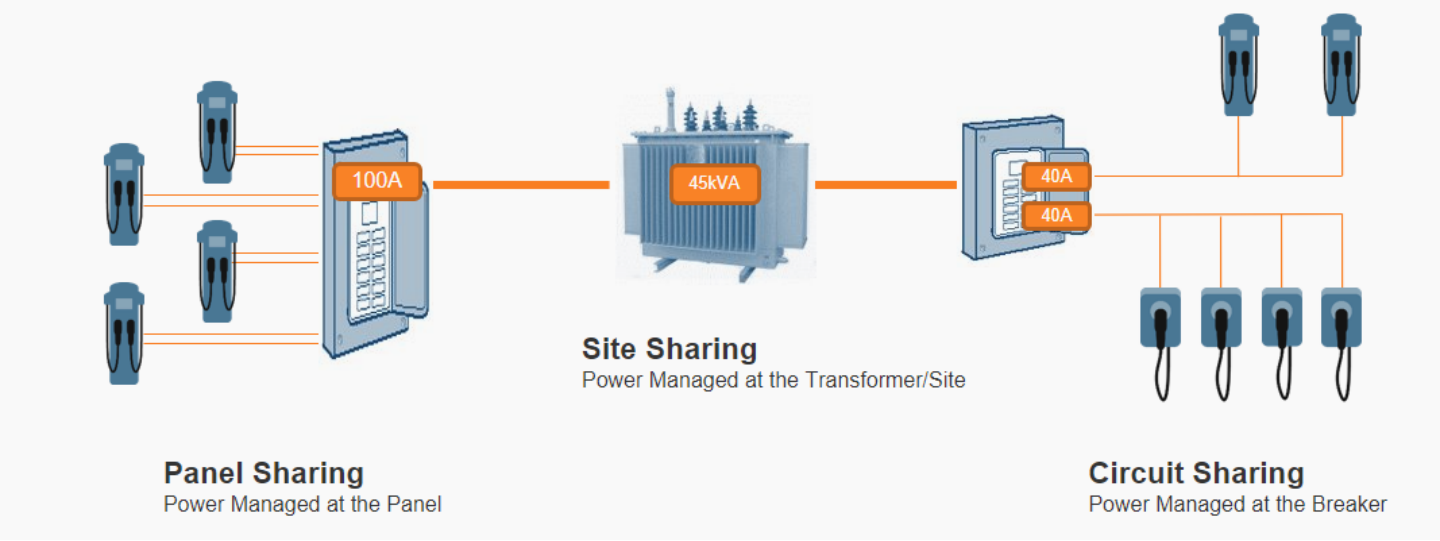
Power Sharing

Reference Guide



In This Document

What is Power Sharing

Power Sharing is a software-driven feature that manages a group of EV charging stations. It ensures the total power draw from all stations in the group never exceeds a set limit. This limit can be applied at the circuit, panel, or site level, allowing for a hierarchical approach.

Circuit Level: Enables multiple charging ports on a single circuit breaker.

Panel Level: Ensures all chargers under a panel stay within its capacity.

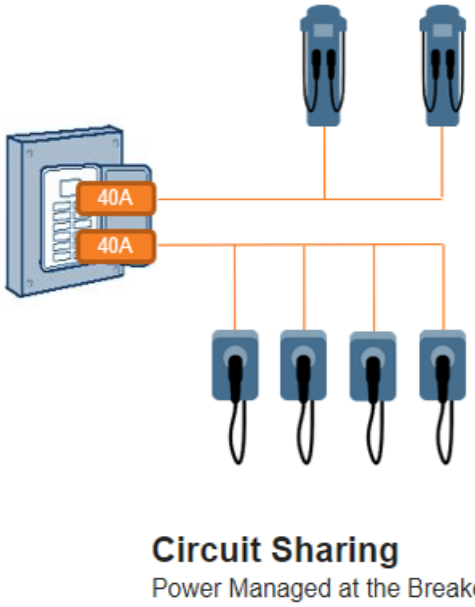
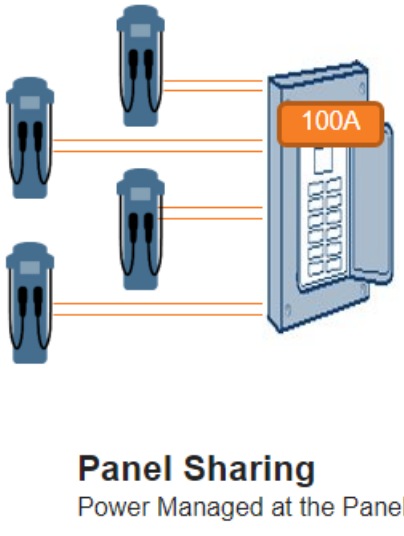
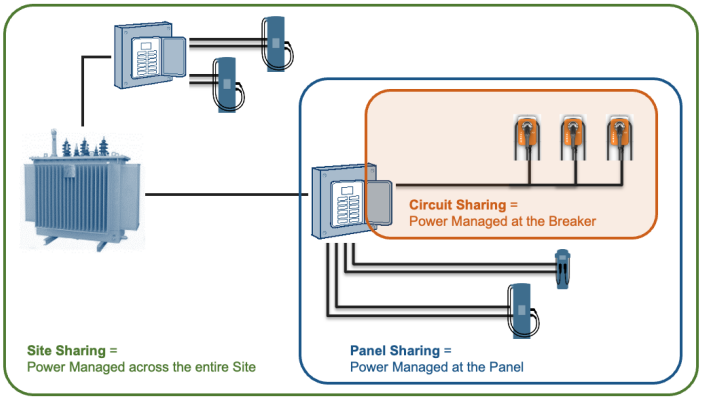
Site Level: Manages total power usage for the entire site.

There is no limitation to the number of stations or ports that you can put on a given circuit, panel or site power level. Any number of ports will work together to ensure that the National Electric Code (NEC) rating of the upstream electrical equipment is not exceeded. It is important to consider the driver experience as power is stretched. See Oversubscription Ratio Recommendations for site design guidance.

Benefits of Power Sharing

Power Sharing allows the customer to save money in multiple ways by:

- Avoiding individual "home run" wiring for each charger (circuit level).
- Controlling peak power demand to minimize expensive demand charges.
- Optimizing charging during Time of Use (TOU) periods to save on energy costs.

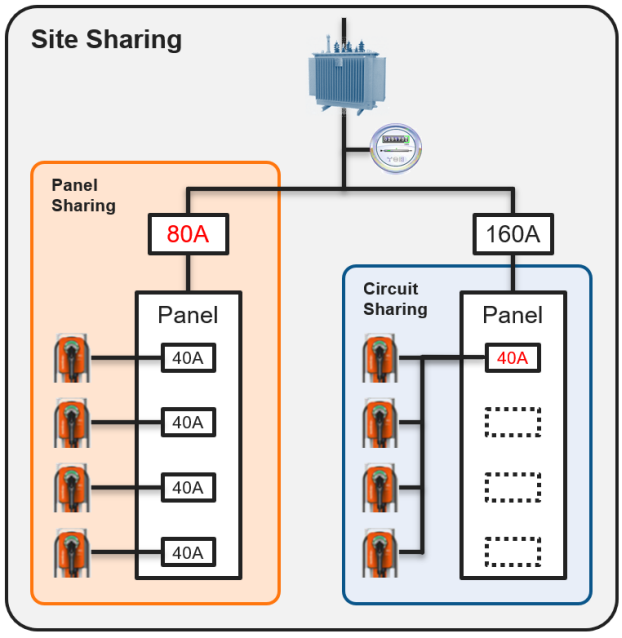
Groupings	Diagram	Breakers and Circuits
Power Sharing at the **Circuit Level**		The Power Group is managed at a circuit breaker. Stations are grouped in software to a specific breaker and will not exceed 80% of the breaker rating combined.
Power Sharing at the **Panel Level**		The Power Group is managed at a breaker panel. Single phase or 3-phase panels can be utilized in this application. The aggregate load of all ports installed onto the panel will not exceed 80% of the panel rating. The software will factor in which phases a port is installed onto to ensure each phase of a 3-phase panel does not exceed the panel rating.
Power Sharing at the **Site Level** (or, **Transformer Level**)		The Power Group is managed as an aggregate load to a site level transformer or main switchgear. The aggregate load of ports in the group will not exceed the ratings of the upstream transformer or upstream site-level panel.

Power Sharing Groupings

The ChargePoint implementation of Power Sharing supports the following:

- **Hierarchy** of groups, allowing for circuit-level power groups, panel-level power groups and site-level power groups to be applied simultaneously. Each group within the hierarchy will ensure that the ratings of each level of infrastructure are not exceeded in the hierarchy.
- **Time of Use** (TOU) power limits, wherein the group limit(s) can vary by hour of the day or day of the week, in recurring weekly fashion.

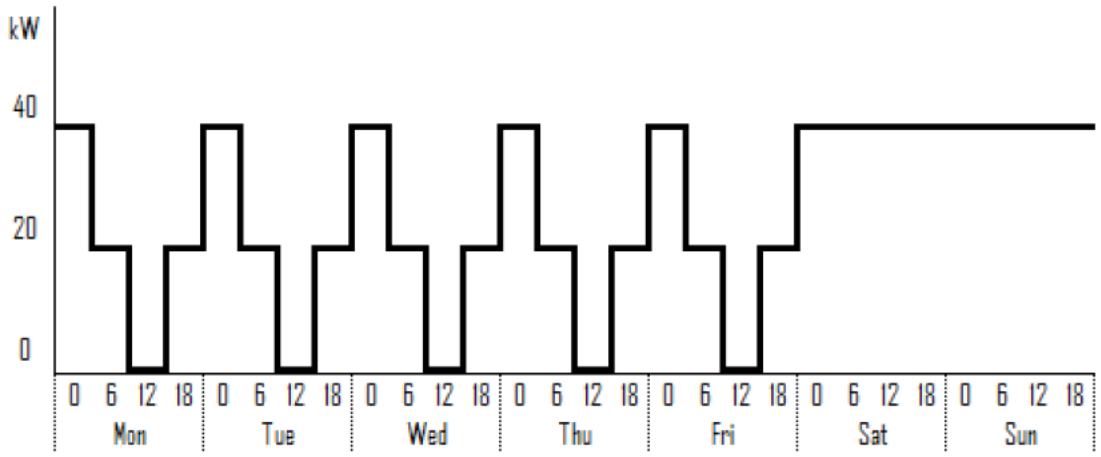
Power Sharing Features

		Aliases	Use Cases
Power Sharing		**Power Sharing** Algorithm	Back-end based power/energy management for sharing charging power between a group of chargers due to limited supply capacity
What	Power Sharing allocates power dynamically among a group of chargers so that the aggregate (total) power of the group never exceeds the configured ceiling (the maximum power limit). Power can be shared at the **Circuit/Panel [A]**, or **Site/Transformer [kW]** level, or at multiple levels, **simultaneously**, as shown in the diagram. The ceiling can be static (fixed) or set dynamic via the following: Pre-configured Time-of-Use schedule.		
Why	Save money on installation cost by avoiding electrical service upgrades and by using less wire (circuit sharing). Mitigate demand charges by capping overall power for the group, but still allowing charging at full speed when only a few vehicles are plugged in. May help shift some charging to times when energy rates are cheaper.		
Who	Workplace, Multifamily, Fleets, long term parking (airports), who do not want or need all chargers to run at full speed simultaneously, while still delivering a good driver experience or meeting the needs of the fleet.		
Example Diagram	Site Sharing 		

Power Sharing and Its Uses

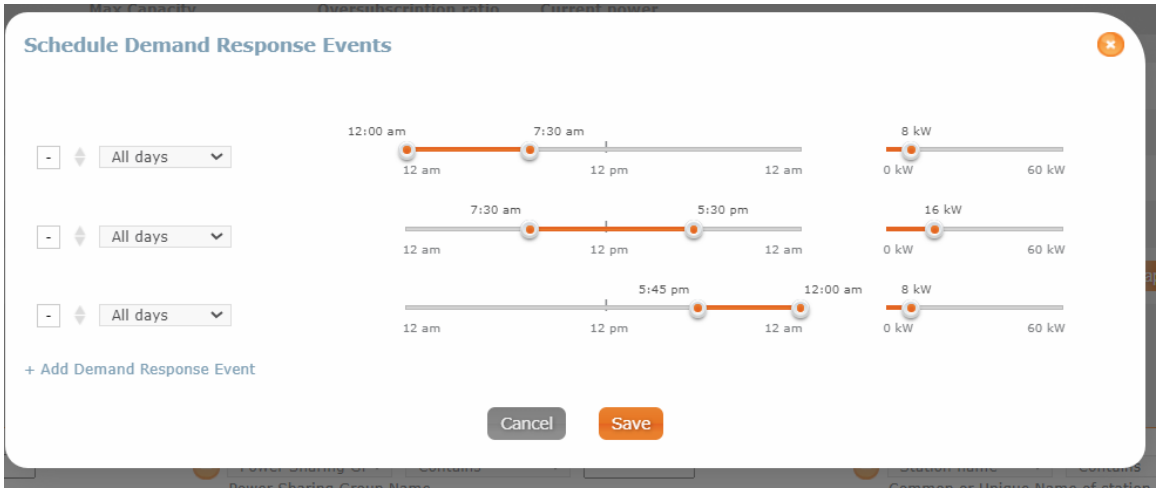
Time of Use (TOU) Power Sharing allows power to be reduced, without necessarily being shut off completely during various time intervals. It is used to configure the charging power with a dependency on time of day.

Example: An office wants to limit the amount of power available as follows:



- Mon-Fri 00:00 – 06:00: max 40 kW
- Mon-Fri 06:00 – 12:00: max 20 kW
- Mon-Fri 12:00 – 18:00: max 0 kW
- Mon-Fri 18:00 – 00:00: max 20 kW
- Sat-Sun All day long: max 40 kW

kW limits set at different times/days



Manage Energy - Share Power

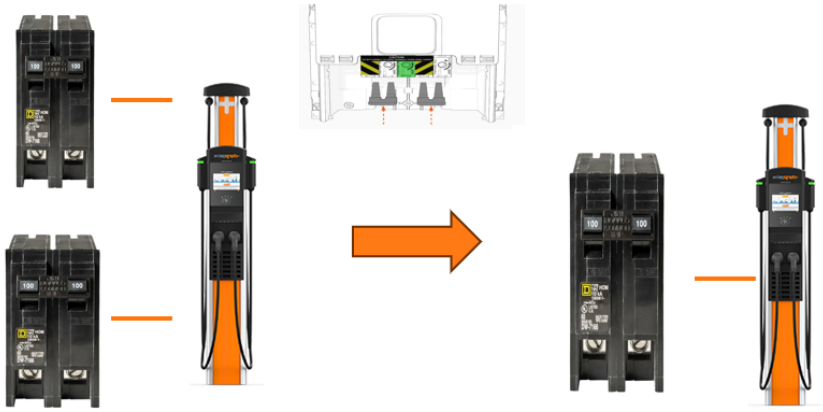
Compare a Regular Install to Power Sharing

Standard Installation

Each port will receive a dedicated 100 A feed, allowing for the station to have the maximum amount of power output available. Each port will operate independently from the other. The dedicated feed allows both ports to receive a full rate of charge without impacting the other port since no power management strategies are applied in the standard installation.

Power Sharing Jumper

Utilizing the Power Sharing jumper kit (available on CT4000 and CP6000 station types) allows for the station to be fed from a single feed. During installation, a sticker kit is installed to reflect the reduced electrical input requirements to meet National Electric Code (NEC).



When a Power Sharing jumper is included, the station will manage power locally to not exceed the installation topology. When a single vehicle plugs in, it will take as much power as it can up to 80% of the installed breaker rating. When a second vehicle plugs in, the power is shared between the two ports, never exceeding 80% of the installed breaker rating.

By default, power is shared 50/50 between the two vehicles. If one vehicle cannot take as much power as 50% of the available power, it will receive the highest rate that it can accept. As a result, the second vehicle may receive a higher charge such that the amperage of the two vehicles does not exceed 80% of the breaker rating.

By utilizing the Power Sharing jumper, you are able to provide some local power management to the stations and reduce the number of home runs required on a project, which can lead to significant cost savings. As with other forms of power management, we recommend ensuring that the amperage output when both ports are occupied meets or exceeds the desired speed of the driver groups to ensure a good driver experience. For this reason, ChargePoint recommends selecting a higher rated station such as the CP6000 that can be installed up to a 100 A feed while still meeting UL safety requirements, allowing for the maximum power available between the two ports.

Power Sharing via Cloud Connection

ChargePoint's Power Sharing technology utilizes the cloud to manage power in real-time. Stations continously send their connectivity status and power levels back to the cloud where the ChargePoint Power Sharing Algorithm sends commands to reduce power to stay under the upstream electrical infrastructure limitations.

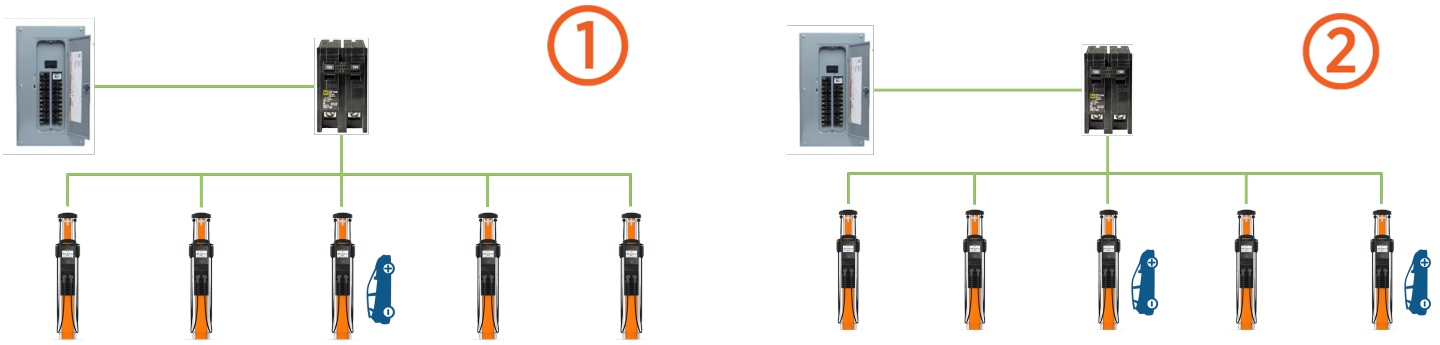
We will discuss common applications in the next sections starting with the most simple and working up to more complex topologies.

Power Sharing at the Circuit Level

This example demonstrates sharing 10 ports across a single 100 A feed. The 10 ports are added to a Power Share Group at a circuit level allowing for the 10 ports to use up to 80% of the installed breaker rating, or 80 A in this example. While this is an example that will help illustrate how Power Sharing works for this document, any number of ports could be added to the selected breaker. Likewise any approved breaker size could be utilized with the circuit level power share strategy. Note that power levels will change.

As vehicles plug in, power is managed such that 80% of the breaker rating is not exceeded at any given time. So when a single vehicle is charging it will get up to 80 A (or its max AC input level). As more vehicles plug in, power is shared proportionally allowing for the available power to be split amongst the total number of vehicles.

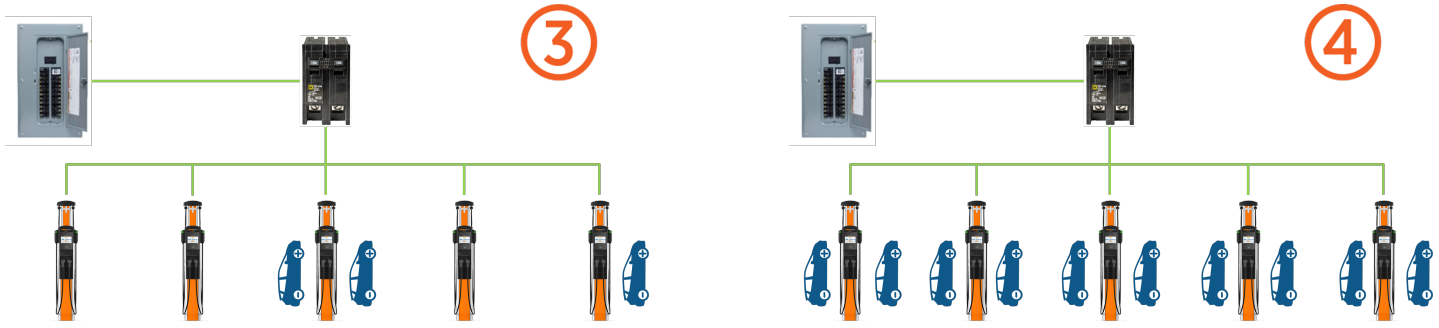
100 A Breaker (80 A available)



Single vehicle receives 80 A

Two vehicles share at 40 A each

100 A Breaker (80 A available)



Three vehicles share at 26 A each

10 vehicles share at 8 A each

In this example 8 A * 208 V = 1664 W = 1.664 kW. Assuming 3 miles of RPH, a driver will receive approximately 4.992 miles per hour of charge at this power level. Note that some vehicles may receive more than this and some larger vehicles may receive less than this.

As time continues, vehicles will complete their charge (shown in green in the image above). Our software automatically detects that its charge is complete and rediverts the available power proportionally to the remaining actively charging vehicles.

Note: There is no need for the driver to unplug their vehicle - the system will handle this without driver interaction.

Likewise, some ports may not be plugged in, which will allow for the remaining actively charging vehicles to receive a higher rate of charge.

Site designers should factor in the minimum charge when all ports are occupied and actively charging. This will account for the 'worst case scenario' and ensure that even when all ports are charging simultaneously, the drivers will receive their necessary rate of charge. Real-world examples will always yield that rate or greater as not all ports will be occupied and actively charging, so the drivers will typically receive a higher rate of charge.

Power Sharing Through the Panel

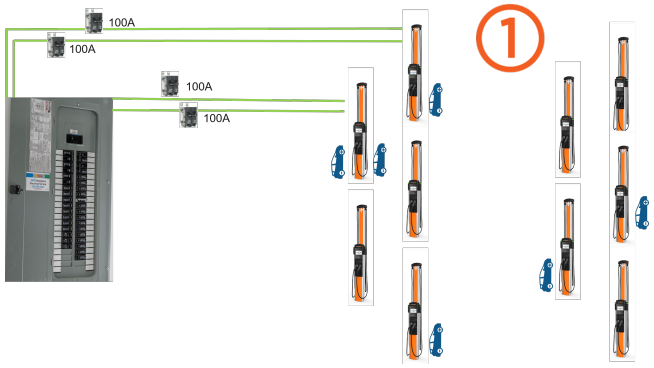
As more ports are needed on a project, it becomes necessary to install the ports on more than one circuit. In this case, power is grouped at the circuit breaker panel level, allowing for more ports to be installed on a single panel. Power is managed such that the amperage of each phase of the panel does not exceed 80% of the breaker rating.

In the example below, we show a typical 400 A/208 V 3-phase panel. The 400 A panel is just one example - any size panel can be utilized with any number of ports connected to the breaker panel.

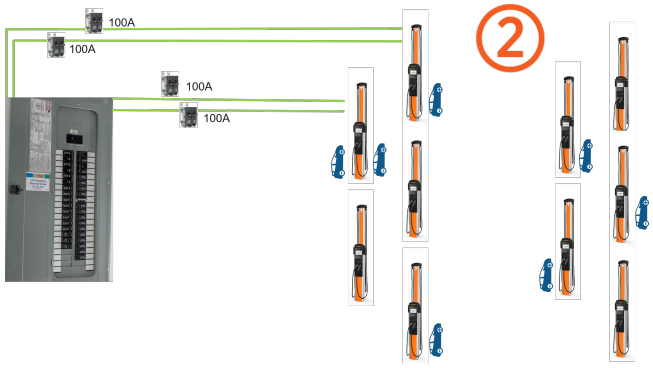
With Panel Level Power Sharing, power is grouped at the power panel level. In the drawings above, we have shown two home runs from each dual-port breaker, indicating a dedicated feed per port. While not drawn to every station, the two home runs are typical of all 10 stations in the example with 20 home runs back to the 400 A panel.

With this example, any six vehicles can plug into any port on the panel and receive the full 80 A of charge available at the station. When a seventh vehicle plugs in, the panel ratings would be exceeded, so stations throttle back their outputs to ensure that the total load on the panel does not exceed the rated panel ampacity.

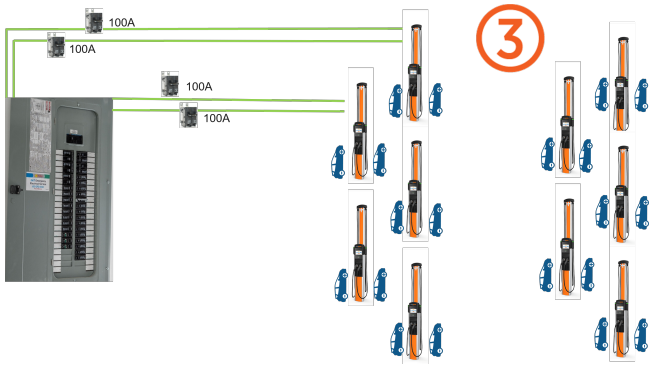
Standard Breaker Panel 400 A/ 208 V
Standard Circuit Breakers (100 A - 2 Pole)



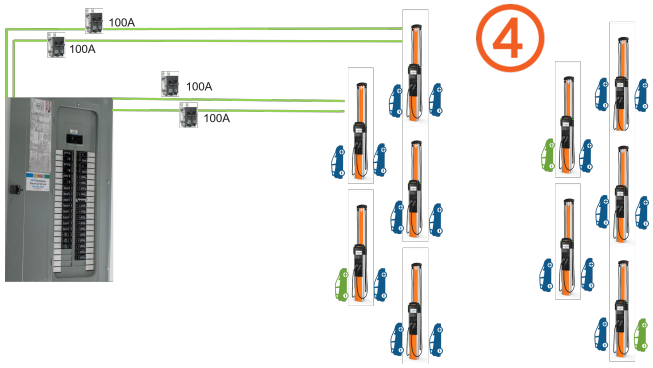
Six of 20 ports occupied - every vehicle gets a charge at 80 A



Seventh vehicle begins charging - every vehicle throttles back to about 79 A as power is shared



All 20 ports occupied - each vehicle charges at 27 A



Vehicles become fully charged or leave - remaining vehicles' charging power increases to 32 A

Similar to the circuit share example, vehicles will continue to plug in until all ports are occupied and actively charging. This becomes your minimum charge level (27 A in this example). Site designers will want to ensure that this minimum level meets or exceeds the desired charge rate of the driver group and application. In reality, not all ports will be occupied and actively charging simultaneously. As time progresses, some vehicles will complete their charge sooner than others, and some vehicles will unplug leaving unoccupied ports. As this occurs, the available power is shifted automatically to the remaining actively charging vehicles.

It is important to remember that while you should design around the minimum charge level (27 A in this example), the driver will always receive that level or greater.

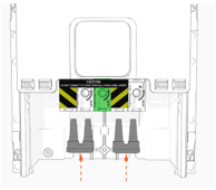
Combining Power Sharing Strategies

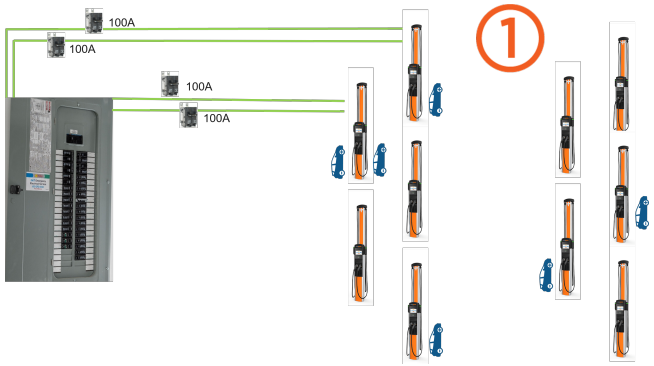
It is possible to utilize multiple power sharing options simultaneously to reduce project costs. In this example, we take our previous panel level topology, which showed a dedicated feed to each port. By installing the Power Sharing jumper, we can reduce the number of wire runs by half providing significant installation and material savings.

Standard Breaker Panel 400 A/ 208 V
Standard Circuit Breakers (100 A - 2 Pole)

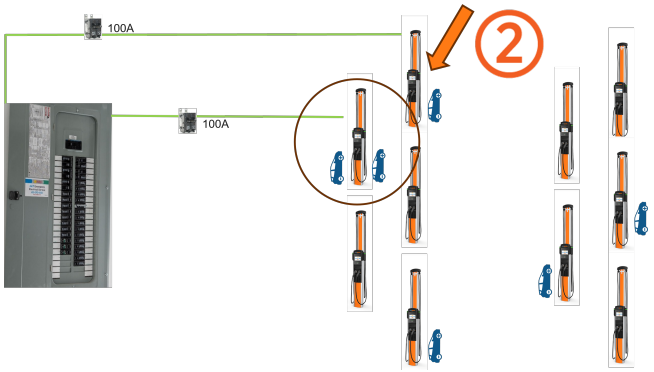
Original design:
Home run per port

New design:
Power Sharing jumper to share a home run

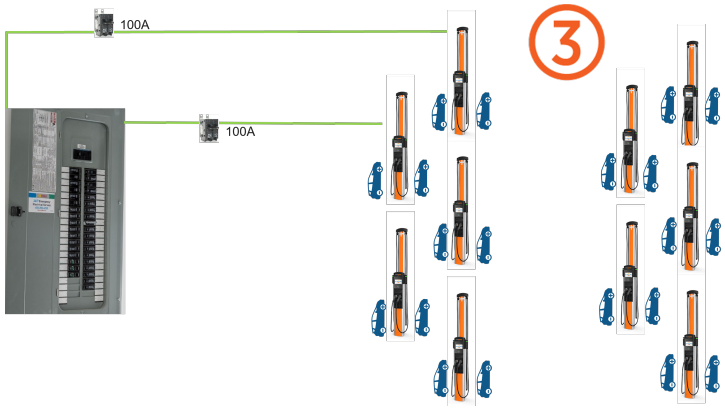




6 vehicles in 6 ports every vehicle gets full charge



With a jumper, power is shared between 2 vehicles with each at 40 A each

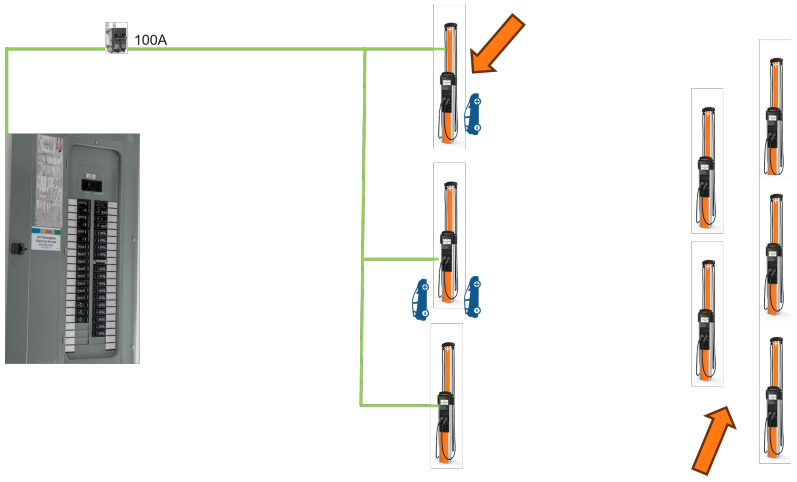


20 vehicles at 20 ports - power is shared with all vehicles at 27 A each

As the jumper is utilized, the only drawback is indicated in the circle (in the above illustration). When two vehicles are charging at the same station, that station cannot exceed 80% of its breaker rating (80 A in this example). So, in this example, while the power at the panel is not exceeded, you still have vehicles charging at a reduced rate.

However, as even more ports get occupied, the panel rating is exceeded and the output to each stall becomes less than 40 A anyway. Furthermore most vehicles on the market today cannot take 80 A, so the power limitation is actually limited by the vehicle. So, the Power Sharing jumper is used for installations like this to help reduce infrastructure and installation costs.

Power Sharing jumper at each station

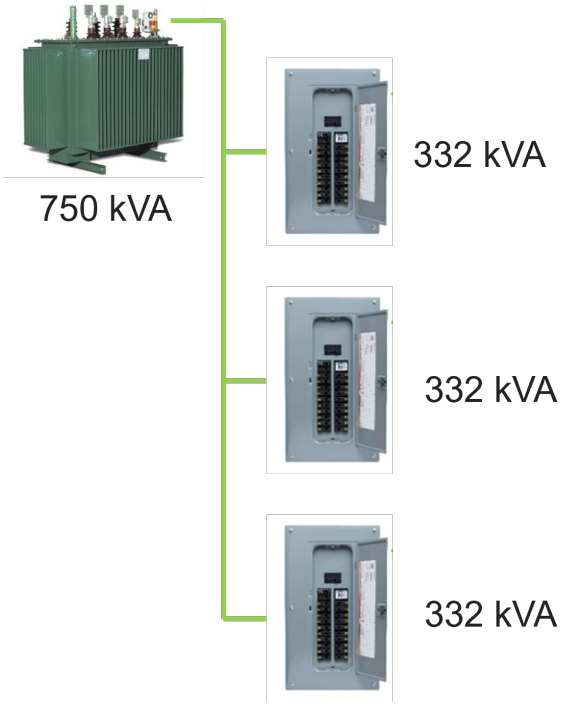


More stations can be on other branch circuits

Power shared at Circuit Level and Panel Level

Power Sharing Using a Site (Transformer) Level

As projects scale beyond a single Breaker Panel, Power Management will need to be applied to a group of panels. This level of power management can be called Site-Level or Transformer-Level power sharing. At this level, we can look at the incoming transformer rating feeding the group of charging stations or the available site-level power



As projects scale to this level, it becomes challenging to draw how each vehicle's rate of charge will change, however the same concepts discussed in previous topologies apply at the Transformer or Site level. As vehicles plug in, they will receive their maximum rate of charge until the electrical component limitations upstream of the charging stations are reached. At that point, stations will throttle down their individual rate of charge to remain under the NEC ratings of the upstream panels or transformers.

Just like with circuit grouping and panel grouping, it is important to realize that the minimum charge level will be when all ports are utilized and actively charging. This can be calculated by taking the total number of available Amps or Kilowatts and dividing by the total number of ports installed onto the infrastructure. For Assistance with these larger scale projects, please review the Where to get help section below.

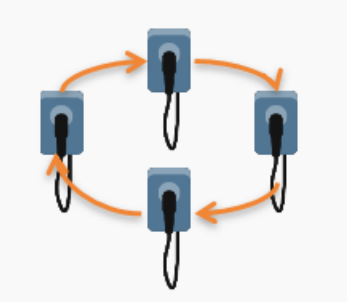
Available Power Sharing Algorithms

There are two Power Sharing algorithms to choose from today, Equal Share and First In, First Charged. It is most common to select Equal Charge. Site hosts can easily switch between these two configurations in their ChargePoint Cloud software platform.

Equal Charge Policy

Since Equal Charge is the most commonly chosen algorithm, this document was created reflecting how this policy would work. Each vehicle will receive the same amount of amperage allowing for all vehicles to receive the same power level.

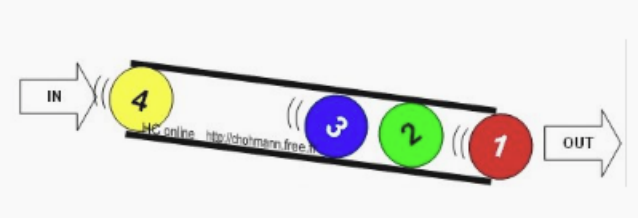
As power is stretched such that vehicles would receive less than 8 Amps, a secondary policy called round robin will automatically be activated. There are some vehicles on the market that will not charge below 8A and so the Round Robin policy keeps vehicles at 8 A or more and rotates power through vehicles. Over time, this will yield a similar power level to equal charge as an average charge rate, giving the driver a very similar experience as Equal Charge applications above 8 A.



In general, it is best to provide more than 8 A as a minimum charge level for a variety of reasons. With the exception of Long Term Parking, the driver experience will suffer below 8 A and there are also repercussions when cellular connection drops out when stations are below 8 A. ChargePoint generally recommends designing around 8A or greater for most applications that utilize Power Management whenever possible.

First in, First Out Policy

In this policy, vehicles are given a priority charge based on the time they plug into their charging stations. As the electrical infrastructure limitations are reached, the first vehicles that plugged in will continue to receive their increased rate of charge and later vehicles will be put into a waiting period.



As the first vehicles complete their charge, the system will automatically look to the next vehicle in the waiting queue and assign available power to the next vehicle in line.

The reason that this is not used as commonly is that waiting vehicles will not receive any charge while waiting their turn. This can lead to driver frustration as they may assume that their station is not functioning correctly, and does not suit for shorter dwell time applications.

With that in mind, this could be useful for valet applications, fleet applications, longer-term parking applications like Airports and other scenarios where it may be beneficial to prioritize the first vehicles that plugged in. As discussed previously, a site host can toggle between Equal Charge and First In, First Out policies in the software, so a site host could try this and see if it is applicable to their installation knowing that they could always fall back to the equal charge policy if it does not meet their expectations.

ChargePoint Power Sharing

Once enabled, Power Sharing continuously monitors the demand for power and informs the charging stations what power level they're allowed to dispense, all in an effort to satisfy the group limit(s) that have been configured, and according to the sharing policy. This means that:

- The stations continuously send power readings to the cloud. This allows the Power Sharing Algorithm (PSA) to understand how fast each individual port is providing power to the connected vehicles.
- When the total demand is less than the limit, the algorithm allows the chargers to deliver all the power the vehicles are willing and able to draw.
- Only when the total demand exceeds the limit, the algorithm kicks in and instructs the chargers how much power they're allowed to dispense on a per-port basis.
- Which port gets how large a share of the available power is determined by the Sharing Policy: Proportional Share or First Come First Served. (More details on this are available below.)
- If the total demand dips below the limit, then again, the chargers are allowed to deliver all the power the vehicles are willing and able to draw.

Ways to Set Limits

Currently, the following methods are possible:

1. **Static/Fixed Limit:** the group has a single, fixed, static power limit for the group (for example, 500 kW at all times). This is typically used to prevent overload of a panel or a circuit.

2. **Time of Use Varying Limit**: the group has a limit that varies by Hour of the Day, by Day of the Week, or both, on a recurring weekly calendar. This is typically used to match the amount of power to the cost of electricity, when that cost varies by Time of Use. An example would be: 500 kW during nights and weekends, but only 200 kW during weekdays. This and the subsequent methods below requires the Fleet Enterprise or Enterprise plans.

Oversubscription Ratio Recommendations

The "oversubscription ratio" refers to the proportion of charging stations installed compared with the rated capacity. For example, an oversubscription ratio of 4:1 refers to installing four charging stations where only one is rated.

In the chart below, we are showing recommended starting points based on the application. The Range per Hour (RPH) estimate factors in the minimum charge level, where all ports are being utilized simultaneously and actively charging vehicles. For this reason, the actual driver experience would be to receive at least the number of miles shown below, but the actual miles recouped will always be that level or greater as not all ports will be actively charging simultaneously.

Vertical/Application	CT4000 (40 A Circuit)	CPF50 (80 A Circuit)	CP6000 (100 A Circuit)
Long Term Parking	8:1; ~3 RPH	16:1; ~3 RPH	20:1; ~3 RPH
Overnight Parking	4:1; ~6 RPH	8:1; ~6 RPH	10:1; ~6 RPH
All-Day Parking	4:1; ~6 RPH	8:1; ~6 RPH	10:1; ~6 RPH
Short-Term and Hourly Parking	Not recommended	2:1; ~23 RPH	3:1; ~19 RPH
Multifamily	4:1; ~6 RPH	6:1; ~7 RPH	10:1; ~6 RPH

IMPORTANT: RPH in the above table stands for Range Per Hour and refers to the approximate number of miles vehicles are going to recoup in an hour. In this example, we are assuming 3 miles per kWh.

You will see from the chart above, that how far you can stretch the power is going to depend on both the application and chosen station hardware. Another factor to consider is how many miles a typical driver will be traveling from when they arrive at this destination. As drivers travel shorter distances and vehicles are parked for longer dwell times, it allows you as a designer to stretch power further. As drivers travel from further away, for example hotels targeting traveling salespeople, or dwell times are lower such as short term parking, designers should avoid stretching power as far and ensuring that drivers can receive their desired number of miles in their regular time frame.

For example, if we look at a **multifamily** application and the typical driving patterns of the residents, most drivers will drive less than 40 miles per day. Their vehicle will be parked overnight and it would not be reasonable to expect a resident to move their vehicle during the overnight hours since they are asleep. For this reason it would be more beneficial to electrify more parking stalls at a lower charge rate, while still meeting the driver needs. Likewise, most residents would be sleeping for 8 hours, but parked for longer than that when we factor in making dinner, getting ready for work, and other activities at home. Most drivers would really be plugged in for 10-13 hours

generally. When we factor in 6 miles of range recouped per hour, that would yield 60-78 miles of range or greater, well exceeding the 40 miles of range of a typical driver.

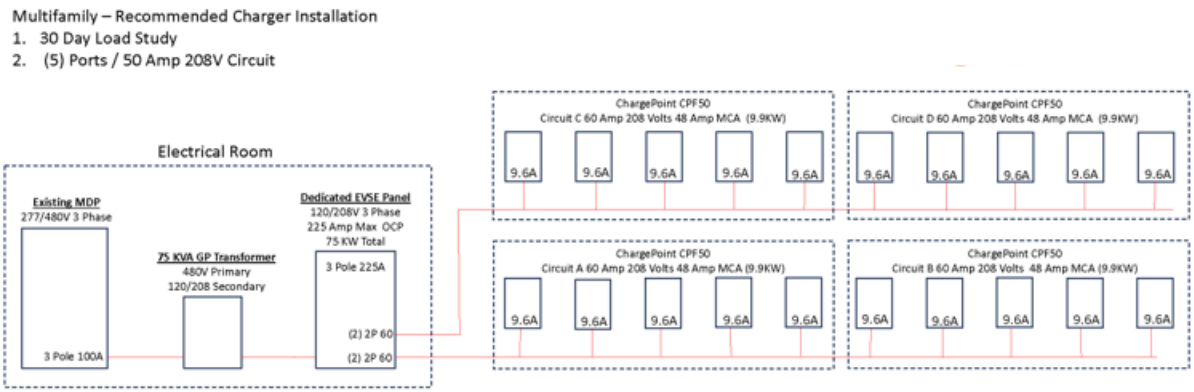
Similarly for **workplace** charging, drivers are parked for 8 hours as they are at work. Even at 6 miles of RPH, they would recoup their 40-mile daily average miles in less than 7 hours making this an acceptable rate of charge for the worker. By adding more ports, you have also allowed for more workers to be plugged in simultaneously. This can help with business operations compared to having fewer ports at a higher rate of charge since it would not be as critical for drivers to relocate their vehicle to free up a more limited number of ports.

Note: if workplace customers would prefer to have higher level chargers and more turnover than the Power Sharing example, ChargePoint does include a Waitlist feature which will allow workplace customers to join a virtual queue and hold the station for them. Both Waitlist and Power Sharing can also be used simultaneously to help with station utilization.

Finally, for longer-term parking applications like **long-term airport parking**, drivers are not expecting to complete their charge as quickly, so a slower rate of charge can be acceptable. As you can imagine, if an airplane traveler wants to plug in their vehicle before their trip and no ports are available, they would be unable to move their vehicle while on their trip. For this reason, ChargePoint recommends long-term parking customers focus on allowing for more available ports at slower charging levels to accomodate more drivers without having to bring in additional power requirements.

For help with your specific project or application, please refer to the Where to get help section below at the bottom of this document.

Example Drawings of Power Sharing Designs



IMPORTANT: Disconnecting Means in the above example:

For equipment rated **more than 60 A** or more than 150 V to ground, the disconnecting means shall be provided and installed in a readily accessible location per NEC 625.43. The disconnecting means shall be lockable open in accordance with NEC 110.25.

What If Stations are Unreachable (Offline)

When Power Sharing is enabled, chargers are programmed with a "fall-back" power level or "offline"power level. The most common reason for a station going offline is that they lost network connectivity. When this occurs, stations automatically revert to their fall-back power level. This level is hard programed such that even if all

stations were in their fall-back power level, the power level would be below the NEC ratings of the upstream electrical equipment, ensuring that the power group limit is not exceeded.

Once the stations come back online, they will resume their normal Power Sharing algorithms without requiring driver or site host intervention.

How is Power Sharing Configured

There are some features of this document that are implemented by the licensed electrical contractor to meet National Electric Code. These include the Power Sharing jumper and Power Select feature that allows stations to be installed on lower breaker sizes. The electrical contractor must configure the station in their installation process reflecting the specific breaker size and confirming whether the Power Sharing jumper was or was not installed.

For the Power Sharing software feature, stations are configured in their power share groups at the activation stage. Installers will need to document the as-built configurations of the stations so that ChargePoint can setup the power share groups correctly.

For information on how Power Sharing is configured, reference “How to Manage Energy” in the Cloud Dashboard, select **Help > Videos and Manuals.**

Where to Get Help

If you need assistance with designing a project around ChargePoint's Power Sharing, please reach out to your local ChargePoint Sales Team or Partner Account Manager. If you do not have a contact, please reach out to sales@chargepoint.com.

For assistance with activation, reach out to activations@chargepoint.com.

chargepoint.com/support

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