

100% “EV Ready” Requirements

Why they exist, how to comply, and design strategies to maximize value

March 2023





EXPERTISE



Buildings + Industry



Energy



Mobility

SERVICES



Quantify Opportunities



Design Strategies



Evaluate Performance



GOVERNMENTS

UTILITIES

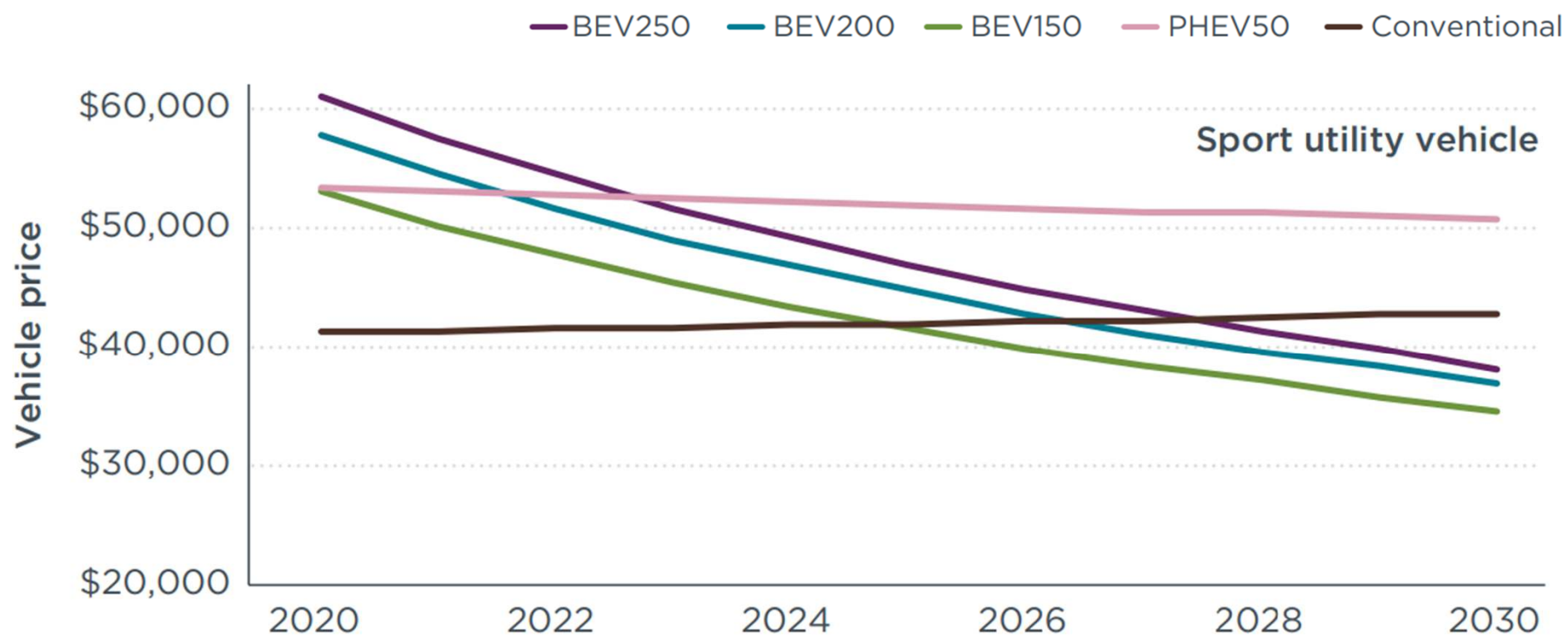
CORPORATE + NON-PROFIT

Outline

- 1 Overview of electric vehicles (EVs)**
- 2 About EV Charging & EV Ready Parking
- 3 About EV Energy Management Systems & EV Charging Service Providers
- 4 New Construction EV Ready Requirements & How to Comply
- 5 Design Strategies to Maximize Value
- 6 EV Charging Infrastructure in Existing Multifamily Buildings (Time Permitting)

EV Overview

Technology advancements, improving economics & strong policies will drive the transition to EVs in the next decade

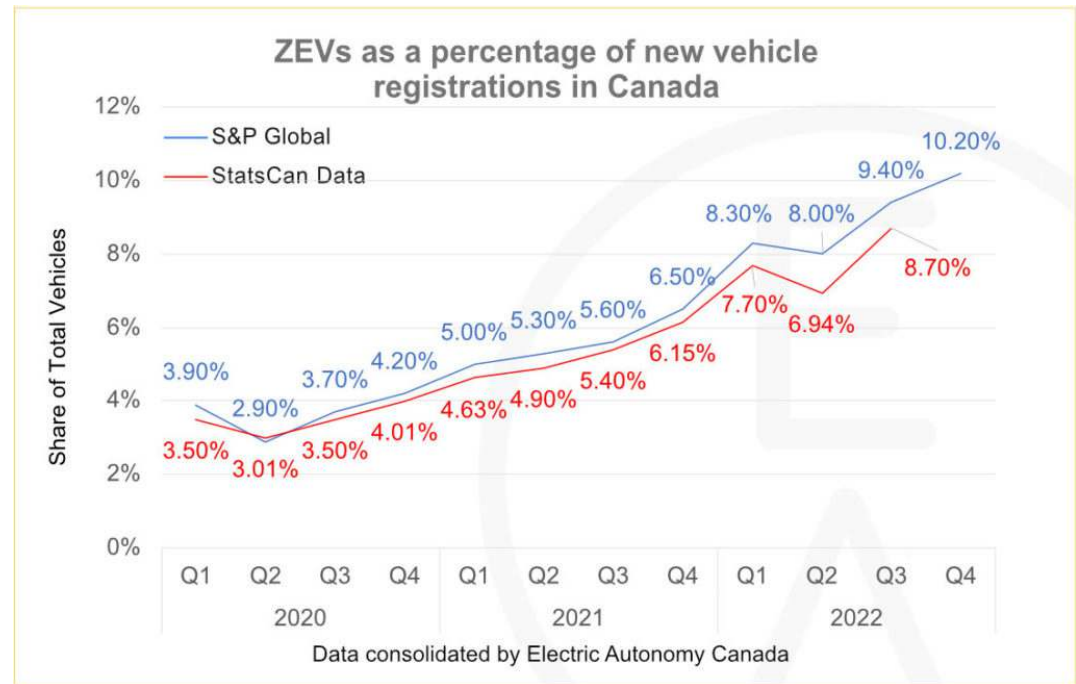


Source: International Council on Clean Transportation. 2019. *Update on electric vehicle costs in the United States through 2030*. https://theicct.org/wp-content/uploads/2021/06/EV_cost_2020_2030_20190401.pdf

Policy is Driving EV Adoption

In June 2021, the Federal Government announced it would adopt zero emissions vehicle sales requirements:

- 20% by 2026
- 50% by 2030
- 100% by 2035






Source: <https://electricautonomy.ca/2023/02/13/canada-zev-sales-q4-2022/>

About EV Charging & EV Ready Parking

About EV Charging

Know your EV Charging Stations

		
<p>AC Level 1</p> <p>Voltage 120V 1-Phase AC</p>	<p>AC Level 2</p> <p>Voltage 208V or 240V 1-Phase AC</p>	<p>DC Fast Charge</p> <p>Voltage 208V or 480V 3-Phase AC</p>
<p>Amps 12 – 16 Amps</p>	<p>Amps 12 – 80 Amps (Typ. 32 Amps)</p>	<p>Amps <125 Amps (Typ. 60 Amps)</p>
<p>Charging Loads 1.4 to 1.9 kW</p>	<p>Charging Loads 2.5 to 19.2 kW (Typ. 7kW)</p>	<p>Charging Loads <90 kW (Typ. 50kW)</p>
<p>Charge time for vehicle 3 – 5 miles of range per hour</p>	<p>Charge time for vehicle 10 – 20 miles of Range per hour</p>	<p>Charge time for vehicle 80% Charge in 20 – 30 minutes</p>

Source: Geotab

Slide 8

BMO [@Justine Provost] - if we have any Dunsky graphics that illustrate the different levels of charging, maybe we can use those

Brendan McEwen, 2022-06-07T17:49:34.866

Where do we charge?

Access to “Home Charging” is Critical to EV Adoption



It's costly & complicated to implement EV charging in existing multifamily buildings that are not future-proofed



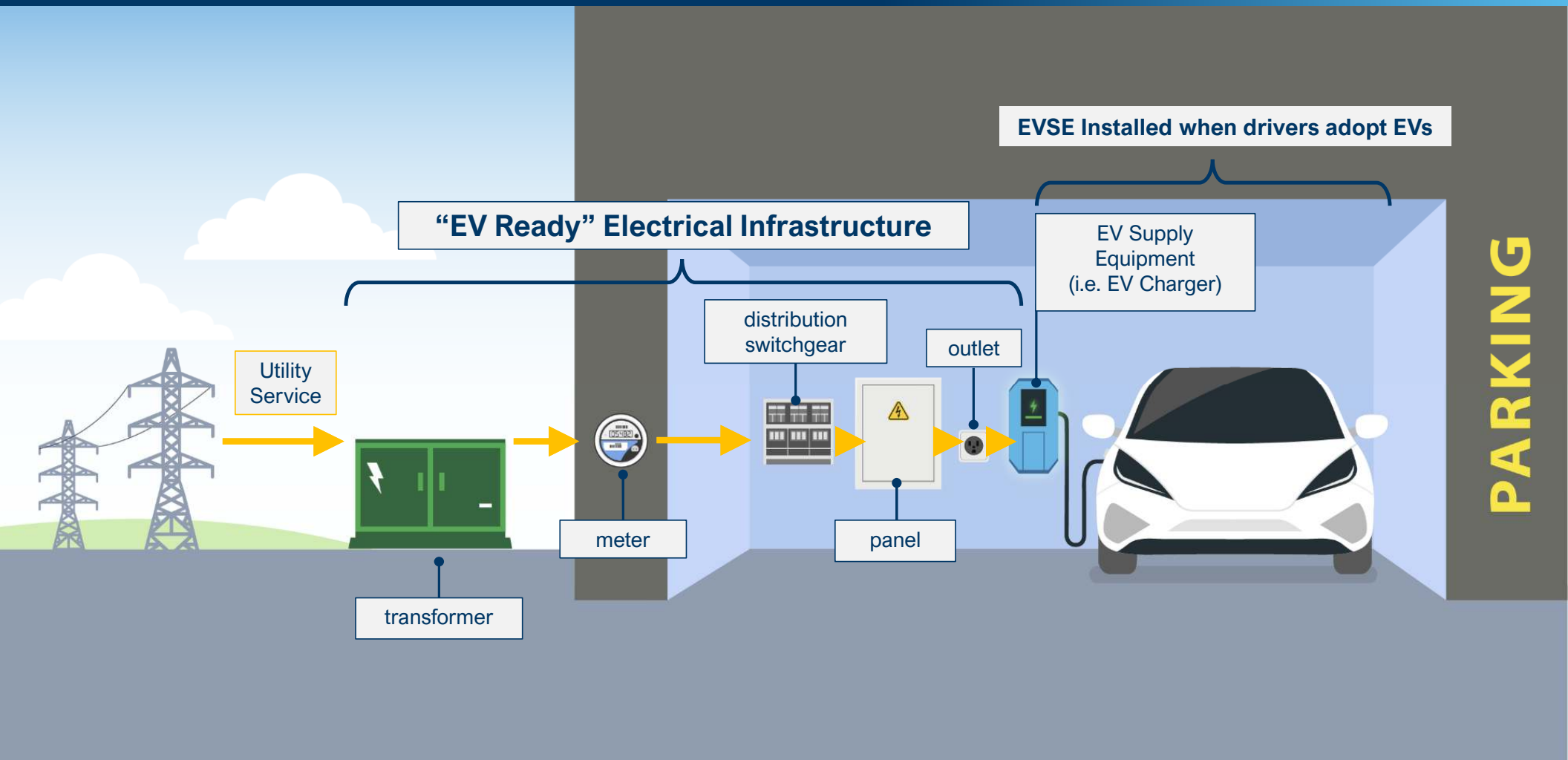
EV Charging in Multifamily Buildings

- **Incremental charger additions costly**
 - ~\$5-\$15k+ per charger
- **Complicated approvals processes**
 - Condo decision-making processes
 - Split-incentives for rental apartments
- **Electrical capacity is limited**
 - Risk of stranded assets & significant costs as EV charging infrastructure grows, if initial designs are properly future-proofed



Future-proofing parking to support easy implementation of EV charging

“EV Ready” Infrastructure



Slide 11

- JPO** [@Brendan McEwen] I leveraged an old illustration to develop this one. Please review all elements and let me know if they are accurate in their representation
Justine Provost, 2022-06-10T16:19:47.920
- BM0 0** [@Justine Provost] looks great - do you think you could also add distribution switchgear (which you'd find in MURBs), per the graphic on the following slide? Thanks
Brendan McEwen, 2022-06-13T01:11:08.016
- JPO 1** [@Brendan] did you mean the switchboard? Are the transformer and meter ok?
Justine Provost, 2022-06-13T13:35:45.742
- BM0 2** Hi Justine - yes, sorry "switchboard" and "distribution switchgear" are roughly synonymous. The switchgear should come after the meter and before the panel.
thanks!
Brendan McEwen, 2022-06-13T13:55:38.478
- JPO 3** Updated!
Justine Provost, 2022-06-13T14:20:27.042
- BM0 4** beauty! You're GENIUS, Provost!!! :)
Brendan McEwen, 2022-06-13T14:25:36.814

What is an electrical outlet?



Junction Box



Receptacle



About EV Energy Management & EV Charging Service Providers

EV Energy Management Systems

- **EVEMS monitor and control EV loads.**
 - Enabled in Canadian Electrical Code.
- **Advantages include:**
 - Reduction in electrical capacity and associated electrical infrastructure costs to provide EV charging.
 - Managing EV loads to maximize value – e.g. avoid demand charges; respond to dynamic rates; respond to utility demand response events; use variable renewable energy; etc.
- **EVEMS are important to enabling high levels of EV charging in many MURBs, workplaces, and fleet parking applications.**

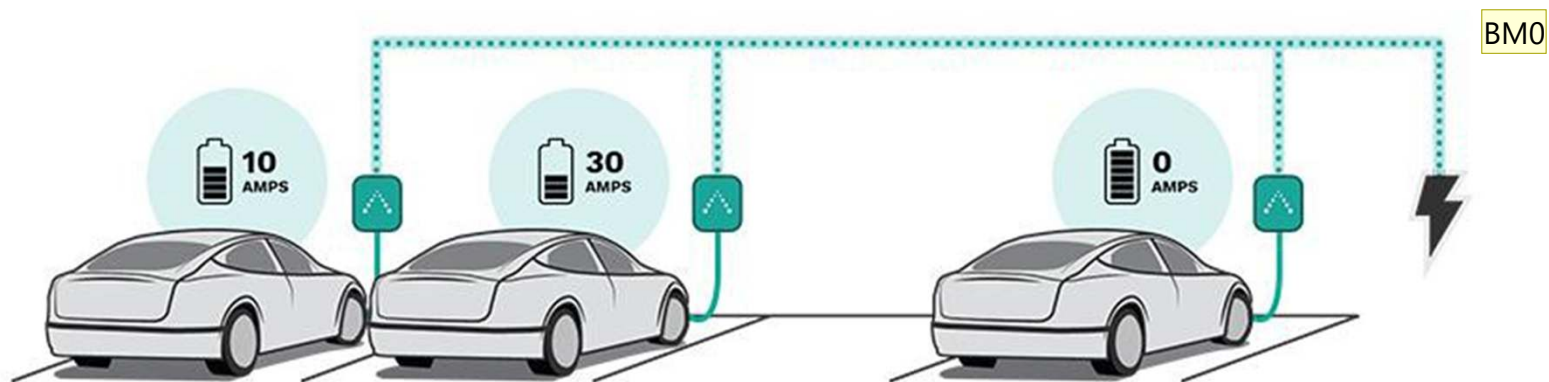


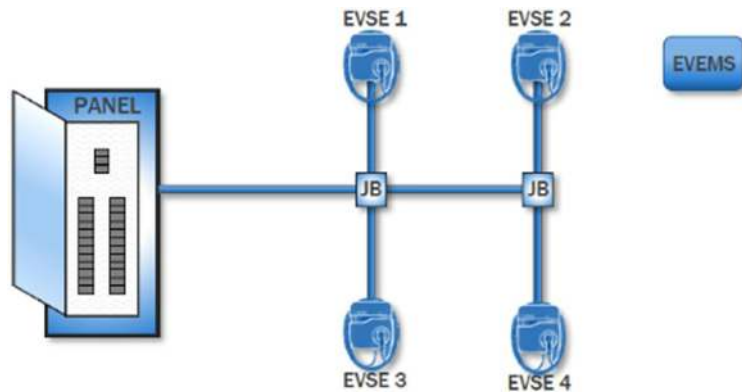
Image Source: Evercharge.

Slide 14

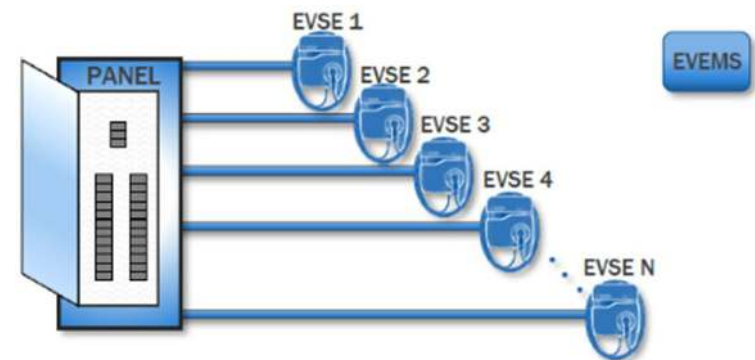
BMO [[@Justine Provost](#)] this generic EVEMS graphic might be nice to Dunksify
Brendan McEwen, 2022-06-08T14:55:02.253

Some Electrical Infrastructure Configurations

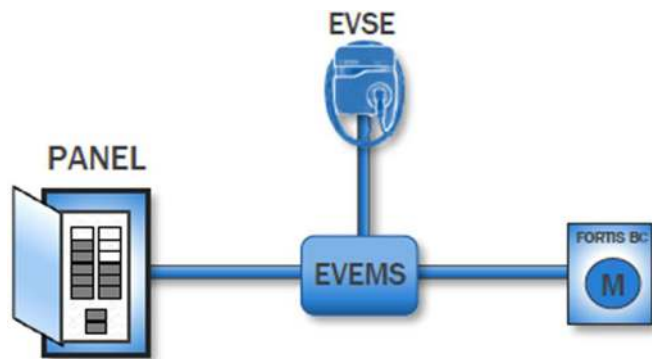
Source: AES Engineering. 2019.



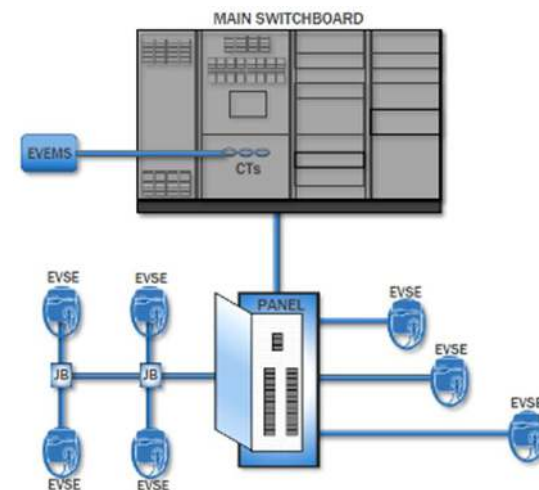
Circuit sharing: Multiple EVSE on a circuit, with control to ensure capacity is not exceeded.



Panel sharing: EVSE loads in excess of panel, with control to ensure capacity is not exceeded.

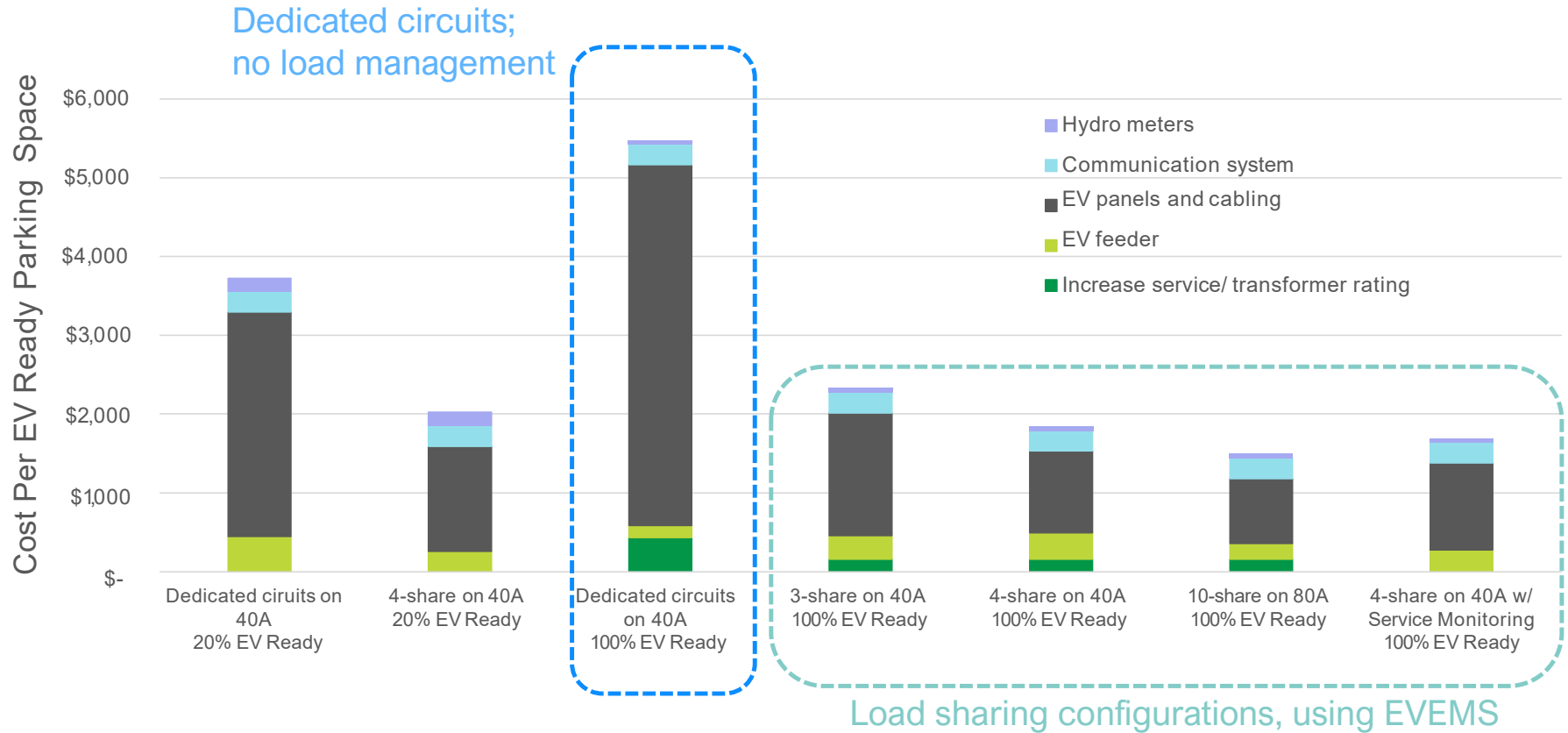


Feeder sharing: on/off control of EVSE based on available capacity on the supply to an electrical panel.



Service monitoring: Monitoring of spare capacity on building's main electrical board; and control of EV loads accordingly.

Designing for load sharing using EVEMS reduces costs



Source: AES Engineering. 2021. *Electric Vehicle Charging Infrastructure Costing Study*. Prepared for the Clean Air Partnership. <https://cleanairpartnership.org/cac/wp-content/uploads/2021/10/2-21-050-GTHA-EV-Ready-Costing-Study-2021.10.14.pdf>

About EV Charging Service Providers

Services provided for “site hosts” (e.g. multifamily buildings)

- Provide EVSE
- Access control
- User apps & admin dashboards
- Reconcile electricity costs - Apply user fees, bill EV drivers, repay condo / owner
- Data
- EV energy management
- Warranties
- O&M
- Customers assistance & support
- Help buildings access revenue for EV charging, e.g.:
 - Utility demand response
 - Clean Fuel Standard

-chargepoint®

ampUp

SWTCH

Hypercharge

And other charging service providers...



EV Ready New Construction Requirements

EV Ready New Construction Requirements



Jurisdiction	Residential	Commercial
City of Toronto, ON	100% EV Ready	25% EV Ready
City of Vancouver, BC	100% EV Ready	45% EV Ready
City of Richmond, BC	100% EV Ready	TBD
City of P. Coquitlam, BC	1 EV Cap. / dwelling	TBD
City of Burnaby, BC	100% EV Ready	TBD
City of Coquitlam, BC	1 EV Ready / dwelling	TBD
City of New West., BC	100% EV Ready	TBD
City of N. Vancouver, BC	100% EV Ready	45% EV Ready
City of P. Moody, BC	100% EV Ready	TBD
District of Squamish, BC	100% EV Ready	TBD
City of Surrey, BC	100% EV Ready	20% EV Ready
Township of Langley, BC	1 EV Ready / dwelling	TBD
District of Saanich, BC	100% EV Ready	Varies
City of Nelson, BC	1 EV Ready / dwelling	10% EV Ready
District of West Van., BC	100% EV Ready	TBD
City of Victoria, BC	100% EV Ready	5% EV Ready
Ville de Laval, QC	50% EV Ready	
Previous Ontario Building Code (rescinded)	20% EVSE	20% EVSE

Toronto's EV Ready Requirements

Zoning By-law 569-2013

200.5.1.14 - Electric Vehicle Infrastructure

Parking spaces must be equipped with an energized outlet, which is clearly marked and identified for electric vehicle charging, in accordance with the following:

- (A) all residential parking spaces provided for dwelling units located in an apartment building, mixed use building, "multiple dwelling unit building", detached house, semi-detached house, townhouse, duplex, triplex, fourplex, or for a secondary suite or laneway suite, excluding visitor parking spaces, must include an energized outlet capable of providing Level 2 charging or higher to the parking space; and
- (B) in cases other than those set out in (A) above, 25 percent of the residential and non-residential parking spaces in a building must include an energized outlet capable of providing Level 2 charging or higher.

Toronto Green Standard V4: Charging Performance Requirements

Circuit Breaker Size	Maximum number of EVs
20A	1
30A	2
40A	4
50A	5
60A	6
70A	8
80A	10

Strategies to Maximize Value

For multifamily apartments/condos & ground-oriented housing with private garages.

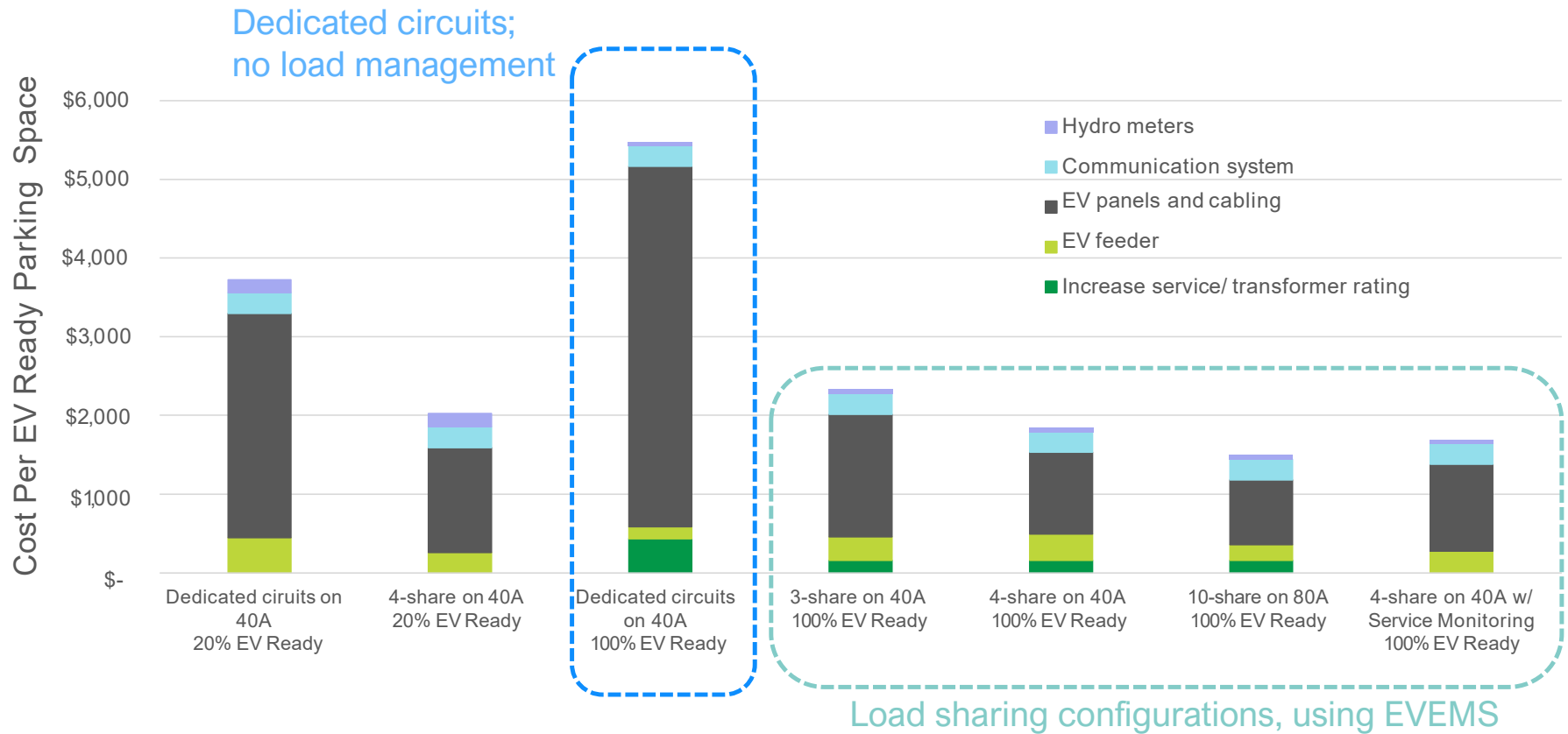
Caveat: I am not an electrical engineer. Nothing supplants the value (& responsibility) of the design professionals & developers associated with a project.

Common Multifamily Parking (e.g. underground parkade)

- **Unmanaged dedicated circuits are allowed, but...**
- **Design strategies will usually be predicated on the use of load sharing using EVEMS**
 - Reduces the size of electrical systems, and associated costs of construction
 - Load sharing using EVEMS will reduce energy costs for buildings / EV drivers
 - May increase costs of EVSE for buildings / EV drivers
 - Design & any associated EV services should ensure EV drivers do not need to prematurely replace EVSE!



Designing for load sharing using EVEMS reduces costs



Source: AES Engineering. 2021. *Electric Vehicle Charging Infrastructure Costing Study*. Prepared for the Clean Air Partnership. <https://cleanairpartnership.org/cac/wp-content/uploads/2021/10/2-21-050-GTHA-EV-Ready-Costing-Study-2021.10.14.pdf>

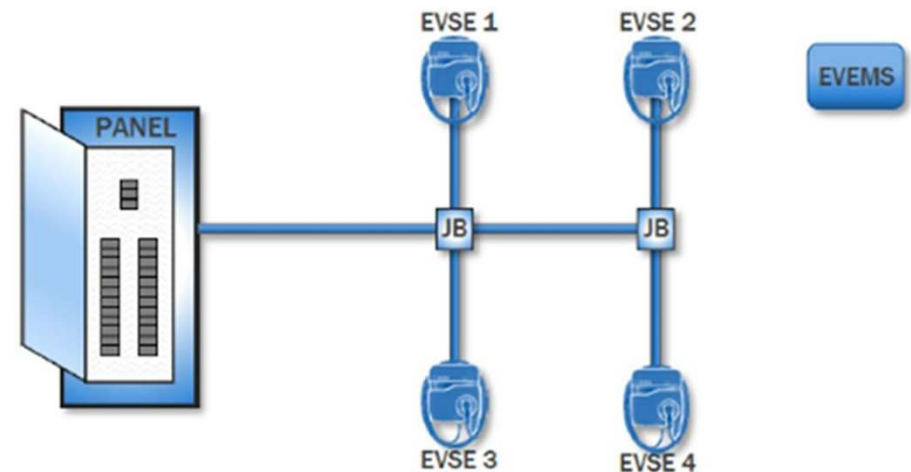
Common Multifamily Parking (e.g. underground parkade)

Branch Circuit Configurations

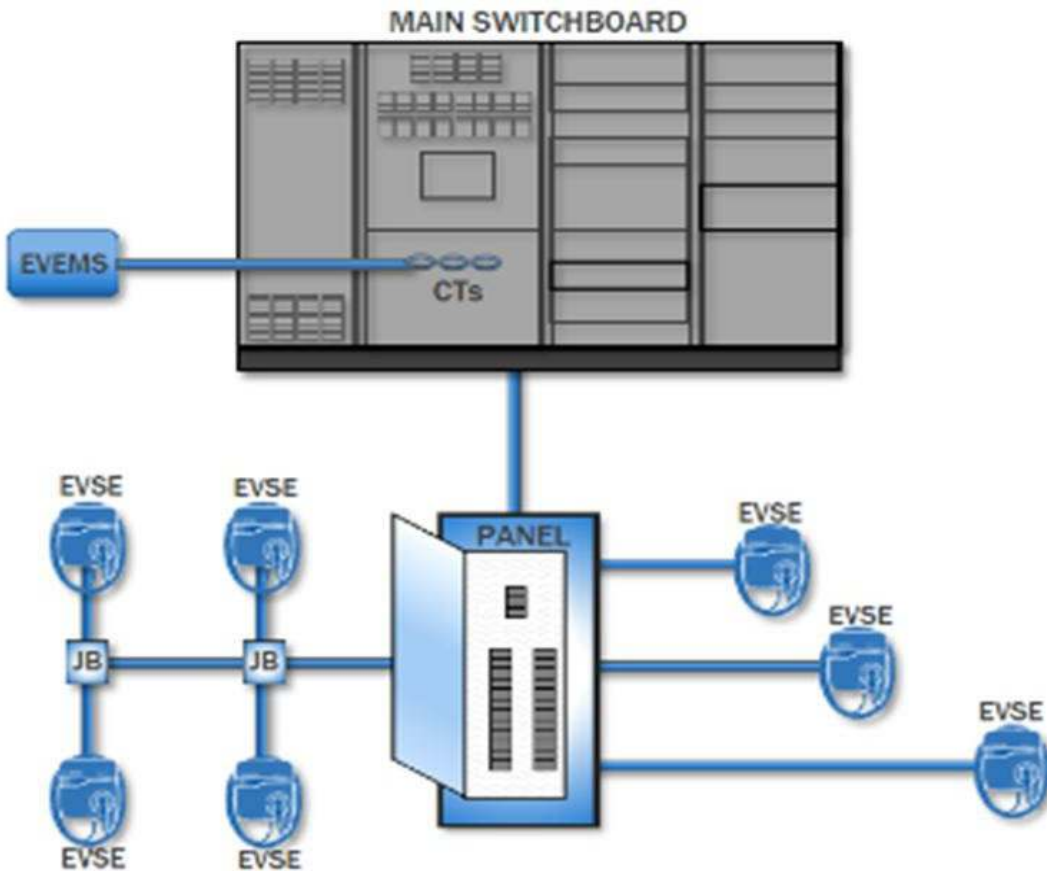


- **4-share on 40A is “bread and butter”**
 - Compatible with many EVSE & associated EV charging services targeted at multifamily buildings
 - Meets Toronto’s Performance Requirements
- **Other design strategies (e.g. 10-share on 80A) are less common**
 - Currently face barriers (e.g. CE Code)
 - Fewer compatible, tested products
 - Could provide value in the future (e.g. reduced cost; reduce loads; etc.)

A 4-share on 40A circuit configuration



Consider service monitoring if otherwise facing expensive electrical service upgrades



A configuration using service monitoring

CE Code determines load calculations

8-106 (10) Where EVSE loads are controlled by an EVEMS, the demand load for the EVSE shall be equal to the maximum load allowed by the EVEMS.

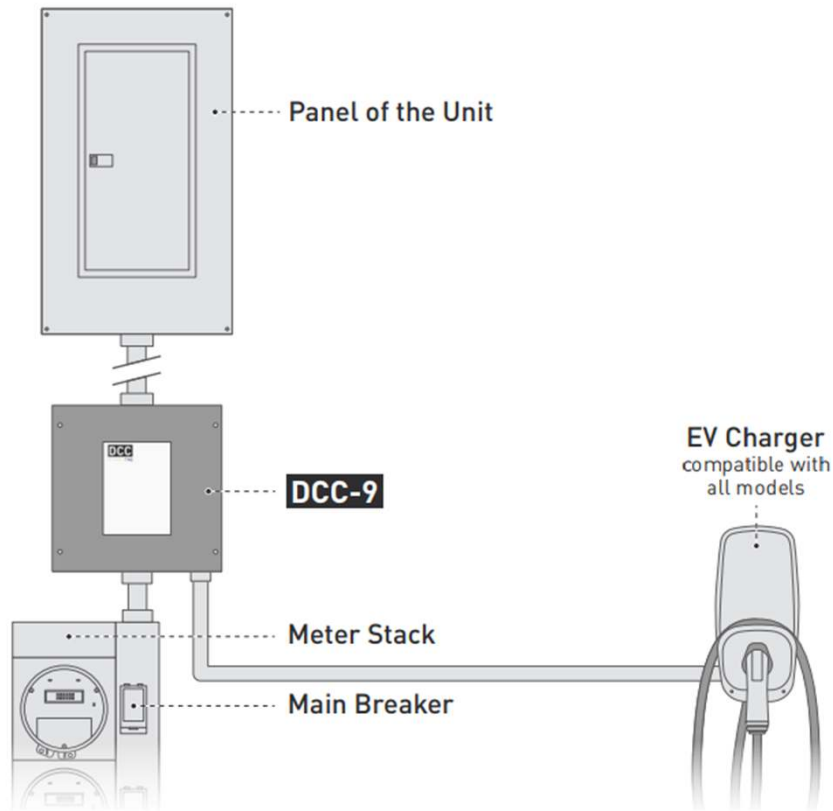
8-106 (11) ... where an EVEMS as described in Subrule 10) monitors the consumer's service and feeders and controls ... the demand load for the EVSE shall not be required to be considered in the determination of the calculated load."

Private Parking (e.g. Townhomes; Single Family Homes)

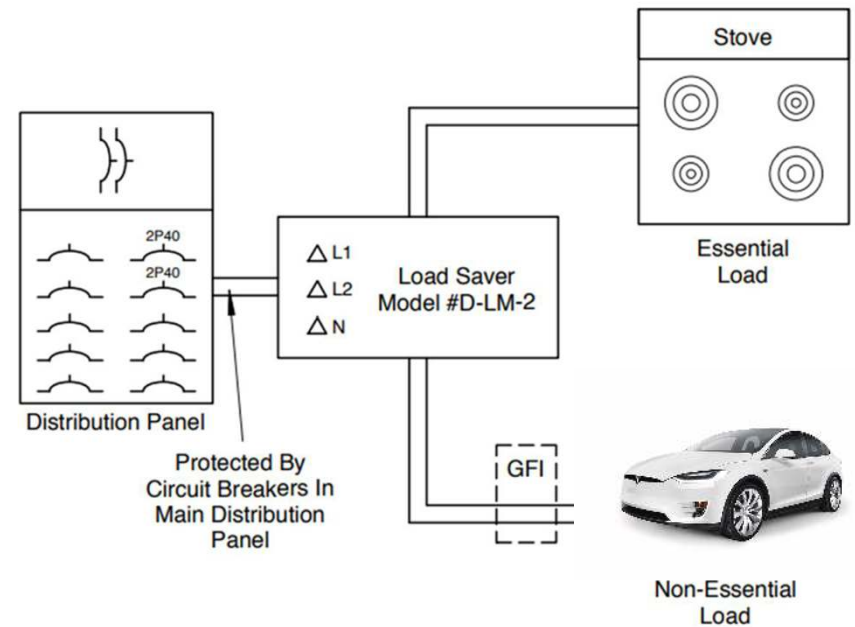
- **Consider 40A dedicated circuits to parking**
- **Explore impacts of utility service costs early on in a developments' design. If service upgrades required:**
 - Consider cost implications of larger service
 - Consider impact of 20A or 30A circuits – Will service upgrades still be required?
 - Consider impacts of load switching, circuit sharing and/or feeder monitoring EVEMS – Will service upgrades still be required?
 - Consider designing for service monitoring EVEMS
 - See CE Code 8-106 (16), 8-106 (11), & 8-500



EVEMS Solutions Applicable to Townhomes & SFHs



An Example of Service / Feeder Monitoring.
Source: RVE.



An Example of Circuit Switching.
Source: AC Dandy.

EV Charging Service Providers

- **Many designs (but not all - e.g. dedicated circuits) require the use of one EV charging service provider for the building**
 - EVSE compatible with the EVEMS
 - Services compatible with building
- **Developers should associate new buildings with a system compatible with the buildings' EV Ready design**
- **Key Considerations When Selecting EV Charging Service Providers**
 - Price (EVSE & ongoing fees)
 - Quality of chargers
 - Warranties
 - Staying power (e.g. market position; reputation)
 - Proprietary systems vs. open protocols (e.g. OCPP)
 - Local service
 - Etc.

Contact



Brendan McEwen

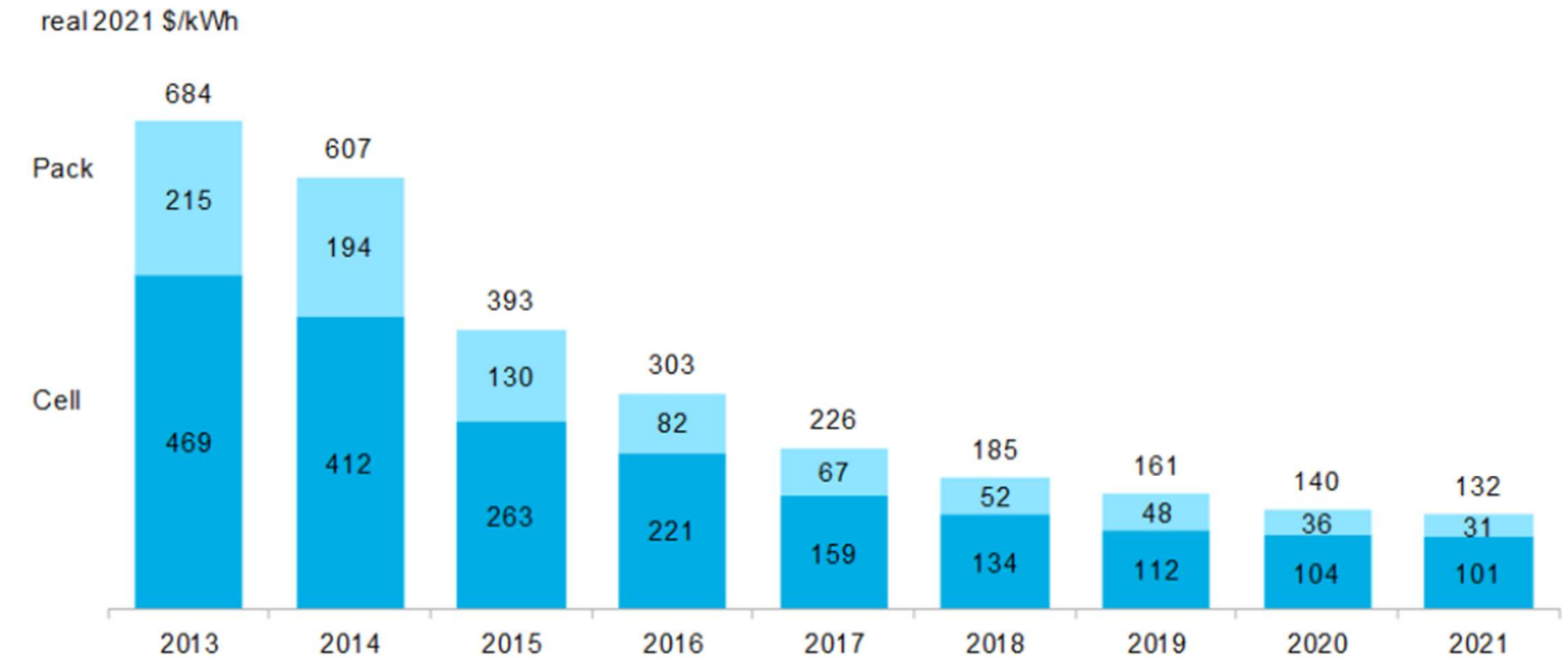
Managing Consultant

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Additional Slides

Battery Prices are Declining



Source: BloombergNEF.

How much load sharing is appropriate depends on how far vehicles drive

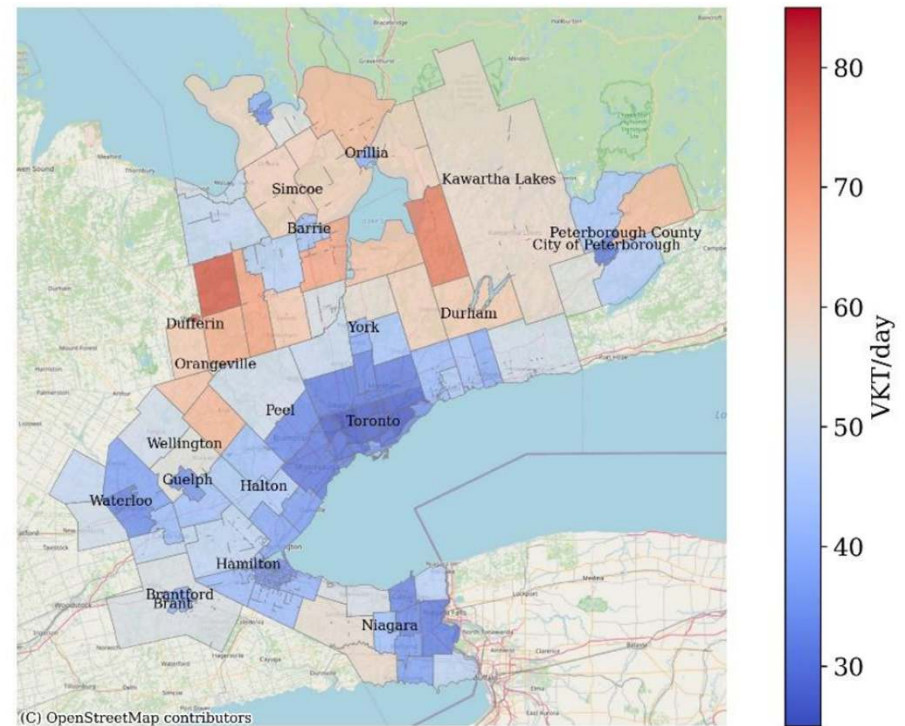
EV Charging Performance Requirements



Maximum number of EVs that can share an electrical branch circuit, if all vehicles receive sufficient charge for next day's driving >99% of time (assuming only home charging is used)

Circuit Breaker Size	Maximum number of EVs (by Mean VKT)					
	45km or less	50km	55km	60km	65km	70km
20A	1					
30A	2	2	1	1	1	1
40A	4	3	3	2	2	2
50A	5	4	4	3	3	2
60A	6	5	5	4	4	3
70A	8	7	6	5	5	4
80A	9	8	7	6	6	5
100A	12	10	9	8	7	7
125A	15	14	12	11	10	9

VKT by Planning District in the GTHA

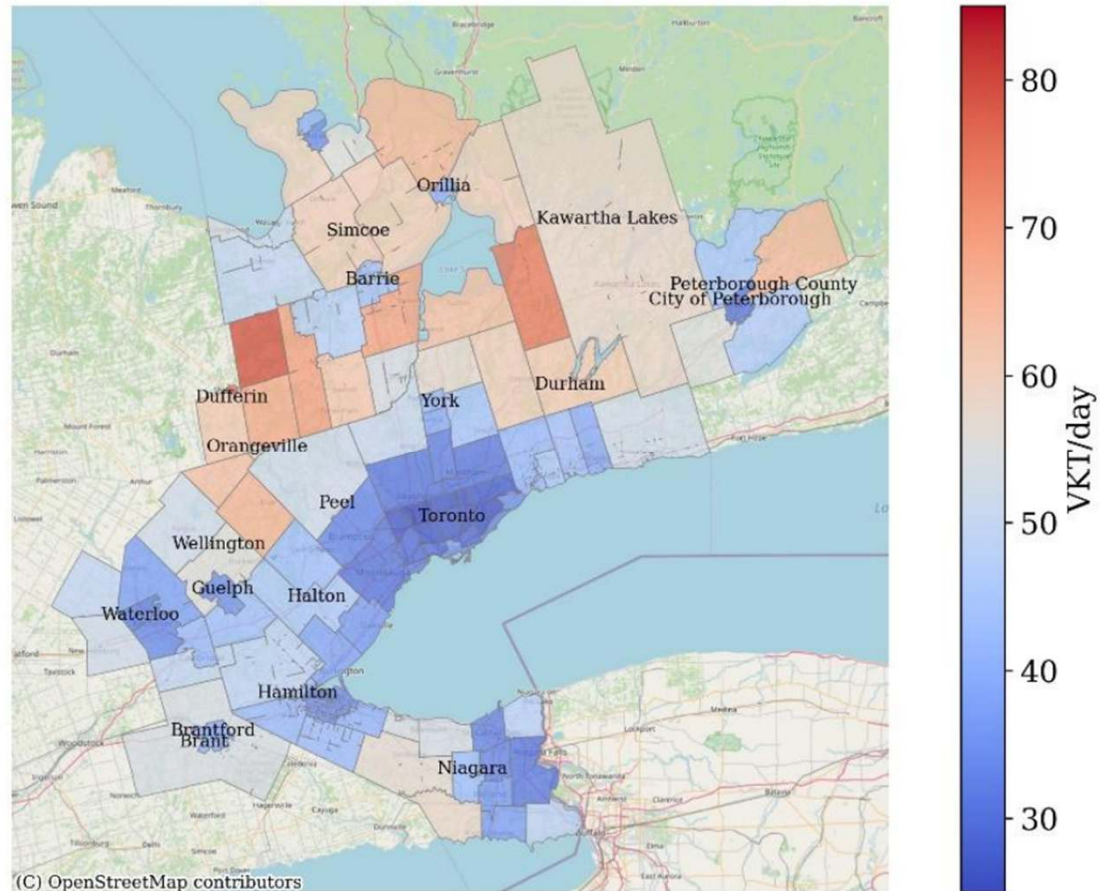


Source: AES Engineering. 2021. *EV Charging Performance R*. Prepared for the Clean Air Partnership.
<https://cleanairpartnership.org/cac/wp-content/uploads/2021/10/2-21-050-GTHA-EV-Ready-Costing-Study-2021.10.14.pdf>

How much load sharing using EVEMS is appropriate? It depends on how far vehicles drive...



VKT by Planning District in the GTHA



Source: AES Engineering. 2021. *EV Charging Performance Requirements*. Prepared for the Clean Air Partnership. <https://cleanairpartnership.org/cac/wp-content/uploads/2021/11/2-21-050-EV-Charging-Performance-Requirements-in-GTHA.pdf>

EV Charging Infrastructure Requirement Options



Infrastructure Option	Minimize upfront costs	Minimize retrofit costs	Simple for condo assn. / owner	Equitable for residents	Simple to enforce	Future-proof
Percentage-based EV Ready or EVSE (e.g. 20%)	Green	Red	Red	Red	Green	Red
Conduit	Green	Red	Red	Red	Red	Red
EV Capable (all stalls)	Yellow	Yellow	Yellow	Yellow	Yellow	Green
EV Ready (all stalls)	Yellow	Green	Green	Green	Green	Green
EVSE Installed (all stalls)	Red	Yellow	Yellow	Green	Green	Yellow

Legend	
Least Impacts	Green
Some Challenges	Yellow
Major Challenges	Red

Source: Derived from AES Engineering, Fraser Basin Council, C2MP. 2018. *Residential Electric Vehicle Charging: A Guide for Local Governments*. Prepared for City of Richmond and BC Hydro.