Vehicle-to-Building/Grid

Presentation for the Ontario Energy Board Framework for Energy Innovation Working Group

EB-2021-0118

July 29, 2021

Elson Advocacy

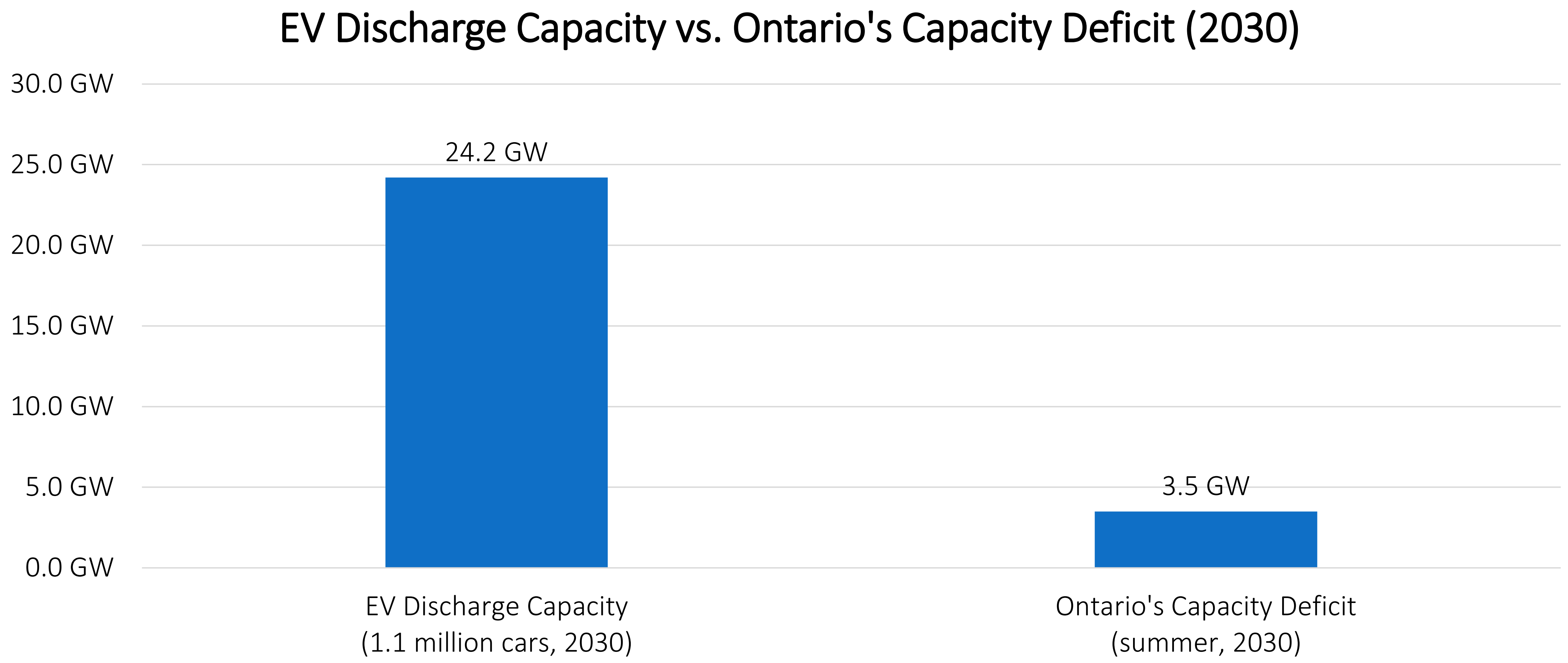
Elson Advocacy

Overview

1. EVs are an enormous opportunity to lower distribution costs and electricity rates
2. Simple smart chargers and EV rates are highly cost-effective – EVs saved California distribution customers more than $500 million by shifting load profiles
3. Bi-directional charging offers even greater benefits by offsetting other loads
4. Technical barriers to bi-directional charging have largely disappeared
5. Bi-directional charging is important potential LDC tool as (a) a non-wires alternative and (b) to manage grid impacts of EV expansion
6. When all cars are electric, their gross discharge capacity (GW) will be more than 6 times Ontario's total peak demand
7. This is urgent – it is cheaper to incentivize bi-directional charging now before millions of "dumb" and "one-directional" chargers are purchased

Elson Advocacy

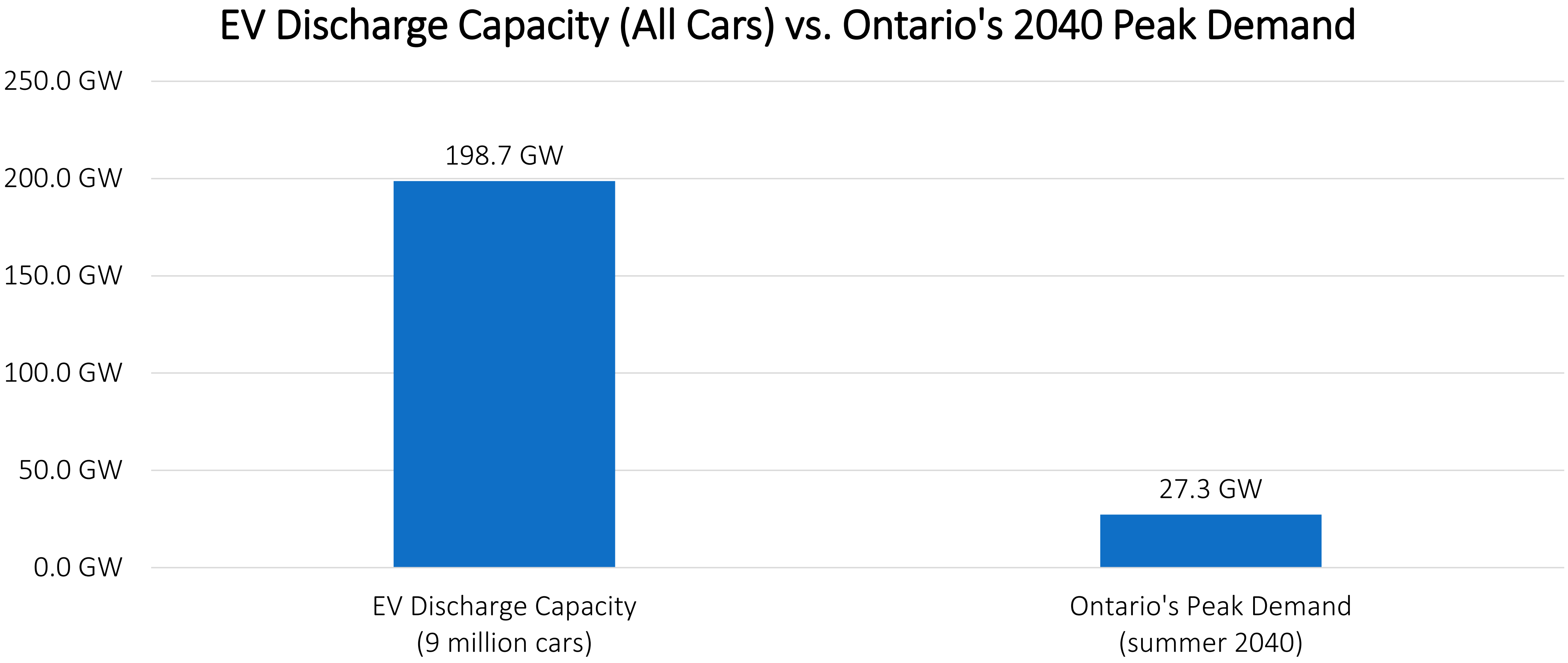
Enormous opportunity



For sources and calculations, see slide 5.

Elson Advocacy

Enormous opportunity



For sources and calculations, see slide 5.

Enormous opportunity

Discharge Capacity of EV Batteries (GW)		
	All Cars (2019)	EVs by 2030
Number of Cars	9,031,832[1]	1,100,000[2]
GW Capacity (@ 22 kW) [3]	198.7 GW	24.2 GW

[1] Statistics Canada (link).
[2] Strategic Policy Economics, *EV Batteries Value Proposition for Ontario's Electricity Grid and EV Owners A Preliminary Cost and Benefit Assessment*, July 2020 (link).
[3] Calculation: cars * 22 kW (see slide 6 re example discharge rates). In-home discharging will typically be less than 22 kW whereas commercial discharging can be much higher – see slide 6.

Ontario Capacity Needs		
Capacity Deficit (2030)	Peak Demand (2030)	Peak Demand (2040)
3.5 GW	25.5 GW	27.3 GW

[1] IESO, 2020 Annual Planning Outlook (link)

Elson Advocacy

Capacity to reduce distribution peaks

- Factors impacting capacity to reduce peaks:
  - Number of EVs
  - Number, discharge capacity (kW), and capability of bidirectional EV chargers
    - Some examples: The new Ford F150 will have a ~10 kW discharge capacity; there are some intermediate DC options with 22 kW including one from Volkswagen and some others; commercial grade chargers can reach higher rates, such as 30 kW, 51 kW, 60kW and 125 kW.
  - Appropriate regulatory treatment and price signals
  - Customer behavior
- Note: Cars are parked 95% of the time on average; car commutes are less than 30 minutes on average; and most cars are parked even at rush hour

[Donald Shoup, *The High Cost of Free Parking* (link); Professor Paul Barter, "*Cars are parked 95% of the time*", (link); Avg. car commute is 26.3 minutes in Ontario (per Statistics Canada); Most cars are not used for commuting (per Statistics Canada)]

Elson Advocacy

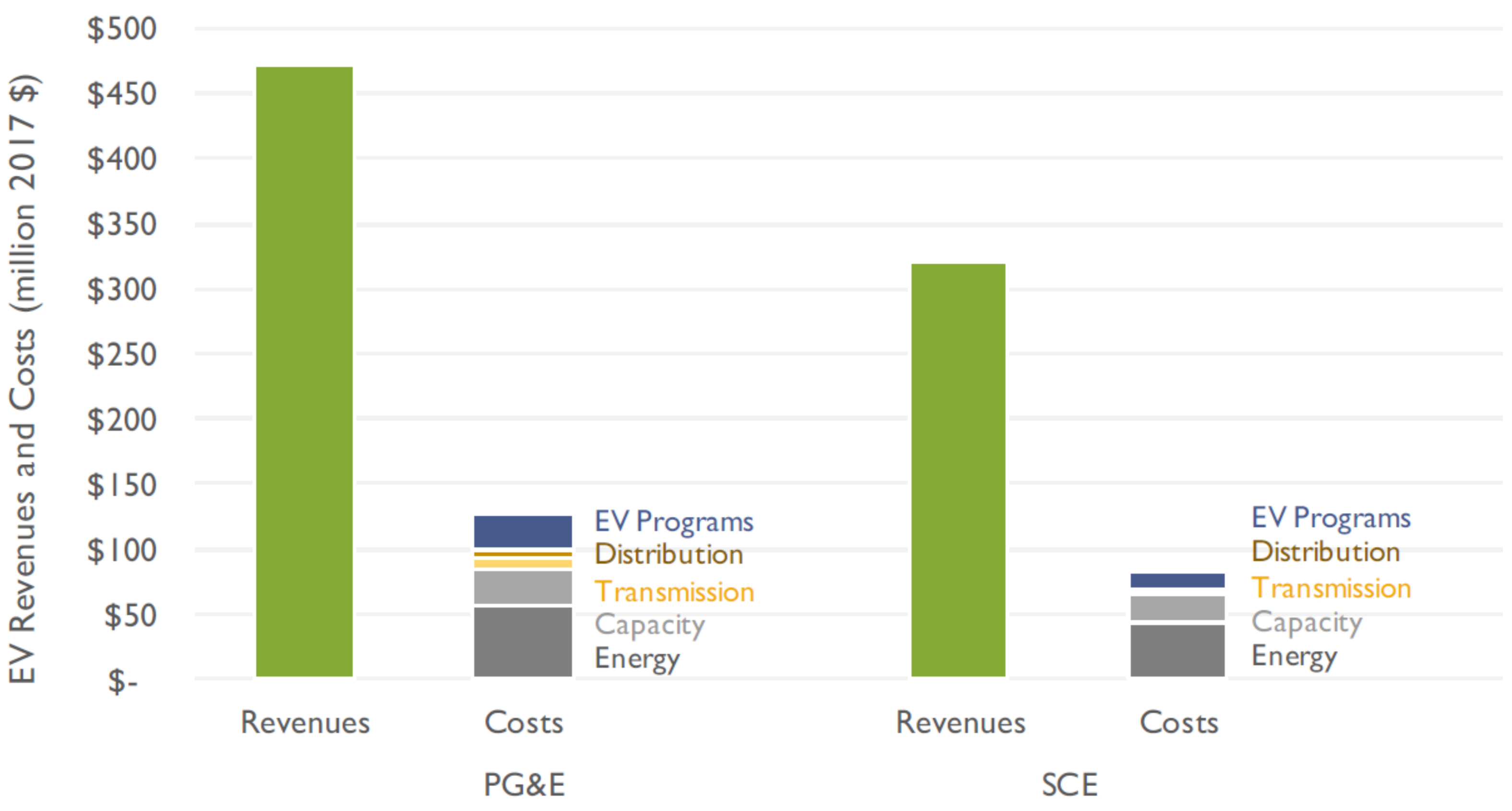
Types and terms

- **One-way smart charging** (V1X), which shifts EV load to off-peak times
- **Bi-directional charging** (V2X), which offsets other loads
  - **Vehicle-to-building** (V2B): Discharging battery to offset other building loads at the peak (often includes vehicle-to-home, which is the residential version of vehicle-to-building)
  - **Vehicle-to-grid** (V2G): Discharging battery to export into the grid to offset other grid loads

Smart charging (V1X) & EV/TOU rates

- Major distribution system benefits opportunity
- EV's saved distribution customers **$584 million** in California (Synapse Energy Study)
- Results transferable to Ontario (Plug'n Drive study)
- Off-peak loads lower electricity costs ($/kW and $/kWh)

Figure 4. PG&E and SCE Revenues and Costs of EV Charging, 2012-2018



Elson Advocacy

Barriers to V2G/B disappearing

- More EVs available with bi-directional capabilities
  [Including Volkswagen Group EVs starting in 2022 (incl. VW, Audi, etc.), Tesla vehicles (date TBD), the Ford F150 Lightning, and the 2022 Hyundai Ioniq 5. Previously only the Nissan Leaf and Mitsubishi Outlander had official bidirectional capabilities in Canada (for other vehicles there was a risk of voiding the warranty).]
- More chargers available with bi-directional capabilities [See slide 6 for a few examples.]
- "Million mile+" batteries will reduce concerns about reduced battery life
  [Bloomberg, *A Million-Mile Battery From China Could Power Your Electric Car*, June 7, 2020 (link); RMI, *A Million-Mile Battery: For More Than Just Electric Vehicles*, June 24, 2020 (link).]
- V2B is becoming a selling point: Ford is advertising that its new F150 can power your home for up to 10 days
- EVs are expanding faster: The federal government is mandating that 100% of new cars be EVs by 2035
- Regulatory barriers persist (see slide 13)

Elson Advocacy

Nova Scotia Power pilot

- David Landrigan, vice-president of commercial for Nova Scotia Power: **"I think we can call it a game-changing resource"**
- $2.2 million pilot project
- One-way smart charging: subsidized chargers, 200 customer target
- Bi-directional charging: 4 different charger types, target of 20 chargers
  - Coritech 30kW bi-directional connected to a College's building automation system
  - Next will be a unit from Quebec-based Ossiaco
  - Residential units planned
- Goals include: Testing the equipment, testing energy systems platform software, and being ready both the challenges and opportunities of EV integration
- More info: CBC & NS UARB

Elson Advocacy

Other programs / pilots

- UK Power Networks has contracted 248 MW capacity from EV batteries through Octopus Energy
- Utilities in the United States are piloting vehicle-to-grid, including:
  - San Diego Gas & Electric in California (10 V2G busses, 25 kW/bus, 250 kW)
  - Con Edison in New York (5 V2G busses, 10 kW/bus, 50 kW)
  - EDF Energy in the UK (Customer-facing V2G program based on ABB equipment)
  - National Grid in Rhode Island (Fermata V2G bidirectional pilot, 15-20 kW)
  - Roanoke Electric Cooperative in N. Carolina (Fermata V2G system, 15-20 kW)
  - Green Mountain Power in Vermont (Fermata V2G bidirectional pilot, 15-20 kW)
  - Austin Energy in Texas (V2G/V2B pilot)
  - Snohomish County Public Utility District in Washington State (V2G pilot)
- Building owners are installing and piloting vehicle-to-building systems
  [For example: Alliance Centre, Colorado and City of Boulder, Colorado]

Uses for LDCs: NWAs and EV mitigation

- Important for distributors as:
  A. A non-wires-alternative (NWA) to traditional capital infrastructure
  B. A tool to manage impacts of EV expansion on the distribution grid
- Potential programs (if cost-effective):
  - Subsidize bi-directional chargers conditional on accepting an EV rate structure
  - Purchase V2X peak demand reductions from an aggregator controlling customer chargers
  - Bi-directional chargers for on-street or municipal parking
  - Partnering with institutions (e.g. public transit, schools) to access fleet capacity
  - EV rate structures
- NWAs are geographically targeted; efforts to manage EV impacts may or may not be

Removing regulatory barriers

1. Improve rate design: opt-in EV rates (e.g. Alectra Pilot), enhanced TOU rates, co-incident peak demand charges…
   - This would fix a market failure. Costs are peak-driven; prices should be too. Price signals would encourage lower-cost & competitive vehicle-to-building solutions
2. Adjust utility incentives: level the playing field for non-wires alternatives and traditional capital investments
   - This is necessary to align utility and consumer interests
3. Appropriate cost-effectiveness tests for non-wires alternatives
4. Reduce connection cost and effort for vehicle-to-building/grid technology
   - E.g.: Standardized requirements, simplified fast-track connection process, etc.
5. Pilots, technical guidance, and other steps…

Elson Advocacy

Urgent priority

- It is cheaper to incentivize bi-directional charging sooner, before millions of “dumb” and “one-directional” chargers are purchased
- About 1 million customers will start charging EVs at home between now and 2030; many commercial EV chargers will be purchased over that time
- The opportunity to upgrade to bi-directional chargers is greatest before the initial purchase (i.e. the *incremental* cost is lowest)
- The lead time for a vehicle-to-building/grid program is likely long (needs OEB policy changes, LDC program development, program approval by OEB, etc.)

Appendix 1: Comparison of Some Example Implementations

Smart chargers (shift charging load to off-peak times)	• Minimal to no setup effort and cost • Best with good rate design (e.g. opt-in EV rates, strong TOU rates) • Reduces EV charging load only (no offset of building/grid loads)
Vehicle-to-building Not-utility dispatched	• Greater setup effort/cost (mainly equipment cost) • Best with good rate design (e.g. EV rates, co-incident peak demand charges) • Best if fully automated and price-signal responsive • Reduces EV charging load AND other building loads • Little to no customer loss of control / convenience • Demand reductions not 100% certain, need to be modelled at aggregate level like efficiency programs
Vehicle-to-building Utility dispatched	• Greater setup effort/cost (incl. admin/effort to contract with utility or aggregator) • Better with good rate design (e.g. EV rates, co-incident peak demand charges) • Reduces EV charging load AND other building loads • Some customer loss of control / convenience • Demand reductions certain
Vehicle-to-grid Utility dispatched	• Greater setup effort/cost (incl. connection costs) • Better with good rate design (e.g. EV rates, co-incident peak demand charges) • Reduces EV charging load AND building loads AND grid loads • Some customer loss of control / convenience • Demand reductions certain