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Memorandum on Consideration of Bidirectional Charging in Non-Wires Analysis

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The intent of this memo is to explain the IESO's decision to exclude bidirectional charging from the electricity Demand Side Management (eDSM) measures studied in the Local Achievable Potential Studies for Toronto and Ottawa. Presently, a number of utilities and other parties in North America are undertaking bidirectional charging demonstrations and program pilots to better understand how the technology can act as a grid resource. This includes the IESO which has supported a number of such projects through the Grid Innovation Fund.

After careful consideration and discussion with the L-APS consultant ICF and local utility partners Hydro Ottawa and Toronto Hydro, the IESO decided against including bidirectional charging measures in the study as it does not have confidence that V2G/B[1] could be credibly modelled for the purposes of the study with currently available information, and more fundamentally, the IESO does not have confidence that a program of meaningful scale could be delivered cost-effectively in the near-term. The rationale for these conclusions is detailed below.

This memo is not intended to suggest that V2G/B cannot in the future contribute to maintaining a reliable, affordable, and sustainable electricity system; however, as the memo explains, a variety of uncertainties and barriers must be overcome before V2G/B can become a reliable planning solution.

#1 Limited availability of V2G/B-capable vehicles and uncertain customer acceptance

While a growing number of electric vehicle (EV) models now include a Vehicle-to-Load (V2L) capability (i.e. charging outlets for appliances, tools, etc.) the number of EV models available in

[1] Vehicle-to-grid/Vehicle-to-building

North America that support the capability to feed power back into a building or grid remains limited and predominantly luxury models (e.g. Cadillac, Polestar, Lucid).

While several automative manufacturers have been expanding bidirectional charging capability on product "roadmaps," these plans are highly uncertain and in the past year, many major automakers and their suppliers have delayed plans for introducing new features, expanding their EV model line-up, and increasing production reflecting lower-than-expected consumer demand. This includes Honda, Hyundai General Motors, Ford, Volkswagen, Mercedes, and Volvo.[2,3,4] Related, globally governments and regulators have revised EV sales mandates, deferring targets, introducing more flexibility to manufacturers, or removing the targets altogether. Most strikingly given the linkage of Canadian and American vehicle markets, the current US federal government has ended the previous administration's EV mandate and is presently working to remove the authority of states to impose state-level mandates.

As a result, there is great uncertainty about the future quantity of EVs technically capable of V2G/B that will be present in the Toronto and Ottawa areas under study.

Beyond the uncertainty on the quantity of V2G/B-capable vehicles that will technically be present, there is additional significant uncertainty about customer willingness to participate in V2G/B programs, particularly given customer concerns about battery degradation and warranty impacts.[5] While some research on customer acceptance of V2G/Bs is publicly available, much of it appears based on surveys of EV "early adopters" who are not necessarily representative of the broader population. These factors create greater uncertainty for establishing technical and achievable potential and whether a program could achieve meaningful scale. This risk is demonstrated by Duke Energy's decision to delay a previously announced 100-vehicle V2G pilot citing challenges with customer recruitment.[6]

#2 Uncertain resource availability and performance

Unlike stationary Battery Energy Storage Systems, V2G/B-capable vehicles are not permanently connected to the grid or to building loads and are subject to competing demands (i.e. to provide personal or fleet transportation services, which are the primary function and priority of the batteries in vehicles). This introduces uncertainty as to whether V2G/B resources will a.) be connected to bidirectional charging equipment when required, b.) have energy available to return to the grid or building c.) the vehicle owner will be willing to provide the energy when called upon.

The IESO and other utilities' long experience with customer Demand Response programs has underlined the importance of understanding actual customer availability and event performance

[2] https://www.businesswire.com/news/home/20250512170126/en/Chinese-Competition-and-EV-Delays-Automakers-Top-Concerns-in-2025-Kerrigan-OEM-Survey
[3] https://evxl.co/fr/2025/05/11/hyundai-delays-730m-hypercasting-plant/
[4] https://www.electrive.com/2025/05/27/vw-reveals-key-points-for-the-ssp-electric-platform/
[5] https://sepapower.org/resource/the-state-of-bidirectional-charging-in-2023/
[6] https://www.wfae.org/energy-environment/2023-12-11/duke-energy-delays-program-to-draw-power-from-ev-batteries

in assessing Distributed Energy Resources potential and successful program design. Even where strong financial incentives/penalties are in place, some proportion of customers will be not available to respond, choose not to respond, or will only partially respond when called upon. Better understanding actual resource availability and performance is one of the driving forces behind the IESO and other utilities decisions to undertake V2G/B pilots.

While a simple extrapolation of the battery energy available in the EVs forecasted to be present the study areas is undoubtedly large, this technical potential is not meaningful for planning purposes as it ignores these real-world factors which reduce the achievable potential and currently present uncertainty for the benefits that V2G/B programs would deliver. For V2G, where vehicles inject energy into the grid rather than just displace load behind a customer's meter, there are additional constraints on achievable potential due to physical limitations of transmission and distribution networks to "interconnect" new energy-injecting resources without risking destabilizing voltage and thermal issues (or additional wires investments to manage these issues). On networks with limited interconnection capacity, V2G would be competing for that finite capacity against other resources like stationary battery energy storage and solar PV that may provide greater benefit.

#3 Cost-effectiveness and competitiveness

To justify investing ratepayer funds in an electricity Demand Side Management program, the IESO or local utilities must demonstrate that the benefits to the grid outweigh the costs. We have established that the benefits of V2G/B are currently deeply uncertain. On the other side of the cost-effectiveness equation, the costs appear to vary significantly, but even on the low end, are undoubtedly major. All-in price estimates for residential bidirectional systems are frequently quoted between approximately $7,000 - $27,500 CAD, compared to negligible costs for Level 1 unidirectional charging or generally a few thousand dollars for Level II unidirectional charging.[7] A V2G/B program would need to provide incentives covering a material portion of that incremental installation cost plus ongoing participation incentives to the customer. It would also need to cover standard program administration cost, and the DER management services (i.e. implementation and operation of IT systems allowing the IESO or local utility to communicate with the EV or bidirectional charger) which are typically significant. This uncertainty around cost and benefits led a 2023 survey by the Smart Energy Power Alliance of various utilities working on V2G/B to conclude "the utility SMEs predominantly responded that the value proposition of bidirectional charging needs to be established before they would implement a program."

It should be noted that there are presently opportunities for V2B to contribute to provincial system reliability through the Industrial Conservation Initiative and the IESO's Capacity Auction (through the Dispatchable Load and Hourly Demand Response market participation models). The ICI offers a particularly strong financial incentive for buildings to reduce load during peak hours and has driven major investment in behind-the-meter Distributed Energy Resources, with the 2021 DER Survey reporting over 500 MW of battery energy storage and generation being used for ICI purposes.[8] While IESO is aware of, and has supported, pilots exploring the use of V2B for peak demand reduction, presently these appear to remain limited in scale, underlining questions of cost-competitiveness with stationary battery energy storage.

[7] https://sepapower.org/resource/the-state-of-bidirectional-charging-in-2023/
[8] https://www.ieso.ca/Sector-Participants/Engagement-Initiatives/Engagements/Distributed-Energy-Resources-Survey

#4 Technology integration barriers

Various automative and utility industry publications have highlighted current challenges with gaps in standards or standard implementation for V2G/B interconnection procedures, safety certifications, and communication protocols.[9,10] These issues create barriers to V2G/B program scalability (particularly where initiatives involve multiple manufacturers of EVs and chargers), increases costs, and impact implementation timelines – all of which decrease confidence in the ability to deliver in the near-term a cost-effective V2G/B program of meaningful size.

The automotive industry, utility industry, and standards bodies are actively collaborating to address the issues; however, the pace of resolution is uncertain particularly given evolving US federal government support for EV initiatives and Department of Energy more broadly under the present administration.

Conclusion

In conclusion, V2G/B is a promising but nascent technology. Presently there is deep uncertainty about the near-term business case and scalability of V2G/B programs and significant barriers, which means the IESO does not have confidence that a program could be successfully delivered in the near-term. For this reason, V2G/B is not presently considered a feasible non-wires option and was excluded from the Local Achievable Potential Studies.

Utilities across North America, including the IESO, are operating or supporting V2G/B pilots to better understand the technology and program characteristics. Simultaneously the automotive and utility industry are collaborating in initiatives to reduce costs and technical barriers. The IESO expects that as the resources' availability, performance, customer willingness to participate, cost, and other characteristics are better understood, V2G/B measures will be included in future potential studies and may be considered in the non-wires analysis in subsequent Integrated Regional Resource Plans for Toronto, Ottawa, and other regions.

[9] https://www.autosinnovate.org/posts/papers-reports/VGI%20White%20Paper_2024.pdf
[10] https://sepapower.org/resource/the-state-of-bidirectional-charging-in-2023/

Appendix 1 – IESO Supported V2G/B Pilots

The IESO has supported a number of pilots through the Grid Innovation Fund or other partnerships as shown in the table below. In 2024 the IESO held a Grid Innovation Fund targeted call with a specific funding stream for V2G/B demonstration projects.

Table 1 - IESO Supported V2G/B Projects

Project Lead	Project Name	Description	Number of vehicles
Peak Power	Peak Drive Pilot Project	With non-financial support from the IESO, this project used bidirectional electric vehicle charging and stationary energy storage to reduce customers' demand charges. These distributed energy resources operated in tandem to maximize economic results for the commercial office building.	21
Sky Clean Energy	V2G Charging System	This project demonstrated a public-facing, V2B charging system that enables EV owners to participate in demand response events DR while aggregated with other on-site distributed energy resources (DERs).	1
SWTCH	Enhancing grid efficiency through a block-chain based EV charging and DER	This project aimed to demonstrate a DER aggregation platform that uses open-standard communication protocols (Open ADR) and included Vehicle-to-Building and smart charging technology. This project simulated test cases spanning Demand Response, Operating Reserve, Frequency Regulation and Target Ramp.	1
Alectra	Grid Responsive EV Charging through Alectra V2X and Alectra Drive for Fleets	This project aims to develop and test technology-enabled business models for customers and utilities to make available the flexible	2-5 planned

		capacity available from commercial electric vehicles and to ascertain the applicability and scale of their role as DERs.	
Attridge	Attridge-Toronto Hydro Electric System Limited (THESL) EV-Storage Project	This project aims to showcase and measure the effectiveness of using medium-duty electric school bus fleets as dynamic energy storage systems, providing essential grid flexibility services such as demand response and peak load management.	36 planned

Appendix 2 – Survey of North American V2G/B initiatives

There are at least 84 Vehicle-to-Everything (V2X) projects (which includes V2B, V2G, and V2L) in North America. The table below describes some high-profile or representative projects.

Table 2 - Select North American V2G/B initiatives

Utility	Initiative Name	Description	Number of Vehicles
Consolidated Edison (ConEd)	Unclear	Rideshare company Revel partnered with Fermata Energy and NineDot Energy to install three 15kW Fermata FE-15 chargers in Red Hook, Brooklyn, configured to discharge directly to the grid.	Three Nissan LEAFs
Pacific Gas & Electric (PG&E)	Vehicle-to-Everything (V2X) pilot programs	In compliance with California Senate Bill 676, PG&E's pilot program provides incentives from $2500 up to $8625 (USD) for residential and commercial costumers in upfront and performance incentives with the goal of testing different applications	Participation data not publicly available

		of bidirectional charging across various customer and vehicle classes.	
Dominion Energy Virginia	Electric School Bus Program	50 V2G-capable electric school buses in various urban and rural environments were deployed in Virginia through the Electric School Bus Program to understand grid impacts and potential utility and customer benefits.	50 Thomas Built Saf-T-Liner C2 Jouley school buses.
BC Hydro	Canada's First Bidirectional EV Charging Hub	Coast To Coast Experience's electric buses, which spend much of the day parked, will serve as mobile energy sources under this pilot program. BC Hydro can tap into the stored power from these bidirectional EVs during peak demand periods, helping to stabilize the grid.	Participation data not publicly available
Xcel Energy	Vehicle-to-Everything Bidirectional Charging Pilot	V2B pilot intended to "provide insights into resiliency and technology deployment strategies in areas of highest risk of prolonger outages due to natural disaster or emergency events" with four directional chargers installed at a multi-family building and a commercial building.	Six light-duty EVs