AMOR ENERGY

EV READY PLAN

FOR NEWPORT MEWS
1870 YEW STREET
VANCOUVER, V6K 3G2
VR1191 (STRATA BUILDING)

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PREPARED BY

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INTRODUCTION

The following report provides details of the existing electrical infrastructure and necessary requirements to implement an electric vehicle (EV) charging infrastructure for Newport Mews. The intent of the infrastructure is to provide an electrical distribution system throughout the parkade that will allow all owners an equal opportunity to install an EV charger in their own stall. We have also provided general information about EV charging to help strata members and owners understand this new technology.

The building is a residential low-rise comprised of (24) residential units over (4) levels above ground constructed in 1982. The parkade consists of (1) level below grade covered parking stalls consisting of (24) residential parking stalls with (0) visitor parking stalls.

The study and calculations used to determine the maximum available power for EV charging meet all rules and standards of the Canadian Electrical Code (CEC) and local amendments. We are required to adhere to these rules which are put in place by Technical Safety BC to ensure life safety of the property and its occupants.

DEFINITIONS

EV = Electric vehicle
EVSE = Electric Vehicle Service Equipment (Charger)
L1 = Level 1 charging stations
L2 = Level 2 charging stations
L3 or DCFC = DC Fast Charging Station
V = Volts
A = Amps
kW = Kilowatts
MURB = Multi unit residential building
CEC = Canadian Electrical Code

CHARGER LOCATIONS WITHIN A MURB

Shared Parking

- Installed in common area stalls such as visitor parking and can be used by all owners, one at a time.
- Quick solution to provide charging options within your building.
- Short period of time that owners can charge. Most buildings have 2-hour max, per owner, per day.
- Limited number of users can use the charger effectively each day making them very inconvenient.
- Not a long-term, scalable solution due to limited common area parking spots.

Owner Stall Charging

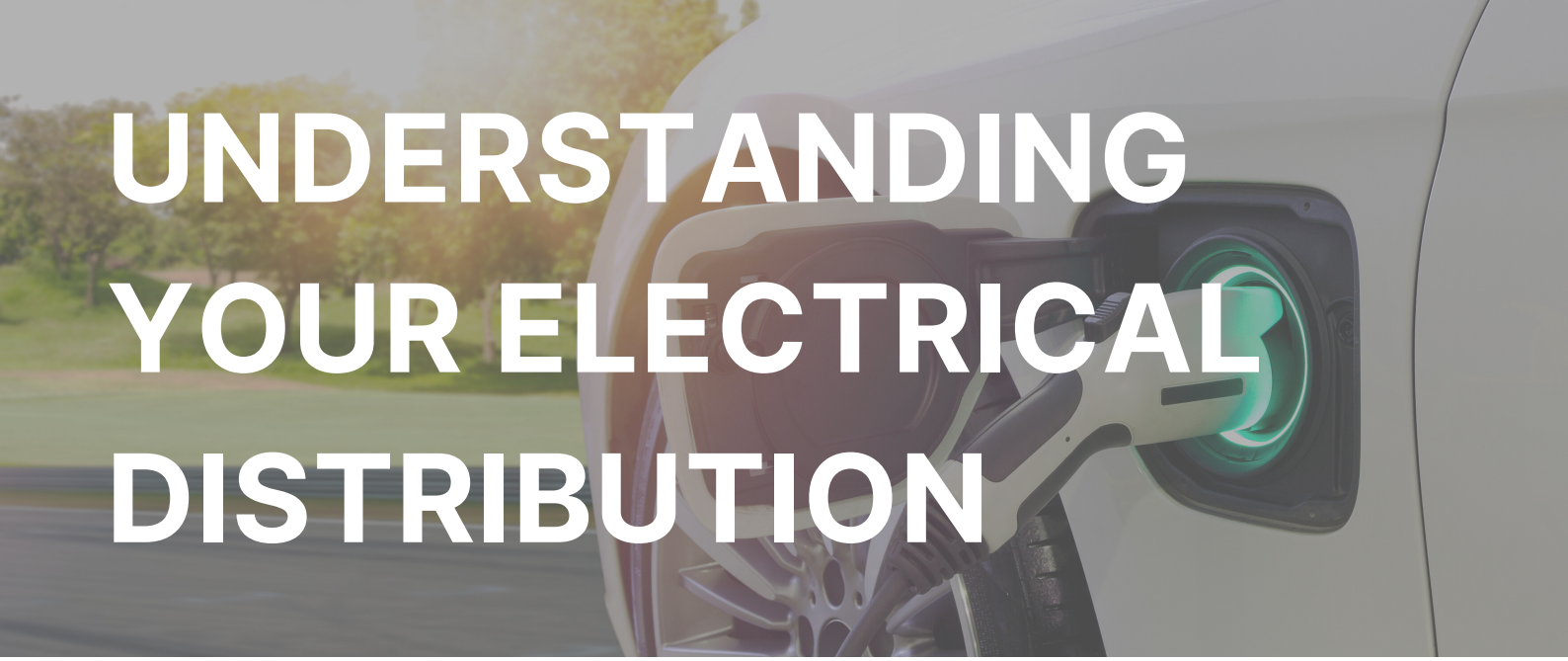
- Installed in private stalls and owned by the associated unit owner.
- Fair opportunity for all owners to have EV charging every day.
- Convenient way for owners to charge without worrying about missing their 2-hour “window” for the shared chargers.
- Owners will have a fully charged vehicle to carry out daily errands/activities without the need to use public charging.
- More cost-effective (per owner) when installing full building infrastructure to allow a power feed to each owner or stall.
- Full infrastructure will increase the value of unit properties even for owners who do not have a charger installed.

CHARGER OPTIONS

Level 1	Level 2*	Level 3
Least expensive, slowest charging option available.	The most common charging option for home charging.	DCFC – or DC Fast charging is for commercial and public applications.
Rated at 20A, 120V, 1Ph. This will draw 12A, 1.44 kW when charging.	Rated at 40A, 208V, 1Ph. This will draw 30A - 32A, 6.66 kW when charging.	Rated at 100A, 480V, 3Ph, 25 kW - 150 kW.
Recharges at a rate of approx. 8 Km/hr.	Recharges at a rate of approx. 38 Km/hr.	Recharges at a rate of up to 250+Km/hr.
Plugs into a 5-20R receptacle. These are the same receptacles used throughout a household. However, when used for EV charging, they must be installed as a single receptacle on a dedicated circuit and breaker.	Can be hardwired or plugged into a receptacle. This high level of power allows for a fast-charging rate.	DC power connected directly to the battery of the vehicle.
This level of charging will work for some owners but will not provide sufficient power for the average person to complete their daily driving without the need to use public or workplace charging.	The average MURB building is not designed to have L2 chargers in every stall due to a limited electrical distribution capacity.	Not recommended for residential applications due to the high cost of install/maintenance, and the limited number of users who can use the charger in one day.

*L2 with Load Management:

- Most versatile charging option.
- Rated at 40A, 208V, 1Ph. This will draw up to 32A, 6.66 kW when charging, or as low as 8A, 1.66 kW depending on the status of other chargers on the circuit.
- Recharges at a rate of 9 – 38 Km/hr.
- A load managed system utilizes an L2 charge stations fast charge rate but is designed to share power with multiple stations.
- Through load management software the system will provide all owners with a high rate of charge, much of the time they are plugged in. This eliminates the need to increase overall electrical distribution capacity.
- When only 1 vehicle is charging, the vehicle gets 100% of the power. When additional vehicles plug in, the power is equally redistributed among all vehicles.



UNDERSTANDING YOUR ELECTRICAL DISTRIBUTION

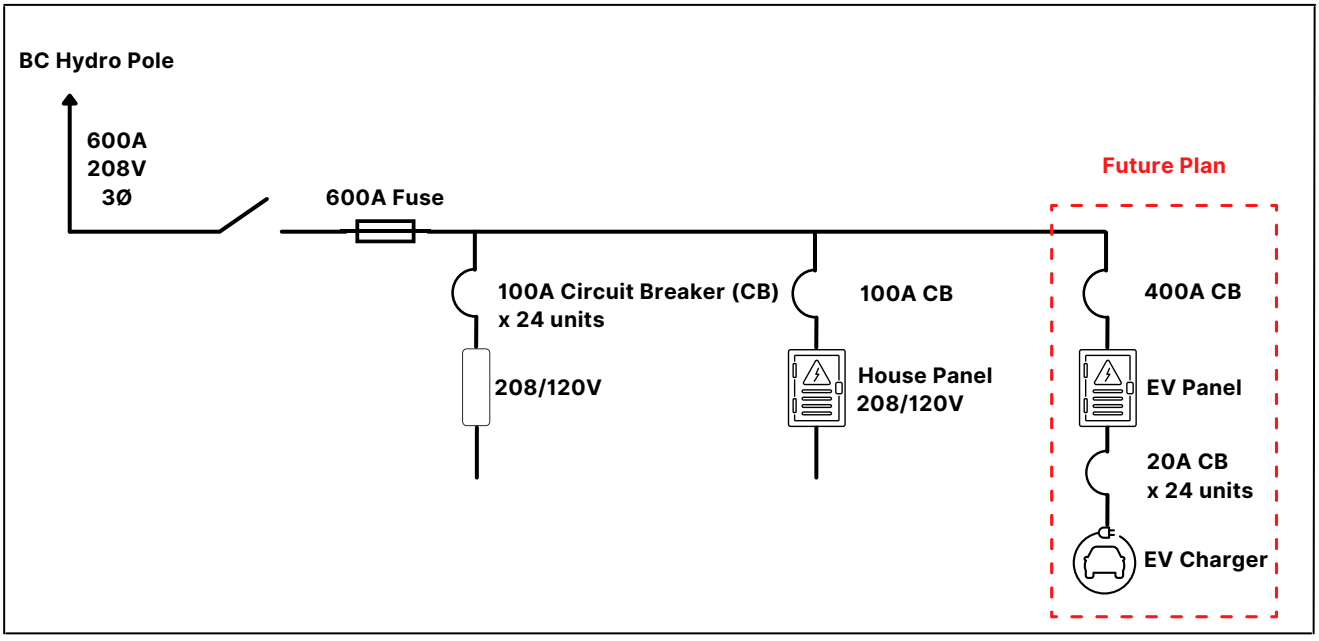
For the purpose of this report, we will refer to the different sections of your electrical distribution as follows:

“Building Distribution” = Main incoming Hydro feed and transformer before it splits to feed both the “Residential Unit Distribution” and the “House Distribution”

“Residential Unit Distribution” = All power and lighting in the individual residential units. This is fed from the Meter Centre Distribution and does not include any common area lighting or power.

“House Distribution” = All common Area lighting and power. This is everything outside of the individual residential units

Figure 1 : One-line Diagram of the Electrical Distribution



ELECTRICAL CAPACITY

There are multiple calculations/readings that must be performed on an electrical distribution to confirm the different sections of distribution (main feeds, sub feeds, and unit feeds) do not become overloaded when adding electrical equipment such as EV chargers.

As per CEC, maximum available power can be determined by either process:

1. The data collected from a demand meter in place for 12+ months, or
2. A calculated load based on the appropriate CEC specified load calculation.

This distribution has a meter on the House Distribution but does not have one on the Building Distribution. Therefore, we can determine the spare capacity of the “House Distribution”, but we are unable to determine the effect this will have on the Building Distribution. An engineered load calculation can be completed to determine this loading; however, these generally have allowances that greatly exceed the buildings actual usage and requires the additional cost of an engineer to perform this calculation.

BC Hydro recently changed its policies to provide strata with an easy method to obtain collective power demand readings of all the individual units. This will provide us with the necessary information to determine the Building Demand.

The information below details the existing building and house electrical distribution as well as the calculated available spare capacity per stall and per unit.

Table 1 Distribution Allowance Chart

Distribution	Capacity
BUILDING DISTRIBUTION CAPACITY MAX	600.0 A, 216.159 KW, 208V, 3 phase
BUILDING DISTRIBUTION (Transformer) CAPACITY PEAK (Based on BC Hydro transformer load data)	93.813 KW at 208V
SPARE CAPACITY ON BUILDING DISTRIBUTION at 100% EV loading. Maintaining 20% power as buffer on distribution	216.159 KW * 80% = 172.928 KW 172.928 KW - 93.813 KW = 79.115 KW 79.115 at 208 V is available for EV charging

Distribution	Capacity
Maximum number of L2 charger on House Distribution, non-load managed, 6.656 kW (40 AMP breaker) Charge stations rated at 100%, able to be added to the House distribution	11.88 KW
Maximum number of L2 charger on House Distribution, non-load managed, 4.992 kW (30 AMP breaker) Charge stations rated at 100%, able to be added to the House distribution	15.84 KW
Maximum number of L2 charger on House Distribution, non-load managed, 3.328 kW (20 AMP breaker) Charge stations rated at 100%, able to be added to the House distribution	23.77 KW
Minimum power per unit / stall using load managed L2 Charge stations, able to be added to the House Distribution (24 units with 24 private stalls in the garage)	3.328 KW

Building Distribution

- Has a maximum peak BC Hydro transformer demand over the past years of 93.8 kW which brings our calculation for the available capacity to 78.89 kW. Please keep in mind that allowances have been made in our calculations to allow for some additional future loads, as we do not suggest loading your electrical distribution to max capacity.
- There is only enough capacity to allow for the installation of up to (11) non-load managed 6.67 kW, (15) non-load managed 4.99 kW and (24) non-load managed 3.33 kW Level 2 chargers.
- BC Hydro's EV ready infrastructure requirement document appendix A recommends annual distance travelled of:
  12775 KM to have at least 20 AMP (3.33 kW) charging speed
  16425 KM to have at least 30 AMP (4.99 kW) charging speed
- There is barely enough to provide every unit / stall with a charge station to have at least 3.33 kW charging speed; therefore, we recommend either to:

1. Utilize installation of load managed Level 2 chargers OR
2. Upgrade the building service to provide each unit/stall with at least 3.33 kW non-load managed level 2 chargers. (We recommend 4.99 KW or higher of charging speed)

- The minimum power needed to provide a load managed Level 2 charger is 1.66kW per stall or per unit.

EV CHARGING OPTIONS

Below is a chart showing the different EV infrastructure design options, the distribution capacity required, and the budgetary cost for the installation of each unit. Your current distribution does not have sufficient spare capacity to allow for dedicated charging option to be implemented, but you do have sufficient spare capacity to allow load shared option.

Below options were done based on local driving requirements.

*Table 2 EVSE Distribution Chart**

Design	1 hour of charge (MIN KM/MAX KM)	10 hours of charge (MIN KM/MAX KM)	Distribution Capacity Required	Budget Cost per unit	Is service upgrade required & included?
Dedicated					
At 40 AMP	36/36	360/360	160 KW	$7000 ~ $9000	YES
At 20 AMP	18/18	180/180	79.87 KW	$2000 ~ $3000	NO
Load Share					
Circuit Share - 2	22/36	220/380	80 KW	$3000 ~ $4000	NO
Panel Share - 2	22/36	230/380	80 KW	$3500 ~ $4500	NO
Circuit Share -4	11/36	110/380	40 KW	$1800 ~ $2800	NO
Panel Share - 4	11/36	110/380	40 KW	$2300 ~ $3300	NO

**The charging rates (km) stated in this graph are based on an average calculation. Every car manufacture is slightly different, and the on-board charge station for each manufacture is programmed differently. Charging rates are dependent on many variables such as the state of the battery, power consumption for auxiliary equipment, outdoor temperature, and driving habits. Please keep in mind that you may experience a higher or lower charging rate.*

Dedicated

40 AMP-Refers to a dedicated 6.67kW circuit for each charger/receptacle. No-load management is needed for this design because the distribution is rated to provide power full power to every charger even if they are all on at the same time.

20 AMP-Refers to a dedicated 3.328 KW circuit for each charger/receptacle. No-load management is needed for this design because the distribution is rated to provide power full power to every charger even if they are all on at the same time.

Share-2

The first stage of load management. The design refers to having (2) chargers for each 6.67kW available. This requires 50% of the distribution capacity needed to feed the same number of chargers as a dedicated circuit design.

Share-3

Further load management was utilized, spreading less power over more stations. The design refers to having (3) chargers for each 6.67kW available. This requires 33% of the distribution capacity needed to feed the same number of chargers as a dedicated circuit design.

Panel Share vs Circuit Share

You will notice that “Circuit Share-2” and “Panel Share-2” both have identical values for min/max charging rates and distribution size. However, the cost of the install is different. This is because there is more conduit and wire required to provide a “Panel Share-2” infrastructure.

Panel Share design refers to the practice of installing the charger power feeds in the same manner as dedicated charging. Each charger receives a dedicated circuit rated for its max charging rate. Circuit share refers to multiple chargers being connected on a single circuit. Although both utilize load management on a smaller distribution, the method of design drastically changes the efficiency of power-sharing.

The benefit to the Panel Share is that users will have a much higher average rate of charge. Meaning they will see charging speeds closer to the max charge rate much of the time. Circuit Sharing systems cost less; however, they are very inefficient at distributing power equally.

With a circuit sharing design, (2) Chargers will share the power of each 40A circuit. if (2) users plug in at the same time their charging rate is instantly lowered to 50%. This means each will get 20 A, roughly 19 KM / hour. If (3) users are plugged in at the same time, the charging rate will lower to 33.3%. This means each will get 13.3 A, roughly 12.7 KM/hour. When a car is fully charged, then the power will be redistributed evenly to the remaining cars that are still plugged in and not yet fully charged.

With panel sharing design, if (20) chargers share the power of one 200A panel. Charging rates will stay at the max rate of charge for up to (5) users. As more users plug in, the power will distribute evenly among them, resulting in a less drastic drop-in charge rate. (10) users will need to plug in at the same time before their charge rate lowers 50% or (20) users for 25%.

We will be happy to take the time to explain these designs in further detail with council or strata at a scheduled meeting and owners at an AGM/SGM.

CONCLUSION

Dedicated 20 AMP to – Individual Owner parking

There are currently no EV chargers installed in the garage and no Wi-Fi or telecommunication (cellular) network available in the garage.

Based on our findings and the owner's desire, we recommend the design and implementation of a dedicated 20 AMP receptacle to each individual owner's stall within 0.5M. This will allow 208 V level 2 charging capacity to each owner without overloading the electrical distribution, preventing the need for a costly Hydro service upgrade. 20 AMP provides an adequate range for the building's owner's need as it can charge up to 180 KM of range per night (10 hours of charging) which meets the owner's need for city driving. Since we are not implementing network power-managed EV chargers, there is no need for installing new Wi-Fi or Telecom network infrastructures.

This recommendation will consist of adding a separate EV distribution to the existing House or Building Distribution system. Conduit systems, wires, and panels will be installed throughout the parkade to feed each charging receptacle located in individual owner stalls. A backbone network providing data communication for all receptacles will not be required. This will eliminate the need for active management by strata or the property manager.

However, there will be no access control, but since it is a gated garage and every stall owner will have their own level 2 receptacle, access control seems not necessary. There will be separate meter to monitor total usage of the, therefore, a flat fee policy for every stall owner that wishes to activate charging is recommended. For those who does not wish to activate at this time , strata can simply turn offer the breaker in the locked electrical room. Stall owner can later choose to purchase a power adjustable EV charger (set to 20 AMP) to charger their electric vehicle. If the EV charger is not set to correct amperage, the charge will just simply go into error mode and the breaker for that stall will trip, all other stalls will not be affected.

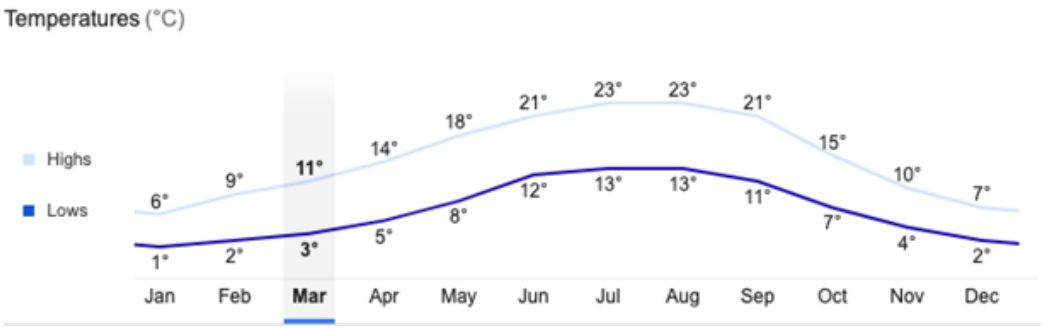
Shared charging – Common parking

Through our site investigation, we noted that there is no common or shared parking available. Since there are only spaces in the parking for 24 stalls, we don't see the possibility to add common or shared parking.

EV READY PLAN

From the conversation we had with the strata council members, we have determined that the average person drives less than 45 km/day. The building is near Kitsilano area of Vancouver Lower Mainland with coldest temperature in January ranging from 1 degree Celsius to 6 degrees Celsius and hottest temperature in July/August ranging from 13 degrees Celsius to 23 Degree Celsius

Figure 2 : Lower Mainland Average Temperature



The building is located on a normal topography with not many hillier landscapes. Demographic of the building resident is

- 19 or younger: ~ 10 %
- 20~39: ~ 40%,
- 40 ~ 64: ~ 30 %
- 65 and above ~ 20%

With average household size of 3~4 people

Vehicles types in the buildings are mid-size sedan, SUV and mini-Van with only 1 vehicle being electric vehicle.

Based on these returns, a Level 2, dedicated 20 AMP charging would be an effective balance of cost and rate of charge. A level 2, 20 AMP at 208V compliments BC Hydro recommended minimum rate of charge recommendations chart.

For this to work, there would be an added EVSE Distribution consisting of:
A 80 Kw Distribution
2 x 200 AMP panels placed in the garage hosting 24 stations.
Power to the two 200 AMP panel will be supplied from central electrical room
Conduit runs to one parking space per unit (24)
Wire suited to one parking space per unit (24)
Budgetary total costs: $60,000
Budgetary per unit (24) costs: $2500

Plan Details

To this end a 400A rated EVSE dedicated panel will be installed on a plywood board mounted to the wall in the building main electrical room. The EVSE panel will be fed from central distribution junction box, via 500MCM aluminum ACWU cable run along the ceiling.

To safely install the 400A EVSE Panel feeder breaker in the main electrical central distribution panel, it will be necessary to de-energize the building via the 600A main breaker for an estimated five hours. Unforeseen site conditions that impact the installation of the breaker may also impact the amount of time the building de-energized and possibly the cost. Amor Energy Corporation will not be held responsible for any damage that may occur to customer electronics due to the temporary shut-down of power for the proposed work.

Conduit, Wiring & Junction Boxes

From the 400A EVSE dedicated electrical panel in the main electrical room, the plan is to do TWO runs of 2-inch EMT conduit, sized to carry twelve (12) EVSE circuits each using 8 AWG copper 24 x RW90 wire connect to TWO 12-inch by 12-inch junction boxes. From the two junction boxes, run 3/4 inch EMT to each parking stall (24) and installed a 4 11/16-inch by 4 11/16-inch square junction box with metal cover. Wires are made safe within the junction box in lieu of an EV charger.

EV Ready Budget

<u>Includes:</u>
• New EVSE electrical panel in the main electrical room
• Conduits from EVSE electrical panel to end of each unit stall within 1.5 meters of receptacle’s final location.
• Permit and design costs.
• All material & labour costs

<u>Exclusions:</u>
• Level2 EV Charger

NEXT STEPS

We would like to thank you for the opportunity to provide this report and EV charging recommendations. Amor Energy Corporation has been providing EV solutions since 2018.

Over this time, we have developed a tailored approach to help strata's implement a reliable charging infrastructure for owners. We break this down into 3 stages:

1. EV Ready Plan (completed)
2. Design/Engineering/Installation
3. Commissioning

These separate stages allow your strata council to make informed decisions, resulting in a charging infrastructure properly tailored to your building. This will provide owners with the confidence that they are getting a lot of value out of the project being proposed.

The next step will be for us to review this report with the council. If needed, we will go over the report and clarify any information we provided. We have provided our recommendation for the system design but understand that the council may want to choose a higher or lower cost option depending on the available budget or individual needs.

After the review, the strata council will agree on a design option, and we can move forward and submit the proposal for EV ready plan approval from BC hydro.

After BC hydro reviews the and approves the proposal, we can further finalize exact installation cost and implementation schedule.

Please contact us at your earliest convenience to schedule a review meeting.

Respectfully Submitted,

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