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March 8, 2022

The Honorable Bobby L. Rush, Chairman
Subcommittee on Energy
House Committee on Energy & Commerce
2125 Rayburn House Office Building
Washington, DC 20515

The Honorable Fred Upton, Ranking Member
Subcommittee on Energy
House Committee on Energy & Commerce
2322 Rayburn House Office Building
Washington, DC 20515

RE: Hearing on "Charging Forward: Securing American Manufacturing and our EV Future"

Dear Chairman Rush, Ranking Member Upton, and Honorable Members of the committee,

We are writing to you today to furnish you and your staff with information that is pertinent to your hearing on "Charging Forward: Securing American Manufacturing and our EV Future." We applaud the subcommittee and its members for focusing on this key issue, and we at the R Street Institute always acknowledge and affirm the importance of addressing the global challenge of climate change. With electric vehicles (EVs) in particular, we have unique expertise at the R Street Institute that supports our writing on the role of EVs in the U.S. economy and related public policy.

To this end, there are three key issues that policymakers should keep in mind in the pursuit of policy supporting EV adoption in the United States:

1) The potential for EV subsidy policies to deliver benefits is challenged by existing literature on EV adoption and usage patterns.
2) Proposed EV support policies, such as further subsidizing initial costs or public charging infrastructure, fail to consider the challenges of charging convenience to low-income households, and may widen existing transportation inequities

3) Policy objectives entailing massive adoption of EVs fail to consider the mineral intensity of EVs and potential national security risks stemming from critical mineral dependency on rival powers.

EV Subsidies are Rarely Cost-Effective

Currently, the federal government subsidizes EV manufacturing and adoption in the United States by providing a $7,500 subsidy for new vehicles.[1] The rationale is that by closing the difference in cost between internal combustion engine vehicles (ICEVs) and EVs, that a transition to lower-polluting EVs will take hold. Conventionally, these subsidies may have some economic utility if they are likely to accelerate the capture of economies of scale, innovation or other "spill over benefits" to the economy. In instances where there are no such benefits to be had, the only utility of the subsidy is in incentivizing the emission reductions that an EV produces relative to an ICEV. As a note, we feel it is important to direct attention to the Congressional Budget Office's estimated cost of subsidies for new EVs in the Build Back Better Act (BBB), which seem to indicate that these subsidies do not in fact accelerate EV adoption.[2]

While we make no judgment as to potential acceleration of EV production that tax credits may have, we do feel it is important to acknowledge that the emission benefits likely to be garnered by EV tax credits are unlikely to exceed the cost of the tax credits for two reasons. Firstly, the size of the tax credit per vehicle relative to the expected emission benefits are exceptionally large. Secondly, the current behavioral characteristics of EV utilization do not produce scenarios of high emissions avoidance.

Large Per-Vehicle Subsidies Unlikely to Produce Net-Benefits for Average Vehicle

The current estimated social cost of carbon is approximately $51 per metric ton, assuming a 3 percent discount rate.[3] This suggests that for each ton of avoided greenhouse gas in carbon dioxide equivalent, there is a $51 global benefit. Ideally environmental policies should carry a cost that is below $51 per ton of avoided emission, as this ensures net benefits. Currently, the International Energy Agency (IEA) estimates the life cycle emissions of a mid-size ICEV to be 41.9 metric tons.[4] At a per-vehicle subsidy of $7,500, this would suggest the best possible abatement cost achievable by the subsidy is $179, which is roughly triple the benefit. When considering the $4,000 – $12,500 proposed per vehicle subsidy in BBB, the range would be $95 – $298 per ton abatement costs.

Such estimates, however, ignore the emissions from EVs. When considering that the IEA estimates the life-cycle emissions of a mid-size EV to be 19.7 metric tons, the average difference in life-cycle emissions

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[1] "Plug-In Electric Drive Vehicle Credit," Internal Revenue Service. https://www.irs.gov/businesses/plug-in-electric-vehicle-credit-irc-30-and-irc-30d.

[2] Philip Rossetti, "EV Subsidies Likely to Have Minimal Impact," R Street Institute, Feb. 24, 2022. https://www.rstreet.org/2022/02/24/ev-subsidies-likely-to-have-minimal-impact.

[3] Geoffrey Giller, "The Social Cost of Carbon is Still the Best Way to Evaluate Climate Policy," Yale School of the Environment, Aug. 23, 2021. https://environment.yale.edu/news/article/social-cost-of-carbon-still-best-way-to-evaluate-climate-policy.

[4] "Comparative life-cycle greenhouse gas emissions of a mid-size BEV and ICE vehicle," International Energy Agency, May 6, 2021. https://www.iea.org/data-and-statistics/charts/comparative-life-cycle-greenhouse-gas-emissions-of-a-mid-size-bev-and-ice-vehicle.

becomes 22.2 metric tons.[5] This would suggest that current EV subsidies should have an abatement cost of approximately $338 per ton, and the proposed subsidies in the Build Back Better Act should have an abatement cost of between $180 – $563 per ton. These abatement costs would be roughly in line with current assessments in economic literature, which are $350 – $640 per ton.[6]

Current EV Utilization Behavior Less Likely to Produce Emission Benefits

Estimations of EV subsidy abatement cost, which already seem unlikely to produce net benefits, should also be tempered by the understanding that those estimates assume that an EV replaces an ICEV. The importance of this is that EV-related emissions are characterized by high-upfront emissions owing to upstream emissions for manufacturing and mineral inputs, and then low emissions from utilization. For an EV to produce an emission benefit over an ICEV, it must be driven enough to overtake its manufacturing related emissions, and each mile driven after the fact further improves its life-cycle emissions vis-à-vis an ICEV. Existing literature, though, suggests that EVs have lower utilization rates than ICEVs. An assessment of EV household electricity utilization found that EV households likely utilize their EVs for 5,300 miles per year, which is less than half of the average vehicle utilization in the United States.[7] Similarly, an assessment of EV households in Norway found that households with both an ICEV and an EV utilize their EV for only 40 percent of their total driving.[8]

For EVs to realize an emissions advantage over ICEVs, they should be utilized more, but current research seems to indicate that they may be utilized less than ICEVs.[9] This potentially worsens the expected efficiency of federal subsidies for EVs as an environmental policy, which already are not expected to yield more benefit than cost.

EV Subsidies Fail to May Contribute to Inequity

Ideally, an EV owner would have access to dedicated at-home charging to ensure a near-full charge anytime the vehicle is needed. The time to charge an EV from to full capacity can range between 25 minutes with rapid charging, or up to 18 hours from a wall outlet.[10] Typical EV users can expect it to take around 8 hours to charge an EV using conventional wall connectors.[11]

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[5] Ibid.

[6] Kenneth Gillingham and James H. Stock, "The Cost of Reducing Greenhouse Gas Emissions," *Journal of Economic Perspectives,* (2018). https://pubs.aeaweb.org/doi/pdfplus/10.1257/jep.32.4.53.

[7] Fiona Burlig et al., "Low Energy: Estimating Electric Vehicle Electricity Use," National Bureau of Economic Research, (February 2021). https://www.nber.org/papers/w28451.

[8] Torstein Otterlei Fjørtoft and Geir Martin Pilskog, "A quarter of the richest households have an electric car," *Statistics Norway,* Aug. 15, 2019. https://www.ssb.no/transport-og-reiseliv/artikler-og-publikasjoner/kvart-sjette-av-dei-rikaste-hushalda-har-elbil.

[9] Ibid.

[10] "Tesla car charging: how long does it take to charge a tesla?" EnergySage, Nov. 5, 2021. https://www.energysage.com/electric-vehicles/charging-your-ev/charging-a-tesla.

[11] Ibid.

The ability to charge while having an EV parked for several hours lends an advantage to homeowners. However, homeownership rates for minorities are significantly lower than for white Americans.[12] The latest Census data indicates that although the overall homeownership rate in the United States is 65.5 percent, it is 74.4 percent for white Americans, 43.1 percent for Black Americans, and 57.6 percent for all other races.[13] This indicates that in terms of who benefits the most from EV subsidies, it will be white Americans.

Policymakers may attempt to allay these concerns by pointing out support for public charging infrastructure, such as the Build Back Better Act's proposed 50,000 EV charging stations across the United States. However, the discrepancy between ICEV fill up time and EV charging times should not be ignored. It takes, on average, two minutes to fill a car's tank with gasoline,[14] but even the fastest EV charging stations take 25 minutes.[15] An average driver logs about 14,263 miles per year, or an average of 274 miles per week.[16] The average EV range is approximately 195 miles, meaning a low-income household without at-home charging available and relying on an EV can expect to have to make at least one or two trips per week expressly to charge their EV.[17]

The lack of convenience for having to charge an EV outside of a home setting should not be ignored. A 2021 study found that 20 percent of EV owners in California return their EVs and return to full ICEV utilization, and that this discontinuance is directly attributable to charging convenience dissatisfaction.[18] These findings would suggest that low-income households—for whom charging convenience is likely to be even more of a challenge—would be disproportionately dissatisfied with a reliance on EVs.

Furthermore, low-income households are far more likely to have multiple persons using one vehicle, while high-income households are more likely to have multiple vehicles.[19] Unlike high income households that are less likely to be inconvenienced by an uncharged EV, owing to the likelihood of an additional vehicle available to them, a low-income household is more likely to be disadvantaged by insufficient charging availability. Also, low-income households are far more likely to utilize carpooling, meaning multiple households may be reliant on a single vehicle, which not only reduces the vehicle's

[12] Ashley Nunes, "The inequities of electric vehicles," *Financial Times,* Aug. 11, 2021. https://www.ft.com/content/f0659114-94dc-4181-ae50-db0d86b84feb.
[13] "Quarterly Residential Vacancies and Homeownership Fourth Quarter 2021," U.S. Census Bureau, Feb. 2, 2022. https://www.census.gov/housing/hvs/files/currenthvspress.pdf.
[14] "Staying Safe at the Pump," American Petroleum Institute. https://www.api.org/oil-and-natural-gas/consumer-information/consumer-resources/staying-safe-pump.
[15] "Tesla car charging," https://www.energysage.com/electric-vehicles/charging-your-ev/charging-a-tesla.
[16] Chris Hardesty, "Average Miles Driven Per Year: Why It is Important," Kelley Blue Book, Sep. 22, 2021. https://www.kbb.com/car-advice/average-miles-driven-per-year.
[17] "As More Americans Choose EVs, Price and Range Continue to Hold Back the Market, According to new Cox Automotive Study," Cox Automotive, Nov 16, 2021. https://www.coxautoinc.com/news/as-more-americans-choose-evs-price-and-range-continue-to-hold-back-the-market-according-to-new-cox-automotive-study; Ashley Nunes, "The inequities of electric vehicles," *Financial Times,* Aug. 11, 2021. https://www.ft.com/content/f0659114-94dc-4181-ae50-db0d86b84feb
[18] Scott Hardman and Gil Tal, "Understanding discontinuance among California's electric vehicle owners," *Nature Energy,* April 26, 2021. https://www.nature.com/articles/s41560-021-00814-9.
[19] "Status of the Nation's Highways, Bridges, and Transit," U.S. Department of Transportation, Nov. 22, 2019. https://www.fhwa.dot.gov/policy/23cpr/chap3.cfm.

available unused time for charging, but also increases the importance of the vehicle being adequately charged.

Additionally, it is not yet fully understood what the effect of rapid charging on battery chemistry and longevity is. It is speculated that rapid charging may result in additional wear on batteries, which are among the largest cost component of EVs.[20] Battery replacements can cost up to $20,000, and are only covered under warranty under limited conditions.[21] A low-income family that is entirely reliant upon public EV charging and rapid charging may be more likely to wear out their battery sooner, and incur significantly greater expenses for EV ownership than high income households that would only rarely utilize rapid charging.

Public policy assumptions that broad transitions to EVs, like those outlined by the Biden administration's 50 percent EV adoption target, would improve the quality of life for low-income households seem to be unfounded. Households without at-home or at-work access to EV charging are more likely to be disadvantaged by a transition to an EV, as a reliance on public-charging infrastructure will increase the burdens of vehicle ownership in terms of both time and financial costs.

Critical Minerals Concerns are Not Adequately Addressed in Ambitious EV Proposals

From an energy security perspective, EVs have an important advantage over ICEVs in reducing the demand for oil and gas, much of which is produced by state owned enterprises of adversarial regimes, such as Russia's Rosneft. Reducing the demand for oil, and thus its price, is an important means of mitigating reliance on foreign powers. However, EVs may present national security vulnerabilities of their own due to a heightened reliance on mineral inputs.

The International Energy Agency estimates that an EV requires six times as much critical minerals as an ICEV.[22] Of particular interest are lithium and cobalt, key minerals that are utilized for EV batteries but not required for ICEVs at all. Three separate analyses of the mineral requirements for achieving net zero emissions globally found that reducing transportation emissions primarily through critical minerals would require over 100 percent of global cobalt reserves and over 100 percent of global lithium reserves.[23] This has raised questions as to where these minerals will come from, and who will supply them.

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[20] Mothilal Bhagavathy et al., "Impact of Charging Rates on Electric Vehicle Battery Life," *Findings,* March 2021. https://findingspress.org/article/21459-impact-of-charging-rates-on-electric-vehicle-battery-life.

[21] Jon Witt, "Costs of Electric Car Battery Replacement," Recurrent Auto, Oct 27, 2021. https://www.recurrentauto.com/research/costs-ev-battery-replacement.

[22] "The Role of Critical Minerals in Clean Energy Transitions," International Energy Agency, 2021. https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions/executive-summary.

[23] Alicia Valero et al., "Material bottlenecks in the future development of green technologies," *Renewable and Sustainable Energy Reviews,* (October, 2018). https://www.sciencedirect.com/science/article/abs/pii/S1364032118303861; Elsa Dominish et al., "Responsible minerals sourcing for renewable energy," Institute for Sustainable Futures, (2019). https://earthworks.org/assets/uploads/2019/04/MCEC_UTS_Report_lowres-1.pdf; André Månberger and Björn Stenqvist, "Global metal flows in the renewable energy transition: Exploring the effects of substitutes, technological mix and development," Energy Policy, (August, 2018). https://www.sciencedirect.com/science/article/pii/S0301421518302726.

Currently, the Democratic Republic of the Congo (DRC) is the world's largest cobalt producer. The DRC produces about 68 percent of the world's cobalt.[24] Australia is the world's largest lithium producer, at 49 percent of global production.[25] In both cases, though, there is growing concern that foreign powers—particularly China—are positioning themselves to dominate supply chains through purchases of refining and processing capacity.[26] China has been acquiring stakes in foreign mineral reserves and refining capacity, and a 2018 estimate was that China controlled 51 percent of the global lithium market and 62 percent of the global cobalt market.[27]

China has been pursuing a strategy to expand its control over mineral commodities. The Center for Studies of International Crises and Conflicts has found that the "Chinese government intends to diversify its mineral supply and to grab a monopoly situation on other minerals and elements, or to use its influence as the world leader of the sector over foreign firms."[28]

While some policymakers attempt to alleviate concerns of foreign influence by having expanded tax credit eligibility for domestic firms, there is no getting around the fact that even domestic companies require foreign mineral inputs. Just last November, Ganfeng—a Chinese lithium company—signed a three-year deal to supply lithium to Tesla.[29] In 2020, Tesla signed a five-year deal to acquire lithium from the Chinese company Yahua.[30] A 2019 report found that China has massive influence over global mineral supplies required for EVs, including influencing 80 percent of the world's rare earth elements production and 70 percent of graphene.[31] Tax credits for domestic assembly of EVs do not alleviate mineral reliance on foreign powers.

We feel it is key to note though that EVs are not the same type of security vulnerability as oil and gas, where short term supply disruptions can have immediate economic impacts. EVs are durable commodities that remain in operation for years, and as such supply disruptions to their inputs will likely take longer to manifest economically than conventional energy disruptions. However, this does not in

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[24] "Mineral Commodity Summaries: Cobalt," U.S. Geological Survey, 2022. https://pubs.usgs.gov/periodicals/mcs2022/mcs2022-cobalt.pdf; https://www.washingtonpost.com/politics/2019/08/08/democratic-candidates-promise-action-climate-change-heres-what-stands-way.

[25] "Mineral Commodity Summaries: Lithium," U.S. Geological Survey, 2022. https://pubs.usgs.gov/periodicals/mcs2022/mcs2022-lithium.pdf.

[26] "Mining the Future: How China is set to dominate the next Industrial Revolution," *Foreign Policy,* May 2019. https://docs.house.gov/meetings/II/II06/20190509/109423/HMTG-116-II06-20190509-SD002.pdf.

[27] Christian Roselund, "State Department issues strategy on diversifying clean energy, storage supply chains," *PV Magazine,* June 14, 2019. https://pv-magazine-usa.com/2019/06/14/state-department-issues-strategy-on-diversifying-clean-energy-storage-supply-chains.

[28] Maria Pulina, "The Chinese policy of lithium and REEs mines' purchase," *Centre d'étude des crises et conflits internationaux*, *Université catholique de Louvain*, (2019). http://cecrilouvain.be/wp-content/uploads/2019/06/Note-danalyse-62.pdf

[29] "China's Ganfeng Lithium Inks 3-year supply contract with Tesla," *Reuters,* Nov. 1, 2021. https://www.reuters.com/business/autos-transportation/chinas-ganfeng-lithium-inks-lithium-battery-supply-contract-with-tesla-2021-11-01.

[30] Tom Daly, "China's Yahua agrees five-year deal to supply lithium to Tesla," *Reuters,* Dec. 29, 2020. https://www.reuters.com/article/us-yahua-group-electric-tesla-lithium/chinas-yahua-agrees-five-year-deal-to-supply-lithium-to-tesla-idUSKBN293132.

[31] "Mining the Future: How China is set to dominate the next Industrial Revolution," *Foreign Policy,* May 2019. https://docs.house.gov/meetings/II/II06/20190509/109423/HMTG-116-II06-20190509-SD002.pdf.

and of itself mitigate national security risks that could ensue from having a high reliance on foreign minerals.

Conclusion

We feel that it is important for policymakers to understand that ambitious EV-centric proposals for reducing transportation related emissions suffer from a central planning bias. Because it is easier for policymakers to envision EV replacement of ICEVs as a pathway to emission reduction, rather than complementary options such as alternative fuels or hybrid vehicles, the comparative advantages and disadvantages of increased EV adoption are not adequately considered in policy design. We at the R Street Institute commend EV adoption but note that it is EV utilization and not adoption in and of itself that produces environmental benefits, and similarly alternative policies that yield comparable benefits should be explored.

We recommend policymakers:

1) Instead of subsidizing EVs based on purchases, focus policies to incentivize EV utilization.
2) Consider non-EV-related policies that could more conveniently allow for low-income households to reduce transportation related emissions, such as through hybrid vehicles or alternative fuels.
3) Be cognizant of mineral supply chain risks that recent scholarship has highlighted, as federal subsidy that incentivizes adoption of mineral intensive products—such as EVs—can exacerbate potential national security vulnerabilities.

With respect,

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