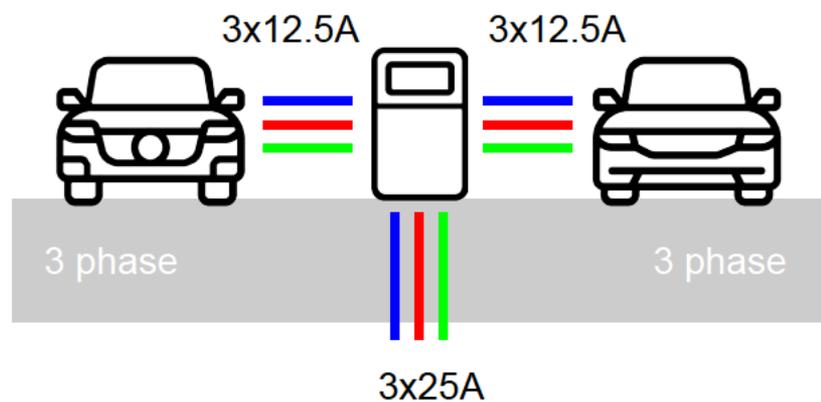
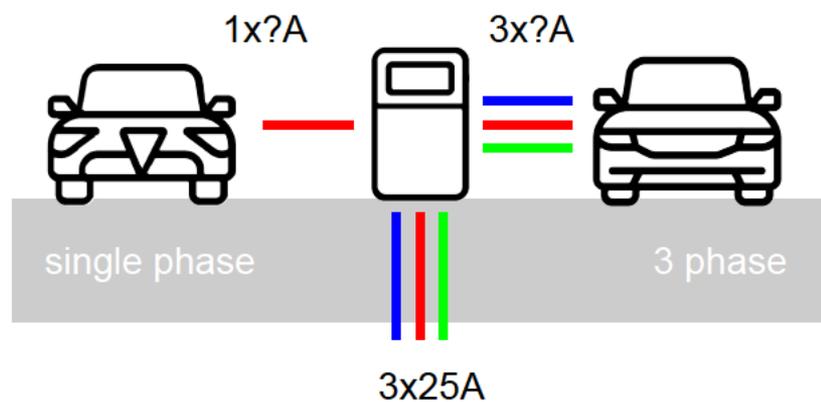
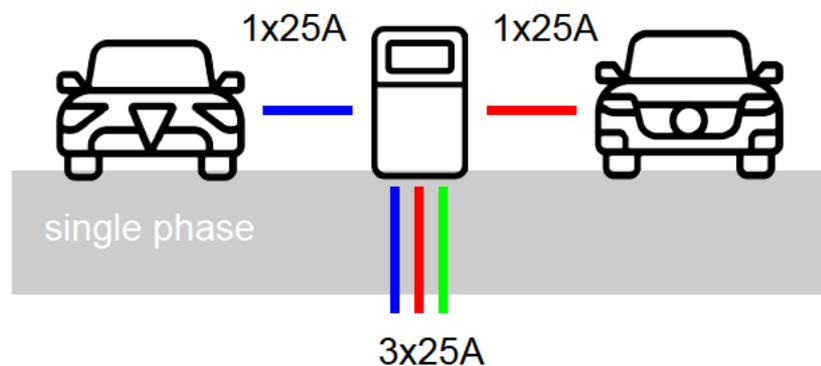


Standard charging stations

Each charging station has 3 phases and usually 2 charge points per station. Standard charging stations can deliver 25A per phase. Most cars can either charge using 1 phase or 3 phases. Two single-phase cars can use one phase each and could theoretically charge at 25A, although most cars charge at a max of 16A. Two 3-phase cars will split the power per phase and will each charge at 12,5A per phase.



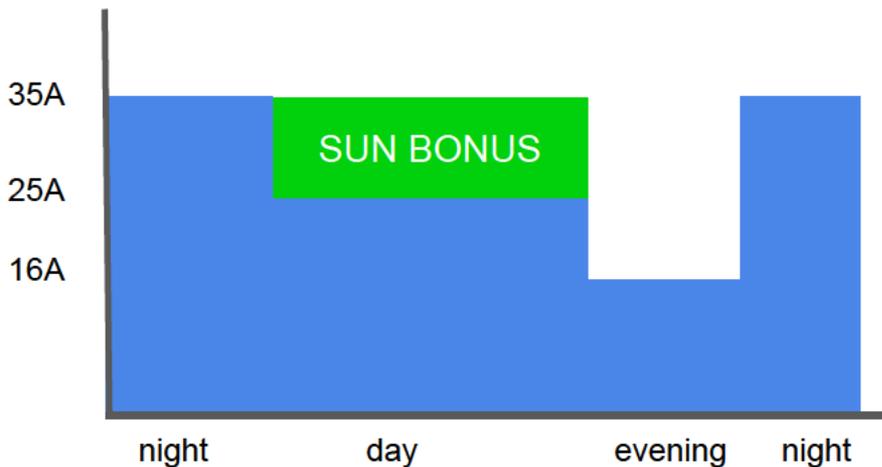
Flexpower 2

Flexpower 2 has **3 distinct power levels**:

- **16A** in the evening during peak demand
- **25A** during the day,
- **35A** at night or during the day if the sun is shining

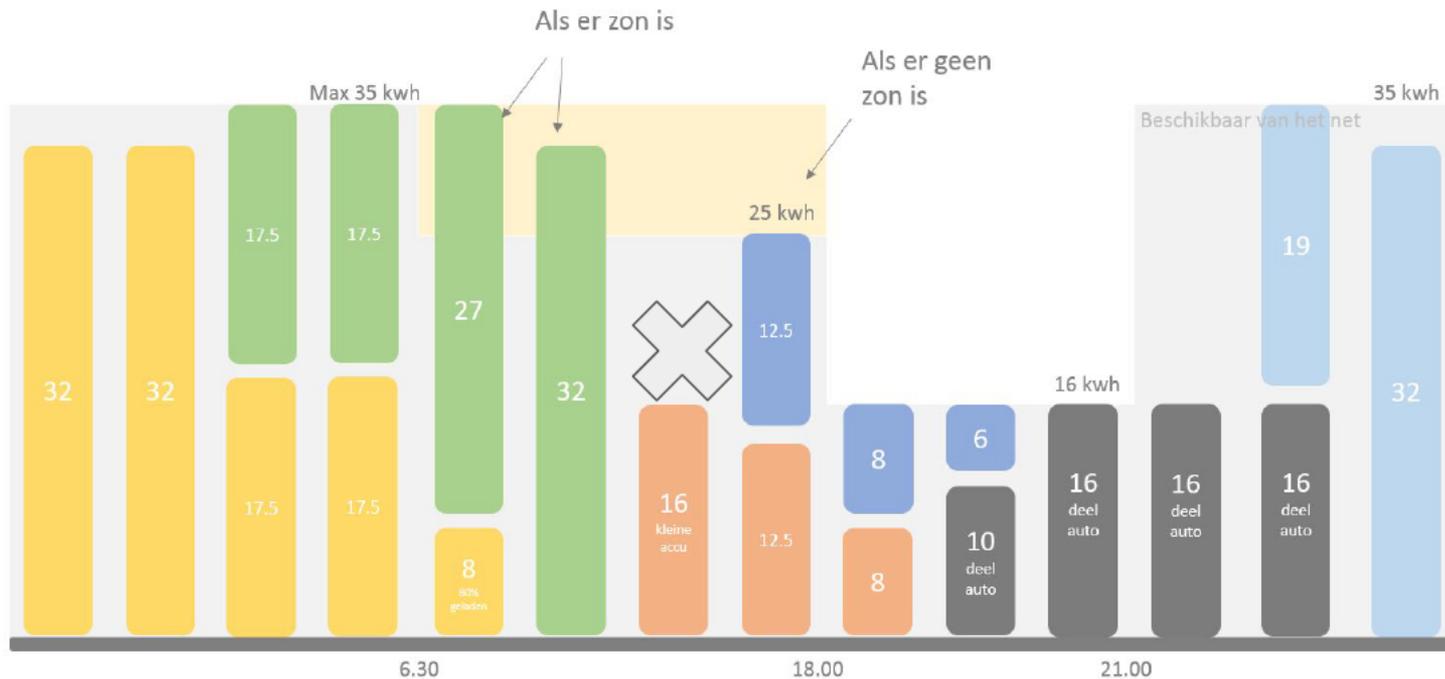
Next to that it will be possible to **prioritise car sharing** vehicles (most of the time single phase cars) during the peak hours.

Cars cannot be charged below 6A, so dynamic switching is necessary. This can be the way to prioritise car sharing vehicles.



Car variables

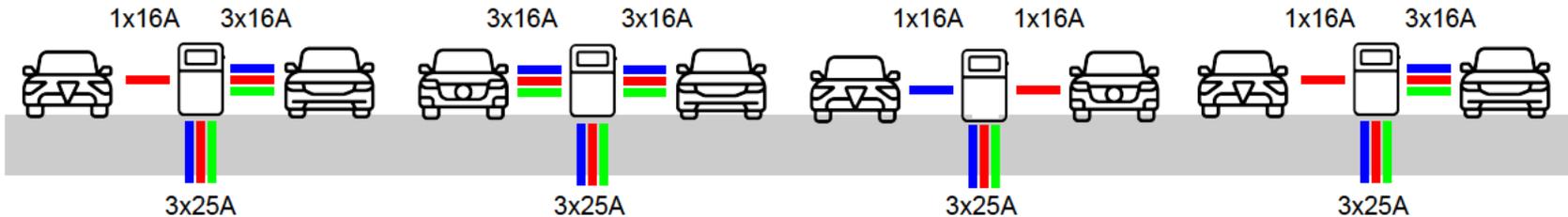
Cars differ in the number of phases they use to charge and the maximum at which they can charge. They will have different battery capacities and mileage ratios. Some cars will also charge the remaining 20% at a lower rate. This creates many variables that influence the rate at which your car can charge and how to evaluate a fair distribution.



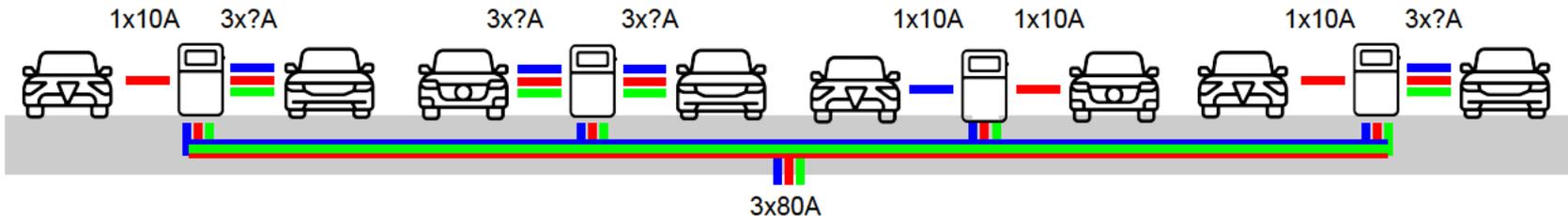
Raamplein

The 4 charging stations on Raamplein currently have a connection each, meaning they can independently provide up to $3 \times 35\text{A}$. It is therefore not a true charging square (laadplein) where a single connection could deliver up to $3 \times 80\text{A}$. With such a setup all cars would notice a reduced output if more cars would charge.

Current situation at Raamplein



A charging square



Different frictions

The frictions that seem to most prevalent are the amount and type of cars that are charging and the low supply during peak hours. In the current situation this only holds between the two cars that are both using a charging station, not between all 8 cars that can charge there.

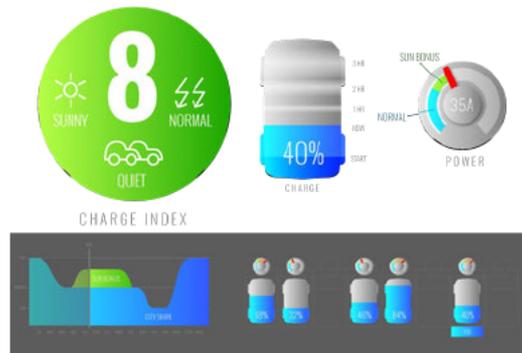
QUESTION:

Do we design the pilot around the current setup and focus on frictions per station or do we design for a charging square?

The design solutions might use similar solutions, but might differ quite a bit. To proceed with the design process it would be good to answer this question.



Compare 2 cars



← Compare 8 cars

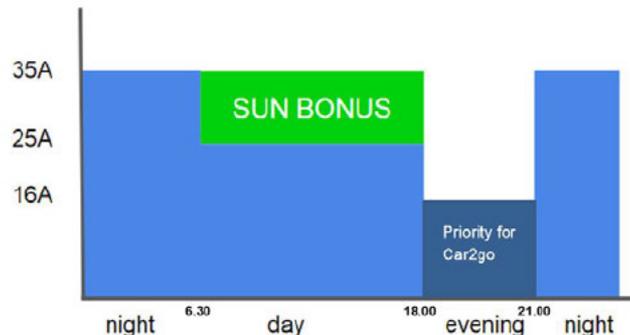
Assumptions

Extra energy from the sun can only occur between 6.30 and 18.00. When this extra energy is present, the power will go up to 35 A, so the energy available between 6.30 and 18.00 is either 25A or 35A (nothing in between).

The amount of energy from the sun that will be available is decided beforehand based on the weather forecast.

From 18.00 till 21.00 is the only time Car2go cars get priority while charging. The power available will always be 35A, 25A or 16A. (3-phase)

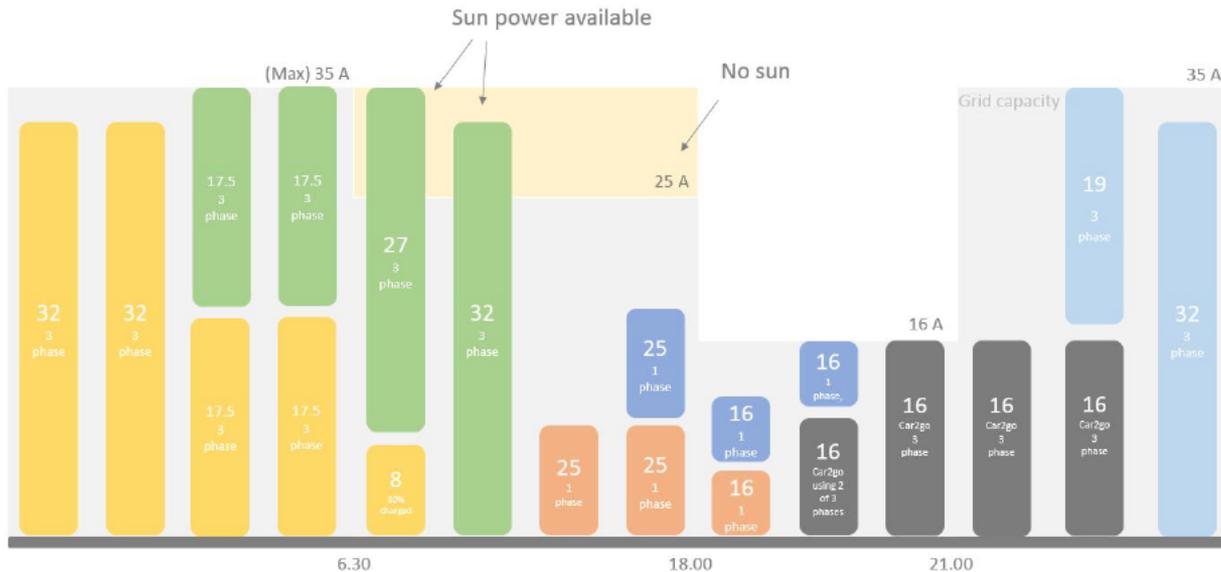
We assume that during low power periods the power is not divided per car, but the charge time is, where every car will be charged with full power, half of the time. We also assume that Car2go will get more time than normal cars, for example, a normal car will charge full power for 20 min in an hour and the car2go will charge for 40 minutes.



Some cars can charge a maximum of 32A and others a maximum of 16A.
 Every charging station has the same power, which the station divides between a maximum of two cars.

We can exclude 2-phase charging.

Example, based on our assumptions



Questions about powerdistribution:

- Do 1-phase cars always charge with a maximum of 32A or can this also be 16A?
- Do 3-phase cars always charge with a maximum of 32A or can this also be 16A?
- How is power divided between a 1-phase and 3-phase car?
- How is the power divided when one car is at 80%?
- What kind of connection does the car2go have? (expectation, 16A with 3-phase)
- How do Car2go cars get priority? (When sharing with 3-phase and 1-phase car)
- What happens when the power from the sun is not as expected? Can it be adjusted later during the day or is other energy used to compensate?

Influence of other cars on your charging speed

	Sharing with 1 phase 16A	Sharing with 1 phase 32A	Sharing with 3 phase 16A	Sharing with 3 phase 32A
Charging speed of 1 phase 16A	Maximum possible speed	Maximum possible speed	35A max 23A max or lower 16A max or half	35A max 23A max or lower 16A max or half
Charging speed of 1 phase 32A	Maximum possible speed	Maximum possible speed	35A max or half 23A max or half 16A max or half	35A max or just above half 23A max or half 16A max or half
Charging speed of 3 phase 16A	35A max 23A max or lower 16A max or half	35A max or lower 23A lower 16A lower	35A max 23A lower 16A half	35A max 23A lower 16A half
Charging speed of 3 phase 32A	Lower than maximum speed	Lower than maximum speed	35A just above half 23A half 16A half	Half of maximum possible speed

The charging speed is rated in comparison to what the car would charge in this situation, when it did not have to share.