



Smart Grid

Electric Vehicle Bi-Directional Charging Research Study

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Prepared For

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Prepared By

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Executive Summary

Introduction/Background

As directed by the Illinois Commerce Commission, ComEd undertook a comprehensive research initiative to evaluate customer awareness, understanding, and interest in electric vehicle (EV) bidirectional charging technologies as part of its investigation into Backup Power Capabilities. The project is grounded in the principles of Beneficial Electrification (BE), which promotes replacing fossil fuel use with electricity to leverage Illinois' increasingly clean grid, and bidirectional charging technologies - commonly referred to as vehicle-to-everything (V2X). V2X enables electric vehicles (EVs) not only to draw power from the grid but also to send stored energy back to homes, buildings, or the grid, supporting energy resilience and grid flexibility.

The primary purpose of the research was to assess customer readiness for the adoption of vehicle-to-grid (V2G), vehicle-to-home (V2H), and vehicle-to-building (V2B) technologies, with particular attention to perceived benefits, barriers, and equity considerations. The study also sought to understand how adoption and awareness vary by region, customer segment (residential vs. commercial/industrial), and community type, including low-income (LI), Environmental Justice (EJ), and Restore, Reinvest, Renew (R3) communities.

The research employed a five-phase, mixed-methods design to comprehensively assess awareness, attitudes, and readiness for adoption of bidirectional EV technologies. The phases included:

- **Phase 1: Market Intelligence Analysis (Secondary Research)** – In-depth review of publicly available data and industry sources to evaluate the current and projected market for V2X technologies, including adoption rates, regional differences, market drivers and barriers, and equity-related challenges affecting low-income (LI), Environmental Justice (EJ), and Restore, Reinvest, Renew (R3) communities.
- **Phase 2: Qualitative Stakeholder Interviews** – Ten (10), one-hour, web-enabled, in-depth interviews with V2X subject matter experts across industry, policy, and energy sectors to assess the state of technology development, regulatory influences, incentive structures, and anticipated future demand. Stakeholders were selected based on their V2X experience and represented a range of relevant fields within the V2X ecosystem.
- **Phase 3: National Quantitative Web-Panel Survey** – A national online survey of residential EV owners (n=165) and intenders (n=184), commercial and industrial EV owners and intenders who are fleet decision makers (n=127), and targeted LI (n=29), EJ (n=218), and R3 (n=123) audiences to measure awareness, understanding, perceived benefits, barriers, and interest in V2X adoption across regions and segments.
- **Phase 4: ComEd Customer Qualitative Research** – Online residential focus groups and commercial in-depth interviews with ComEd customers to explore attitudes, perceived value, use cases, and concerns related to V2H, V2B, and V2G technologies, supported by standardized educational stimuli. Seven (7) online focus groups were conducted across four Residential customer segments (EV Owners, EV Intenders in Single-Family Homes, EV Intenders in Multi-Family Homes, and Select ComEd customers from Low-Income

(LI), Environmental Justice (EJ), and Restore, Reinvest, Renew (R3) communities). Additionally, seven (7) one-hour in-depth interviews representing Small businesses, Large businesses, and School districts were conducted among Commercial customers.

- **Phase 5: ComEd Customer Quantitative Survey** – A ComEd-specific online survey of general residential (n=621) and commercial (n=275) customers designed to validate earlier findings and evaluate customer response to additional education materials and cost information related to bidirectional charging.

Overall, the research revealed varying levels of awareness and understanding of bidirectional EV technologies, with interest often driven by backup power, resilience, and cost-savings potential, while adoption remains constrained by cost, technology availability, infrastructure requirements, and regulatory uncertainty. Equity-focused segments face additional barriers related to affordability, housing type, and access to charging infrastructure. Collectively, the findings provide ComEd with actionable insights to inform program design, customer education, and policy strategies that support equitable adoption of bidirectional EV technologies and advance Beneficial Electrification goals.

Key Findings

Across secondary research, stakeholder expert interviews, national surveying, and ComEd-specific qualitative and quantitative work, a consistent story emerges: **V2X is strategically important and may increasingly be “inevitable,” but it is not yet positioned for broad near-term adoption in ComEd’s territory without meaningful cost reduction, clearer standards/interoperability, and a clear path to customer return on investment (ROI).** The strongest near-term value proposition is **resilience** (backup power), while the strongest structural adoption barrier is **upfront equipment + installation cost**, compounded by uncertainty around interoperability, program rules, and (for V2G) compensation and customer control.

Several patterns repeat across research phases:

- **Awareness is low-to-moderate, while actual usage is negligible.** Even where familiarity exists (especially among EV Owners/Intenders nationally), current adoption remains in the low single digits (4% V2H nationally). Among ComEd customers, familiarity is notably low (19% very/somewhat familiar with V2H), and reported usage is essentially nonexistent.
- **Interest is “soft” and highly conditional, especially for residential ComEd customers.** When customers are given a simple description of V2H/V2G, interest rises (particularly among EV Owners and EV Intenders), but **drops sharply once costs are introduced**, indicating that today’s economics do not clear customers’ value filter, payback expectations, and/or budget constraints.
- **Residential: V2H is the lead use case.** Households most readily understand and value V2H for **backup power** and (secondarily) bill management, whereas V2G adds perceived complexity, uncertainty, and “loss of control” concerns.
- **Business: V2B/V2G interest exists nationally among EV Owners and Intenders (to a limited extent). Among all ComEd business customers, interest is very limited.** In the

national business sample of EV Owners and Intenders, interest is higher and relatively less cost-sensitive (88%-89% interested); Among general business customers in ComEd's territory, interest is lower (4%-7%) and often driven by a **lack of perceived operational need** (not only cost).

- **Equity considerations are central to V2X market development.** Current market evidence shows that adoption is significantly more likely among higher-income households, largely due to greater access to home charging, upfront capital, financing options, and compatible housing (e.g., single-family homes with garages). Without intentional program design to address structural barriers, such as affordability, multi-family charging access, financing support, and trusted community-based education, V2X benefits risk accruing disproportionately to higher-income customers, leaving LI, EJ, and R3 communities behind.
- **The practical path forward is targeted, not mass-market.** The combined evidence supports a near-term strategy focused on the customer segments most likely to adopt (EV Owners/Intenders; select fleet operators with predictable dwell time; school districts in certain cases), paired with clear education, OEM partnerships, and risk-reducing program rules.

Segment Highlights Across all Research Phases

- **EV Owners:** Consistently show the highest familiarity and interest. They are the most plausible early adopters, especially those who already value distributed energy (e.g., solar owners) and those with strong resilience needs. Still, cost and concerns about battery degradation/control remain significant friction points.
- **EV Intenders:** Often show meaningful interest after education but are more likely to cite EV cost as a barrier and are sensitive to total system economics; they may require clearer ROI and simpler, bundled offerings.
- **Non-owners/non-intenders:** Low perceived need is a dominant limiter; broad marketing to this group is unlikely to convert near term.
- **LI/EJ/R3:** Show slightly lower familiarity nationally and face structural barriers (cost, access to charging, financing, housing constraints). Without targeted design (upfront cost relief, accessible installation models, and trusted messengers), V2X risks reinforcing existing energy and mobility inequities.

Phase 1 Summary: Market Intelligence Analysis (Secondary Research)

Phase 1 establishes that **bidirectional charging is a high-potential enabling technology** for resilience and grid optimization, but the **current market is extremely small** and constrained by foundational readiness gaps. EV adoption is growing, and policy signals (in certain states, including CA, MD, and NY) are accelerating OEM and infrastructure attention, yet **V2X penetration remains limited** and uneven across states due to differences in incentives, charging infrastructure availability, and supportive policies.

Scaling is constrained by four interlocking barriers: **technical fragmentation** (lack of standards and interoperability), **high upfront equipment and installation costs**, **unclear and inconsistent**

state-level regulatory frameworks, and structural equity gaps that favor higher-income households. Unlocking broader adoption will require unified standards, streamlined interconnection, targeted financial incentives, equity-focused program design, cross-sector coordination, and clearer customer education tied to tangible use cases.

Key Takeaway: The long-term opportunity is credible, but foundational technical, economic, and policy gaps limit near-term scale.

Phase 2 Summary: Qualitative Stakeholder Interviews

Stakeholders broadly describe V2X as an innovation moving from experimentation toward early scaling preparation, but **not yet “easy” or mainstream**. Many expect V2X to become meaningfully viable **5–10 years out**, with modest adoption near-term and greater acceleration later as vehicle compatibility expands, standards mature, and utility/business models clarify.

Barriers exist across levels:

- **EV-side constraints:** limited availability and cost of bidirectional-capable vehicles and chargers; early software/first-generation reliability issues
- **Utility-side constraints:** utilities’ satisfaction with existing demand response approaches, concerns about required investment, and worries about network impacts
- **Market-wide constraints:** lack of universally approved communications standards, battery degradation concerns, and low consumer awareness

Use case differentiation is clear:

- **V2H** is viewed as the most viable near-term pathway due to direct customer value.
- **V2B** may lag where backup generation already exists.
- **V2G** could become compelling for fleets if compensation and operational rules become workable.

Key Takeaway: Technical maturation and credible economic frameworks are prerequisites to scale.

Phase 3 Summary: National Quantitative Web-Panel Survey

Nationally, among EV Owners and Intenders, **awareness of V2X is moderate but current usage is extremely limited**. Among residential EV Owners and Intenders, 52% report being very or somewhat familiar, while business familiarity reaches 74%. Initial interest is strong but declines when cost is introduced—particularly among residential customers, where interest drops from 82% prior to cost information to 63% after. Businesses demonstrate stronger and more cost-resilient interest (89% pre-cost vs. 88% post-cost), though upfront installation cost remains the primary barrier across segments.

Among residential EV Owners and Intenders, familiarity is higher for V2H than V2G, yet actual usage remains rare. Special segments (LI, R3, E1) show slightly lower familiarity, indicating an early equity awareness gap.

Across audiences, the value proposition is consistent: backup power during outages and bill management through peak-rate optimization dominate as primary drivers, while upfront installation cost is the primary limiter.

Trusted education channels include automaker websites, utilities, and online sources, reinforcing the importance of coordinated messaging.

National EV Owner and Intender interest exists, but cost sensitivity—especially among residential customers—is the central gating factor.

Phase 4 Summary: ComEd Customer Qualitative Research

Within ComEd's territory, qualitative findings deepen the understanding of the relationship between perceived value and economic feasibility. **Residential customers gravitate toward V2H** because it offers tangible resilience benefits, particularly backup power. In contrast, **V2G introduces stronger concerns around control, fairness, and complexity.**

Across both residential and business segments, adoption consistently hinges on three conditions: affordable upfront cost, clear and reasonable payback expectations (often **five to ten years** for residential and **three to five years** for business), and reassurance regarding battery durability and day-to-day usability.

Business participants evaluate V2X primarily through an ROI and operational lens. Many already have backup solutions and are hesitant to invest in infrastructure that is non-transferable, particularly in leased facilities. School districts stand out as a potentially viable early segment due to electrification mandates and available funding that may offset cost barriers.

Program design implications are clear: **adoption becomes substantially more attractive when charger and installation costs are covered**, when autonomy protections are embedded (such as minimum battery reserves and override capability), and when savings and compensation are transparently reported.

Perceived value is present, but economic feasibility and customer control protections determine real-world participation.

Phase 5 Summary: ComEd Customer Quantitative Survey

Phase 5 confirms that **within ComEd's service territory, awareness and interest are very limited**. Only 19% of residential and 17% of business customers report familiarity. Interest is limited, 8% among Residential and 2% among Business customers after cost information is introduced.

Even among higher-propensity segments, **interest declines meaningfully when costs are disclosed**, confirming that the current economic landscape is the primary constraint. Among EV Owners, barriers center on **upfront cost**, perceived lack of ComEd support, and **uncertain ROI**. Among less-interested customers, **lack of perceived need** dominates, indicating that awareness-building alone will not drive broad adoption. For businesses, operational irrelevance further suppresses interest, and many indicate that tested incentives would not influence participation.

V2X is not mass-market ready in ComEd's territory. Near-term advancement should focus on EV Owners and Intenders, lead with resilience value, reduce upfront risk, and provide structured support and transparent performance reporting to build confidence and refine program design.

Recommendations

Across five research phases, a consistent conclusion emerges: **V2X technologies may be strategically important but are not close to ready for broad, near-term adoption within ComEd's territory without targeted intervention.**

The strongest customer value proposition is resilience (backup power). The most significant adoption barrier is upfront cost, compounded by uncertainty around standards, compensation structures, and long-term return on investment.

The following recommendations outline a potential path forward. More detailed recommendations can be found in section 4.0.

1. Adopt a Targeted Early-Adopter Strategy

Broad-based deployment is unlikely to generate meaningful participation given low awareness and strong cost sensitivity. Near-term efforts should prioritize segments most likely to adopt, EV Owners and Intenders, customers with distributed energy investments, and fleets or school districts with operational alignment.

Start narrow, learn quickly, and scale deliberately.

2. Lead with Resilience and Position V2H as the Near-Term Entry Point

Backup power is the clearest and most compelling customer benefit. V2H provides tangible value without requiring complex compensation models, while V2G introduces greater perceived complexity and control concerns.

Anchor early programs in resilience to build trust and momentum before expanding to grid-facing applications.

3. Reduce Cost Barriers to Unlock Participation

Economics, not awareness, is the gating factor. Interest declines sharply once installation costs are introduced. Without meaningful cost mitigation, participation will remain limited to a narrow segment.

Strategic mechanisms may include rebates, financing options, OEM partnerships, or structured compensation approaches.

Reduce first-cost risk to unlock adoption.

4. Design Programs That Preserve Customer Autonomy

Loss-of-control concerns, particularly around V2G, are a consistent barrier. Customers require assurance that they can retain battery reserves, override participation, and clearly understand financial outcomes.

Trust and autonomy must be embedded in program design.

5. Embed Equity in Program Architecture from the Outset

Current participation potential skews toward higher-income households due to access, affordability, and housing constraints. Without intentional design, V2X risks reinforcing inequities.

Enhanced incentives, multi-family solutions, and community-based outreach should be integrated into program architecture from inception.

Equity should be built in, not layered on later.

6. Coordinate Education with OEMs and Via Trusted Channels

Awareness remains low, and customers rely primarily on automakers and utilities for credible information. Messaging must be coordinated, transparent, and realistic, clearly explaining costs, benefits, compatibility, and participation rules.

Align OEM and utility education to reduce confusion and build informed adoption.

7. Business Segment Strategy - Avoid a One-Size-Fits-All Approach

Business interest is limited and often constrained by operational relevance. Programs should focus on high-alignment segments such as municipal fleets and school districts, while avoiding a one-size-fits-all approach.

Prioritize segments where economics and operational fit are strongest.

8. Prepare the Regulatory and Technical Foundation for Long-Term Scale

Broader viability is expected over the next 5–10 years as standards, interoperability, and compensation frameworks mature. Near-term pilots should serve as learning platforms to inform regulatory engagement, technical readiness, and infrastructure planning.

Advance through disciplined pilots while preparing for future scale.