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BE Backup Power Pilot - Environmental and Social Impact Study: Final Report

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Prepared For
Commonwealth Edison Company (ComEd)

Prepared By
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1.0 Executive Summary

Walker Miller Energy Services (Walker-Miller) collaborated with ComEd to conduct an innovative, exploratory research study designed to directly inform ComEd's investment strategies, program design, and policy development by providing detailed environmental impact estimates for a range of energy technologies, including Vehicle-to-Everything (V2X), stationary battery energy storage systems (BESS), and unidirectional smart-grid-integrated electric vehicle (EV) charging (i.e., managed charging). Key life-cycle impact categories were selected to assess how the technologies influence global warming potential (CO_2e), air quality (SO_x and NO_x) and human health ($PM_{2.5}$) impacts. This study is intended to support decision-makers in aligning future deployments and incentive structures with ComEd's broader goals of reducing greenhouse gas (GHG) emissions, improving system resilience, and advancing equity while accounting for the unique functions and varying levels of technical maturity across these solutions.

1.1 Key Findings

The key findings and recommendations below distill the most significant insights from the analysis, identifying where targeted technology deployment and strategic integration can most effectively drive emissions reductions, improve environmental benefits, and strengthen social outcome.

- Vehicle-to-Grid (V2G), Vehicle-to-Home/Building (V2H/V2B), and Battery Energy Storage Systems (BESS) offer limited global warming (i.e., CO_2e) reduction potential in the early years. Emissions outcomes for these technologies are highly time- and scenario-dependent.
- V2G, V2H/V2B, and BESS currently face significant round-trip efficiency and distance loss penalties that erode emissions savings, often outweighing gains in early deployment years. There is a need to monitor advancements in battery and inverter efficiency, incorporate projected improvements into long-term planning models, and rigorously evaluate cost-benefit trade-offs.
- Managed charging delivers steady emissions benefits across pollutants and scenarios, consistently reducing emissions by avoiding the round-trip efficiency losses associated with V2X technologies.
- Meaningful global warming and health benefits emerge later as the grid decarbonizes and technology efficiency improves. If V2X solutions are deployed solely for emissions reduction, the value proposition may be insufficient without additional benefits in the stack, such as resilience or demand management.
- Criteria pollutant levels generally decline across most scenarios, remaining largely unchanged only under the Pessimistic case. Human health impacts (i.e., $PM_{2.5}$) are highest early in the study period, reflecting the near-term- nature of these pollutants. Initial results also show that the technologies evaluated have minimal influence on SO_2

concentrations. In fact, SO_x impacts are negative across all technologies and scenarios. The very small positive values that do appear stem from marginal emissions tied to round-trip energy losses and charging during hours with residual combustion sources. Although these effects are negligible relative to CO_2e and NO_x, they highlight that SO_x should not drive technology selection and is better suited for ongoing monitoring rather than optimization.

- Deploying targeted V2X pilots in Southeast Chicago, Rockford, and Waukegan presents a meaningful opportunity to reduce pollution while expanding access and equity in these state-designated Low-Income (LI), Environmental Justice (EJ), and Restore, Reinvent, Renew (R3) communities that currently face disproportionate environmental burdens.[1] Findings in this study indicate that these three locations are particularly well suited for V2X deployment because of their proximity to high emitting facilities, making them prime candidates for these technologies that can potentially offset peaked plant emissions during peak hours and enhance environmental health outcomes. Prioritizing V2X investments in these overburdened neighborhoods not only maximizes environmental benefits but also advances environmental justice by directing clean energy resources to the communities that stand to gain the most.
- Developing education and outreach materials, paired with strong baseline metrics, enables communities implementing V2X technologies to ensure equitable access and to accurately assess and inform how these solutions can reduce long-standing burdens while delivering meaningful and sustainable benefits.

1.2 Recommendations

ComEd is well-positioned to lead an equitable rollout of V2X technologies. The following recommendations outline how to ensure that LI/EJ/R3 communities gain equitable access to the environmental and social benefits of V2X technology integration.

- From a planning and reporting perspective, it is recommended to implement an environmental strategy that focuses on CO_2e and NO_x as the primary metrics, given their significant influence on global warming climate and air quality, while treating SO_x

[1] An EJ community is a community that meets "the definition of that term based on existing methodologies and findings, used and as may be updated by the Illinois Power Agency and its program administrator in the Illinois Solar for All Program" as well as those "areas where residents have been historically subject to disproportionate burdens of pollution, including pollution from the energy sector, as established by environmental justice communities as defined by the Illinois Power Agency pursuant to Illinois Power Agency Act, excluding any racial or ethnic indicators." See 20 ILCS 627/45. R3 communities are "areas where residents have been historically excluded from economic opportunities, including opportunities in the energy sector, as defined pursuant to Section 10-40 of the Cannabis Regulation and Tax Act." See 20 ILCS 627/45. LI describes "persons and families whose income does not exceed 80% of the state median income for the current State fiscal year as established by the U.S. Department of Health and Human Services." See 20 ILCS 627/45. For purposes of ComEd's Beneficial Electrification Plan 1, ComEd is interpreting a LI community as "a census tract where at least half of households are low-income." See 805 ILCS 155/20-10.

and $PM_{2.5}$ as monitor-only indicators due to their minimal impact observed. V2X deployment should be evaluated not solely on emissions reductions but also on broader system benefits such as resiliency, distribution deferral, and other grid services.

- To strengthen future decision-making, a more comprehensive life cycle assessment is recommended to expanded datasets and refined equations that capture emissions from raw material extraction through end-of-life recycling, along with more detailed assumptions about operating strategies and upstream processes. These processes were excluded from the analysis due to data availability, time constraints, and focus on operational emissions. Future analyses should incorporate factors like discharge cycles, energy per discharge, and degradation, which influence lifetime emissions even if they do not affect instantaneous intensity. Once sufficient data on extraction processes is available, raw material savings should be added as a key impact category to fully evaluate the technologies' environmental benefits.
- An equity driven- V2X strategy is recommended to expand access through diverse ownership models, strengthen community economic stability, and prioritize deployment in areas that could benefit most from V2X integration. ComEd can reduce barriers by leveraging site host, utility owned, charging-as-a-service, and community ownership structures that keep value local while enabling broader participation. Economic benefits can be deepened through revenue sharing mechanisms, workforce development aligned with R3 grants, and community codesign that ensures investments reflect local priorities. Building an equity centered pilot portfolio—supported by affordability measures, transparent metrics, and lessons from leading V2X initiatives—will help validate- benefits and maximize impact for underserved communities.
- Targeted V2X pilots in LI/EJ/R3 communities (Chicago, Waukegan, and Rockford) can advance economic resilience and pollution reduction where it is most needed, while robust outreach, multilingual education, and coalition building will foster trust and long-term engagement. It is recommended that ComEd embrace a phased framework, progressing from early pilots and training to midterm scaling and long-term institutionalization of- equitable deployment which provides a clear roadmap for sustainable, community centered V2X growth and positions ComEd as a national leader in equitable grid innovation.