2020 (PEV + ICE)

3.2.1 CHARGING ACCESS

To model charging behavior the driving population is segmented by where they have access to charging and by PEV type. For personal LDV cases six charging access types are used, while for commercial LDV cases only 3 are assumed. For bus cases, it is assumed that charging access is limited to the bus depot, so no split is required.

For personal LDVs the team used information on population and housing type from the American Community Survey (ACS) to estimate the number of households by type, the percentage of each household type that own a car, and the percentage of car owners that drive to work (U.S. Census Bureau, 2016). The team then used a report from University of California, Davis to estimate the availability of home charging at each type of housing and the percentage of vehicles that would charge at home, at work, and on public chargers (Nicholas & Tal, 2017).

For commercial LDVs, due to limited data availability, the team halved the percentage of drivers with access to home charging for personal LDVs and assigned the rest of the population to having access to public charging only. In this study, 42% of commercial LDV drivers would have access to home charging and 58% would charge on public chargers only. This is consistent with the findings that around 24% of Colorado residents and 44% of residents of Denver live in multi-family housing (Svitak, et al., 2017) and most TNC drivers do not have home charging (Colorado PUC, 2019).

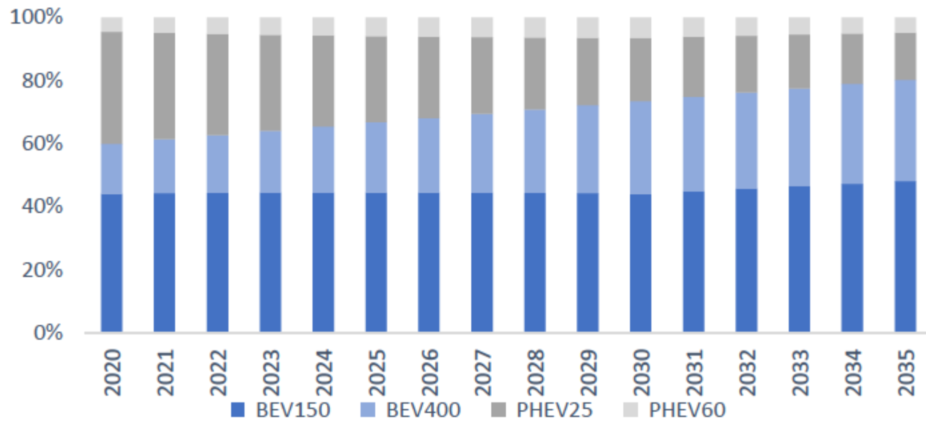
3.2.2 PEV TYPES

The driving population was also segmented by the type of PEV driven, for LDV cases four PEV types were used distinguishing long- and short-range BEVs and PHEVs. Transit bus cases had only 1 BEV for each case. The split between BEV and PHEVs is based on the Bloomberg New Energy Finance EV outlook (BNEF, 2019) while the split between long and short range PEV types were used to ensure the average BEV and PHEV range was aligned with forecasts from NREL (Kontou, et al., 2018).

Figure 4. shows how the vehicle mix used in this study gradually changes towards 2030, assuming a growing role for battery electric vehicles as the market matures.

EXHIBIT A

Figure 4. Cumulative) change in vehicle mix - 2020 -2035



3.3 Vehicle and charger parameters

This study includes an analysis of four driver types: personal LDVs, commercial LDVs, school buses and transit buses. The team assumed that both personal and commercial LDVs adopt the same vehicles types in the same proportions over the modelling period. As described in section 3.2.2 for LDVs four vehicle types were modelled, for which vehicle and charger parameters are shown in Table 5. Note that as described in section 3.1, only charging profiles for 2025 were simulated. The normalized charging profiles for each of the four LDV types were scaled using their relative proportion by year over the modelling period to represent growth in average BEV and PHEV ranges over time. Therefore, the range of BEVs and PHEVs selected represent the lower and upper end of potential vehicle ranges that may be on the market by 2030.

LDVs are expected to have an efficiency of 0.35 kWh/miles based on the weighted average of the LDV market in Colorado. An efficiency de-rate of 10% was applied for colder temperature driving during the winter period from a US Department of Energy source adjusted for the vehicle mix in Colorado (U.S. Department of Energy, 2020; Auto Alliance, 2020).

Table 5. Vehicle and charger parameters of LDVs

Vehicle type	Electric range (miles)	Battery size (kWh)	Max DC charging power (kW)	Max AC charging power (kW)
BEV – long range	400	140	20	105
BEV – short range	150	52.5	20	50
PHEV – long range	60	21	3.6	n/a
PHEV – short range	25	8.75	3.6	n/a

Different parameters were used for transit and school buses based on the vehicle duty cycle. Transit buses require large daily mileage with few in-between charging stops, whereas school buses have lower daily mileage and distinct driving peaks in mornings and late afternoons, leaving room for mid-day charging. The vehicle and charger parameters of both vehicle types are summarized in Table 6. Both bus types are assumed to only use 80% of their total battery capacity to preserve battery life and provide emergency backup. The vehicle efficiencies of both vehicle types are derived from (Eudy & Jeffers, 2018) and (VEIC, 2020).

Table 6. Vehicle and charger parameters of buses

Vehicle type	Effective electric range (miles)	Battery size (kWh)	Max charging power (kW)	Vehicle efficiency (kWh/miles)
Transit buses	170	625	50	2.84
School buses	90	200	20	1.81

3.4 Utility tariffs and charging costs

Residential locations were assigned Xcel Energy's Modified Residential TOU rate[7] (effective January 1, 2021) and Xcel Energy S-EV rate was applied to workplace, public, and bus depot locations. The team also assumed 25% of EV drivers have access to free charging at workplace. It was assumed that all EV chargers were separately metered and therefore building loads were not included when calculating demand charges for the S-EV rate. Since the intention is to measure the impact of EV charging on utility bills versus a counterfactual where an ICE vehicle is owned, all metering charges and fixed charges were not included in the bill calculation for simplicity. Tariffs energy and demand charges are assumed to grow at the inflation rate of 2%/year.

For personal and commercial vehicles, the rates paid by the drivers are distinguished from the electricity bills paid by charging station site hosts for public locations, see Table 7. Commercial charging prices for L2 and DCFC chargers were selected from a publicly available source[8] to reflect the charging costs EV drivers pay at public locations, which are often much higher than the S-EV rate paid by charging station site hosts or owners. This difference will reflect again on the cost

[7] See Steven Wishart's testimony in December 2019 (Public Utility Commission of Colorado , 2019)
[8] Blink member charging fees for Colorado taken from (Blink, 2020)

of charging to drivers in the Participant Cost Test (PCT) and the utility revenue for ratepayers in the Ratepayer Impact Measure (RIM).

Table 7. Charging fees paid by EV drivers versus charging site hosts or owners

	Home	Workplace	Public	Bus Depot
Drivers	Modified RE-TOU	75% S-EV 25% free	Blink L2 or Blink DCFC	S-EV
Charging Site Hosts	-	S-EV	S-EV	S-EV

Table 8. Rate information

	Critical Peak	Peak	Shoulder	Off-peak	Peak Period Definition
Modified RE-TOU	-	0.18	0.13	0.09	Peak: Summer weekdays 3pm-7pm Shoulder: Summer weekdays 11am – 3pm & 7pm-10pm
S-EV (Winter)	-	0.12	-	0.06	Peak: weekdays 12pm – 9pm Critical peak pricing is added to one day in a week in summer from 3pm – 6pm
S-EV (Summer)	1.67	0.18	-	0.09	
Blink L2	-	0.44	0.44	0.44	-
Blink DCFC	-	0.54	0.54	0.54	-

The rates above were used to simulate PEV charging in EVGrid by minimizing the driver's electric bill. For commercial LDV rideshare drivers (such Lyft or Uber) time spent charging during shifts hours could reduce revenue potential from fares. The team therefore added an opportunity cost for charging during shift hours to reflect the cost of time that could have been spent earning income. This results in faster charging being heavily favored by commercial drivers when on shift due to the shorter charging sessions. Note these costs were only applied during the driving and charging simulations to create charging load shapes and were not applied to the bill calculation used in the cost benefit analysis.

Opportunity cost ($/kWh)[9] = expected earning of a driver / charger power

Table 9. Commercial LDV Opportunity Costs ($/kWh)

Location	Initial Rate	Opportunity Cost	Final Rate
Residential	0.09 - 0.18	0	0.06 – 0.18
Public L2	0.44	2.37	2.82
Public DCFC	0.54	0.31	0.85

3.5 Incremental Vehicle Costs

On average, electric vehicles are currently more expensive in purchase price than their ICE counterparts, mostly as a result of battery costs. E3 used the base assumptions on the purchase price for both electric and ICE LDVs in the US from recent projections by the ICCT (ICCT, 2019). These were specified for vehicle mix and battery packages as used in this analysis, resulting in average incremental vehicles costs of an EV over an ICE vehicle of $8,920 in 2020. As battery costs are

[9] Expected earnings for a driver in Colorado is around $15.69/hr (Henao, 2017)
L2: $15.69/6.6kW = 2.37
DCFC: $15.69/50 kW = 0.31

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forecasted to decline towards 2030, incremental vehicle costs are reduced to $1,721 in 2030.[10]

As the annual mileage for commercial rideshare LDVs is very high, E3 estimated battery replacement costs on top of incremental vehicle costs. Assuming a lifespan of a battery pack of around 150,000 miles, E3 estimates commercial LDV's to require battery replacements every 3 years, while an ICE vehicle is replaced after 6 years. Battery replacement costs are calculated using battery costs projections by ICCT combined with labor costs specific to Colorado.

For transit buses, E3 used incremental vehicle costs based on Bloomberg's report on electric buses in cities, corrected for the battery pack size for transit buses used in this analysis (BNEF, 2018). Transit buses are also expected to need battery replacements because of high annual mileage. E3 estimated battery replacements of transit buses at every 4 years, compared to ICE replacements of 12 years. This brings the total incremental vehicle costs for transit buses at $237,595 in 2020, declining to $126,014 in 2030 as a result of declining battery costs.

The relative gap between electric school bus costs and their diesel counterparts is larger than for transit buses. In 2020, incremental vehicle costs are fairly similar to transit buses at $213,614. These costs are based on an analysis of manufacturing data of the Vermont Energy Investment Corporation (VEIC, 2020) and research by the University of Delaware (Noel & McCormack, 2014). As shown in Table 10, the decline in incremental costs is slower for this vehicle group since

[10] In nominal dollars - based on battery costs projections by ICCT (2019)

battery costs take up a much smaller portion of total partly due to lower battery replacement needs.

Table 10. Incremental vehicle costs per vehicle category (Nominal $)

PEV category	2020	2030
Personal LDVs	8,920	1,721
Commercial LDVs	15,047	2,381
Transit buses	237,595	126,014
School buses	213,614	219,295

3.5.1 TAX CREDITS

To reduce the impact of upfront incremental vehicle costs, all EV drivers in Colorado benefit from both federal and state tax credits. Federal tax credits amount up to $7,500 per BEV purchased, phasing out when at least 200,000 vehicles have been sold by each manufacturer in the U.S which E3 assumed would occur by 2023 (Internal Revenue Services, 2020). In addition, Coloradans benefit from the Innovative Motor Vehicle and Truck Credits which reduce upfront vehicle costs by $4,000 per LDV and $16,000 per HDV if purchased in 2020, dropping to $2,000 per LDV and $16,000 per HDV by 2026 (CDOR, 2020).

3.6 Avoided Electric Vehicle Miles Travelled (eVMT)

Avoided electric Vehicle Miles Travelled (eVMT) costs in our analysis are based on two factors: avoided fuel costs and avoided operation and maintenance (O&M) costs. For avoided fuel costs, we calculate the amount of fuel an ICE vehicle would have used under the same circumstances over the lifetime of the vehicle, multiplied by the costs of fuel in each year. The average annual fuel consumption avoided per EV per year is assumed to decrease over time according to the relative improvement in ICE vehicle fuel efficiency projected by NREL in their Light-Duty Vehicle Attribute Projections prepared for the California Energy Commission (Kontou, et al., 2018). The assumed fuel efficiencies per vehicle category are shown in Table 11.

Table 11. Fuel economy assumptions

Year	LDVs (miles/gallon gasoline)	Buses (miles/gallon diesel)
2020	31.5	7.3
2025	35.6	7.7
2030	36.9	8.1

Gasoline and diesel forecasted prices are derived from the EIA Annual Energy Outlook 2020 and include an inflation rate of 2%/year to convert them to nominal dollars. Table 12 shows the projected fuel costs for both gasoline and diesel for several end years (U.S. Energy Information Administration, 2020).

Table 12. Fuel price forecast (Nominal $)

Year	Gasoline (nom $/gallon)	Diesel (nom $/gallon)
2020	2.65	3.00
2025	2.83	3.37
2030	3.29	3.91
2035	3.89	4.54
2040	4.49	5.18

Note that these gasoline prices are based on the EIA's latest long-term price forecasts which were published in January 2020 and therefore do not include recent price impacts of the 2019 novel coronavirus disease (COVID-19). While it is uncertain what the long term price impacts are, the EIA's current Short-Term Energy Outlook shows the price impacts are expected be largest in the second

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quarter of 2020 and then dissipate over the following 18 months (U.S. Energy Information Administration, 2020). Given that much of the avoided gasoline in this study occurs beyond 2025 based on PEV adoption forecasts, this should not have a substantial impact on the analysis.

To calculate annual O&M savings, E3 multiplied annual mileage of different vehicle categories by an estimation of the per mile difference between maintenance costs for ICE and electric vehicles. To inform these estimates for LDVs, E3 used data provided by the International Council on Clean Transportation, estimating conventional vehicle maintenance costs for LDVs at $0.061 per mile versus $0.026 per mile for their electric counterparts (ICCT, 2019).

For buses, E3 assumed maintenance costs of conventional diesel school and transit buses at a relatively conservative estimate of $1.00 per mile following the Bus Lifecycle Cost Model developed by the US Department of Transportation (US DOT Volpe Center, 2019). Electric bus maintenance costs are considered significantly less expensive due to the relatively simple drive system compared to diesel buses. Although exact numbers are still uncertain with relatively few electric buses on the road, the University of Delaware research on electric school buses estimated the cost to maintain an electric school bus at $0.20 per mile (Noel & McCormack, 2014). For transit buses, E3 used a recent study on lessons learned from electric buses currently on the road, which states maintenance costs of electric buses at $0.55 per mile for a study on 16 electric buses (Frontier Group, US Pirg Education Fund, 2019).

3.7 Electricity Supply Costs

Utility electricity supply costs are calculated by multiplying the hourly marginal electricity supply costs with hourly electric PEV charging load. Recall that this study focuses only on adoption between 2020 – 2030 but to account for costs and benefits over the each PEVs' 12 year lifetime, electric supply costs are calculated for charging load out to 2042, when it is assumed all EVs adopted by 2030 will have been retired.

The marginal electricity supply cost used in this analysis is comprised of four components. Xcel Energy provided marginal energy costs ($/MWh), avoided distribution cost ($/kW-year) and avoided transmission cost ($/kW-year) from 2020 to 2042. The generation capacity cost ($/kW-year) provided is only available for 2020 to 2029 and the team applied the 2029 cost to future years, adjusted for inflation, assuming combustion turbine (CT) on the margin.

Table 13. Marginal Electricity Cost Components

Component[11]	Description
Energy	Increase in costs due to change in production from the marginal generator
Generation Capacity	Increase in fixed costs of building new generator to meet the incremental EV load
Transmission Capacity	Increase in fixed costs of building or maintaining transmission lines to meet the incremental EV load
Distribution Capacity	Increase in fixed costs of building or maintaining distribution lines to meet the incremental EV load

[11] All cost components have loss factors included.

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To allocate the kW-year generation and transmission capacity costs to hourly values in $/kWh the PCAF (Peak Capacity Allocation Factor) methodology was used[12]. Using hourly net system load from 2020 to 2035 a threshold (MW) corresponding to the top 250 net load hours was selected. In hours where the net load exceeds the threshold, the exceeded load is divided by the total exceeded load for the 250 hours to create an hourly PCAF allocation factor that sums to 1 over the year. For years beyond 2035, the team used the 2035 PCAF shape.

$$\text{Exceeded load}_t = \min(0, \text{load}_t - \text{the } 250^{th} \text{ top load in a year})$$

$$\text{PCAF}_t\ (\%) = \text{Exceeded load}_t \,/\, \text{total exceeded load in a year}$$

$$\text{Capacity value}_t\ (\$/\text{kWh}) = \text{PCAF}_t\ (\%) * \text{capacity value}\ (\$/\text{kW-year})$$

This same methodology was applied to allocate the distribution capacity value using a typical 2019 residential distribution load provided by Xcel Energy from the Allison feeder.

3.8 Avoided Emissions

Avoided emissions are calculated based on the difference between electric vehicle emissions from charging load and gasoline or diesel combustion. For CO_2, E3 calculated avoided emissions for ICE vehicles based on 0.0085 metric ton/gallon of gasoline and 0.01098 metric ton/gallon of diesel.[13] Emissions from

[12] The methodology was first developed by PG&E in 1993 (California Public Utilities Commission, 2016) and has since been used in various regulatory reports, for example see (Energy & Environmental Economics, 2012)
[13] Derived from the Argonne GREET Model

electric vehicles are expected to decrease over time following the growth of renewables in Xcel Energy's generation mix. For this study, E3 looked at average hourly electricity emissions provided by Xcel Energy between 2019 and 2042 which decline by almost 70% over the period. To convert avoided emissions to costs, E3 assumed social costs of carbon of 46 $/metric ton.

3.9 Charging Infrastructure

3.9.1 CHARGER NETWORK DENSITY

E3 calculated the required number of EVSE chargers to support the vehicle adoption forecasts using NREL's EVI-Pro Lite model (NREL, 2018). EVI-Pro Lite can provide a state specific estimation of the number of workplace, public and DCFC charging required to meet a given adoption forecast. Note that this model only provides a value for meeting personal LDV adoption, does not account for the impacts of managed charging, and only provides values for a maximum PEV market penetration of 10% of total LDV stock. For buses specifically, E3 assumes a ratio of 1 transit bus per DCFC charger due to limited time available for charging, while school buses share 1 charger for every 2 buses. Under these assumptions, the PEV adoption forecast for the Xcel Energy Colorado territory requires the installation of 224,929 EVSE charging ports by 2030, 89% of which are L2 home chargers. Table 14 provides an overview of the number of EVSE chargers for 2020, 2025 and 2030.

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Table 14. Number of required charging ports in Xcel Energy's Colorado territory

EVSE type	2020	2025	2030
Home L2	13,399	74,638	199,314
Public L2	648	3,619	9,638
Workplace L2	923	5,154	13,727
DCFC	132	650	2,250
Total	**15,101**	**84,061**	**224,929**

3.9.2 CHARGER COSTS

Charging infrastructure costs in this analysis are based on two components: EVSE hardware costs and installation costs ("make-ready" costs). The latter component includes all *behind the meter* costs required to get the charging unit working. We assume that infrastructure costs "in front of meter" are paid for by the utility and therefore included under electricity supply costs.

The costs of charging infrastructure are outlined in Table 15. These costs are based on data provided by the International Council on Clean Transportation, with installation costs of home charging averaged based on the proportion of existing types of homes in Colorado (ICCT, 2019). Installation costs for public, workplace and DCFC 150 kW chargers are based on costs per charger with 2 chargers per site, whereas installation costs for DCFC 20 and 50 kW chargers are based on costs per charger with multiple chargers on site (since these chargers are assumed to be installed at large-scale bus depots).

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Table 15. Charging Infrastructure Costs

	Hardware	Installation	Total
Home L2	$ 742	$ 1,299	$ 2,040
Public L2	$ 3,127	$ 3,020	$ 6,147
Workplace L2	$ 3,127	$ 3,020	$ 6,147
DCFC (20 kW)	$ 11,360	$ 10,786	$ 22,146
DCFC (50 kW)	$ 28,401	$ 26,964	$ 55,365
DCFC (150 kW)	$ 75,000	$ 38,047	$ 113,047

For DCFCs, the Benefit Cost Analysis includes the costs a utility is required to make to upgrade transformer capacity. These costs are utility specific and therefore provided by Xcel Energy for Colorado service territory.

For cases involving managed charging we assume there is an additional upfront cost of $100 per charger for networking and communication between the charger and the utility.

4 Results

The first results section covers the impact of all PEV types combined under their respective base cases and provides some impacts on an annual basis such as energy consumption, ratepayer benefits, and emission savings. Subsequent sections explore each modelling scenario described in section 2.3 in detail. Cost-benefit results in these sections are shown on both a total net present value basis and an average per vehicle adopted basis. The total value results provide an understanding of the total magnitude of the costs and benefits from PEV adoption in the Xcel Energy Colorado service territory but are heavily influenced by the PEV population forecast input. The average per vehicle results are more robust to uncertainty in population forecast and can be useful in PEV program design since an incentive or program cost per-vehicle can be directly compared to the per vehicle net benefit.

4.1 Total Transportation Electrification Results

Overall, the results make a strong positive case for transportation electrification in Xcel Energy's Colorado territory across most vehicles types and from ratepayer, driver, and societal perspectives. This study finds that under the base scenario *ratepayers stand to benefit by nearly $1.07 billion* for PEV adoption between 2020 and 2030 across the four vehicle types studied. *Drivers or fleet owners would benefit by $358 million* in total cost of ownership and *Colorado would benefit by $1.51 billion* in avoided gasoline, reduced O&M and emission reductions. Table 16 summarizes the total Net Present Value (NPV) of all cases. These values represent the total costs and benefits over each vehicles' 12-year lifetime, summed for every vehicle adopted from 2020 to 2030 and discounted using Xcel Energy's weighted average cost of capital.[14]

Table 16. Net Present Value of net benefits for all vehicles adopted between 2020 – 2030 in ($ Million)

Case	RIM	PCT	SCT
Personal LDV - base case	$1,018	$326	$1,426
Commercial LDV	$16	$29	$42
School Buses	$7	($27)	($19)
Transit Buses	$27	$30	$59
Sensitivities			
Personal LDV - managed charging	$1,054	$555	$1,533
Personal LDV - high DCFC	$1,193	$577	$1,571
Personal LDV - 50% socialization	$703	$641	$1,426
Com LDV - expensive public charging rates	$16	($41)	$42

Annual electricity consumption of PEV charging from the four vehicle types studied rises from 172 GWh / year in 2020 (~0.4% of current total energy consumption Xcel Energy's Colorado Territory) to 2,172 GWh / year in 2030 (~5.6% of current total energy consumption), as shown in Figure 5. By 2030 charging load could contribute around 0.55 GW to Xcel Energy's Colorado peak load of 7.6 GW, which is around 7.5% of the peak load. Under the base charging scenario 37% of load occurs between 12pm and 9pm on weekdays and the

[14] Note that the costs and benefit streams that contribute to the NPV values calculated extend out to 2042 since all vehicles adopted in the last year of the study period, 2030, would continue to provide costs and benefits over their full lifetime which is assumed to be 12 years.

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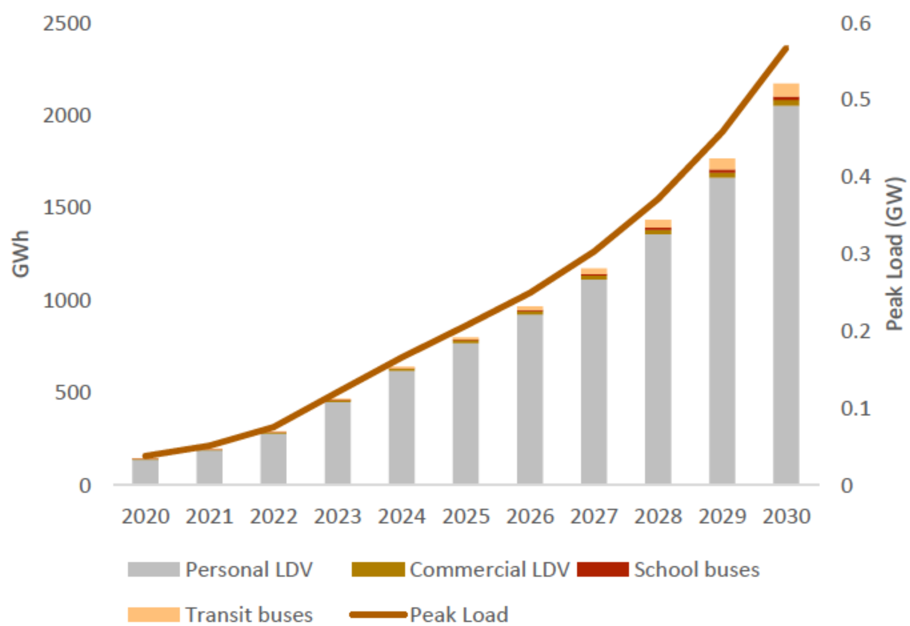
remaining 63% of load is either on weekends or outside of these hours on weekdays where its generally cheaper for Xcel Energy to supply the load.

Figure 5. Annual Load of All Vehicle Types: 2020-2030 (GWh)



As shown in Figure 5, the vast majority of load and consequently the impact, arises from personal LDV vehicles. It should be noted that the load shape and timing of peak load does vary substantially across vehicle type.

The aggregate impact on Xcel Energy ratepayers under the base case scenario is summarized in Figure 6., and shows that by 2030 revenue collected from tariffs is over $257 million or an average of 0.12 $/kWh (in 2030 nominal dollars) which exceeds the total cost to serve PEV charging load at $92 million (0.04 $/kWh). Under all vehicle types and every case explored ratepayers benefited

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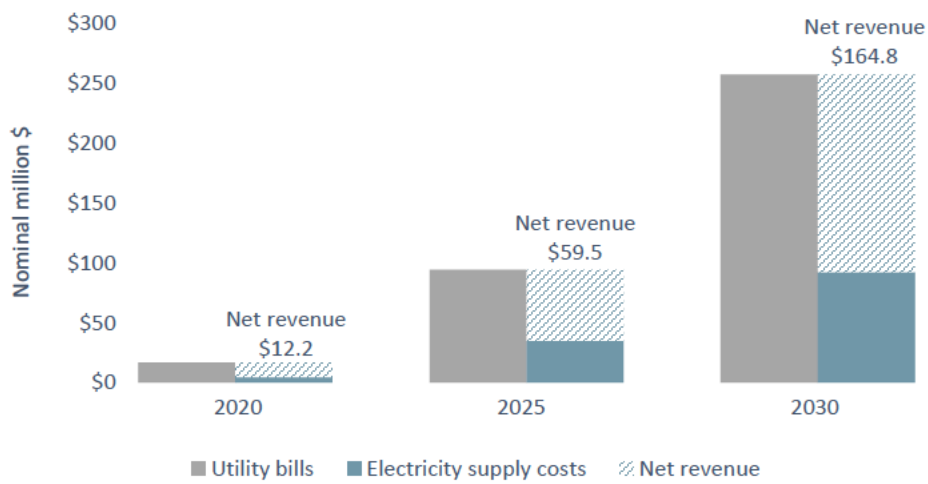
substantially from PEV adoption. Benefits generally scale directly with electricity consumption since bill revenue outweighs supply costs, although tariffs and load shape do play a role as described in subsequent result sections on each case.

Figure 6. Annual utility net revenue from transportation electrification ($ nominal)

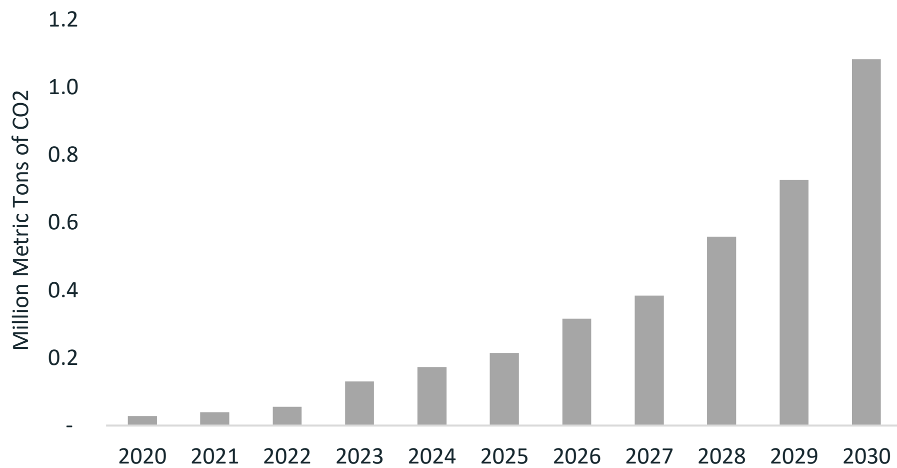


Driver or fleet owner benefits, as reported in the vehicle results sections on a per vehicle basis, show that for nearly all cases PEVs are cheaper in total cost of ownership than ICE vehicles. This is from the cost savings from reduced gasoline or diesel consumption and reduced O&M. These savings are very high and outweigh the higher upfront cost of PEVs, the charger installation costs, battery replacements, and charging costs. Drivers also benefit from tax credits at the federal and state level although these benefits only apply to PEVs adopted prior to 2027.

The societal benefits to Coloradans in Xcel Energy territory amount to nearly $1.51 billion for all PEVs adopted between 2020 and 2030 over each vehicles' lifetime. The benefits from eVMT savings and emission savings far exceed the charging infrastructure, electric supply, and incremental vehicle costs in all but the school bus cases. The vehicle results sections describe nuances between cases in greater detail. Note that the societal cost benefit results presented in this study do not include other indirect benefits such as the energy security value from lower reliance on fossil fuels and financial impact of reduced criteria pollutants (although emission values are reported).

For all vehicle types and scenarios explored in this study, the carbon emissions from electricity generation to meet charging load were lower than the emissions from gasoline or diesel combustion. The total carbon emission reduction impacts of all PEVs adopted between 2020 and 2030 sum to 11.7 MMTons over their lifetime, with annual carbon emissions savings peaking in 2030 at 1.1 MMTons /year. In line with annual energy consumption, personal LDVs make up nearly all the carbon emissions savings at 11.2 MMtons, while commercial LDVs, school buses and transit buses contribute 0.2, 0.1, and 0.2 MMtons respectively. Carbon emission savings vary based on the timing of charging throughout the day as grid emissions fluctuate depending on the marginal generator. Consequently, emission savings vary by vehicle type and whether managed charging occurs which is explored in the vehicle result sections.

Figure 7. Annual avoided CO_2 emissions from all vehicle types



Other pollutants were also included in the analysis, NO_x emissions were found to decrease with PEV adoption by 3,242 metric tons while SO_2 emissions *increase* by 1,151metric tons relative to the adoption of an ICE vehicle. The results show that new efficient ICE vehicles tend to have lower emission intensity for SO_2 than the average emissions from Xcel Energy Colorado's generation fleet. Note that under these emission calculations average emissions were used rather than marginal emissions. The average hourly electric system emission intensity tends to be lower than the emission intensity of the marginal generator and therefore these results may be a slight overestimate of the emission savings from PEVs.

4.2 Personal Light Duty Vehicles

4.2.1 BASE CASE

Personal LDVs are by far the largest contributor to vehicle electrification benefits in Colorado simply because they make up 99% of vehicles adopted over the study horizon. Results show that personal LDVs adopted between 2020 and 2030 could provide $1,018M in NPV of benefit to Xcel Energy's Colorado ratepayers and $1,426M of benefit to Colorado state. The NPV of costs and benefits averaged per vehicle are shown in Figure 8. For drivers, the present value benefits total $1,150 per vehicle over its useful life. For the state of Colorado and for Xcel Energy ratepayers the NPV per vehicle benefits are $5,027 and $3,589, respectively.[15]

[15] As mentioned, the average NPV per vehicle values are calculated by taking the total NPV result for all vehicles adopted between 2020 – 2030 and dividing it by the total number of vehicles adopted during this period.

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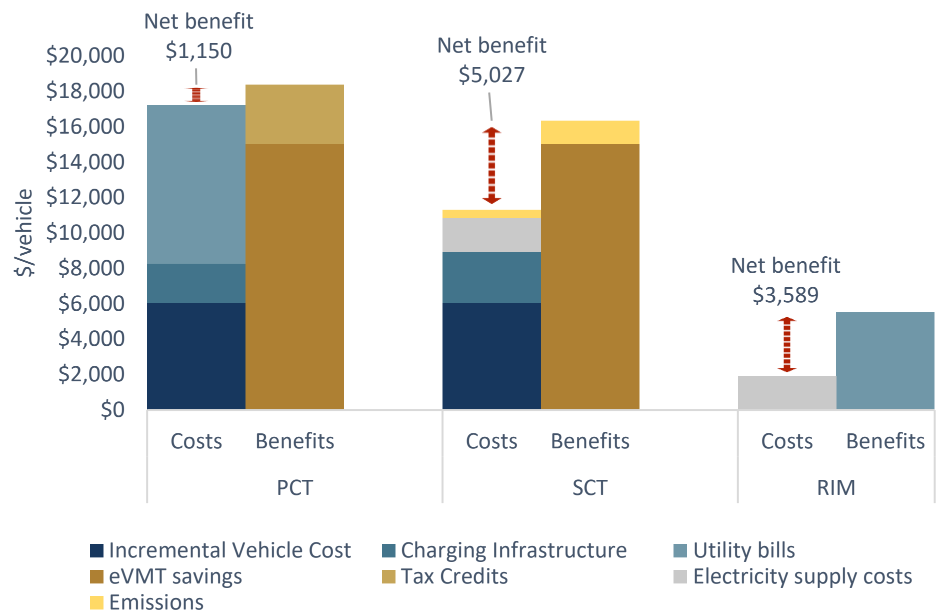
Figure 8. Costs and Benefits of Personal LDV Adoption – Base Case



This study finds that personal LDV drivers in Colorado would benefit from PEV adoption. Since Colorado drivers have a relatively high VMT and the per mile costs for PEVs are lower for than ICE vehicles, drivers would enjoy large cost savings from reduced O&M and gasoline. On average over vehicle lifetimes these benefits along with tax credits outweigh the incremental upfront cost of PEVs over ICE vehicles, the cost of charging infrastructure, and electricity bills.

Ratepayers see large net benefit from PEV adoption as the revenue collected from electricity bills exceeds Xcel Energy's cost to supply the additional load from PEV charging. Marginal energy costs constitute 57% of the total cost to serve PEV charging load, 37% is from increased generation capacity, and 6% from transmission and distribution capacity upgrades.

Colorado state benefits substantially from electrifying personal LDVs given the large eVMT cost savings and low electric supply costs. Lifetime vehicle emission reductions for all vehicles adopted between 2020 – 2030 total 11.2 MMt of CO_2 across Xcel Energy's Colorado territory. In addition, NO_x emissions are reduced by 3,157 metric tons whole SO_2 emissions are *increased* by 1,092 metric tons.

It is important to be aware of uncertainties in these cost-benefit projections. As discussed in the Inputs and Assumptions section, this study is not a detailed feeder by feeder level analysis of the distribution impacts from PEV charging. Our method uses marginal distribution impact costs provided by Xcel Energy and allocated using a single generalized residential feeder load. Higher resolution analysis of distribution grid impacts with greater EV penetrations, EV clustering, and higher powered charging could result in higher utility costs that would reduce ratepayer benefit. Furthermore, Xcel Energy's electric tariffs may evolve substantially over the next decade, which would have strong implications for these results. This analysis assumes tariffs stay constant in real terms but if rates were to shrink, ratepayer benefits could decrease.

4.2.2 MANAGED CHARGING SENSITIVITY

Recall that in this personal LDV sensitivity charging is managed to *minimize utility bills* at residential and workplace locations. The team assumed further charge management is performed by Xcel Energy at residential locations to mitigate 'rebound peaks' that occur when drivers begin charging as soon as the peak period ends causing very large peak loads. This additional charge management is through cascading or staggering the start time of different residential locations over a 45-minute period, and through 'load flattening' where the timing of each drivers' charging is adjusted to flatten peak load as much as possible whilst ensuring the vehicle is sufficiently charged before departure. Figure 9. shows the original base case load where charging is uncontrolled or unmanaged, Figure 10. shows the new managed load assuming 100% of drivers in Xcel Energy Colorado territory have their charging managed.

Figure 9. Base Case Personal LDV Charging Load in 2030 – Summer Week

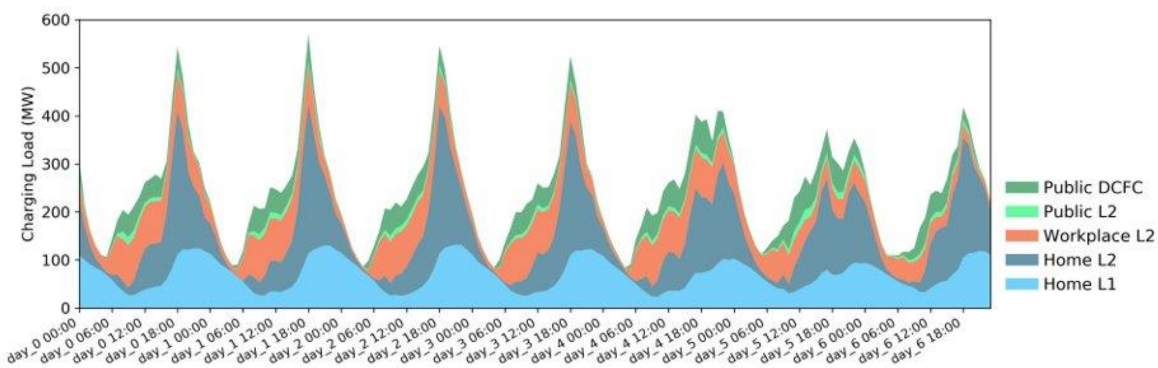
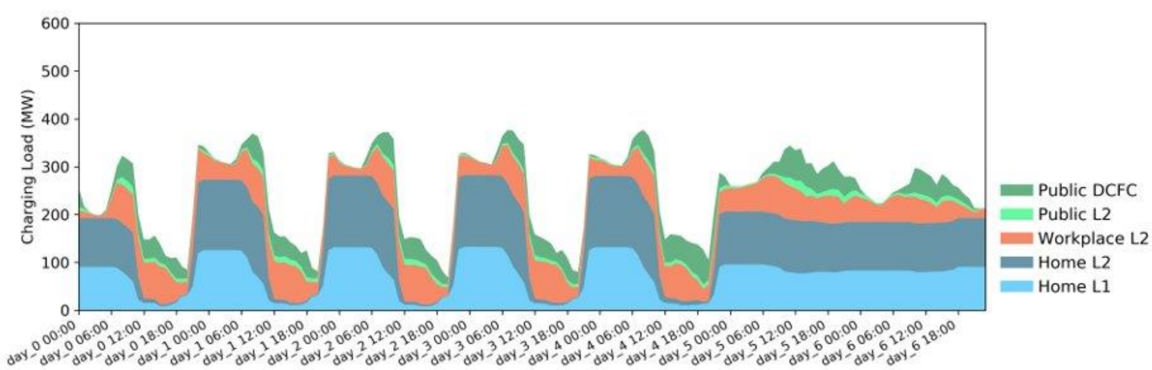


Figure 10. Managed Personal LDV Charging Load in 2030 – Summer Week

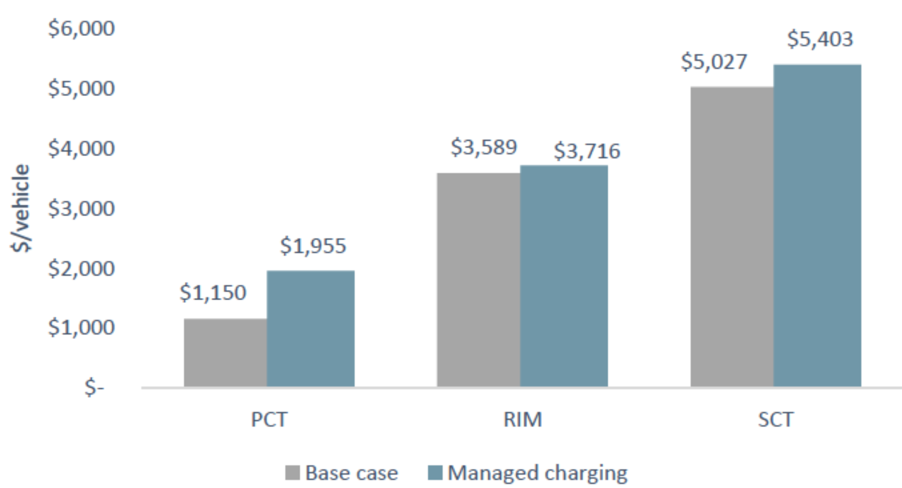


The objective of managed charging in this scenario is to minimize customers' bills, not to reduce system costs, hence charging during TOU peak periods for residential and workplace locations is drastically reduced. Peak load management enables a reduction in peak charging load from 536 MW to 377 MW in 2030.

Under this scenario net benefits for drivers increase across all costs tests with benefits increasing 70% for drivers, 5% for ratepayers, and 8% for Colorado (Figure 11.). Managed charging also increases total avoided CO_2 emissions by 100,000 metric tons over the vehicle lifetime of all PEV's adopted between 2020 – 2030.

Since the objective of managed charging in this scenario is to minimize customer bills, there is a large reduction in utility revenue. However, this is narrowly outweighed by a reduction in supply costs leading to a ratepayer benefit of $127 per vehicle over its lifetime or $36M if every PEV adopted was managed between 2020 – 2030.

Figure 11. Net Benefit Comparison of Personal LDV Base Case vs. Managed Charging



In this managed charging scenario the $100 upfront cost to ensure chargers have network communication is easily offset by annual electric bill savings resulting in a net gain of $805 per vehicle from managed charging for each driver over the 12-year vehicle lifetime. Drivers are assumed to be much more price sensitive and therefore shift slightly more charging from public to work and home where they can enjoy cheap off-peak charging rates. Recall that drivers in this scenario pay the typical price for public charging which is much higher than the revenue collected by Xcel Energy through the S-EV tariff. Therefore, changes in the amount of public charging result in a much greater reduction in driver charging costs than reduction in utility bill revenue.

It is important to highlight that these results are sensitive to the price signal used to manage charging. If charging were instead managed to minimize electric supply costs it is likely that the ratepayer benefit would be much greater but at the expense of drivers who would not receive as large bill savings. It should also be noted that for this case the team assumed no change in adoption despite the reduction in total cost of ownership for PEVs. There is likely to be slightly increased adoption due to price elasticity effects, but these are not modelled here.

4.2.3 HIGH DCFC SENSITIVITY

The High DCFC sensitivity explores a scenario where the number of DCFC's deployed in Colorado doubles to 2,875 across Xcel Energy's Colorado territory by 2030 versus the base scenario of 1,437. The primary benefit of having a denser network of public fast charger stations is greater adoption of PEVs through a reduction in range anxiety and increased consumer awareness, often referred to

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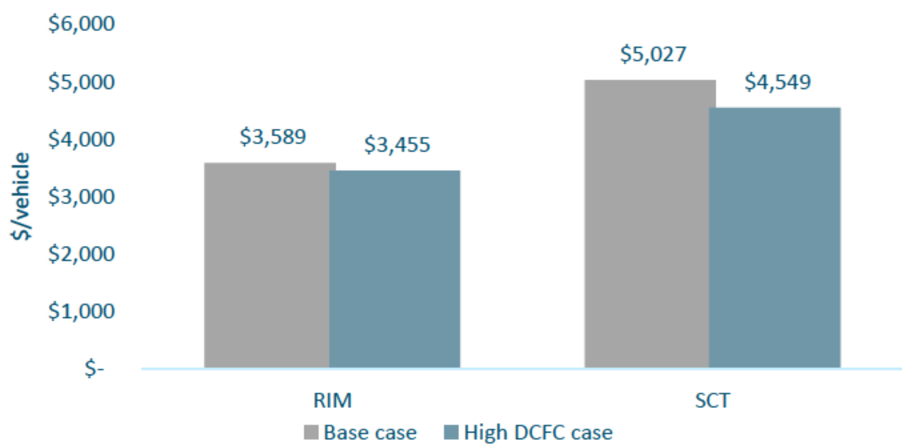
in economic literature as indirect network effects.[16] Based on a survey of the literature the team assumed that increasing DCFC deployment by 100% causes an increase in PEV adoption of 20% but that VMT for each vehicle remained the same as the base case. It should be stressed that the impact of denser DCFC networks on PEV adoption and driving behavior is highly uncertain, as is discussed later in this section.

Figure 12. Net Benefit Comparison of Personal LDV Base Case vs. High DCFC Case



Since more vehicles are adopted in this scenario and ratepayers benefit by around $3,500 for each vehicle, the total ratepayer benefits over the vehicle lifetime increases by 17% to $1,193 million for all vehicles adopted between 2020 – 2030. The ratepayer benefit on a per vehicle basis decreases slightly because the additional DCFC charging increases energy supply cost by 21% due to the higher peaking load shape (lower load factor) but only increases utility revenue by 18%.

[16] For a detailed review of evidence for network effects see (Li, et al., 2016; Sierzchula, et al., 2014; Slowik & Lutsey, 2017) for an example of network effect theory being used to inform a transportation electrification plan see (PGE, 2017)

Colorado state also sees an overall rise in net-benefits of 10% but a lower per vehicle value due to the infrastructure costs of building additional DCFC's. Driver benefits remain relatively unchanged under this scenario.

It is important to emphasize that while total ratepayer benefits from this scenario appear high there is great uncertainty around indirect network effects and the causal effect of DCFC deployment on PEV adoption. This sensitivity is intended as a high-level analysis for one scenario and it is far from guaranteed that heavy investment in DCFC infrastructure will yield a 20% lift in adoption through 2030. Indirect network effect studies rely on empirical data and therefore are based on today's PEV market conditions rather than a future market. Studies show that the size of the effect depends strongly on a host of factors such as PEV range, home and workplace charging access, socio economics, geography, and others, many of which are rapidly evolving. Therefore, it is highly likely indirect network effects will vary over time and may well diminish. To get a fuller understanding of how the DCFC deployment could impact PEV sales further study on this subject that is specific to Colorado would be required.

4.2.4 SOCIALIZING CHARGING INFRASTRUCTURE COSTS

This scenario explored the impacts of splitting half of all residential charging infrastructure costs on the customer side of the meter between drivers and Xcel Energy. For simplicity, the team did not explore the elasticity of demand for PEVs from altering the cost of charging infrastructure for those drivers that have access to charging at home. Therefore, it was assumed that PEV adoption in this scenario is the same as the base case.

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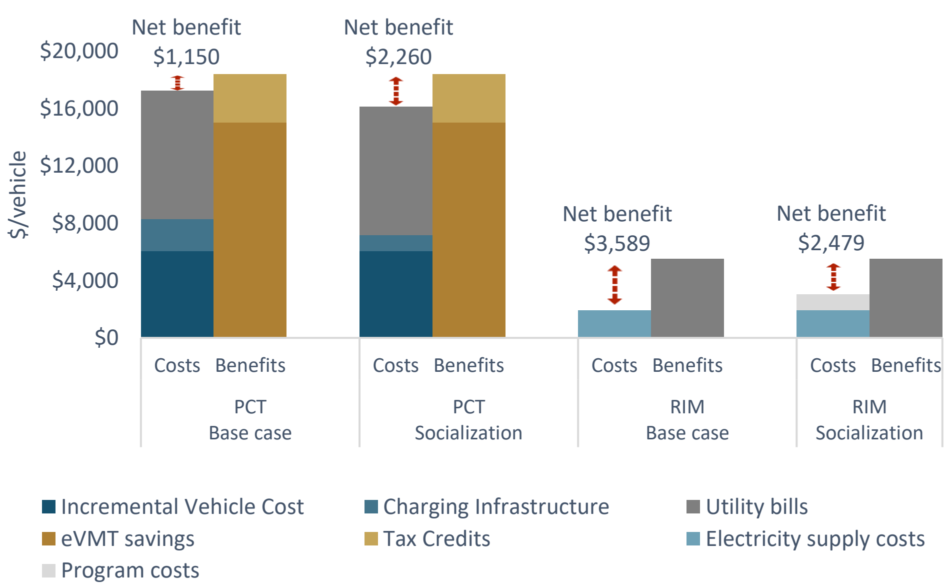
Residential charger infrastructure costs total $630 Million for all PEVs adopted between 2020 – 2030. Sharing this cost between drivers with residential charging and Xcel Energy results in ratepayers still seeing net present benefits of $703 Million for all PEVs adopted between the 2020 – 2030 over the vehicle lifetime. Adding $315 Million in charger infrastructure increases costs by 58% but overall revenue from electricity consumption of around 54.6 MWh over each vehicle's 12-year lifetime still leads to net benefits for ratepayers. Drivers see average lifetime net benefits nearly double to $2,260 per driver or $641 million across Xcel Energy's Colorado territory over the 2020 – 2030 period. There is no impact on net benefits to Colorado state since costs are only reallocated from participants to ratepayers in this case.

Figure 13. per vehicle results for the socialized program cost sensitivity



As with the managed charging sensitivity, for simplicity, this case assumed no change in adoption relative to the base case. It is likely that reducing upfront costs for drivers would result in higher PEV adoption due to price elasticity effects. Increased adoption would result in greater benefits to Colorado compared to the base case. It would also narrow the gap between the $1,018 million of ratepayer benefit seen in the base case and the $703 million of ratepayer benefit in this case. However modelling price elasticity effects in detail is beyond the scope of this study.

4.3 Commercial Light Duty Vehicles

4.3.1 BASE CASE

The objective of the commercial LDV case was to calculate net benefits arising from electrification of rideshare drivers such as Uber or Lyft. Rideshare drivers do significantly more mileage (nearly 60,000 miles annually) and around 40% have access to charging at home with the remainder rely purely on public charging infrastructure. Results shows that electrifying rideshare vehicles could benefit ratepayers by over $13,000 per vehicle over its lifetime or $16 million for all rideshare PEVs adopted between 2020 – 2030. Since rideshare drivers do over four times as much driving annually than personal LDVs, ratepayer benefits scale similarly as revenue from electricity bills exceeds supply costs. Colorado state also benefits substantially from rideshare electrification with each PEV providing an average of $34,908 over its lifetime or $42.4 million across all vehicles adopted between 2020 – 2030 in Xcel Energy territory. The high mileage leads to very large avoided maintenance and gasoline savings as well as a net reduction in carbon emissions that are well beyond the incremental upfront cost of PEVs and extra PEV battery replacements due to the high mileage.

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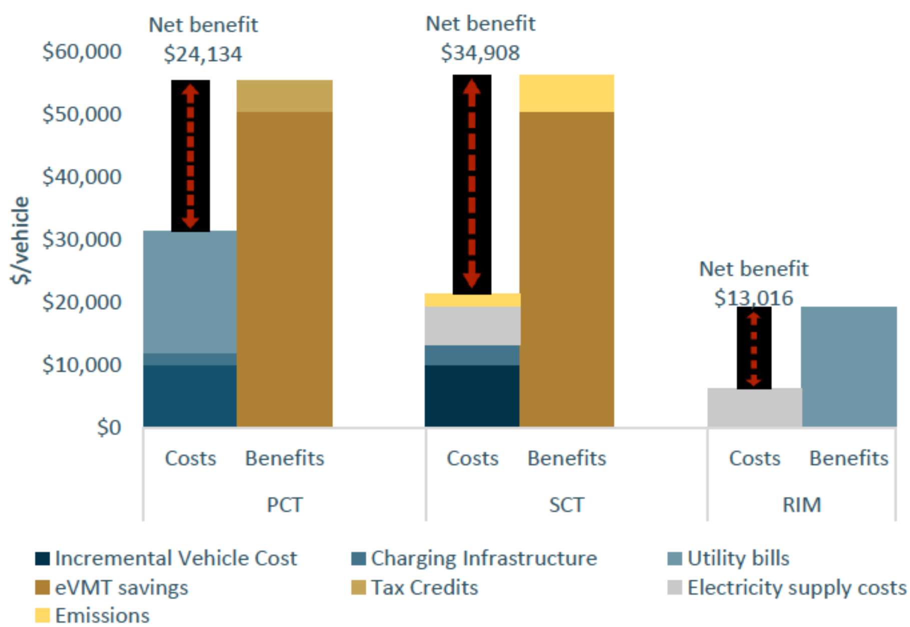
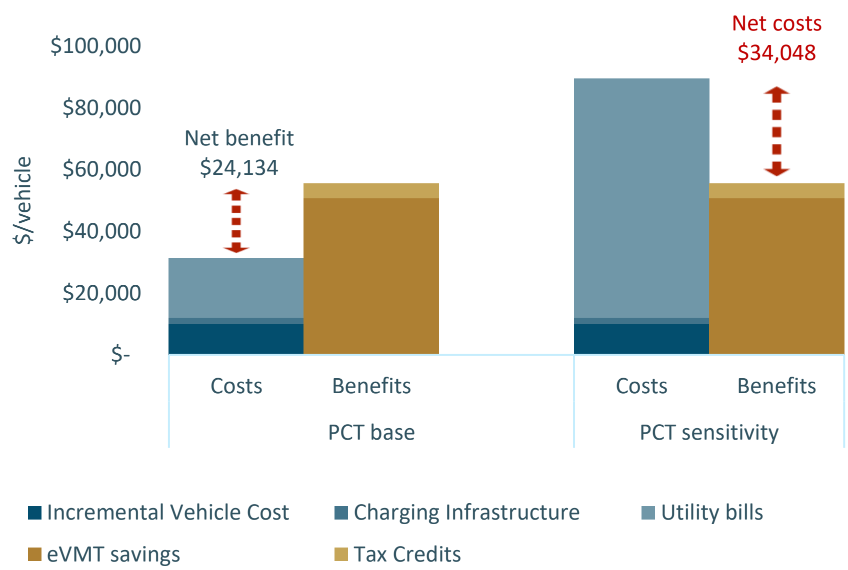
Figure 14. Costs and Benefits of Commercial LDV Adoption



4.3.2 EXPENSIVE PUBLIC CHARGING RATES

Rideshare drivers could see vehicle lifetime net benefits as high as around $24,000 per vehicle due to the large eVMT savings of around $50,000 from their very high mileage. However, this result assumes that drivers pay the Xcel Energy S-EV tariff when charging in public. If rideshare drivers were to pay a typical rate for public charging today it would be far more expensive on average to adopt a PEV than an ICE vehicle and *cost* rideshare drivers around $34,000 per vehicle. The dramatic fluctuation stems from the high VMT resulting in heavy reliance on fast charging which accounts for around 65% of all energy consumed and because of the wide variation in charging cost between the S-EV tariff (0.06 ~ 0.18 $/kWh) and the typical cost for DCFC charging today (~0.54 $/kWh). If DCFC charging sessions are paid at the S-EV tariff rate then over the vehicle lifetime drivers would pay around $26,000 for the electricity charged, if these sessions were paid at today's DCFC charging rates then lifetime charging costs jump to $77,000 per vehicle. Note that these two scenarios only affect the PCT since Xcel Energy will always collect revenue at the utility tariff rate (S-EV).

Figure 15. Comparing driver costs and benefits of the base commercial LDV case against the commercial LDV public charging rate sensitivity



Pubic charging costs for commercial PEV drivers may be lower than the rates paid by personal LDV drivers today. Rideshare companies may secure better deals for these drivers or full utility ownership of some DCFCs could enable public charging prices much closer to utility tariffs. Given this speculation, the team chose to present these two bookend cases and with the more economically favorable assumption as the base case since it better aligns with the adoption forecast anticipated for these vehicles.

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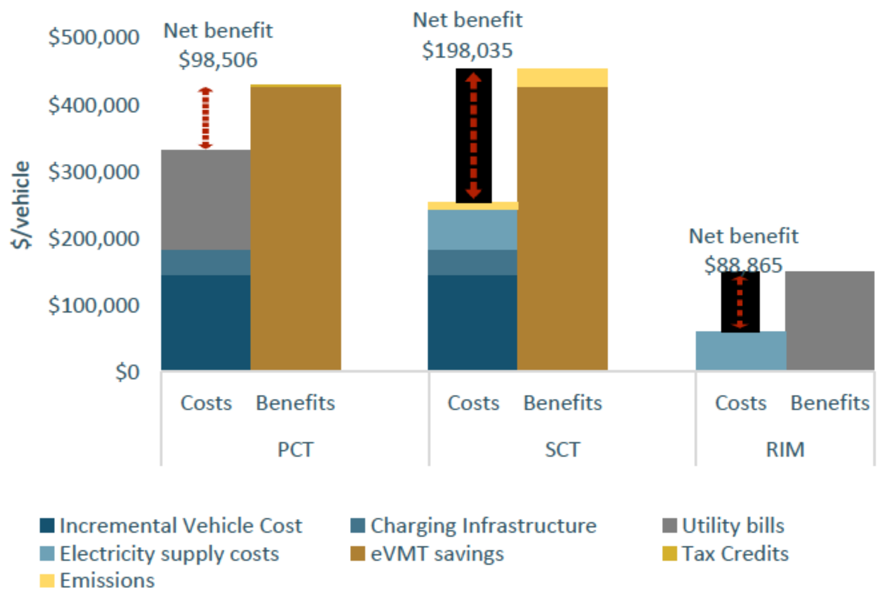
To ensure rideshare electrification is economically favorable for drivers one alternative to lowering the cost of public charging is to increase residential charging access. Since residential charging costs, particularly during off-peak periods, are significantly lower than today's public charging prices, the economics for drivers that have access to charging at home is considerably more favorable than those who depend entirely on public charging. Rideshare drivers generally have lower incomes and are more likely to live in multi-unit dwellings compared to the average personal light duty PEV driver (Colorado PUC, 2019). Therefore, increasing the number of chargers at multi-unit dwellings might also be an effective way to lower charging costs for rideshare drivers and make PEVs more attractive.

It should also be noted that these calculations do not factor in the opportunity cost of charging during shift hours which could also impact the economics of rideshare electrification. Average earnings for taxi drivers in Boulder are roughly $15.7 per hour, presenting a high opportunity cost of charging during shift hours especially at slower level 2 charging rates where charging sessions are often multiple hours (Henao, 2017). Moving more charging outside of rideshare drivers' shift hours such as overnight at home is therefore likely to be even more economically favorable.

4.4 Transit Buses

To analyze the electrification of transit buses in Xcel Energy Colorado territory the team assumed buses are only charged at their depot locations, where they would always be parked if not on shift. Transit buses have demanding schedules with high mileage and little downtime and therefore need lots of fast charging infrastructure to ensure batteries can adequately be replenished between shifts. Only daily bus schedules that cover fewer miles than the effective range of the electric transit bus were electrified in the analysis, leading to a lower annual VMT of 42,500 miles compared to the Colorado average of 51,000 miles. Charging was assumed to be managed to mitigate large demand charges under the S-EV rate from fast charging.

Figure 16. Per vehicle costs and benefits for transit buses in Xcel Energy Colorado territory



Electric transit buses provide significant net benefit for Xcel Energy ratepayers, transit fleet operators, and Colorado. Ratepayer net benefits of approximately $27 million could be obtained by 2042 for all buses adopted between 2020 – 2030 or an average of nearly $90,000 per bus. With charge management to reduce peak loads, the cost of suppling the new charging load is offset by the revenue collected under the S-EV tariff.

Transit agencies or transit bus fleet owners would see net benefits of $98,506 per bus on average over the vehicles' 12-year lifetime. Despite the higher up-front cost of electric buses compared to diesel, the cost of installing 1 DCFC per bus, and the cost of battery replacements every 200,000 miles, these costs are still outweighed by the diesel and O&M costs for ICE buses as a result of high annual mileage, resulting in net benefits for transit agencies.

The significant O&M and diesel savings along with the net emissions benefit far exceed the incremental vehicle cost, charger costs and battery replacement costs leading to a societal benefit of $59 million for the Colorado population in Xcel Energy territory for all buses adopted between 2020 – 2030 over their lifetime. In addition, a net emissions reduction of approximately 0.21 million metric tons of CO_2 is achieved by 2042 for all vehicles adopted between 2020 – 2030.

It should be noted that transit bus schedules do vary significantly regionally and this study utilized NREL's fleetDNA database rather than Colorado specific transit agency bus block schedules (NREL, 2019). Results with Colorado specific bus data are likely to alter the results. Furthermore, the makeup of the current Colorado bus fleet was unknown so it was assumed the default ICE bus use diesel fuel. However, CNG buses have lower fuel costs and therefore could alter the results substantially if used for comparison.

4.5 School Buses

School buses were modelled similarly to transit buses with charging only occurring at depot locations where they were assumed to always be parked when not driving. School buses cover less mileage than transit buses and have longer

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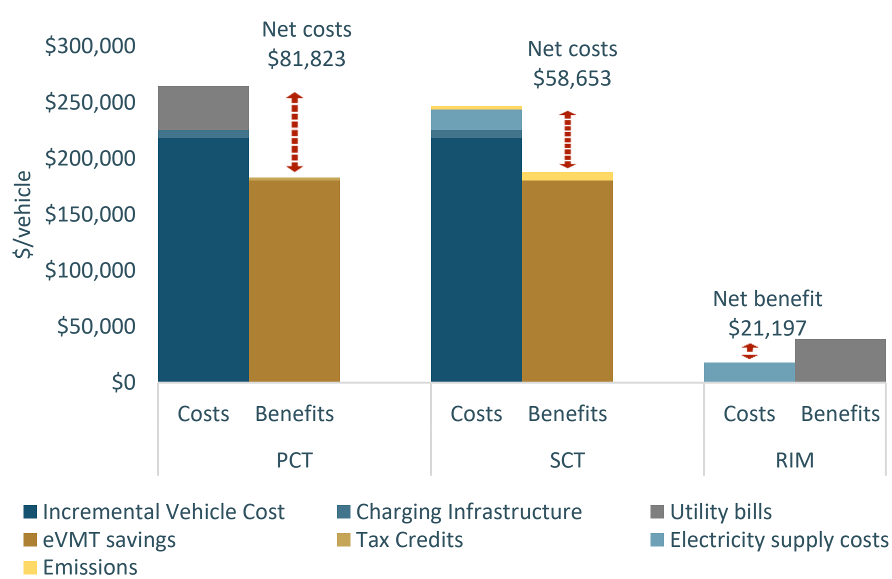
overnight parked periods but have narrow midday windows for charging between school drop-offs. The team assumed that the buses were only operated during school semesters and only 10% of buses were used on weekends for extracurricular activities. Like transit buses it was assumed that charging was managed to mitigate large demand charges under the S-EV rate.

Unlike transit buses, school buses are not cost effective for bus fleet owners or for Colorado state but are still beneficial to ratepayers. For reasons very similar to transit buses, net benefit of school bus electrification is high, around $7.0 million for all buses adopted between 2020 – 2030 or an average of $21,197 per bus over its lifetime.

Figure 17. Per vehicle costs and benefits for school buses in Xcel Energy Colorado territory



Based on current cost data the incremental upfront cost of an electric school bus over an ICE school bus is far higher than the difference for transit buses and due to the lower VMT (12,792 miles annually on average), these upfront costs cannot be recovered by savings in avoided diesel and O&M. Results show that adopting an electric bus would cost fleet owners on average nearly $82,000 over the vehicle lifetime while societal impacts for the Xcel Energy territory population in Colorado would be around $19 million for vehicles adopted between 2020 – 2030.

School buses have long periods of downtime throughout the year in which additional use could allow them to recover the high upfront costs. One potential future avenue that has been explored through various pilot programs across the US is vehicle-to-grid technology. Either to reduce onsite electric bills, participate in demand response, or potentially participate in ISO markets through energy, or ancillary service products. Pursuing these additional sources of revenue during weekends and holidays throughout the year could start to close the gap and make school buses more attractive for fleet owners.

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5 References

Anon., 2018. *Senator Nancy Skinner.* [Online]
Available at: https://sd09.senate.ca.gov/news/20180531-california-senate-passes-senator-skinner%E2%80%99s-electrify-california-ride-hailing-e-car
[Accessed 14 April 2020].

Auto Alliance, 2020. *Autos Drive Colorado Forward.* [Online]
Available at: https://autoalliance.org/in-your-state/CO
[Accessed 16 March 2020].

Blink, 2020. *EV Charging Fees.* [Online]
Available at: https://www.blinkcharging.com/ev-charging-fee
[Accessed 17 March 2020].

BNEF, 2018. *Electric Buses in Cities - Driving Towards Cleaner Air and Lower CO2,* s.l.: s.n.

BNEF, 2019. *Elevtric Vehicle Outlook 2019.* [Online]
Available at: https://about.bnef.com/electric-vehicle-outlook/
[Accessed 17 March 2020].

Bureau of Transportation Statistics, 2018. *National Transportation Statistics 2017,* Washington, DC: U.S. Department of Transportation .

EXHIBIT A

California Public Utilities Commission, 2016. *Pacific Gas and Electric Company 2017 General Rate Case Phase II Updated and Ammended Prepared Testimony Exhibit (PG&E-9) Volume 1 Marginal Costs,* San Francisco: CPUC.

CDOR, 2020. *Income 69: Innovative Motor Vehicle and Truck Credits for Electric and Plug-in Hybrid Electric Vehicles,* s.l.: Colorado Department of Revenue.

City of Chicago, 2020. *Chicago Data Portal.* [Online]
Available at: https://data.cityofchicago.org/Transportation/Taxi-Trips/wrvz-psew
[Accessed 1 April 2020].

Colorado Energy Office, 2020. *Colorado EV Plan 2020.* [Online]
Available at: https://energyoffice.colorado.gov/zero-emission-vehicles/colorado-ev-plan-2020
[Accessed 4 May 2020].

Colorado PUC, 2019. *Colorado PUC Electric Vehicle Working Group Report,* s.l.: Colorado Public Utilities Commission.

Energy & Environmental Economics, 2012. *Technical Potential for Local Distributed Photovoltaics in California,* San Francisco: Energy & Environmental Economics.

Eudy, L. & Jeffers, M., 2018. *Zero-Emission Bus Evaluation Results: County Connection Battery Electric Buses,* Golden, CO: NREL.

Federal Highway Administration, 2017. *2017 National Household Travel Survey,* Washington, DC: U.S. Department of Transportation.

Federal Transit Administration, 2019. *2018 National Transit Database,* Washington, DC: U.S. Department of Transportation.

FHWA, 2019. *FHWA Forecasts of Vehicle Miles Traveled (VMT): Spring 2019,* s.l.: Federal Highway Administration.

Frontier Group, US Pirg Education Fund, 2019. Electric Buses in America, Lessons from Cities Pioneering Clean Transportation.

Henao, A., 2017. *Impacts of Ridesourcing - Lyft and Uber - on Transportation Including VMT, Mode Replacement, Parking, and Travel Behavior,* Denver: University of Colorado.

ICCT, 2019. *Estimating electric vehicle charging infrastructure costs across major U.S. metropolitan areas,* s.l.: Working Paper 2019-4.

ICCT, 2019. *Update on electric vehicle costs in the United States through 2030,* s.l.: s.n.

Internal Revenue Services, 2020. *Plug-in Electric Drive Vehicle Credit at a Glance.* [Online]
Available at: https://www.irs.gov/credits-deductions/individuals/plug-in-electric-

drive-vehicle-credit-section-30d
[Accessed April 2020].

Kontou, E., Melaina, M. & Brooker, A., 2018. *Light-Duty Vehicle Attribute Projections (Years 2015-2030),* Sacramento: California Energy Commission.

Li, S., Tong, L., Xing, J. & Zhou, Y., 2016. The Market for Electric Vehicles: Indirect Network Effects and Policy Impacts. *The Association of Environmental and Resource Economists,* 4(1).

Nicholas, M. A. & Tal, G., 2017. *Survey and Data Observation on Consumer Motivations to DC Fast Charge ,* Davis: University of California, Davis.

Noel, L. & McCormack, R., 2014. A cost benefit analysis of a V2G-capable electric school bus compared to a traditional diesel school bus. *Applied Energy,* Volume 126, pp. 246-265.

NREL, 2018. *CEC EV Infrastructure Projection Tool (EVI-Pro),* s.l.: s.n.

NREL, 2018. *Light-Duty Vehicle Attribute Projections (2015-2030),* s.l.: s.n.

NREL, 2019. *Fleet DNA Project Data.* [Online]
Available at: www.nrel.gov/fleetdna
[Accessed 7 March March].

EXHIBIT A

Paul, J. & Chuang, T., 2019. *The Colorado Sun.* [Online]
Available at: https://coloradosun.com/2019/11/14/kia-niro-lyft-colorado-fleet/
[Accessed 10 April 2020].

PGE, 2017. *Transportation Electrification Plan,* Portland: s.n.

Public Utility Commission of Colorado , 2019. *Direct Testimony and Attachements of Steven W. Wishart on Behalf of Public Service Company of Colorado.* Denver, Public Utility Commission of Colorado .

Sierzchula, W., Bakker, S., Maat, K. & Wee, B. v., 2014. The influence of financial incentives and other socio-economic factors on electric vehicle adoption. *Energy Policy,* Volume 68, pp. 183-194.

Slowik, P. & Lutsey, N., 2017. *Expanding the electric vehicle market in US cities,* s.l.: ICCT.

Svitak, T., Salisbury, M. & Toor, W., 2017. *Opportunities for Vehicle Electrification in the Denver Metro area and Across Colorado,* City & County of Denver: City & County of Denver, Department of Environmental Health.

U.S. Bureau of Labor Statistics, 2018. *Occupational Employment Statistics.* [Online]
Available at: https://www.bls.gov/oes/2018/may/oes533041.htm
[Accessed 11 April 2020].

U.S. Census Bureau, 2016. *American Community Survey,* s.l.: s.n.

U.S. Department of Energy, 2020. *Alternative Fuels Data Center: Colorado Laws and Incentives.* [Online]
Available at: https://afdc.energy.gov/laws/all?state=CO
[Accessed 30 April 2020].

U.S. Department of Energy, 2020. *Average Annual Vehicle Miles Traveled by Major Vehicle Category.* [Online]
Available at: https://afdc.energy.gov/data/widgets/10309
[Accessed 16 March 2020].

U.S. Department of Energy, 2020. *Fuel Economy in Cold Weather.* [Online]
Available at: https://www.fueleconomy.gov/feg/coldweather.shtml
[Accessed 16 March 2020].

U.S. Energy Information Administration, 2020. *Annual Energy Outlook 2020,* Washington, DC: U.S. Department of Energy.

U.S. Energy Information Administration, 2020. *Short-Term Energy Outlook.* [Online]
Available at: https://www.eia.gov/outlooks/steo/
[Accessed 8 May 2020].

US DOT Volpe Center, 2019. *Bus Lifecycle Cost Model for Federal Land Management Agencies User's Guide,* s.l.: Department of the Interior.

EXHIBIT A

VEIC, 2020. *Electric School Buses Available for Purchase.* [Online]
Available at: https://www.veic.org/Media/success-stories/types-of-electric-school-buses.pdf
[Accessed 17 March 2020].

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Benefit-Cost Analysis of Transportation Electrification in the Xcel Energy New Mexico Service Territory

June 2020

Energy+Environmental Economics

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Energy and Environmental Economics, Inc.
44 Montgomery Street, Suite 1500
San Francisco, CA 94104
415.391.5100
www.ethree.com

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1 Study Aims

This study aims to support Xcel Energy, policymakers, and other stakeholders in understanding:

+ the costs and benefits of plug-in electric vehicle (PEV) adoption, from a ratepayer, driver, and broader societal perspective,
+ potential carbon dioxide reductions from electrified transportation, and
+ potential impacts of electric vehicles on utility planning, specifically electricity consumption and planning loads.

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2 Methodology

2.1 Benefit-Cost Overview

To perform a Benefit-Cost Analysis (BCA) of transportation electrification in Xcel Energy's New Mexico service territory, E3 compared the costs and benefits accrued over the lifetime of each PEV adopted against an equivalent Internal Combustion Engine (ICE) vehicle. Whether a particular value stream is a cost or a benefit depends on the perspective taken. E3 performed BCAs from the perspective of EV owners (drivers), other utility customers, and New Mexico as a whole. Each perspective offers distinct insights that help describe the overall impact of EV adoption in Xcel Energy's New Mexico service territory and inform development of policy and programs. The three perspectives are as follows:

+ Participant Cost Test (PCT): the costs and benefits to the vehicle driver or fleet owner in the case of buses – is the total cost of ownership higher or lower for the driver?
+ Societal Cost Test (SCT): the costs and benefits to New Mexico State – do EVs provide net benefits for the state?
+ Ratepayer Impact Measure (RIM): the costs and benefits to all Xcel Energy New Mexico ratepayers – will average utility rates increase or decrease?

Table 1 provides an overview of the various costs and benefits analyzed under each perspective:

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Table 1. Cost and benefits associated with each cost test perspective

Cost/Benefit Component	PCT	SCT	RIM
Incremental EV cost	Cost	Cost	
Federal EV tax credit	Benefit		
EV O&M savings	Benefit	Benefit	
Fuel savings	Benefit	Benefit	
Electricity Supply Costs for EV charging		Cost	Cost
Charging infrastructure cost	Cost	Cost	
Electricity Bill for EV charging	Cost		Benefit
Emission savings		Benefit	

2.2 Modelling methodology

E3's EVGrid model performs BCAs from each of the perspectives described above and uses various input streams that are described in detail in the Inputs and Assumptions section. The model calculates the net present value of EV adoption relative to gasoline vehicles across a region of interest. Accurate forecasting of electricity supply costs and electricity bills depends strongly on the hourly load shape from PEV charging. Charging load shapes in turn vary substantially across the driver population and depend on several factors such as vehicle type, charging access, cost of charging and many others.

To model charging behavior E3 has developed a bottom-up modelling approach that simulates driving and charging of thousands of PEV drivers. Driving behavior is captured using travel survey data and converted to 15-minute driving patterns though a Markov-Chain Monte Carlo method. The driving population is characterized by drivers' access to charging and the type of EV they drive. For

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personal Light-Duty Vehicle (LDV) cases there are 4 PEV types and 6 charging access types, resulting in 24 combinations or customer types. Potential charging locations are categorized into residential, workplace, and public areas and drivers choose where and when to charge by minimizing their charging cost through linear optimization subject to various constraints. This generates a normalized load shape for each customer type which is then weighted by the percentage of drivers that represent the customer type. The final load shape therefore captures the diversity of driving behavior, charging access, and PEV adoption across the driving population.

In addition, charging sessions can then be further managed to minimize peak loads or demand charges at each location through a heuristic cost minimizing method. This modelling framework enables PEV charging load shapes to be generated under various scenarios for Vehicle-Grid Integration (VGI), charging infrastructure deployment, and adoption scenarios. PEV charging load shapes that are output from EVGrid's load shape module have been benchmarked and calibrated using real Original Equipment Manufacturer (OEM) charging session data.

This study calculates the lifetime costs and benefits for every PEV adopted between 2020 – 2030. Only personal LDVs were modelled in this study but this encompasses a majority of future PEV adoption in Xcel Energy's New Mexico territory. The personal LDV case calculates the costs and benefits arising from personal light duty PEV drivers. We simulate four different PEV types and assume charging is unmanaged or uncontrolled. Drivers are still sensitive to the average cost of charging in each location and choose where to charge based on this cost, but when they arrive at a location that they plan to charge in they immediately plug-in and the vehicle is charged at the maximum rate until the battery is full or the vehicle leaves the charging premises.

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3 Inputs and Assumptions

3.1 Driving and Charging Behavior

To simulate PEV driving and charging behavior the team utilized thousands of vehicle trips from detailed trip datasets. For the personal LDV case, trip data was extracted from the 2017 National Household Travel Survey (NHTS) (Federal Highway Administration, 2017). The dataset was cleaned, filtered for the specific vehicle of interest, and where possible filtered for trips in the New Mexico region. The origin and destination locations were categorized and the mileage was adjusted slightly to align with New Mexico specific annual VMT which was calculated to be 12,938 miles per year.[1]

A random sample of trips is then drawn from the dataset covering 500 driver days to construct driving profiles through a Markov-Chain Monte Carlo approach. An example weekly driving pattern for a group of drivers is shown in Figure 1.

[1] New Mexico personal LDV mileage from the Federal Highway Administration Highway Statistics 2018 ((Federal Highway Administration, 2018)

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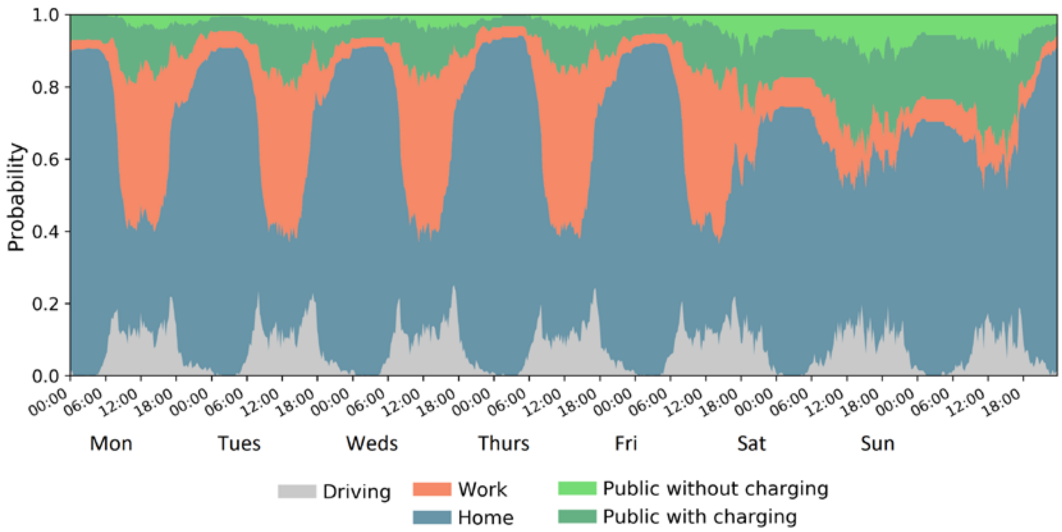
Figure 1. A weekly driving profile generated for personal LDV drivers using 2017 NHTS data and the Markov Chain methodology



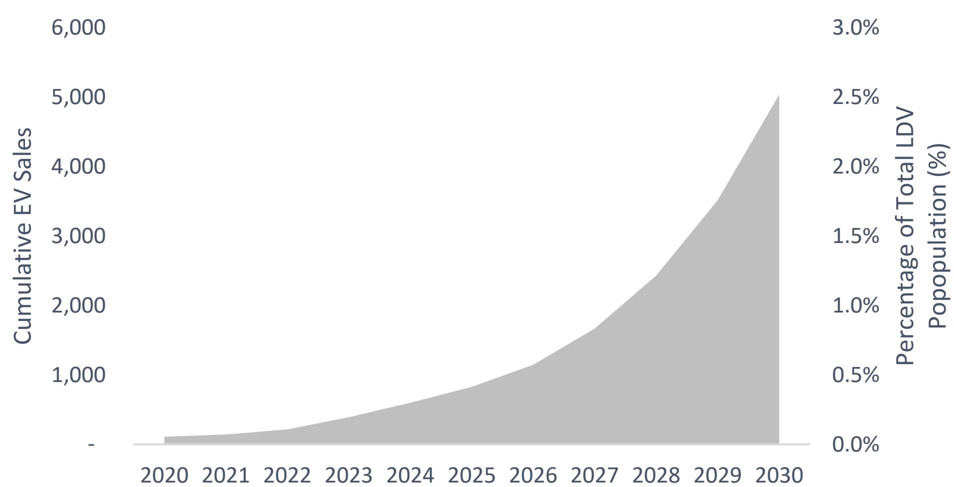
Drivers who had travel days that could not be completed using the EV and charging access options assigned to them were deemed to have 'unserved driving energy' and were dropped from the sample to generate the final aggregated charging loads. This implies that drivers with driving patterns where they cannot complete their travel day with the EV and charging access they were assigned would not purchase this EV type and would not therefore contribute to the final load. A minimum dwell time of 15 mins was set for charging, if the driver was parked at a destination for less time than this time, no charging was assumed to occur.

Due to the computational intensity of simulating driving and charging behavior only a winter and summer week in 2025 was simulated, the resulting load shapes were scaled based on PEV adoption and interpolated for adoption forecast between 2020 – 2030.

3.2 EV Adoption

EV adoption assumptions in this analysis are based on forecasts by Xcel Energy's EV strategy team for Southwestern Public Service Company's (SPS) New Mexico service territory. Personal LDVs are expected to grow cumulatively to 5,035 vehicles in Xcel Energy's territory in 2030, 2.4% of the total LDVs population. The total market for LDVs is expected to grow 1% per year, according to Xcel Energy's total LDVs forecast. In 2020, there are around 193,106 LDVs, including PEV and ICE vehicles, in Xcel Energy SPS's territory.

Figure 2. Overview of EV adoption for personal LDV



3.2.1 CHARGING ACCESS

To model charging behavior the driving population is segmented by where they have access to charging and by PEV type. For personal LDV cases six charging access types are modelled. The team used information on population and housing type from the American Community Survey (ACS) to estimate the number of households by type, the percentage of each household type that own a car, and the percentage of car owners that drive to work (U.S. Census Bureau, 2016). The team then used a report from University of California, Davis to estimate the availability of home charging at each type of housing and the percentage of vehicles that would charge at home, at work, and on public chargers (Nicholas & Tal, 2017).

3.2.2 PEV TYPES

The driving population was also segmented by the type of PEV driven; four PEV types were used distinguishing long- and short-range Battery Electric Vehicles (BEVs) and Plug-in Hybrid Electric Vehicles (PHEVs). The split between BEV and PHEVs is based on the Bloomberg New Energy Finance EV outlook (BNEF, 2019) while the split between long and short range PEV types were used to ensure the average BEV and PHEV range was aligned with forecasts from NREL (Kontou, et al., 2018).

Figure 3 shows how the vehicle mix used in this study gradually changes towards 2030, assuming a growing role for battery electric vehicles as the market matures.

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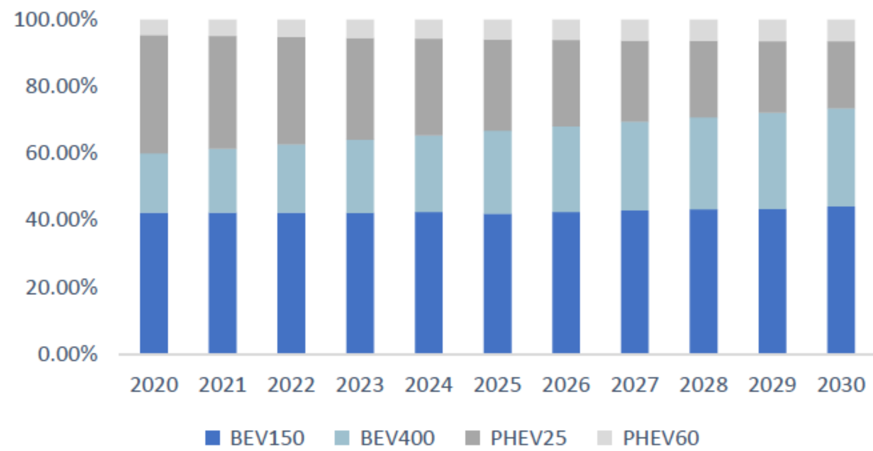
Figure 3. Cumulative change in vehicle mix - 2020 -2030



3.3 Vehicle and charger parameters

As described in section 3.2.2 for LDVs, four vehicle types were modelled, for which vehicle and charger parameters are shown in Table 2. Note that as described in section 3.1, only charging profiles for 2025 were simulated. The normalized charging profiles for each of the four LDV types were scaled using their relative proportion by year over the modelling period to represent growth in average BEV and PHEV ranges over time. Therefore, the range of BEVs and PHEVs selected represent the lower and upper end of potential vehicle ranges that may be on the market by 2030.

LDVs are expected to have an efficiency of 0.39 kWh/miles based on the weighted average of the LDV types currently on the market in New Mexico (U.S. Department of Energy, 2020; Auto Alliance, 2020).

Table 2. Vehicle and charger parameters of LDVs

Vehicle type	Electric range (miles)	Battery size (kWh)	Max DC charging power (kW)	Max AC charging power (kW)
BEV – long range	400	140	20	105
BEV – short range	150	52.5	20	50
PHEV – long range	60	21	3.6	n/a
PHEV – short range	25	8.75	3.6	n/a

3.4 Utility tariffs and charging costs

Residential locations were assigned Xcel Energy's Residential Service rate (Tariff No. 1018.19) and Secondary General Service rate (Tariff No. 4060.6) was applied to workplace locations.[2] It was assumed that all EV chargers were separately metered and therefore building loads were not included when calculating demand charges for the Secondary General Service rate. Since the intention is to measure the impact of EV charging on utility bills versus a counterfactual where an ICE vehicle is owned, all metering charges and fixed charges were not included in the bill calculation for simplicity. Tariffs energy and demand charges are assumed to stay flat in real dollars (i.e. only grow at the inflation rate of 2%/year).

The rates paid by the drivers are distinguished from the electricity bills paid by charging station site hosts for public locations, see Table 3. Commercial charging prices for L2 and DCFC chargers were selected from a publicly-available source[3]

[2] These were the latest tariffs available at the time of analysis, see Southwestern Public Service Company Electric Rate Book (Southwestern Public Service Company, 2019)

[3] Blink member charging fees for New Mexico taken from (Blink, 2020)

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to reflect the charging costs EV drivers pay at public locations, which are often much higher than the Secondary General Service rate paid by charging station site hosts or owners. This difference will reflect again on the cost of charging to drivers in the PCT and the utility revenue for ratepayers in the RIM.

Table 3. Charging fees paid by EV drivers versus charging site hosts or owners

	Home	Workplace	Public
Drivers	Residential Service rate	Secondary General Service	Blink L2 or Blink DCFC
Charging Site Hosts	-	Secondary General Service	Secondary General Service

Table 4. Rate information

	Energy ($/kWh)		Demand ($/kW)	
	Summer	Winter	Summer	Winter
Residential Service	0.075186	0.063324	-	-
Secondary General Service	0.004634	0.004634	18.49	15.4
Blink L2	0.44	0.44	-	-
Blink DCFC	0.54	0.54	-	-

Note that this analysis did not incorporate the power factor adjustment or a cap on demand charge for commercial tariffs. The rates above were used to simulate PEV charging in EVGrid by minimizing the driver's electric bill.

3.5 Incremental Vehicle Costs

On average, electric vehicles are currently more expensive in purchase price than their ICE counterparts, mostly due to battery costs. E3 used the base assumptions on the purchase price for both electric and ICE LDVs in the US from recent projections by the International Council on Clean Transportation (ICCT, 2019). These were specified for vehicle mix and battery packages as used in this analysis, resulting in average incremental upfront vehicle costs of an EV over an ICE vehicle of $8,920 in 2020. As battery costs are forecasted to decline towards 2030, incremental vehicle costs are reduced to $1,721 in 2030.[4]

Table 5. Incremental upfront vehicle costs per vehicle category (Nominal $)

PEV category	2020	2030
Personal LDVs	8,920	1,721

Note that other costs for operating and maintaining the vehicle are discussed in the electric vehicle miles travelled section. Disposal costs for batteries are sometimes included in total cost of ownership studies but are not included in this analysis. While there is much research underway for second life applications, recycling, and disposal of PEV batteries there is still great uncertainty on costs and who will bear those costs. A rough estimate for recycling costs, one of the more expensive end of life options, is around 300 - 500 $ per EV battery, but more research is required to obtain reliable figures (IER, 2019).

[4] In nominal dollars - based on battery costs projections by the International Council on Clean Transportation (ICCT, 2019)

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3.5.1 TAX CREDITS

All EV drivers in New Mexico benefit from federal tax credits, which reduces the impact of upfront incremental vehicle costs. Federal tax credits amount up to $7,500 per BEV purchased, phasing out when at least 200,000 vehicles have been sold by each manufacturer in the U.S, which E3 assumed would occur by 2023 (Internal Revenue Services, 2020). New Mexico has proposed a state tax credit for PEVs but the bill did not pass the 2020 legislative session and although it is expected to be proposed again in 2021 no state tax credit was included in this analysis.

3.6 Avoided Electric Vehicle Miles Travelled (eVMT)

Avoided electric Vehicle Miles Travelled (eVMT) costs in our analysis are based on two factors: avoided fuel costs and avoided operation and maintenance (O&M) costs. For avoided fuel costs, we calculate the amount of fuel an ICE vehicle would have used under the same circumstances over the lifetime of the vehicle, multiplied by the costs of fuel in each year. The average annual fuel consumption avoided per EV per year is assumed to decrease over time according to the relative improvement in ICE vehicle fuel efficiency projected by NREL in their Light-Duty Vehicle Attribute Projections prepared for the California Energy Commission (Kontou, et al., 2018). The assumed fuel efficiencies per vehicle category are shown in Table 6.

Table 6. Fuel economy assumptions

Year	LDVs (miles/gallon gasoline)
2020	32.6

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2025	36.3
2030	37.2

Gasoline and diesel forecasted prices are derived from the EIA Annual Energy Outlook 2020 and include an inflation rate of 2%/year to convert them to nominal dollars. Table 7 shows the projected fuel costs for both gasoline and diesel for several end years (U.S. Energy Information Administration, 2020).

Table 7. Fuel price forecast (Nominal $)

Year	Gasoline (nom $/gallon)
2020	2.65
2025	2.83
2030	3.29
2035	3.89
2040	4.49

Note that these gasoline prices are based on the EIA's latest long-term price forecasts which were published in January 2020 and therefore do not include recent price impacts of the 2019 novel coronavirus disease (COVID-19). While it is uncertain what the long-term price impacts are, the EIA's current Short-Term Energy Outlook shows the price impacts are expected be largest in the second quarter of 2020 and then dissipate over the following 18 months (U.S. Energy Information Administration, 2020). Given that much of the avoided gasoline in this study occurs beyond 2025 based on PEV adoption forecasts, this should not have a substantial impact on the analysis.

To calculate annual O&M savings, E3 multiplied annual mileage of different vehicle categories by an estimation of the per mile difference between maintenance costs for ICE and electric vehicles. To inform these estimates for

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LDVs, E3 used data provided by the International Council on Clean Transportation, estimating conventional vehicle maintenance costs for LDVs at \$0.061 per mile versus \$0.026 per mile for their electric counterparts (ICCT, 2019).

3.7 Electricity Supply Costs

Utility electricity supply costs are calculated by multiplying the hourly marginal electricity supply costs with hourly electric PEV charging load. Recall that this study focuses only on adoption between 2020 – 2030 but to account for costs and benefits over the each PEVs' 12-year lifetime, electric supply costs are calculated for charging load out to 2041, when it is assumed all EVs adopted from 2020 to 2030 will have been retired.

The marginal electricity supply cost used in this analysis is comprised of three components. Xcel Energy provided marginal energy costs (\$/MWh), avoided transmission and distribution capacity cost (\$/kW-year), and combustion turbine generation capacity cost (\$/kW-year) from 2020 to 2041.

Table 8. Marginal Electricity Cost Components of PEV charging load

Component[5]	Description of cost from PEV charging load
Energy	Increase in costs due to change in production from the marginal generator
Generation Capacity	Increase in fixed costs of building new generator to meet the incremental EV load

[5] All cost components have loss factors included.

Transmission and Distribution Capacity	Increase in fixed costs of building or maintaining transmission and distribution lines to meet the incremental EV load

To allocate the kW-year generation and transmission capacity costs to hourly values in \$/kWh, the PCAF (Peak Capacity Allocation Factor) methodology was used[6]. Using hourly Xcel Energy New Mexico load in 2019 a threshold (MW) corresponding to the top 250 net load hours was selected. In hours where the net load exceeds the threshold, the exceeded load is divided by the total exceeded load for the 250 hours to create an hourly PCAF allocation factor that sums to 1 over the year.

$$\text{Exceeded load}_t = \min(0, \text{load}_t - \text{the } 250^{th} \text{ top load in a year})$$

$$\text{PCAF}_t\ (\%) = \text{Exceeded load}_t / \text{total exceeded load in a year}$$

$$\text{Capacity value}_t\ (\$/\text{kWh}) = \text{PCAF}_t\ (\%) * \text{capacity value } (\$/\text{kW-year})$$

3.8 Avoided Emissions

Avoided emissions are calculated based on the difference between electric vehicle emissions from charging load and gasoline or diesel combustion. For CO_2, E3 calculated avoided emissions for ICE vehicles based on 0.0085 metric ton/gallon of gasoline.[7] Electric sector emission rates are constant throughout

[6] The methodology was first developed by PG&E in 1993 (California Public Utilities Commission, 2016) and has since been used in various regulatory reports, for example see (Energy & Environmental Economics, 2012)
[7] Derived from the Argonne GREET Model

the study period. To convert avoided emissions to costs, E3 assumed social costs of carbon of 20 $/MWh, which is equivalent to around $37/metric ton.

3.9 Charging Infrastructure

3.9.1 CHARGER NETWORK DENSITY

E3 calculated the required number of electric vehicle supply equipment (EVSE) chargers to support the vehicle adoption forecasts using NREL's EVI-Pro Lite model (NREL, 2018). EVI-Pro Lite can provide a state specific estimation of the number of workplace, public and DCFC charging required to meet a given adoption forecast. Note that this model only provides a value for meeting personal LDV adoption, does not account for the impacts of managed charging, and only provides values for a maximum PEV market penetration of 10% of total LDV stock. Under these assumptions, the PEV adoption forecast for SPS's New Mexico service territory requires the installation of 4,579 EVSE charging ports by 2030, 94% of which are L1 or L2 home chargers. Table 9 provides an overview of the number of EVSE chargers for 2025 and 2030.

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Table 9. Number of required charging ports in SPS's New Mexico service territory

EVSE type	2025	2030
Home L1	315	1,914
Home L2	396	2,403
Workplace L2	23	142
Public L2	17	104
Public DCFC	3	16
Total	**754**	**4,579**

3.9.2 CHARGER COSTS

Charging infrastructure costs in this analysis are based on two components: EVSE hardware costs and installation costs ("make-ready" costs). The latter component includes all *behind the meter* costs required to get the charging unit working. We assume that infrastructure costs "in front of meter" are paid for by the utility and therefore included under electricity supply costs.

The costs of charging infrastructure are outlined in Table 10. These costs are based on data provided by the International Council on Clean Transportation, with installation costs of home charging averaged based on the proportion of existing types of homes in New Mexico (ICCT, 2019). Installation costs for public, workplace and DCFC 150 kW chargers are based on costs per charger with 2 chargers per site.

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Table 10. Charging Infrastructure Costs

	Hardware	Installation	Total
Home L2	$ 742	$ 1,299	$ 2,040
Public L2	$ 3,127	$ 3,020	$ 6,147
Workplace L2	$ 3,127	$ 3,020	$ 6,147
DCFC (150 kW)	$ 75,000	$ 38,047	$ 113,047

For DCFCs, the BCA includes the costs a utility is required to make to upgrade transformer capacity.

4 Results

Benefit-cost results are shown on both a total net present value basis and an average per vehicle adopted basis. The total value results show the full magnitude of costs and benefits from PEV adoption in the SPS's New Mexico service territory but are heavily influenced by the PEV adoption forecast input. The average per vehicle results are more robust to adoption forecast uncertainty and can be useful in PEV program design since an incentive or program cost per-vehicle can be directly compared to the per vehicle net benefit.

E3 forecasts that electrification of personal LDVs in SPS's New Mexico service territory will generate benefits for ratepayers, drivers, and for the State of New Mexico. Table 11 summarizes the total present value of costs and benefits from each of these perspectives. These values represent the total costs and benefits over each vehicles' 12-year lifetime, summed for every vehicle adopted from 2020 to 2030 and discounted using SPS's weighted average cost of capital.[8]

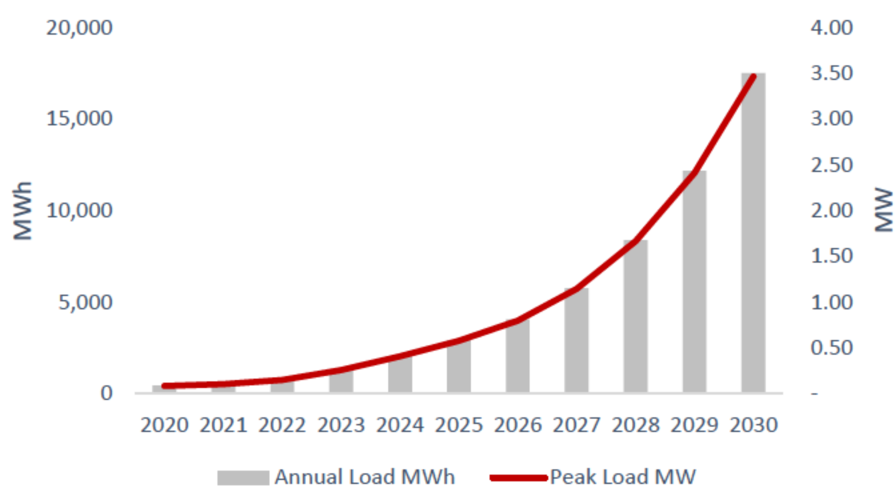
Table 11. Present value of costs and benefits for all vehicles adopted between 2020 – 2030 in ($ Million)

Perspective	Costs	Benefits	Net Benefit
Ratepayers	6.31	8.32	2.01
Drivers	34.92	43.00	8.08
New Mexico State	28.66	44.32	15.66

[8] Note that the costs and benefit streams that contribute to the NPV values calculated extend out to 2041 since all vehicles adopted in the last year of the study period, 2030, would continue to provide costs and benefits over their full lifetime which is assumed to be 12 years.

To understand these results we first look at the annual electricity consumption of PEV charging from personal LDVs which rises from 422 MWh / year in 2020 (~0.01% of 2019 total energy consumption Xcel Energy's New Mexico Territory) to 17,494 MWh / year in 2030 (~0.21% of 2019 total energy consumption), as shown in Figure 4. By 2030 coincident charging load could contribute around 3.5 MW to SPS's New Mexico 2019 peak load of 1,377 MW, which is around 0.25%.

Figure 4. Annual Load and Peak Load of Personal LDVs: 2020-2030



The cost for SPS to serve this new PEV charging load will be around $1 million or 0.06 $/kWh on average by 2030 (in nominal 2030 dollars) while the revenue collected from tariffs is over $1.4 million or 0.08 $/kWh. The aggregate impact of this charging load on SPS's ratepayers is summarized in Figure 5. Recall that this scenario assumes PEV charging is unmanaged.

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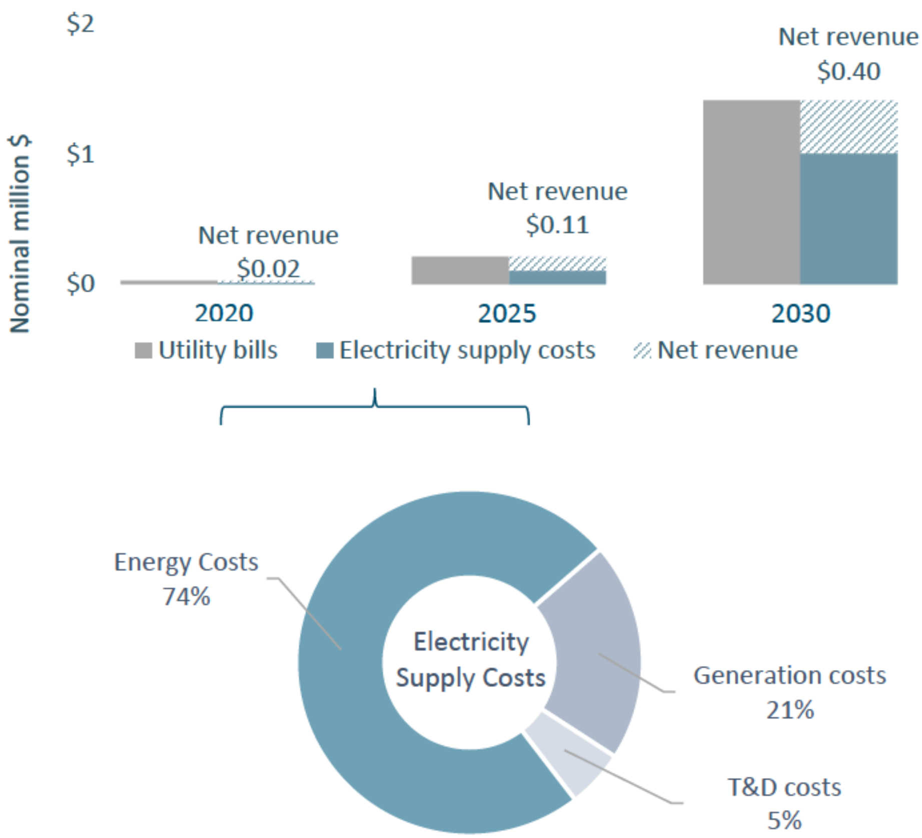
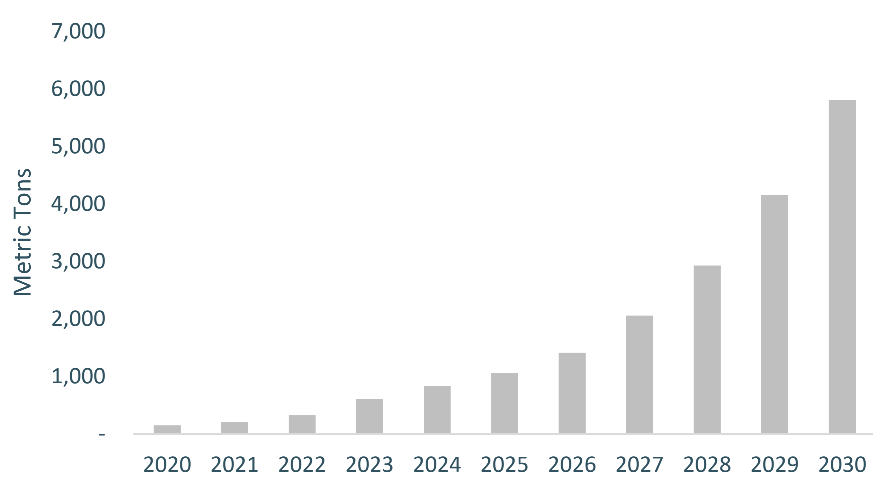
Figure 5. Annual utility net revenue from transportation electrification ($ nominal)



Marginal energy costs constitute 74% of the total cost to serve PEV charging load while 21% is from increased generation capacity, and 5% from transmission and distribution capacity upgrades. It is important to be aware of the uncertainties in these benefit-cost projections. As discussed in the Inputs and Assumptions section, this study is not a detailed feeder by feeder level analysis of the distribution impacts from PEV charging. Higher resolution analysis of distribution grid impacts with greater EV penetrations, EV clustering, and higher-powered charging could result in higher utility costs that would reduce ratepayer benefit. Furthermore, Xcel Energy's electric tariffs may evolve substantially over the next decade, which would have strong implications for these results. This analysis assumes tariffs stay constant in real terms (i.e. only grow with inflation) but if rates were to be lowered, ratepayer benefits could also decrease.

As with many other studies, this analysis shows that GHG emissions associated with the combustion of gasoline in modern efficient ICE vehicles is generally higher than the additional electric sector emissions from PEV charging load. The lifetime emission savings for all PEVs adopted between 2020 – 2030 total 49,552 metric tons of CO_2 across Xcel Energy's New Mexico territory. In addition, NO_x emissions are reduced by 86 metric tons but SO_2 emissions are *increased* by 328 metric tons. Figure 6 illustrates annual avoided CO_2 emissions are scaled with EV adoption between 2020 – 2030.

Figure 6. Annual avoided CO_2 emissions from personal LDVs



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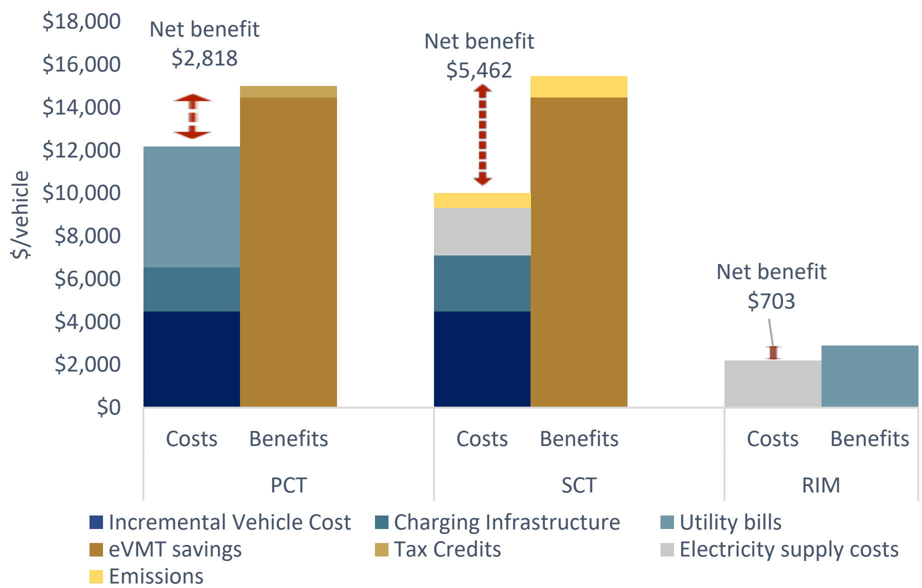
Results show that personal LDVs adopted between 2020 and 2030 could provide \$2M in net present benefits to SPS's New Mexico ratepayers, \$8M in benefits to drivers, and \$16M in benefit to New Mexico state. Figure 7 shows these NPVs averaged over all vehicles adopted during the study horizon. For drivers, the present value benefits total \$2,818 per vehicle over its useful life. For the state of New Mexico and for Xcel Energy ratepayers the NPV per vehicle benefits are \$5,462 and \$703, respectively.[9]

Figure 7. Costs and Benefits of Personal LDV Adoption



Drivers see a net benefit over the lifetime of the vehicle since PEVs are have lower fuel and maintenance costs that outweigh the higher upfront vehicle cost and the

[9] As mentioned, the average NPV per vehicle values are calculated by taking the total NPV result for all vehicles adopted between 2020 – 2030 and dividing it by the total number of vehicles adopted during this period.

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cost of buying charging infrastructure. The more miles the driver covers annually, the higher the benefit and New Mexico drivers have a relatively high VMT compared to other states.

From the perspective of New Mexico, PEV adoption brings a lifetime net benefit of $5,462 per PEV by reducing gasoline consumption, O&M costs, and net emissions. Ratepayers see a modest net benefit for each PEV adopted as the revenue collected from electricity bills exceeds Xcel Energy’s cost to supply the additional load from PEV charging. Recall that it is assumed that what drivers pay to charge in public is not the same and often significantly higher than what the electric bill paid by the site host. Hence the utility bill from the utility (RIM) perspective is much lower than from the driver (PCT) perspective.

Note that this study was focused purely on assessing the relative costs and benefits of PEVs that charge in an unmanaged or uncontrolled manner. It is likely that future charging loads could be controlled through charger timing or more sophisticated vehicle-grid integration technology that could further reduce electric supply costs and utility bills. Various studies have concluded that managed charging generally increases benefits for drivers, ratepayers, and society but this was beyond the scope of this analysis.

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5 References

Auto Alliance, 2020. *Autos Drive New Mexico Forward.* [Online] Available at: https://autoalliance.org/in-your-state/NM [Accessed 20 May 2020].

Blink, 2020. *EV Charging Fees.* [Online] Available at: https://www.blinkcharging.com/ev-charging-fee [Accessed 17 March 2020].

BNEF, 2019. *Elevtric Vehicle Outlook 2019.* [Online] Available at: https://about.bnef.com/electric-vehicle-outlook/ [Accessed 17 March 2020].

Bureau of Transportation Statistics, 2018. *National Transportation Statistics 2017,* Washington, DC: U.S. Department of Transportation .

California Public Utilities Commission, 2016. *Pacific Gas and Electric Company 2017 General Rate Case Phase II Updated and Ammended Prepared Testimony Exhibit (PG&E-9) Volume 1 Marginal Costs,* San Francisco: CPUC.

Energy & Environmental Economics, 2012. *Technical Potential for Local Distributed Photovoltaics in California,* San Francisco: Energy & Environmental Economics.

EXHIBIT A

Federal Highway Administration, 2017. *2017 National Household Travel Survey,* Washington, DC: U.S. Department of Transportation.

Federal Highway Administration, 2018. *Highway Statistics 2018.* [Online] Available at: https://www.fhwa.dot.gov/policyinformation/statistics/2018/ps1.cfm [Accessed 1 June 2020].

ICCT, 2019. *Estimating electric vehicle charging infrastructure costs across major U.S. metropolitan areas,* s.l.: Working Paper 2019-4.

ICCT, 2019. *Update on electric vehicle costs in the United States through 2030,* s.l.: s.n.

Internal Revenue Services, 2020. *Plug-in Electric Drive Vehicle Credit at a Glance.* [Online]
Available at: https://www.irs.gov/credits-deductions/individuals/plug-in-electric-drive-vehicle-credit-section-30d
[Accessed April 2020].

Kontou, E., Melaina, M. & Brooker, A., 2018. *Light-Duty Vehicle Attribute Projections (Years 2015-2030),* Sacramento: California Energy Commission.

Nicholas, M. A. & Tal, G., 2017. *Survey and Data Observation on Consumer Motivations to DC Fast Charge ,* Davis: University of California, Davis.

EXHIBIT A

NREL, 2018. *CEC EV Infrastructure Projection Tool (EVI-Pro),* s.l.: s.n.

Southwestern Public Service Company, 2019. *Electric Rate Schedules.* s.l., Southwestern Public Service Company.

U.S. Census Bureau, 2016. *American Community Survey,* s.l.: s.n.

U.S. Department of Energy, 2020. *Fuel Economy in Cold Weather.* [Online] Available at: https://www.fueleconomy.gov/feg/coldweather.shtml [Accessed 16 March 2020].

U.S. Energy Information Administration, 2020. *Annual Energy Outlook 2020,* Washington, DC: U.S. Department of Energy.

U.S. Energy Information Administration, 2020. *Short-Term Energy Outlook.* [Online] Available at: https://www.eia.gov/outlooks/steo/ [Accessed 8 May 2020].

EV Home Service Revenue Calculation @ 395 kwh

In dollars, except where specified

	Rate	KWh	EV Service Pilot	
Energy Charges				
Off-Peak	$ 0.027840	374.5	$10.43	
Mid-Peak (Summer)	$ 0.090130	3.8	$0.34	
Mid-Peak (Winter)	$ 0.075150	10.0	$0.75	
On-peak (Summer)	$ 0.225760	2.0	$0.45	
On-peak (Winter)	$ 0.192660	5.3	$1.02	
Sub-Total Energy Charges		395.6	$12.99	
Months in a Year			12	
Annual Base Rate Revenue			$155.88	
Incremental Customer Charge				
Fuel Clause Rider	$ 0.026735	395.6	$10.58	
Other Riders Charges				
Transmission Cost Recovery	$ 0.003607	395.6	$1.43	
Renewable Development Fund	$ 0.001252	395.6	$0.50	
Conservation Improvement Program	$ 0.001682	395.6	$0.67	
Renewable Energy Standard	0.450%		$0.06	
Sub-Total Other Rider Charges			$13.24	
			Monthly	Annual
Revenue			$26.23	$314.76
On-peak Cost			$1.47	$17.64
Fuel Clause Cost			$10.58	$126.96
Revenue - Net of Cost			$14.18	$170.16

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☐ **Public Document – Not Public Data Has Been Excised**
☒ **Public Document**

Xcel Energy		Information Request No. 11
Docket No.:	E,G-999/CI-20-492	
Response To:	Citizens Utility Board	
Requestor:	Brian Edstrom	
Date Received:	September 24, 2020	

Question:
Reference: Xcel Comments, electric vehicle proposals (pages 15-18 and Attachment C)

a. Reference Attachment C, Table 2: Electric Transit Bus and School Bus Rebates by Year
   i. How did Xcel determine the proposed rebate amounts for transit buses, school buses (V2G), and school buses (non-V2G)?
   ii. What is the purchase price of an electric transit bus to Metro Transit and to other transit agencies? If the Company is not aware of actual purchase prices, provide an estimate.
   iii. What is the purchase price of electric school buses (V2G and non-V2G models) to Minnesota school districts? If the Company is not aware of actual purchase prices, provide an estimate.

b. Share any information Xcel is aware of regarding where electric transit or school buses would be put in place should this program be approved, including specific Metro Transit routes, school districts, and school bus routes.

c. Provide detailed cost-benefit analyses of each of the EV programs proposed in this filing.

d. How do the results of the Company's cost-benefit analyses of each of the EV programs proposed in this filing compare to that of existing Xcel EV pilots or programs?

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Response:

a(i) *Proposed Rebates*. The Company determined the proposed rebate amounts for electric transit buses and electric school buses based on what we believe is necessary to incentivize strong efforts at transportation electrification over the next few years, while also balancing the costs involved in order to create benefits for transit operators, school bus operators, our electric customers, and the State of Minnesota. Part of developing the proposed rebate levels for electric transit buses stem from conversations with Metro Transit and the desire to strike an appropriate balance between strong upfront incentives to encourage economic recovery and electrification and declining rebates over time as the market develops in order to reduce the costs of the program.

We developed the school bus rebates with the same goals in mind. The specific rebates proposed for non-V2G electric school buses are designed to offset the incremental costs of electric school buses and associated charging equipment and mirror the maximum award announced for the Minnesota Pollution Control Agency's electric school bus pilot in the near-term in an effort to complement state efforts on school bus electrification. The proposed V2G electric school bus rebate is designed to offer a larger award in order to incentivize school bus operators to participate in a future program that will require additional coordination and collaboration with the Company on charging schedules, preferences, and parameters.

a(ii) *Transit Bus Prices*. The Company estimates that the purchase price of an electric transit bus can average between roughly $800,000 and $1.3 million, depending on the length of the bus and other features. The price of associated charging equipment to provide garage and on-route charging for each bus can add another approximately $250,000 in costs. This compares to costs of about $500,000 to $850,000 for a diesel transit bus, depending on the length of the bus.

a(iii) *School Bus Prices.* The purchase price of an electric school bus is approximately $350,000. This compares to about $140,000 for a diesel bus. The purchase price of a V2G enabled bus and non-V2G-enabled bus does not differ greatly, as the leading bus manufacturers allow for bi-directional charging in new models; the cost difference for these two alternatives stems from the charging equipment and infrastructure investment required to allow for V2G, which can cost between an additional $30,000 - $50,000 compared to non-V2G charging infrastructure.

b. Given past discussions, the Company is generally aware of Metro Transit's interest in electrifying buses housed at various Minneapolis and St Paul garages, but does not know the specific routes that Metro Transit may decide to offer

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electric service in the future. Similarly, the Company has had discussions with the Bloomington, Edina, and Saint Cloud school districts Schmitty and Sons bus operators, who have expressed an interest in electric school bus programs. However, the Company is not certain which specific transit operators and school districts may take advantage of the Company's proposed electric bus rebates or on which bus routes the resulting electric buses may focus, should this program be approved.

c-d. Given the expedited nature of this docket and the Commission's request for proposals to rapidly contribute to the relief and recovery of Minnesota's economy, the Company has not conducted an in-depth analysis quantifying costs and benefits for each of the proposed EV programs. In Attachment C of our September 15, 2020 filing, however, we presented a high-level cost-benefit analysis discussing the benefits of our EV rebate proposal,[1] including results for the electrification of light-duty and heavy-duty vehicles from a study conducted in the spring of 2020 for Xcel Energy-Colorado.

Those results show significant net benefits for drivers, electric customers, and society as a whole from vehicle electrification, as also demonstrated in other cost-benefit studies in Minnesota and around the country on vehicle electrification. Indeed, as the Commission has identified, "EVs have the potential to deliver a variety of benefits to Minnesota, especially environmental and public health benefits. Replacing fossil fuel powered vehicles with EVs can reduce greenhouse gas and other harmful emissions, especially as the rise of EVs coincides with the rise of renewable energy and the decline in coal-fired electric generation. […] By using more electricity, EVs can benefit all ratepayers."[2] For this and other reasons, it requested utilities "Develop and file EV-related proposals intended to encourage the adoption of EVs by […] [f]acilitating the electrification of vehicle fleets."[3]

The Company's EV proposals seek to bring about these lasting benefits for customers and for Minnesota. The Company believes that our proposals can help to speed up the transition to electric vehicles and hasten the arrival of these benefits. The EV proposals in this filing seek to incentivize the purchase of electric transportation options across market segments, reduce range anxiety for drivers, and help to encourage vehicle charging at times that are beneficial for the grid.

[1] We do not believe our other proposals require a cost-benefit analysis under the Commission's February 1, 2019, Order in Docket No. E-999/CI-17-879, and consequently have not conducted any such analyses.
[2] ORDER MAKING FINDINGS AND REQUIRING FILINGS, In the Matter of a Commission Inquiry into Electric Vehicle Charging and Infrastructure, Docket No. E-999/CI-17-879, February 1, 2019.
[3] *Id.*

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When viewed holistically, they can support increased EV adoption in the near-term to help Minnesota realize the benefits offered from widespread electric transportation. The Company believes that any analysis that sought to estimate the incremental EV adoption that may result from the EV proposals would have a high degree of uncertainty and would risk creating a false sense of precision. As a result, the Company encourages a more general and longer-term approach of considering the benefits of electric transportation and what programs can help support a market transformation.

Preparer:	Jason Peuquet	Kevin Schwain
Title:	Principal Consultant Strategy and Performance	Director Transportation Electrification
Department:	Electric Transportation	Electric Transportation
Telephone:	484-947-7383	612-330-5961
Date:	October 5, 2020	

The Office of
Minnesota Attorney General Keith Ellison
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August 26, 2021

Mr. Will Seuffert
Executive Secretary
Minnesota Public Utilities Commission
121 7th Place East, Suite 350
St. Paul, MN 55101

Re: ***In the Matter of Xcel Energy's Petition for Approval of Electric Vehicle Programs as Part of Its COVID-19 Pandemic Economic Recovery Investments***
MPUC Docket No. E-002/M-20-745

Dear Mr. Seuffert:

Enclosed and e-filed in the above-referenced matter please find Comments of the Minnesota Office of the Attorney General—Residential Utilities Division.

By copy of this letter all parties have been served. A Certificate of Service is also enclosed.

Sincerely,

/s/ **Max Kieley**
MAX KIELEY
Assistant Attorney General

(651) 757-1244 (Voice)
(651) 296-9663 (Fax)
max.kieley@ag.state.mn.us

Enclosure

CERTIFICATE OF SERVICE

Re: ***In the Matter of Xcel Energy's Petition for Approval of Electric Vehicle Programs as Part of Its COVID-19 Pandemic Economic Recovery Investments***
MPUC Docket No. E-002/M-20-745

I, JUDY SIGAL, hereby certify that on the 26th day of August, 2021, I e-filed with eDockets ***Comments of the Minnesota Office of the Attorney General—Residential Utilities Division*** and served a true and correct copy of the same upon all parties listed on the attached service list by e-mail, electronic submission, and/or United States Mail with postage prepaid, and deposited the same in a U.S. Post Office mail receptacle in the City of St. Paul, Minnesota.

/s/ Judy Sigal
JUDY SIGAL

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
Tamie A.	Aberle	tamie.aberle@mdu.com	Great Plains Natural Gas Co.	400 North Fourth Street Bismarck, ND 585014092	Electronic Service	No	OFF_SL_20-745_Official
Michael	Ahern	ahern.michael@dorsey.com	Dorsey & Whitney, LLP	50 S 6th St Ste 1500 Minneapolis, MN 554021498	Electronic Service	No	OFF_SL_20-745_Official
Michael	Alvarez	Michael.Alvarez@longroadenergy.com	Community Wind North, LLC	c/o Longroad Development Company, LLC 330 Congress Street, 6th Fl Boston, MA 02210	Electronic Service	No	OFF_SL_20-745_Official
Kristine	Anderson	kanderson@greatermngas.com	Greater Minnesota Gas, Inc.& Greater MN Transmission, LLC	1900 Cardinal Lane PO Box 798 Faribault, MN 55021	Electronic Service	No	OFF_SL_20-745_Official
Alison C	Archer	aarcher@misoenergy.org	MISO	2985 Ames Crossing Rd Eagan, MN 55121	Electronic Service	No	OFF_SL_20-745_Official
Thomas	Ashley	tom@greenlots.com	Greenlots	N/A	Electronic Service	No	OFF_SL_20-745_Official
Kevin	Auerbacher	kauerbacher@tesla.com	Tesla, Inc.	1050 K Street NW, Suite 101 Washington, DC 20001	Electronic Service	No	OFF_SL_20-745_Official
Anjali	Bains	bains@fresh-energy.org	Fresh Energy	408 Saint Peter Ste 220 Saint Paul, MN 55102	Electronic Service	No	OFF_SL_20-745_Official
Max	Baumhefner	MBAUMHEFNER@NRDC.ORG	Natural Resources Defense Council	111 Sutter St 21st Fl San Francisco, CA 94104	Electronic Service	No	OFF_SL_20-745_Official
Carolyn	Berninger	cberninger@mncenter.org	Minnesota Center for Environmental Advocacy	26 E Exchange St Ste 206 Saint Paul, MN 55101	Electronic Service	No	OFF_SL_20-745_Official
James J.	Bertrand	james.bertrand@stinson.com	STINSON LLP	50 S 6th St Ste 2600 Minneapolis, MN 55402	Electronic Service	No	OFF_SL_20-745_Official

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
Brenda A.	Bjorklund	brenda.bjorklund@centerpointenergy.com	CenterPoint Energy	505 Nicollet Mall Minneapolis, MN 55402	Electronic Service	No	OFF_SL_20-745_Official
James	Canaday	james.canaday@ag.state.mn.us	Office of the Attorney General-RUD	Suite 1400 445 Minnesota St. St. Paul, MN 55101	Electronic Service	No	OFF_SL_20-745_Official
Cody	Chilson	cchilson@greatermngas.com	Greater Minnesota Gas, Inc. & Greater MN Transmission, LLC	1900 Cardinal Ln PO Box 798 Faribault, MN 55021	Electronic Service	No	OFF_SL_20-745_Official
Ray	Choquette	rchoquette@agp.com	Ag Processing Inc.	12700 West Dodge Road PO Box 2047 Omaha, NE 68103-2047	Electronic Service	No	OFF_SL_20-745_Official
John	Coffman	john@johncoffman.net	AARP	871 Tuxedo Blvd. St, Louis, MO 63119-2044	Electronic Service	No	OFF_SL_20-745_Official
Generic Notice	Commerce Attorneys	commerce.attorneys@ag.state.mn.us	Office of the Attorney General-DOC	445 Minnesota Street Suite 1400 St. Paul, MN 55101	Electronic Service	Yes	OFF_SL_20-745_Official
Riley	Conlin	riley.conlin@stoel.com	Stoel Rives LLP	33 S. 6th Street Suite 4200 Minneapolis, MN 55402	Electronic Service	No	OFF_SL_20-745_Official
Brooke	Cooper	bcooper@allete.com	Minnesota Power	30 W Superior St Duluth, MN 558022191	Electronic Service	No	OFF_SL_20-745_Official
Grace	Corbin	G.Corbin@mpls-synod.org	Eco-Faith Network	122 W Franklin Ave Ste 600 Minneapolis, MN 55404	Electronic Service	No	OFF_SL_20-745_Official
Heidi	Corcoran	Heidi.Corcoran@CO.DAKOTA.MN.US	Dakota County	N/A	Electronic Service	No	OFF_SL_20-745_Official

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
Hillary	Creurer	hcreurer@allete.com	Minnesota Power	30 W Superior St Duluth, MN 55802	Electronic Service	No	OFF_SL_20-745_Official
George	Crocker	gwillc@nawo.org	North American Water Office	PO Box 174 Lake Elmo, MN 55042	Electronic Service	No	OFF_SL_20-745_Official
Timo hy	DenHerder Thomas	timothy@cooperativeenergyfutures.com	Cooperative Energy Futures	3500 Bloomington Ave. S Minneapolis, MN 55407	Electronic Service	No	OFF_SL_20-745_Official
Carrie	Desmond	carrie.desmond@metrotransit.org	Metropolitan Council	560 6 h Avenue North Minneapolis, MN 55411	Electronic Service	No	OFF_SL_20-745_Official
Elizabeth	Dickinson	eadickinson@mindspring.com	Community Power	2720 E 22nd St Minneapolis, MN 55406	Electronic Service	No	OFF_SL_20-745_Official
Bridget	Dockter	Bridget.Dockter@xcelenergy.com		N/A	Electronic Service	No	OFF_SL_20-745_Official
Marie	Doyle	marie.doyle@centerpointenergy.com	CenterPoint Energy	505 Nicollet Mall P O Box 59038 Minneapolis, MN 554590038	Electronic Service	No	OFF_SL_20-745_Official
Michelle	Dreier	mdreier@electricalassociation.com		N/A	Electronic Service	No	OFF_SL_20-745_Official
Ron	Elwood	relwood@mnlsap.org	Mid-Minnesota Legal Aid	2324 University Ave Ste 101 Saint Paul, MN 55114	Electronic Service	No	OFF_SL_20-745_Official
James C.	Erickson	jericksonkbc@gmail.com	Kelly Bay Consulting	17 Quechee St Superior, WI 54880-4421	Electronic Service	No	OFF_SL_20-745_Official

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
John	Farrell	jfarrell@ilsr.org	Institute for Local Self-Reliance	2720 E. 22nd St Institute for Local Self-Reliance Minneapolis, MN 55406	Electronic Service	No	OFF_SL_20-745_Official
Eric	Fehlhaber	efehlhaber@dakotaelectric.com	Dakota Electric Association	4300 220th St W Farmington, MN 55024	Electronic Service	No	OFF_SL_20-745_Official
Sharon	Ferguson	sharon.ferguson@state.mn.us	Department of Commerce	85 7th Place E Ste 280 Saint Paul, MN 551012198	Electronic Service	No	OFF_SL_20-745_Official
Daryll	Fuentes	energy@usg.com	USG Corporation	550 W Adams St Chicago, IL 60661	Electronic Service	No	OFF_SL_20-745_Official
James	Garness	james.r.garness@xcelenergy.com		N/A	Electronic Service	No	OFF_SL_20-745_Official
Edward	Garvey	edward.garvey@AESLconsulting.com	AESL Consulting	32 Lawton St Saint Paul, MN 55102-2617	Electronic Service	No	OFF_SL_20-745_Official
Bruce	Gerhardson	bgerhardson@otpco.com	Otter Tail Power Company	PO Box 496 215 S Cascade St Fergus Falls, MN 565380496	Electronic Service	No	OFF_SL_20-745_Official
Janet	Gonzalez	Janet.gonzalez@state.mn.us	Public Utilities Commission	Suite 350 121 7th Place East St. Paul, MN 55101	Electronic Service	No	OFF_SL_20-745_Official
Anita	Grace	anita@gracemulticultural.com	GRACE Multicltural	12959 196th LN NW Elk River, MN 55330	Electronic Service	No	OFF_SL_20-745_Official
Bill	Grant	billgrant@minncap.org	Minnesota Community Action Partnership	MCIT Building 100 Empire Dr Ste 202 St. Paul, MN 55103	Electronic Service	No	OFF_SL_20-745_Official

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
Todd J.	Guerrero	todd.guerrero@kutakrock.com	Kutak Rock LLP	Suite 1750 220 Sou h Sixth Street Minneapolis, MN 554021425	Electronic Service	No	OFF_SL_20-745_Official
Joe	Halso	joe.halso@sierraclub.org	Sierra Club	1536 Wynkoop St Ste 200 Denver, CO 80202	Electronic Service	No	OFF_SL_20-745_Official
Matthew B	Harris	matt.b.harris@xcelenergy.com	XCEL ENERGY	401 Nicollet Mall FL 8 Minneapolis, MN 55401	Electronic Service	No	OFF_SL_20-745_Official
Erik	Hatlestad	erik@cureriver.org	Cure River	117 1st St Montevideo, MN 56265	Electronic Service	No	OFF_SL_20-745_Official
Kim	Havey	kim.havey@minneapolismn.gov	City of Minneapolis	350 South 5th Street, Suite 315M Minneapolis, MN 55415	Electronic Service	No	OFF_SL_20-745_Official
Adam	Heinen	aheinen@dakotaelectric.com	Dakota Electric Association	4300 220th St W Farmington, MN 55024	Electronic Service	No	OFF_SL_20-745_Official
Annete	Henkel	mui@mnutilityinvestors.org	Minnesota Utility Investors	413 Wacouta Street #230 St.Paul, MN 55101	Electronic Service	No	OFF_SL_20-745_Official
Shane	Henriksen	shane.henriksen@enbridge.com	Enbridge Energy Company, Inc.	1409 Hammond Ave FL 2 Superior, WI 54880	Electronic Service	No	OFF_SL_20-745_Official
Corey	Hintz	chintz@dakotaelectric.com	Dakota Electric Association	4300 220th Street Farmington, MN 550249583	Electronic Service	No	OFF_SL_20-745_Official
Michael	Hoppe	lu23@ibew23.org	Local Union 23, I.B.E.W.	445 Etna Street Ste. 61 St. Paul, MN 55106	Electronic Service	No	OFF_SL_20-745_Official

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
MJ	Horner	mj.horner@xcelenergy.com		N/A	Electronic Service	No	OFF_SL_20-745_Official
Samantha	Houston	shouston@ucsusa.org	Union of Concerned Scientists	1825 K St. NW Ste 800 Washington, DC 20006	Electronic Service	No	OFF_SL_20-745_Official
Lori	Hoyum	lhoyum@mnpower.com	Minnesota Power	30 West Superior Street Duluth, MN 55802	Electronic Service	No	OFF_SL_20-745_Official
Holmes	Hummel	Holmes.Hummel@CleanEnergyWorks.org	Clean Energy Works	925 French St NW Washington, DC 20001	Electronic Service	No	OFF_SL_20-745_Official
Travis	Jacobson	travis.jacobson@mdu.com	Great Plains Natural Gas Company	400 N 4 h St Bismarck, ND 58501	Electronic Service	No	OFF_SL_20-745_Official
Alan	Jenkins	aj@jenkinsatlaw.com	Jenkins at Law	2950 Yellowtail Ave. Marathon, FL 33050	Electronic Service	No	OFF_SL_20-745_Official
Richard	Johnson	Rick.Johnson@lawmoss.com	Moss & Barnett	150 S. 5th Street Suite 1200 Minneapolis, MN 55402	Electronic Service	No	OFF_SL_20-745_Official
Sarah	Johnson Phillips	sarah.phillips@stoel.com	Stoel Rives LLP	33 South Sixth Street Suite 4200 Minneapolis, MN 55402	Electronic Service	No	OFF_SL_20-745_Official
Brendan	Jordan	bjordan@gpisd.org	Great Plains Ins itute & Bioeconomy Coalition of MN	2801 21st Ave S Ste 220 Minneapolis, MN 55407	Electronic Service	No	OFF_SL_20-745_Official
Stacey	Karels	skarels@local563.org	Mankato Area Bldg & Construction Trades Council	310 McKinzie St Mankato, MN 56001	Electronic Service	No	OFF_SL_20-745_Official

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
Mark J.	Kaufman	mkaufman@ibewlocal949.org	IBEW Local Union 949	12908 Nicollet Avenue South Burnsville, MN 55337	Electronic Service	No	OFF_SL_20-745_Official
Thomas	Koehler	TGK@IBEW160.org	Local Union #160, IBEW	2909 Anthony Ln St Anthony Village, MN 55418-3238	Electronic Service	No	OFF_SL_20-745_Official
Frank	Kohlasch	frank.kohlasch@state.mn.us	MN Pollution Control Agency	520 Lafayette Rd N. St. Paul, MN 55155	Electronic Service	No	OFF_SL_20-745_Official
Michael	Krikava	mkrikava@taftlaw.com	Taft Stettinius & Hollister LLP	2200 IDS Center 80 S 8th St Minneapolis, MN 55402	Electronic Service	No	OFF_SL_20-745_Official
Nicolle	Kupser	nkupser@greatermngas.com	Greater Minnesota Gas, Inc. & Greater MN Transmission, LLC	1900 Cardinal Ln PO Box 798 Faribault, MN 55021	Electronic Service	No	OFF_SL_20-745_Official
James D.	Larson	james.larson@avantenergy.com	Avant Energy Services	220 S 6th St Ste 1300 Minneapolis, MN 55402	Electronic Service	No	OFF_SL_20-745_Official
Peder	Larson	plarson@larkinhoffman.com	Larkin Hoffman Daly & Lindgren, Ltd.	8300 Norman Center Drive Suite 1000 Bloomington, MN 55437	Electronic Service	No	OFF_SL_20-745_Official
Amber	Lee	Amber.Lee@centerpointenergy.com	CenterPoint Energy	505 Nicollet Mall Minneapolis, MN 55402	Electronic Service	No	OFF_SL_20-745_Official
Annie	Levenson Falk	annielf@cubminnesota.org	Citizens Utility Board of Minnesota	332 Minnesota Street, Suite W1360 St. Paul, MN 55101	Electronic Service	No	OFF_SL_20-745_Official

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
Ryan	Long	ryan.j.long@xcelenergy.com	Xcel Energy	414 Nicollet Mall 401 8th Floor Minneapolis, MN 55401	Electronic Service	No	OFF_SL_20-745_Official
Susan	Ludwig	sludwig@mnpower.com	Minnesota Power	30 West Superior Street Duluth, MN 55802	Electronic Service	No	OFF_SL_20-745_Official
Kavita	Maini	kmaini@wi.rr.com	KM Energy Consulting, LLC	961 N Lost Woods Rd Oconomowoc, WI 53066	Electronic Service	No	OFF_SL_20-745_Official
Pam	Marshall	pam@energycents.org	Energy CENTS Coalition	823 7 h St E St. Paul, MN 55106	Electronic Service	No	OFF_SL_20-745_Official
Brian	Meloy	brian.meloy@stinson.com	STINSON LLP	50 S 6th St Ste 2600 Minneapolis, MN 55402	Electronic Service	No	OFF_SL_20-745_Official
Joseph	Meyer	joseph.meyer@ag.state mn.us	Office of the Attorney General-RUD	Bremer Tower, Suite 1400 445 Minnesota Street St Paul, MN 55101-2131	Electronic Service	No	OFF_SL_20-745_Official
Kevin	Miller	kevin.miller@chargepoint.com	ChargePoint, Inc.	254 E. Hacienda Avenue Campbell, California 95008	Electronic Service	No	OFF_SL_20-745_Official
Stacy	Miller	stacy.miller@minneapolismn.gov	City of Minneapolis	350 S. 5th Street Room M 301 Minneapolis, MN 55415	Electronic Service	No	OFF_SL_20-745_Official
David	Moeller	dmoeller@allete.com	Minnesota Power	30 W Superior St Duluth, MN 558022093	Electronic Service	No	OFF_SL_20-745_Official
Marc	Monbouquette	marc.monbouquette@enel.com	Enel X North America, Inc.	846 Bransten Rd San Carlos, CA 94070	Electronic Service	No	OFF_SL_20-745_Official

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
Andrew	Moratzka	andrew.moratzka@stoel.com	Stoel Rives LLP	33 South Sixth St Ste 4200 Minneapolis, MN 55402	Electronic Service	No	OFF_SL_20-745_Official
Mark	Nabong	mnabong@nrdc.org	Natural Resources Defense Council	20 N. Wacker Drive #1600 Chicago, IL 60606	Electronic Service	No	OFF_SL_20-745_Official
David	Niles	david.niles@avantenergy.com	Minnesota Municipal Power Agency	220 South Sixth Street Suite 1300 Minneapolis, Minnesota 55402	Electronic Service	No	OFF_SL_20-745_Official
Michael	Noble	noble@fresh-energy.org	Fresh Energy	408 Saint Peter St Ste 350 Saint Paul, MN 55102	Electronic Service	No	OFF_SL_20-745_Official
Samantha	Norris	saman hanorris@alliantenergy.com	Interstate Power and Light Company	200 1st Street SE PO Box 351 Cedar Rapids, IA 524060351	Electronic Service	No	OFF_SL_20-745_Official
Nate	OReilly	nate@iron512.com	Ironworkers Local #512	851 Pierce Butler Route St Paul, MN 55104	Electronic Service	No	OFF_SL_20-745_Official
Matthew	Olsen	molsen@otpco.com	Otter Tail Power Company	215 South Cascade Street Fergus Falls, MN 56537	Electronic Service	No	OFF_SL_20-745_Official
Debra	Opatz	dopatz@otpco.com	Otter Tail Power Company	215 South Cascade Street Fergus Falls, MN 56537	Electronic Service	No	OFF_SL_20-745_Official
Carol A.	Overland	overland@legalectric.org	Legalectric - Overland Law Office	1110 West Avenue Red Wing, MN 55066	Electronic Service	No	OFF_SL_20-745_Official
John	Pacheco	johnpachecojr@gmail.com		N/A	Electronic Service	No	OFF_SL_20-745_Official

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
Greg	Palmer	gpalmer@greatermngas.com	Greater Minnesota Gas, Inc. & Greater MN Transmission, LLC	1900 Cardinal Ln PO Box 798 Faribault, MN 55021	Electronic Service	No	OFF_SL_20-745_Official
Ben	Passer	Passer@fresh-energy.org	Fresh Energy	408 St. Peter Street Ste 220 Saint Paul, MN 55102	Electronic Service	No	OFF_SL_20-745_Official
Jose	Perez	jose@hispanicsinenergy.com		1017 L Street #719 Sacramento, CA 95814	Electronic Service	No	OFF_SL_20-745_Official
Jennifer	Peterson	jjpeterson@mnpower.com	Minnesota Power	30 West Superior Street Duluth, MN 55802	Electronic Service	No	OFF_SL_20-745_Official
Catherine	Phillips	Catherine.Phillips@wecenergygroup.com	Minnesota Energy Resources	231 West Michigan St Milwaukee, WI 53203	Electronic Service	No	OFF_SL_20-745_Official
Marcia	Podratz	mpodratz@mnpower.com	Minnesota Power	30 W Superior S Duluth, MN 55802	Electronic Service	No	OFF_SL_20-745_Official
Kevin	Pranis	kpranis@liunagroc.com	Laborers' District Council of MN and ND	81 E Little Canada Road St. Paul, Minnesota 55117	Electronic Service	No	OFF_SL_20-745_Official
David G.	Prazak	dprazak@otpco.com	Otter Tail Power Company	P.O. Box 496 215 Sou h Cascade Street Fergus Falls, MN 565380496	Electronic Service	No	OFF_SL_20-745_Official
Generic Notice	Residential Utilities Division	residential.utilities@ag.state.mn.us	Office of the Attorney General-RUD	1400 BRM Tower 445 Minnesota St St. Paul, MN 551012131	Electronic Service	Yes	OFF_SL_20-745_Official
Kevin	Reuther	kreuther@mncenter.org	MN Center for Environmental Advocacy	26 E Exchange St, Ste 206 St. Paul, MN 551011667	Electronic Service	No	OFF_SL_20-745_Official

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
Susan	Romans	sromans@allete.com	Minnesota Power	30 West Superior Street Legal Dept Duulth, MN 55802	Electronic Service	No	OFF_SL_20-745_Official
Richard	Savelkoul	rsavelkoul@martinsquires.com	Martin & Squires, P.A.	332 Minnesota Street Ste W2750 St. Paul, MN 55101	Electronic Service	No	OFF_SL_20-745_Official
Tim	Schaefer	thschaef@gmail.com	Environment MN	211 N 1st St Ste 480 Minneapolis, MN 55401	Electronic Service	No	OFF_SL_20-745_Official
Thomas	Scharff	thomas.scharff@versoco.com	Verso Corp	600 High Street Wisconsin Rapids, WI 54495	Electronic Service	No	OFF_SL_20-745_Official
Larry L.	Schedin	Larry@LLSResources.com	LLS Resources, LLC	332 Minnesota St, Ste W1390 St. Paul, MN 55101	Electronic Service	No	OFF_SL_20-745_Official
Elizabeth	Schmiesing	eschmiesing@winthrop.com	Winthrop & Weinstine, P.A.	225 South Sixth Street Suite 3500 Minneapolis, MN 55402	Electronic Service	No	OFF_SL_20-745_Official
Kevin	Schwain	Kevin.D.Schwain@xcelenergy.com	Xcel Energy	404 Nicollet Mall Minneapolis, MN 55401	Electronic Service	No	OFF_SL_20-745_Official
Will	Seuffert	Will.Seuffert@state mn.us	Public Utilities Commission	121 7 h Pl E Ste 350 Saint Paul, MN 55101	Electronic Service	Yes	OFF_SL_20-745_Official
Timo hy	Sexton	Timothy.Sexton@state.mn.us	Minnesota Department of Transportation	395 John Ireland Blvd St. Paul, MN 55155-1899	Electronic Service	No	OFF_SL_20-745_Official

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
Janet	Shaddix Elling	jshaddix@janetshaddix.com	Shaddix And Associates	7400 Lyndale Ave S Ste 190 Richfield, MN 55423	Electronic Service	No	OFF_SL_20-745_Official
Colleen	Sipiorski	Colleen.Sipiorski@wecenergygroup.com	Minnesota Energy Resources Corporation	700 North Adams St Green Bay, WI 54307	Electronic Service	No	OFF_SL_20-745_Official
Anne	Smart	anne.smart@chargepoint.com	ChargePoint, Inc.	254 E Hacienda Ave Campbell, CA 95008	Electronic Service	No	OFF_SL_20-745_Official
Ken	Smith	ken.smith@districtenergy.com	District Energy St. Paul Inc.	76 W Kellogg Blvd St. Paul, MN 55102	Electronic Service	No	OFF_SL_20-745_Official
Peggy	Sorum	peggy.sorum@centerpointenergy.com	CenterPoint Energy	505 Nicollet Mall Minneapolis, MN 55402	Electronic Service	No	OFF_SL_20-745_Official
Jamez	Staples	jstaples@renewablenrgpartners.com	Renewable Energy Partners	3033 Excelsior Blvd S Minneapolis, MN 55416	Electronic Service	No	OFF_SL_20-745_Official
Byron E.	Starns	byron.starns@stinson.com	STINSON LLP	50 S 6th St Ste 2600 Minneapolis, MN 55402	Electronic Service	No	OFF_SL_20-745_Official
Richard	Stasik	richard.stasik@wecenergygroup.com	Minnesota Energy Resources Corporation (HOLDING)	231 West Michigan St - P321 Milwaukee, WI 53203	Electronic Service	No	OFF_SL_20-745_Official
Kristin	Stastny	kstastny@taftlaw.com	Taft Stettinius & Hollister LLP	2200 IDS Center 80 South 8th St Minneapolis, MN 55402	Electronic Service	No	OFF_SL_20-745_Official

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
Cary	Stephenson	cStephenson@otpco.com	Otter Tail Power Company	215 South Cascade Street Fergus Falls, MN 56537	Electronic Service	No	OFF_SL_20-745_Official
James M	Strommen	jstrommen@kennedy-graven.com	Kennedy & Graven, Chartered	150 S 5th St Ste 700 Minneapolis, MN 55402	Electronic Service	No	OFF_SL_20-745_Official
Eric	Swanson	eswanson@winthrop.com	Winthrop & Weinstine	225 S 6th St Ste 3500 Capella Tower Minneapolis, MN 554024629	Electronic Service	No	OFF_SL_20-745_Official
Lynnette	Sweet	Regulatory.records@xcelenergy.com	Xcel Energy	414 Nicollet Mall FL 7 Minneapolis, MN 554011993	Electronic Service	Yes	OFF_SL_20-745_Official
Dean	Taylor	dtaylor@pluginamerica.org	Plug In America	6380 Wilshire Blvd, Suite 1000 Los Angeles, CA 90048	Electronic Service	No	OFF_SL_20-745_Official
Stuart	Tommerdahl	stommerdahl@otpco.com	Otter Tail Power Company	215 S Cascade St PO Box 496 Fergus Falls, MN 56537	Electronic Service	No	OFF_SL_20-745_Official
Karen	Turnboom	karen.turnboom@versoco.com	Verso Corporation	100 Central Avenue Duluth, MN 55807	Electronic Service	No	OFF_SL_20-745_Official
Andrew	Twite	twite@fresh-energy.org	Fresh Energy	408 St. Peter Street, Ste. 220 St. Paul, MN 55102	Electronic Service	No	OFF_SL_20-745_Official
Thomas	Tynes	jjazynka@energyfreedomcoalition.com	Energy Freedom Coalition of America	101 Constitution Ave NW Ste 525 East Washington, DC 20001	Electronic Service	No	OFF_SL_20-745_Official

First Name	Last Name	Email	Company Name	Address	Delivery Method	View Trade Secret	Service List Name
Analeisha	Vang	avang@mnpower.com	Minnesota Power	30 W Superior St Duluth, MN 558022093	Electronic Service	No	OFF_SL_20-745_Official
Lisa	Veith	lisa.veith@ci.stpaul mn.us	City of St. Paul	400 City Hall and Courthouse 15 West Kellogg Blvd. St. Paul, MN 55102	Electronic Service	No	OFF_SL_20-745_Official
Dwight	Wagenius	dwagenius@gmail.com	Minnesota Interfaith Power & Light	4407 E Lake St Minneapolis, MN 55406	Electronic Service	No	OFF_SL_20-745_Official
Francesca	Wahl	fwahl@tesla.com	Tesla	3500 Deer Creek Rd Palo Alto, CA 94304	Electronic Service	No	OFF_SL_20-745_Official
Darrell	Washington	darrell.washington@state.mn.us	DOT	N/A	Electronic Service	No	OFF_SL_20-745_Official
Samantha	Williams	swilliams@nrdc.org	Natural Resources Defense Council	20 N. Wacker Drive Ste 1600 Chicago, IL 60606	Electronic Service	No	OFF_SL_20-745_Official
Justin	Wilson	justin.wilson@chargepoint.com	ChargePoint	240 East Hacienda Ave. Campbell, CA 95008	Electronic Service	No	OFF_SL_20-745_Official
Joseph	Windler	jwindler@winthrop.com	Winthrop & Weinstine	225 South Sixth Street, Suite 3500 Minneapolis, MN 55402	Electronic Service	No	OFF_SL_20-745_Official
Patrick	Zomer	Pat.Zomer@lawmoss.com	Moss & Barnett a Professional Association	150 S. 5th Street, #1200 Minneapolis, MN 55402	Electronic Service	No	OFF_SL_20-745_Official