

Load Management with Terra AC

Global Product Management AC Charging

02-07-2021



LOAD MANAGEMENT

Agenda



Why Load
Management



Where do we start



How does it work



Next steps

— Load Management: Where, Why, What?

Use case: single family home

Case:

- Free standing home, the car is a company car. The owner drives a lot for work and has a flexible schedule
- The grid connection is a standard one from the local utility
- There is place on own premises the car and the charger

How to:

- Define needed capacity for charging
- Ensure the car is charged every morning, while not blowing the fuse
- Handle tax reimbursement
- Ensure connectivity with unclear home Wi-Fi systems, and without requiring cellular connectivity on the charger



Use case: apartment building with underground parking

Case:

- Apartment building complex with an underground parking garage for 150 cars. ~20 parking spots have to be electrified and the system has to allow for upgrades to more at a later time
- The grid connection cannot easily be changed
- There is a shared ownership structure that is investment averse

How to:

- Find out required charging capacity
- Share the load fairly
- Don't exceed the grid connection capacity
- Pay per use
- Make use of solar



Why Load Management?

Single family home

Total installed power exceeds what the grid connection can supply, but many devices in the home use less power during the night.

A schedule is always either too early or too late, never at the right moment



Apartment building with underground parking

20 chargers, 22kW each can provide 440kW at 640A on 3 phases.

To accommodate for the normal commute, the chargers on average need to provide ~40kW during the night.



using load management

the car automatically charges when capacity is available

the required grid connection can be greatly reduced

Static vs. Dynamic

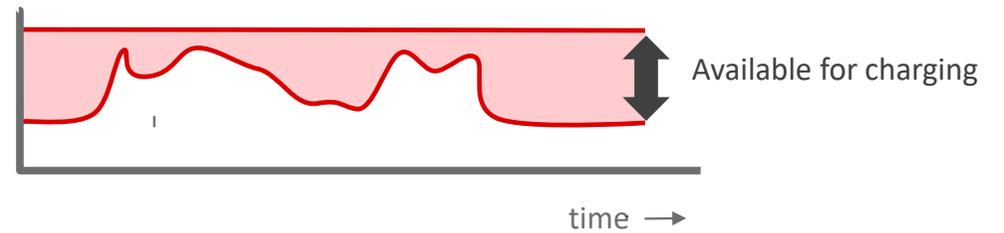
Static



Static limit

- ➔ Static Load Management is good when only chargers have to be managed.
- ➔ Static Load Management is simple, and in a chargers only grid can still make use of a high % of the grid capacity

Dynamic



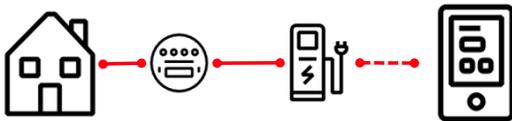
Variable "dynamic" limit

- ➔ Dynamic Load Management is best when the available power depends on other devices on the same grid.
- ➔ Dynamic Load Management is robust and can adjust for a varying amount of power available for the chargers.

Local vs Cloud

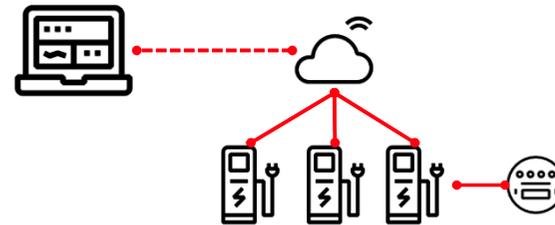
Local: best for homes

- one charger one meter
- static/fixed limit and dynamic
- charger is the controller (controls only itself)
- set via the apps



Cloud: best for big installations

- many chargers (practical limit: ~20 per site)
- static and dynamic load management
- cloud is the controller
- set via the cloud



** Dynamic Cloud multiple chargers available in next FW charger release*

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Where do we start?

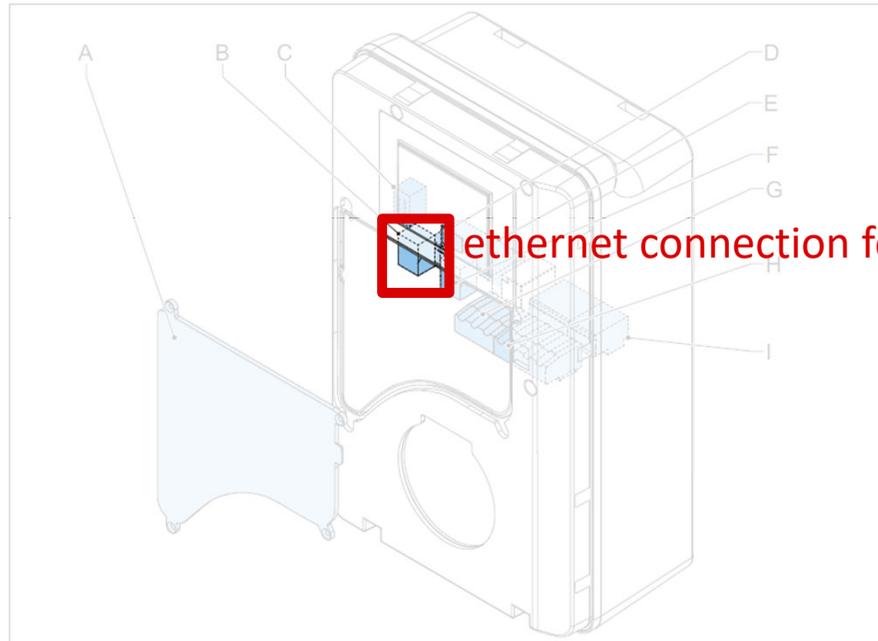
Meter connection on the charger – supported by all Terra AC models



RS485 connection for Modbus RTU

- | | | | |
|---|----------------------------|---|--|
| A | Maintenance cover | D | Smart meter connection |
| B | Ethernet connection | E | Terminal block for the AC input |
| C | Socket for a Nano-SIM card | F | Terminal block for the EV charge cable or the socket |

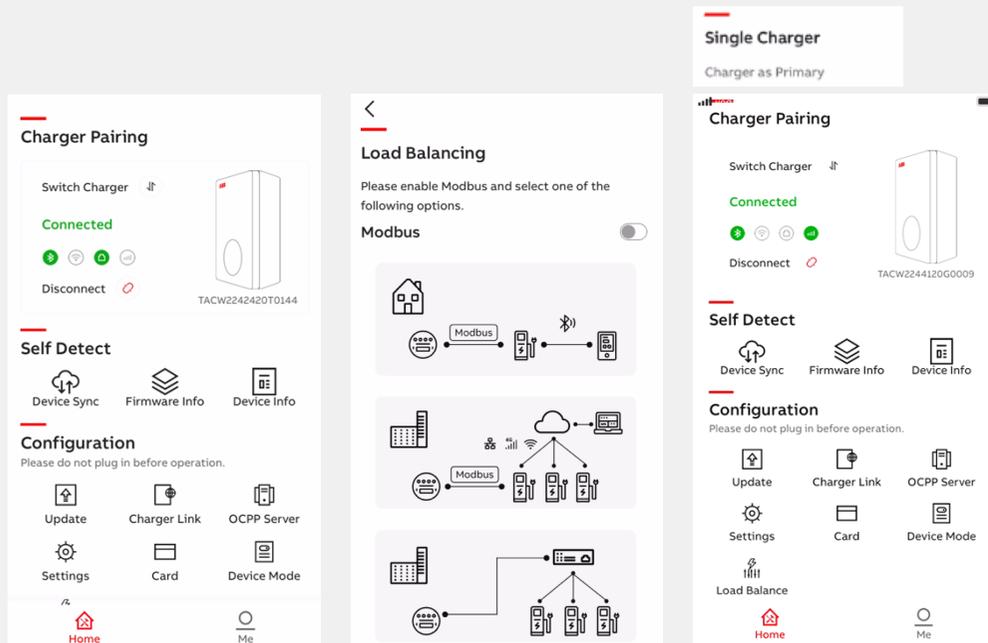
Meter connection on the charger – supported MID, UL, UL Display



ethernet connection for Modbus TCP/IP

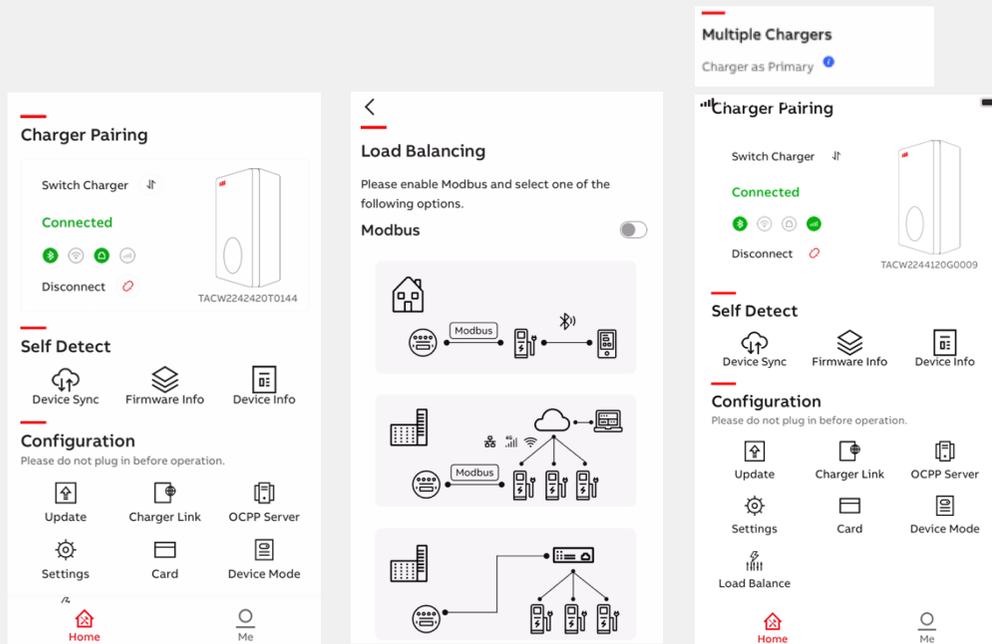
- | | | | |
|---|---------------------------------|---|--|
| A | Maintenance cover | F | Secondary Ethernet connection |
| B | Primary Ethernet connection | G | Smart meter connection |
| C | Electrical pulse connector | H | Terminal block for dry contacts input |
| D | Socket for a Nano-M2M SIM card | I | Terminal block for the EV charge cable or the socket |
| E | Terminal block for the AC input | | |

Meter configuration in TerraConfig 1.6.1 - Single Charger (Modbus Primary)



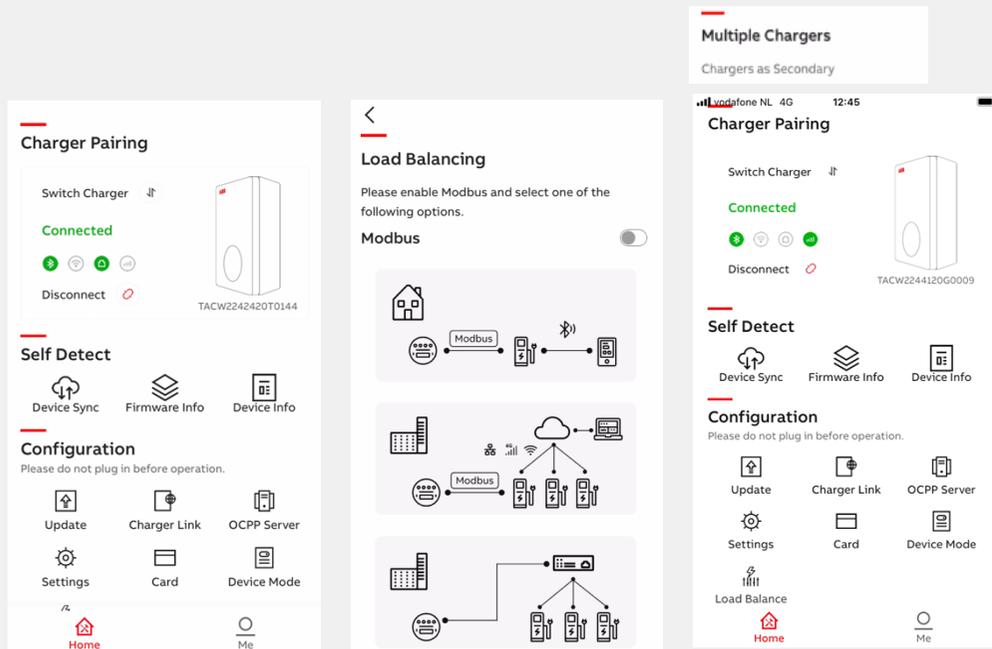
- Configure the meter with TerraConfig by 'Load Balancing' menu.
- Modbus settings can be edited to match with meter settings (address, baudrate, parity)
- Configure 'Load Management' settings (electrical grid, threshold, base line) as well to complete the Load Balancing setup.

Meter configuration in TerraConfig 1.6.1 - Multiple Chargers (Modbus Primary)



- Configure the meter with TerraConfig by 'Load Balancing' menu.
- Modbus settings can be edited to match with meter settings (address, baudrate, parity)
- Configure 'Load Management' settings in the ChargerSync portal. See slide 18.

Meter configuration in TerraConfig 1.6.1 - multiple chargers (Modbus Secondary)



- Configure the meter with TerraConfig by 'Load Balancing' menu.
- Modbus settings can be edited to match with meter settings (address, baudrate, parity, stop, etc.)
- Configure 'Load Management' settings in the local controller. See Modbus documentation as well.

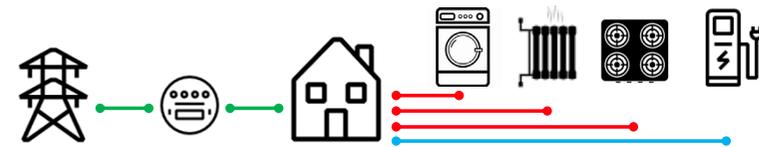
Dynamic Load Management - Single charger



Condition

- one charger, one meter where charger is Modbus Primary and meter Modbus Secondary
- no connectivity (WiFi, LAN, 4G) required
- TerraConfig App (release 1.6.x) to configure meter Modbus settings; address, baud rate and parity
 - charger maximum grid capacity connection setting (10/16/32A)
- ChargerSync App to configure
 - set limits: Electricity Capacity (kW), Load Threshold (%) and Power Decrease Baseline

Use case



How can the Terra AC respond to house load variations?

- The energy meter values are transmitted via the Modbus RTU (RS485) connection to the Terra AC.
- The Terra AC will compare total power consumption with its own integrated energy meter and act according to configured settings to protect the fuse.

Dynamic Load Management - Single charger

How it works



App configurable settings

Electrical Capacity (kW)

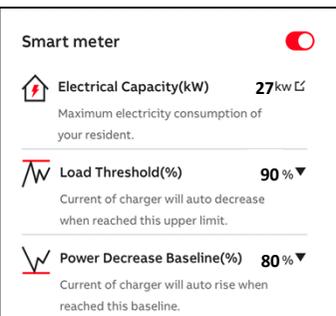
- max house electricity capacity

Load Threshold (%)

- current of charger will decrease when this limit is reached.
- configurable value is 20 - 90% of Electricity Capacity with 10% step size.

Power Decrease Baseline (%)

- current of charger will increase when this baseline is reached.
- configurable value is 20 - 90% of Electricity Capacity including Threshold with 10% step size.



Fixed rules

When the meter value is above the Load threshold:

Charger immediately decrease by 50% of charger capacity.

After the power decrease of the charger:

- 1) if the meter value is in the area between 'Load Threshold' and 'Power Decrease Baseline', the charger will stop decreasing
- 2) if the meter value is lower than the 'Power Decrease Baseline', the charger will start to increase the power 10%. Every 2 mins until the smart meter value in the range between 'Load Threshold' and 'Power Decrease Baseline'
- 3) if the meter value higher than the 'Load Threshold', the charger will continue decrease 10% until it is below 'Load Threshold'.

Load management configuration in ChargerSync™ cloud

Hybrid Load Management OFF ON

Load Control Option

Option A: Static Load Management (Without Smart Meter) Option B: Dynamic Load Management (With Smart Meter)

Electricity Capacity: 3 Phase: Current: 80 A

We don't support mix phase load management

Load Control Threshold: 72 A Max Threshold: 72 A

Power Decrease Baseline: 40 A Max Baseline: 58 A

Description

- Electricity Capacity
- Load Control Threshold
- Power Decrease Baseline
- Power Reduction
- Power Increase

Load Control Group

Group Name	Priority	Chargers	Total Rated Current
VIP Group	Priority 1	1	32A
High Group	Priority 2	0	0A
Medium Group	Priority 3	2	64A

VIP Group (Priority 1): Adjustable, Orderly Charging. Chargers: 1. Total Rated Current: 32A. Alias: TACW2242420T0173.

High Group (Priority 2): Adjustable, Orderly Charging. Chargers: 0. Total Rated Current: 0A.

Medium Group (Priority 3): Adjustable, Orderly Charging. Chargers: 2. Total Rated Current: 64A. Alias: TACW2242420T0144, TACW2242420T0234.

Edit

Load management configuration in ChargerSync™ cloud

nr of phases [1 or 3]

decrease charging power above this value

increase charging power below this value

Grid capacity [A]

Group settings

Hybrid Load Management

Load Control Option

Option A: Static Load Management (With Smart Meter)

Option B: Dynamic Load Management (With Smart Meter)

Electricity Capacity: 3 Phase

Load Control Threshold: 72 A Max Threshold: 72 A

Power Decrease Baseline: 40 A Max Baseline: 58 A

Current: 80 A

Description

Electricity Capacity Load Control Threshold

Power Decrease Baseline

Load Control Group

VIP Group Priority 1

High Group Priority 2

Medium Group Priority 3

Chargers 1 Total Rated Current 32A

Chargers 0 Total Rated Current 0A

Chargers 2 Total Rated Current 64A

Load management configuration in ChargerSync™ cloud

Priority groups

Hybrid Load Management

Load Control Option

Option A - Static Load Management (Without Smart Meter)

Option B - Dynamic Load Management (With Smart Meter)

Electricity Capacity: 3 Phase: Current: 30

We don't support mix phase load management

Load Control Threshold: 72 Max Threshold: 72 A

Power Decrease Baseline: 40 Max Baseline: 55 A

Description

- Electricity Capacity
- Load Control Threshold
- Power Decrease Baseline
- Power Reduction
- Power Increase

VIP chargers

Load Control Group

VIP Group Priority 1

Adjustable Orderly Charging

Chargers: 1 Total Rated Current: 32A

High chargers

High Group Priority 2

Adjustable Orderly Charging

Chargers: 0 Total Rated Current: 0A

MEDIUM chargers

Medium Group Priority 3

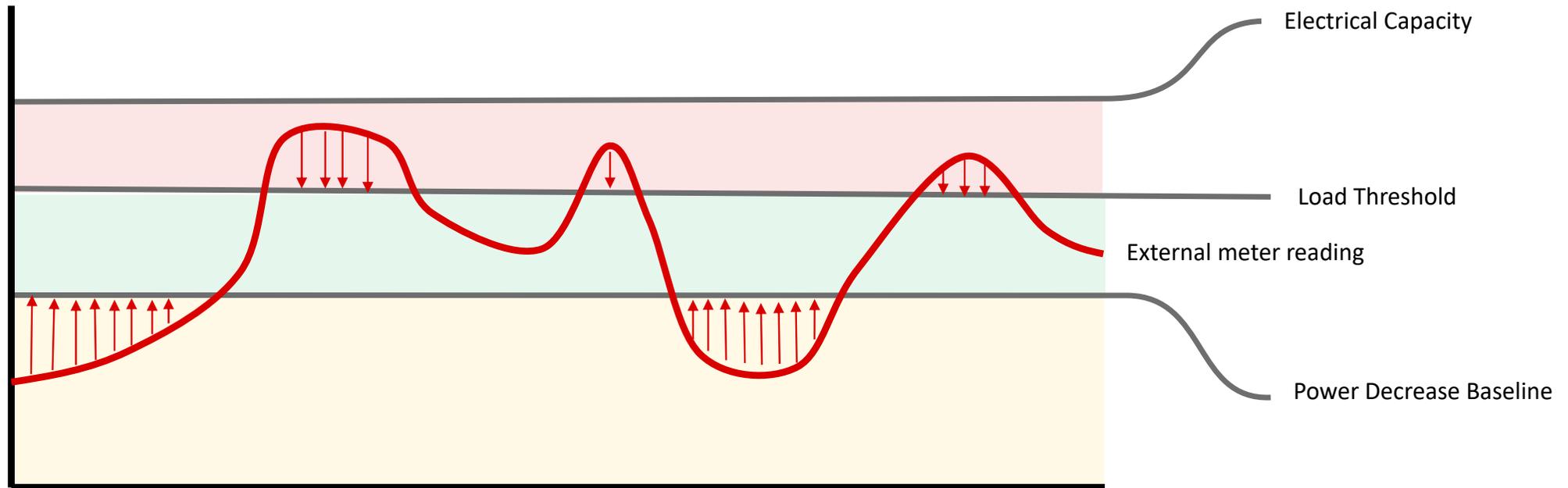
Adjustable Orderly Charging

Chargers: 2 Total Rated Current: 64A

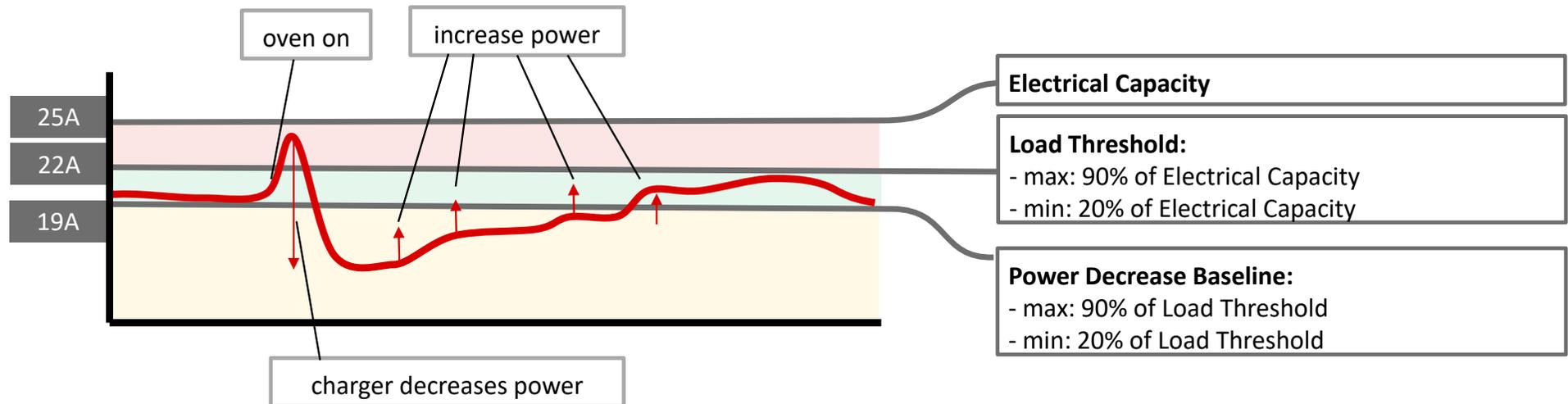
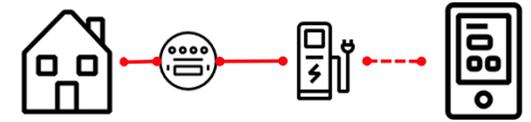
Edit

How does it work?

Values & limits



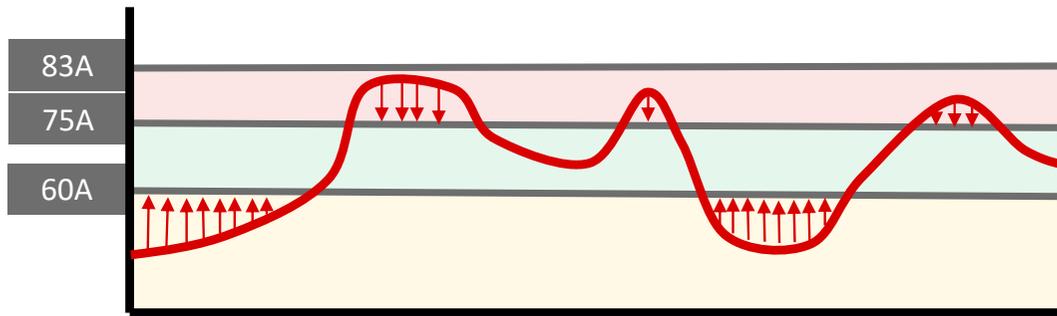
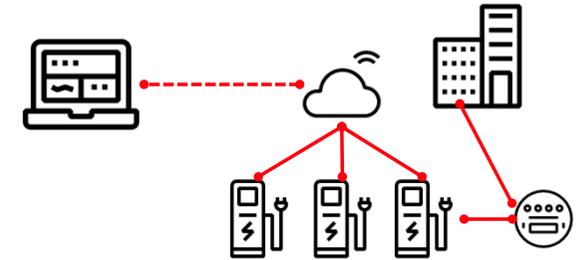
Values & limits: local



When the consumption is **above power decrease power**:

1. the charger immediately **decreases power by 50% of the charger capacity**
2. the charger **increases with 10% of its capacity every 2 min**

Values & limits: cloud control



Electrical Capacity

- min: 111% of Load Threshold

Load Threshold:

- max: 90% of Electrical Capacity
- min: 125% of Power Decrease Baseline

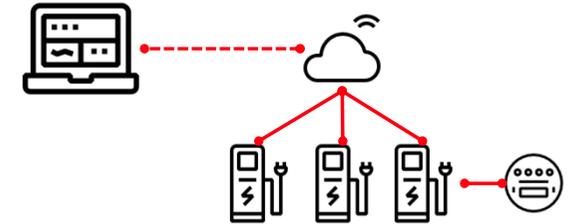
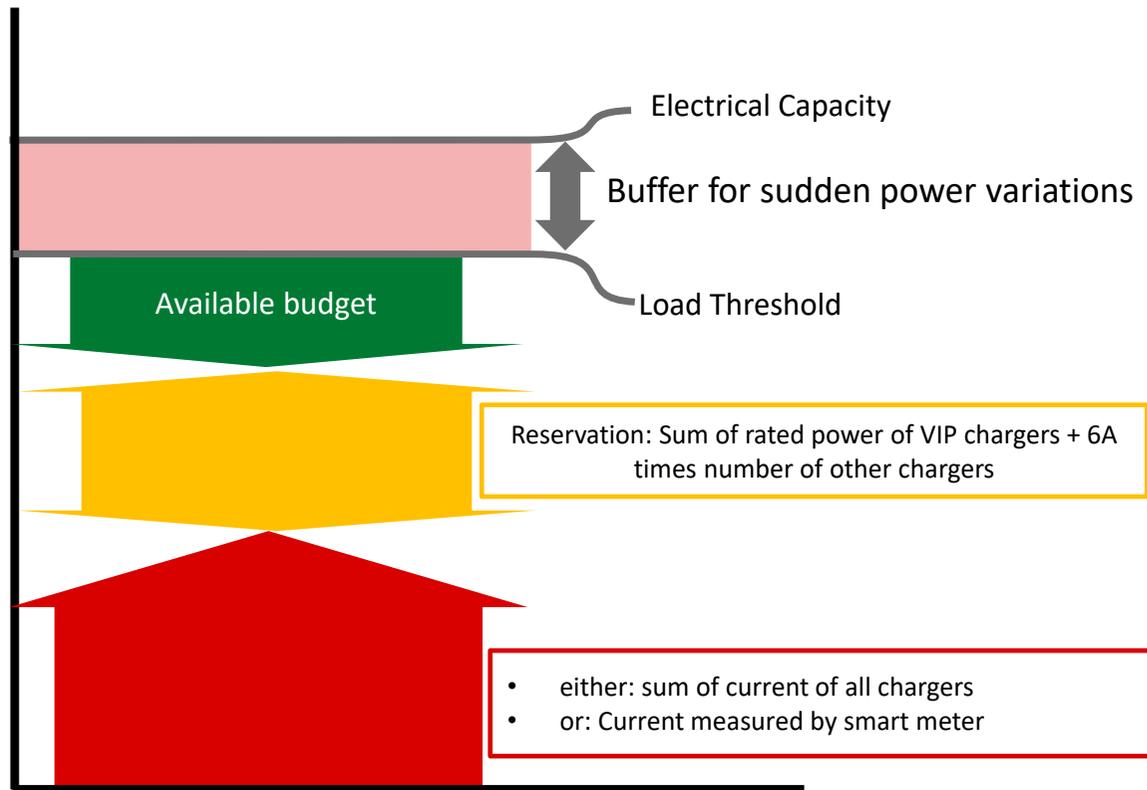
Power Decrease Baseline:

- max: 80% of Load Threshold
- min: (sum of rated power of VIP chargers) + 6A *
(number of med and high chargers)

All groups start at 6A and ramp up according to their profile

- **VIP:** always get their maximum capacity
- **High:**
 - ramp up to charger capacity after 60s to what is available
 - decreased to 6A after new VIP arrives
- **Medium:**
 - ramp up to charger capacity after 60s to what is available
 - decreased to 6A after new EV arrives

Group load management behavior



All

- start with 6A
- ramp up after 60s to what is available
- budget will not exceed maximum of car & cable
- no car will go below 6A

VIP

- never decreased

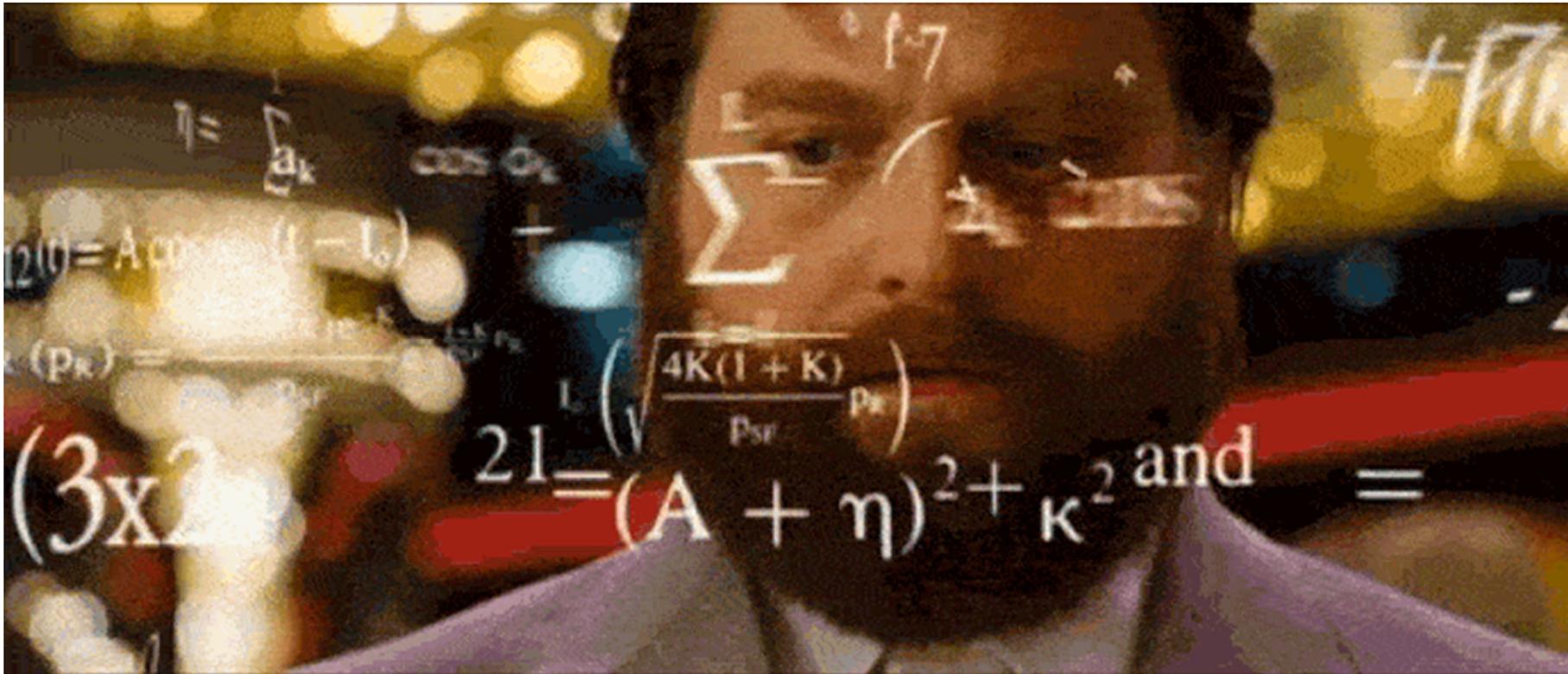
High

- decreased to 6A when a new VIP arrives
- first come first serve with other Highs

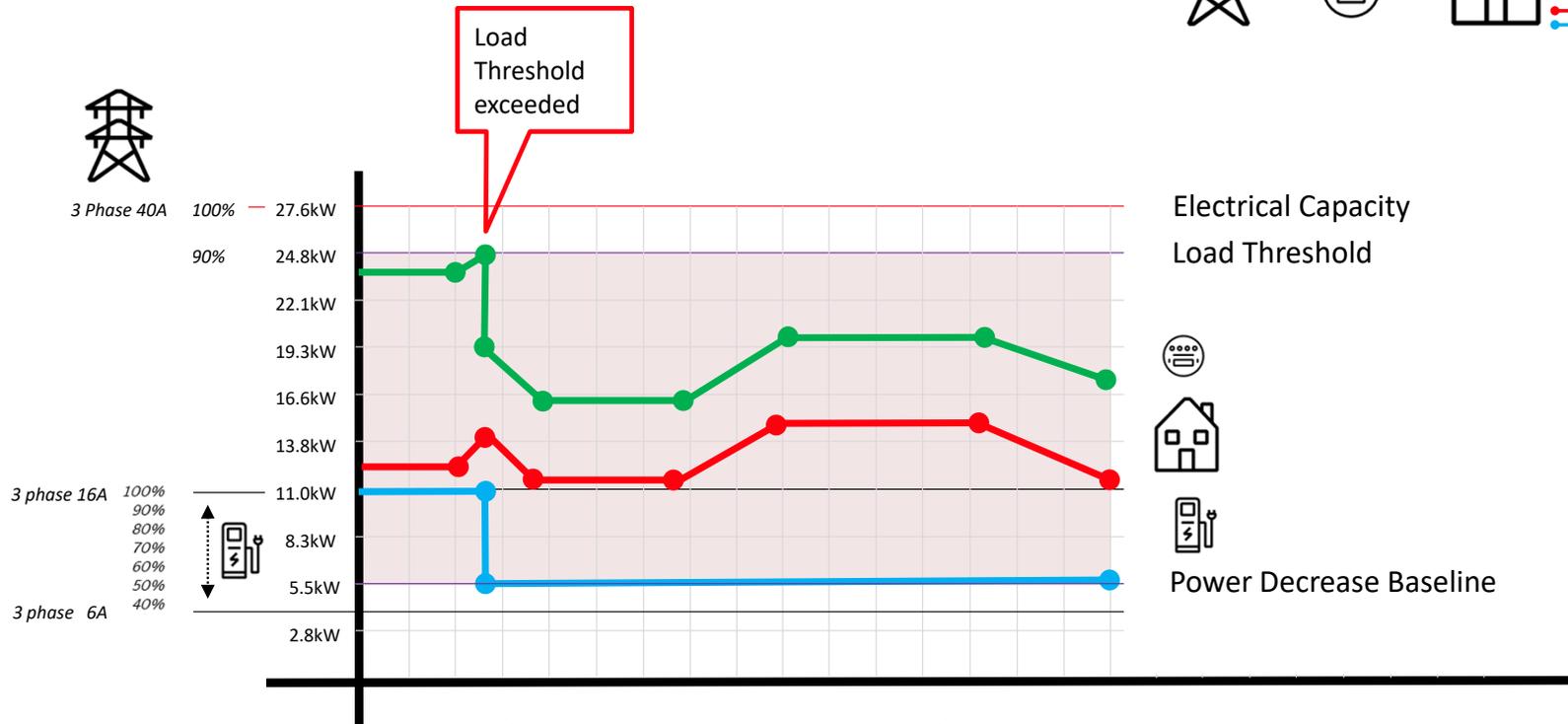
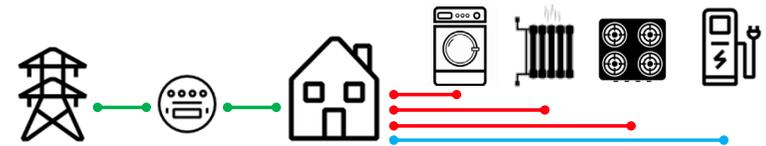
Medium

- decreased to 6A when a new car arrives
- first come first serve with other Mediums

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So... formulas aside, how does it work?



Values & limits



Electrical Capacity
Load Threshold



Power Decrease Baseline

ChargerSync APP

Smart meter

Electrical Capacity(kW) **27 kW**
Maximum electricity consumption of your resident.

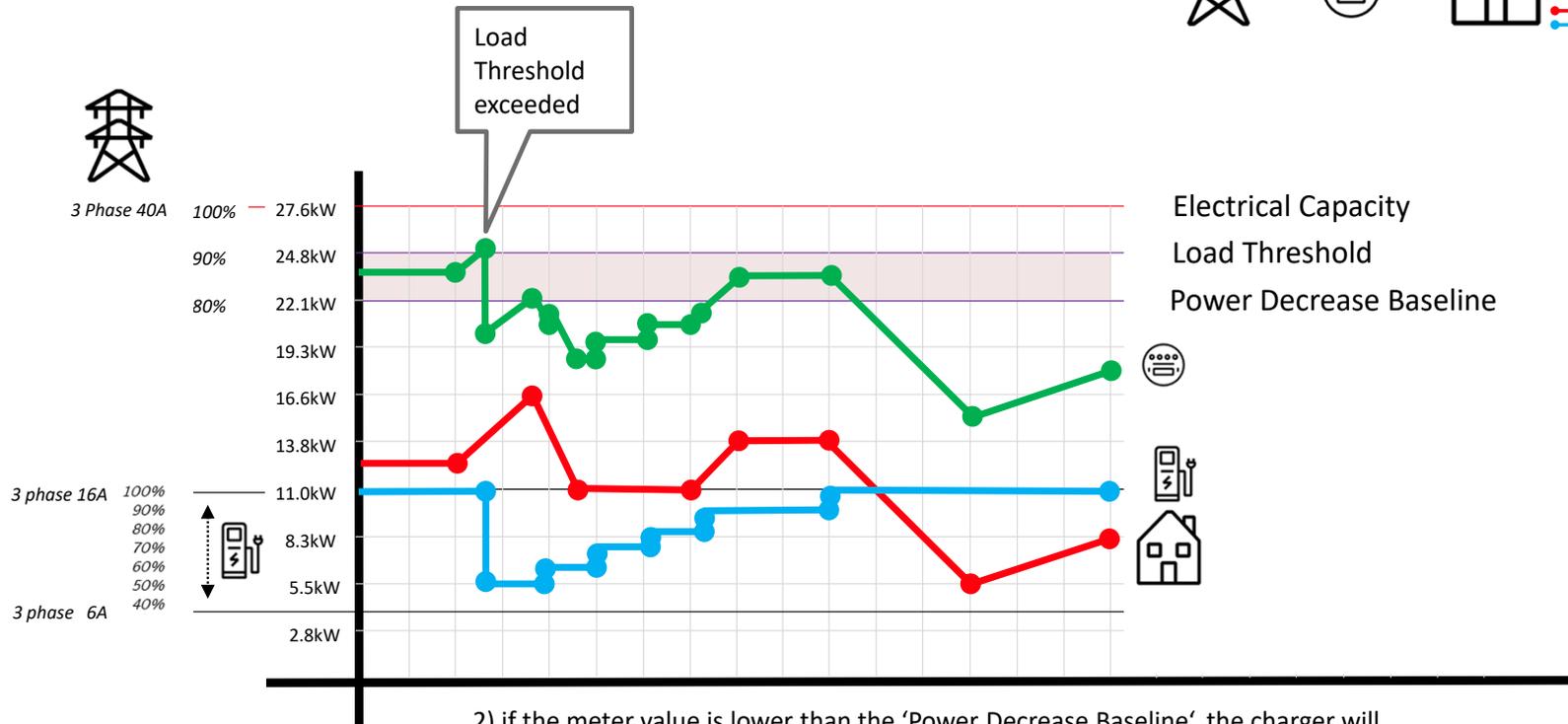
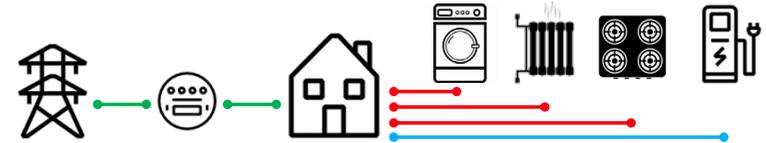
Load Threshold(%) **90 %** ▼
Current of charger will auto decrease when reached this upper limit.

Power Decrease Baseline(%) **20 %** ▼
Current of charger will auto rise when reached this baseline.

1) if the energy smart meter value drops in the area between load threshold and base line, **the charger will stop decreasing**



Values & limits



Electrical Capacity
Load Threshold
Power Decrease Baseline

ChargerSync APP

Smart meter

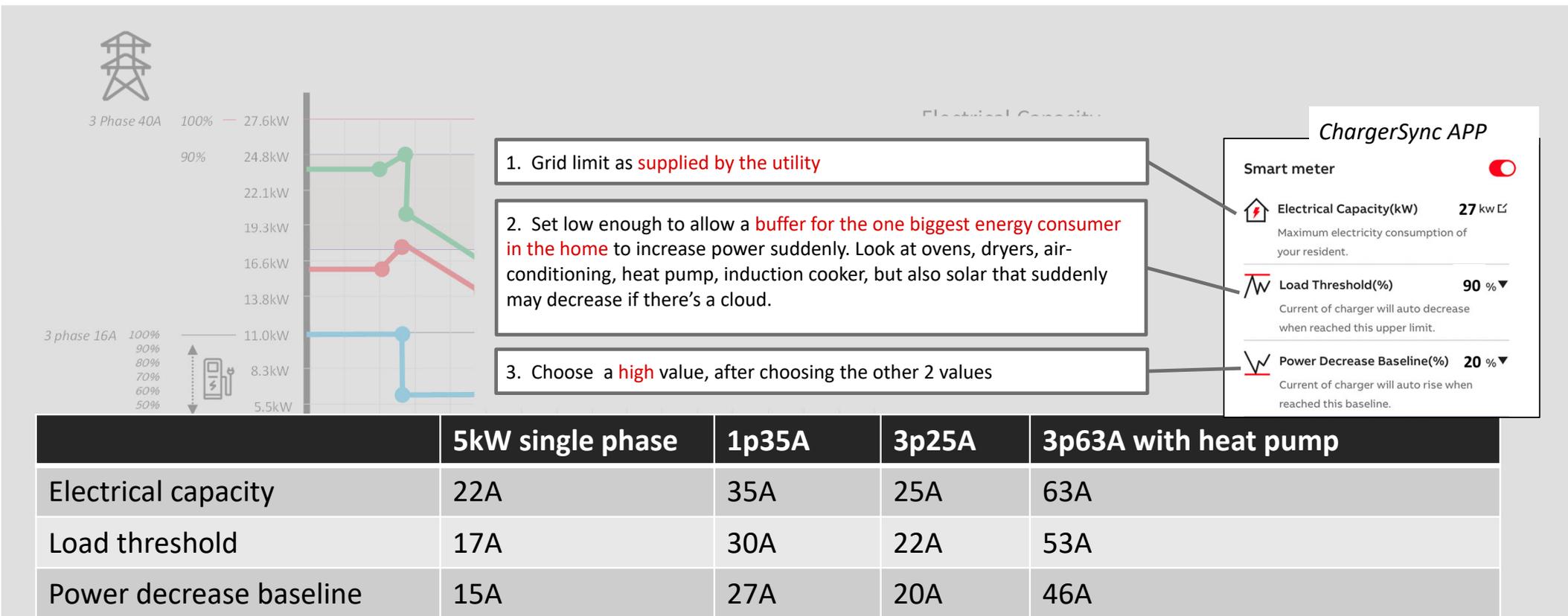
Electrical Capacity(kW) **27 kW**
Maximum electricity consumption of your resident.

Load Threshold(%) **90 %**
Current of charger will auto decrease when reached this upper limit.

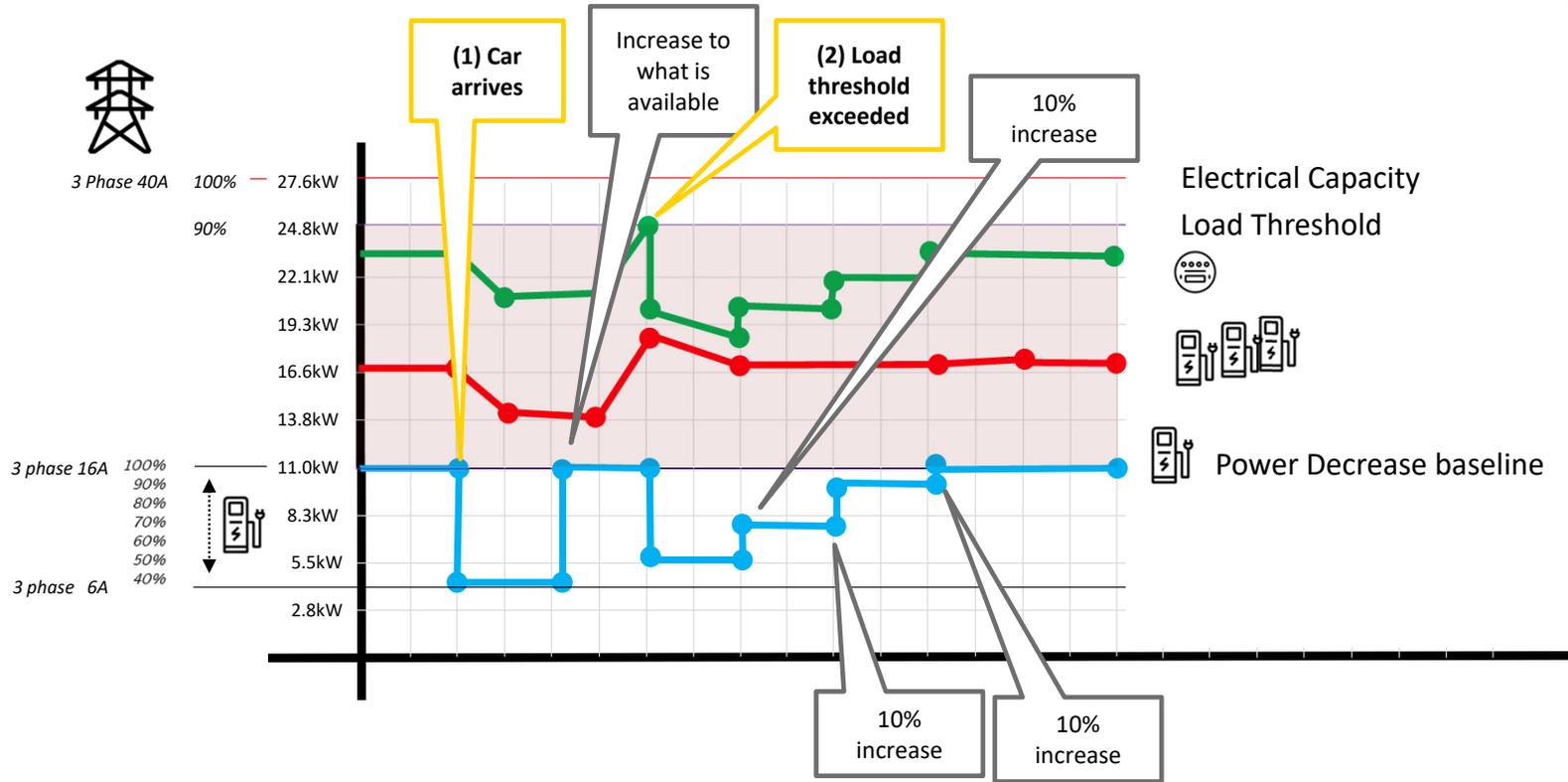
Power Decrease Baseline(%) **80 %**
Current of charger will auto rise when reached this baseline.

2) if the meter value is lower than the 'Power Decrease Baseline', the charger will start to increase the power 10%.
Every 2 mins until the meter value in the range between 'Load Threshold' and 'Power Decrease Baseline'

Values & limits



Values & limits

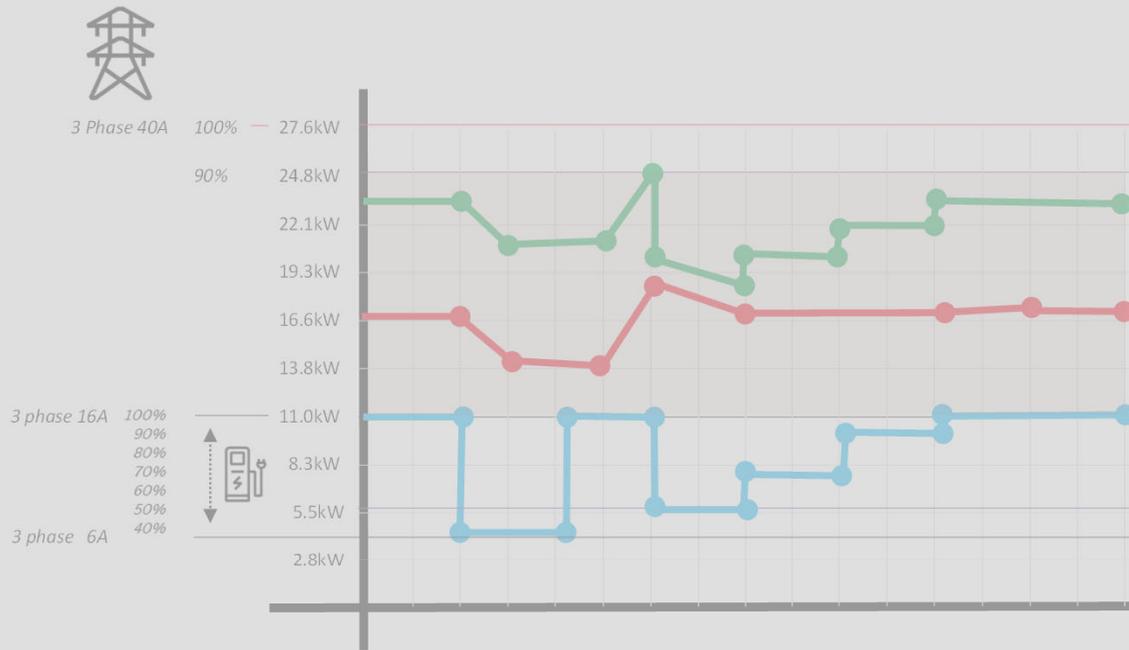


Electrical Capacity
Load Threshold



Power Decrease baseline

Values & limits



1. make as few as possible chargers VIP, place chargers in High and Medium as required.
2. The portal will tell you the minimum grid capacity needed to accomodate this. Make sure the grid capacity is at least that much (for an existing grid, set the actual value).
3. Choose as high as possible values for both the Load Threshold and Power Decrease Baseline.

Values & limits



3 Phase 40A 100% — 27.6kW

Electrical C

	10 chargers	20 chargers	50 chargers and up: make subsites
Electrical capacity	83A	166A	415A
Load threshold	75A	150A	375A
Power decrease baseline	60A	120A	300A

3 phase 6A 10%

2.8kW



Recommendation: create sub-sites

1. make as few as possible chargers VIP, place chargers in High and Medium as required.
2. The portal will tell you the minimum grid capacity needed to accomodate this. Make sure the grid capacity is at least that much (for an existing grid, set the actual value).
3. Choose as high as possible values for both the Load threshold and power decrease baseline.