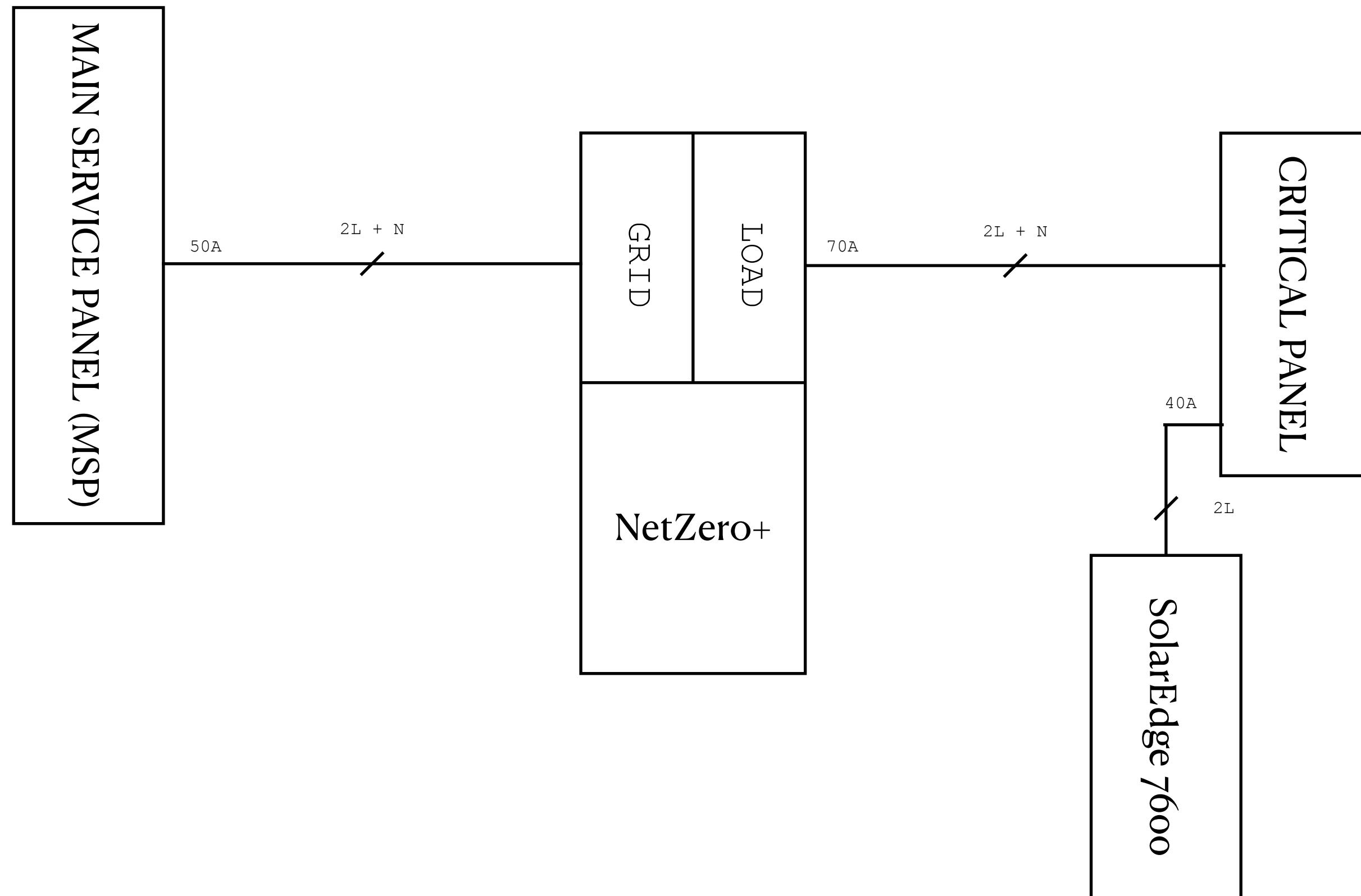
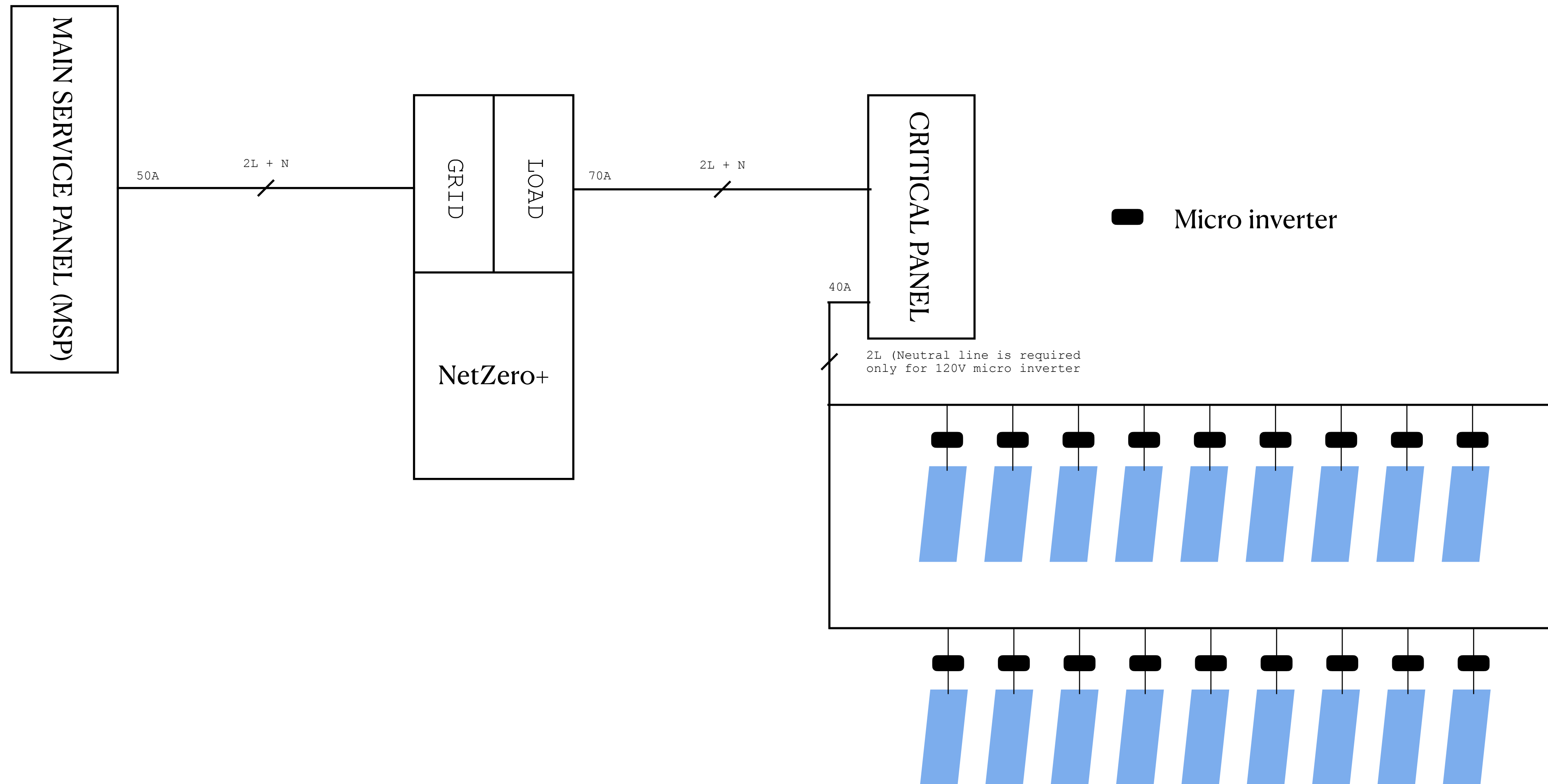


AC Coupled with Grid Tied Inverter(s)

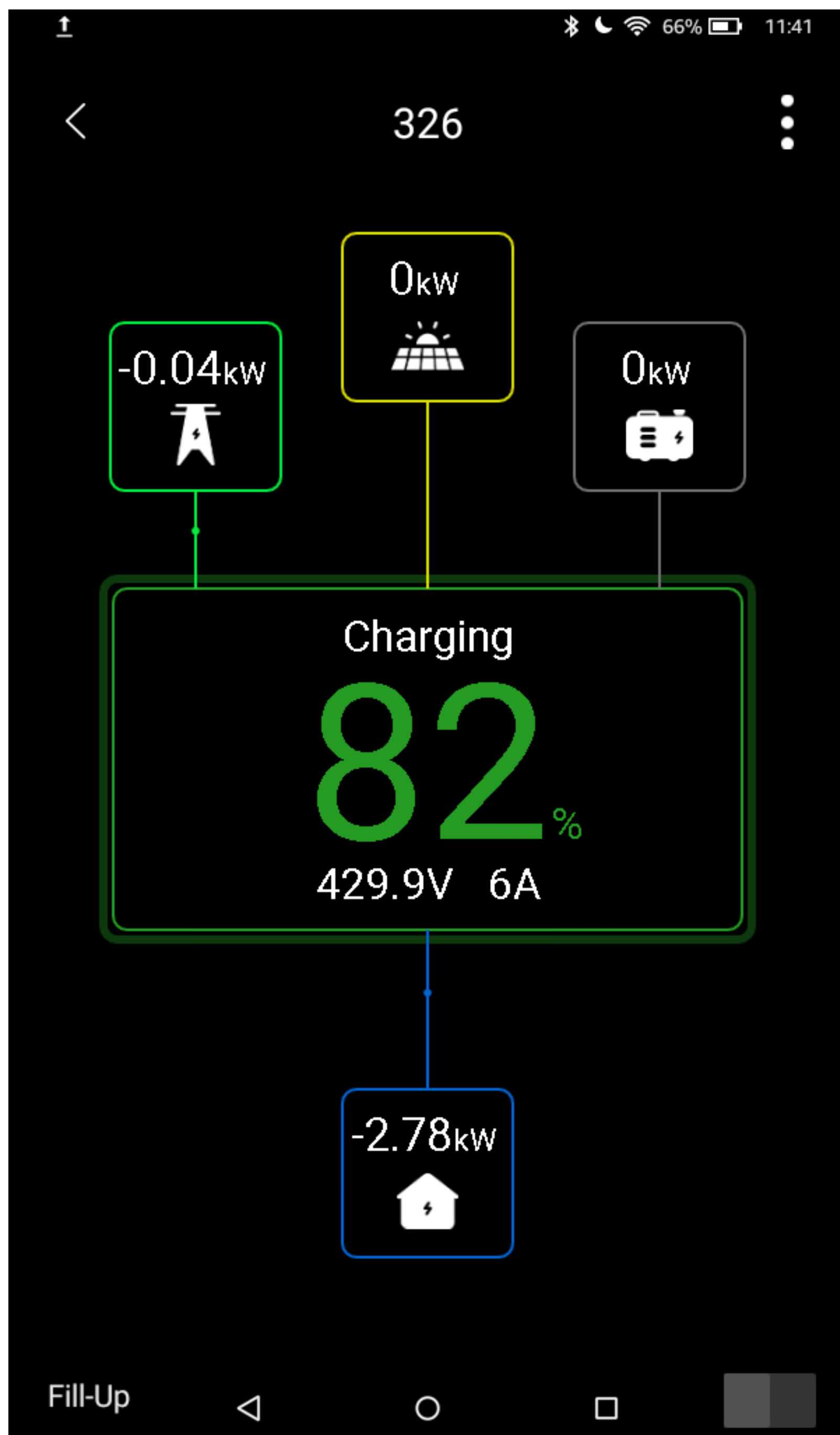
Application Notes



NetZero+ can support grid-tied inverter(s) natively



Grid tied inverter can continue producing energy when grid service is disrupted.



TO UNDERSTAND THE RESULTING VALUES THAT APPEAR TO THE LEFT, IT IS FIRST NECESSARY TO DRAW A CLEAR DISTINCTION BETWEEN THE ONBOARD MONITORING FOR THE ICAN NETZERO+ SYSTEM (NZ+) AND INFLUENCES ON THESE DISPLAYED VALUES WHEN EXTERNAL ENERGY INFLUENCING DEVICES. ONE EXAMPLE IS THE PRESENCE OF 3RD PARTY GRID TIE INVERTERS THAT ARE ELECTRICALLY CONNECTED. THESE SYSTEMS COULD BE ELECTRICALLY CONNECTED TO THE NZ+ SYSTEM OUTPUT OR EVEN UPSTREAM ON THE SYSTEM'S INPUT WHILE ALL THE COMPONENTS STILL ELECTRICALLY REMAIN BEHIND THE RESIDENTIAL OR COMMERCIAL SERVICE ENTRANCE ELECTRIC METER. NOTE ALSO THE 5 DISTINCT MEASUREMENTS POINTS SHOWN ON THE LEFT: UTILITY KW, PV/SOLAR KW, GENERATOR KW, BATTERY CHARGE STATE/ VOLTAGE/CURRENT, AND CONNECTED LOAD PLACED ON THE NZ+

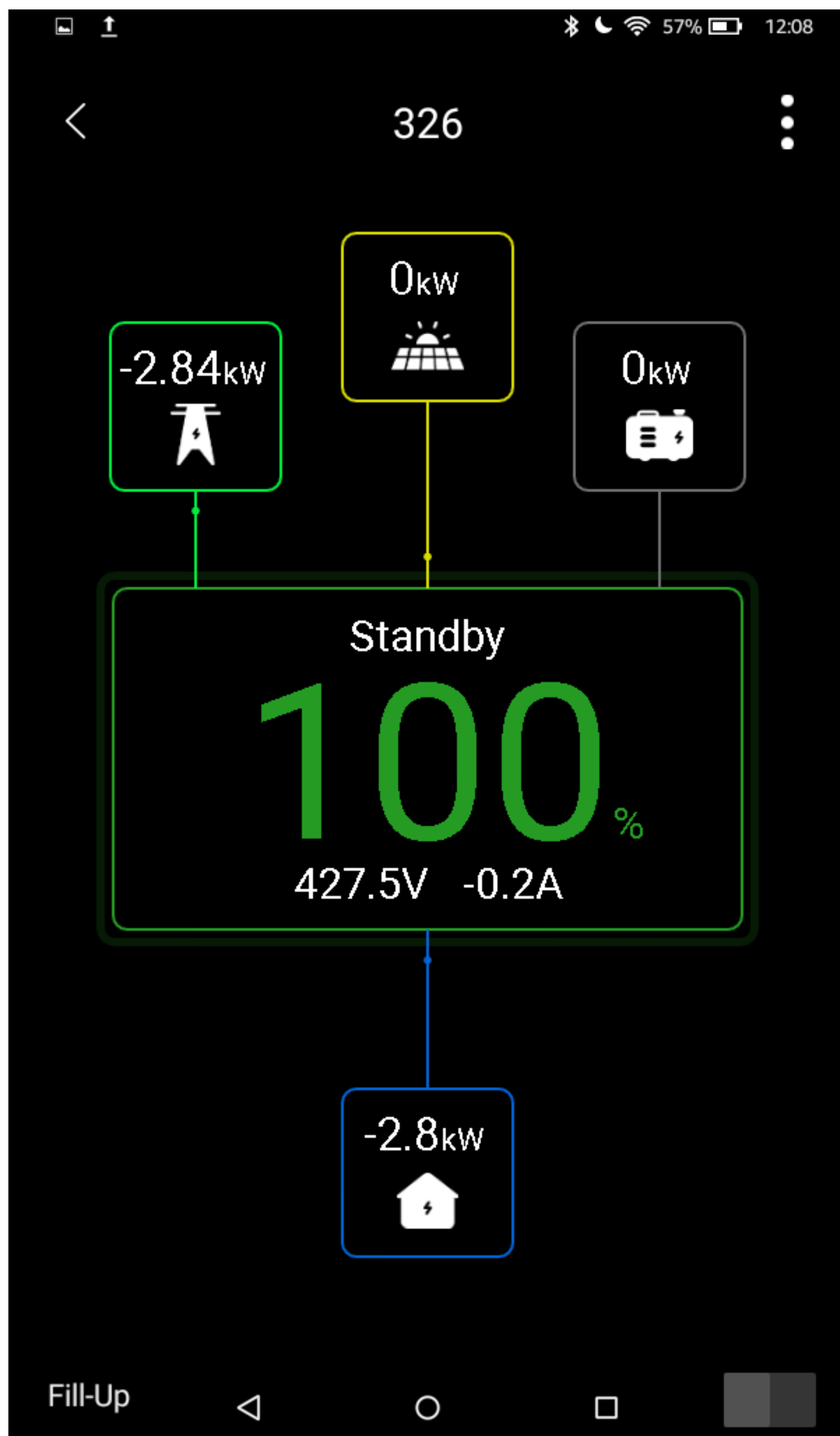
NOTE ALSO YOU CAN SEE BOTH POSITIVE OR NEGATIVE VALUES FOR THE UTILITY AND THE SUPPORTED LOAD. THE REASON IN THIS EXAMPLE FOR A NEGATIVE VALUE SHOWN IN THE CONNECTED LOAD DISPLAY IS DUE TO THE ENERGY PRODUCTION TAKING PLACE FROM A CUSTOMER'S PRE-INSTALLED AND OPERATIONAL STRING INVERTERS. FURTHER NOTE THAT FOR THIS PARTICULAR EXAMPLE, THE GRID TIE INVERTERS ARE ALSO OPERATING IN A NET METERING MODE (ALLOWING NET POWER EXPORT TO UTILITY) WHICH IS WHY A NEGATIVE POWER VALUE IS ALSO SHOWN. THE MINIMUM POWER BEING GENERATED BY THE EXTERNAL STRING INVERTERS FOR THIS EXAMPLE WOULD BE THE NEGATIVE SUM OF THE UTILITY AND CONNECTED LOAD KW: $(-1) \times [(-2.78) + (-0.04)] = 2.82 \text{ KW}$.

BATTERY IS BEING CHARGED AT 2579.4 W (429.0 V X 6A) AUTOMATICALLY, BASED ON THE BACK FLOW RATE.

ANY POWER CONSUMPTION UPSTREAM OF THE NZ+ SYSTEM'S INPUT CURRENT MONITOR WILL NOT BE MEASURED. IF LOAD DEMAND OF THE NZ+ IS ZERO, THE READING WOULD MATCH THE REAL PRODUCTION FROM THE GRID TIED INVERTER. TO DETERMINE THE REAL OUTPUT OF A GRID TIED INVERTER INSTALLED EXTERNAL TO THE NZ+, REFER TO THE SYSTEM INTERFACE DATA OF THE EXTERNAL GRID TIE INVERTER SYSTEM.

OTHER NOTEWORTHY OPERATIONS UNDER THIS SCENARIO: THE NZ+ SYSTEM WOULD APPLY A SAFE LEVEL OF UNCLAIMED POWER TO RECHARGE IT'S BATTERY IF NEEDED WHICH WOULD BE BASED ON A CHARGE RATE THAT TAKES THE NET ABSOLUTE VALUE OF RECORDED LOAD INTO CONSIDERATION (2.78 KW FOR EXAMPLE).

NOTE THAT THE SYSTEM ENGAGES IN "POLLING" OF ELECTRICAL MEASUREMENTS BY WHICH FUNCTIONS ARE AUTOMATICALLY DECIDED. FOR THIS REASON THE USER MAY SEE A DELAY IN DISPLAYED VALUE FROM THE TIME THAT VALUE CHANGES.



EXAMPLE DISPLAY WHEN BATTERY REACHES FULL CHARGE WHILE EXTERNAL GRID TIE INVERTERS (OPERATING IN NET METERING MODE) IS CONNECTED DOWNSTREAM (LOAD SIDE) OF THE ICAN NETZERO+ SYSTEM.

PROVIDED THAT THE UTILITY GRID REMAINS POWERED AND CONNECTED, ALL EXCESSIVE ENERGY PRODUCED BY THE EXTERNALLY INSTALLED GRID TIED INVERTERS WHICH IS NOT CONSUMED BY THE CUSTOMER'S LOAD, WILL FLOW THROUGH THE NZ+ AND ONTO THE GRID IN THIS NET METERING EXAMPLE.

NOTE THAT THE READING FROM THE GRID IS A CALCULATED VALUE. UNLESS NZ+ HAS REVENUE GRADE METERING CONNECTED TO THE GRID OUTPUT CONNECTION (IMMEDIATELY BEHIND THE UTILITY METER), THE READING DISPLAYED IN THE UTILITY FIELD (TOP LEFT POSITION OF THE IMAGE SHOWN TO LEFT) WOULD BE THE BEST CALCULATED REFERENCE TO THE SYSTEM USER.

THE BACK FLOW RATE (NET EXPORT) SHOULD MATCH THE READING FROM THE MANAGEMENT PLATFORM (OR APP) ON THE GRID-TIED INVERTER(S) FOR THIS PARTICULAR CASE.

NOTE THAT IF ANY LOADS ARE CONNECTED DOWNSTREAM OF A CURRENT MONITORING DEVICE THAT IS PLACED DIRECTLY BEHIND THE METER AND UPSTREAM OF THE NZ+ INPUT MEASURING, THOSE LOADS WOULD NOT BE DETECTABLE AND WOULD ACCOUNT FOR THESE VALUES NOT EQUALING EACH OTHER.

Disrupted Grid Service

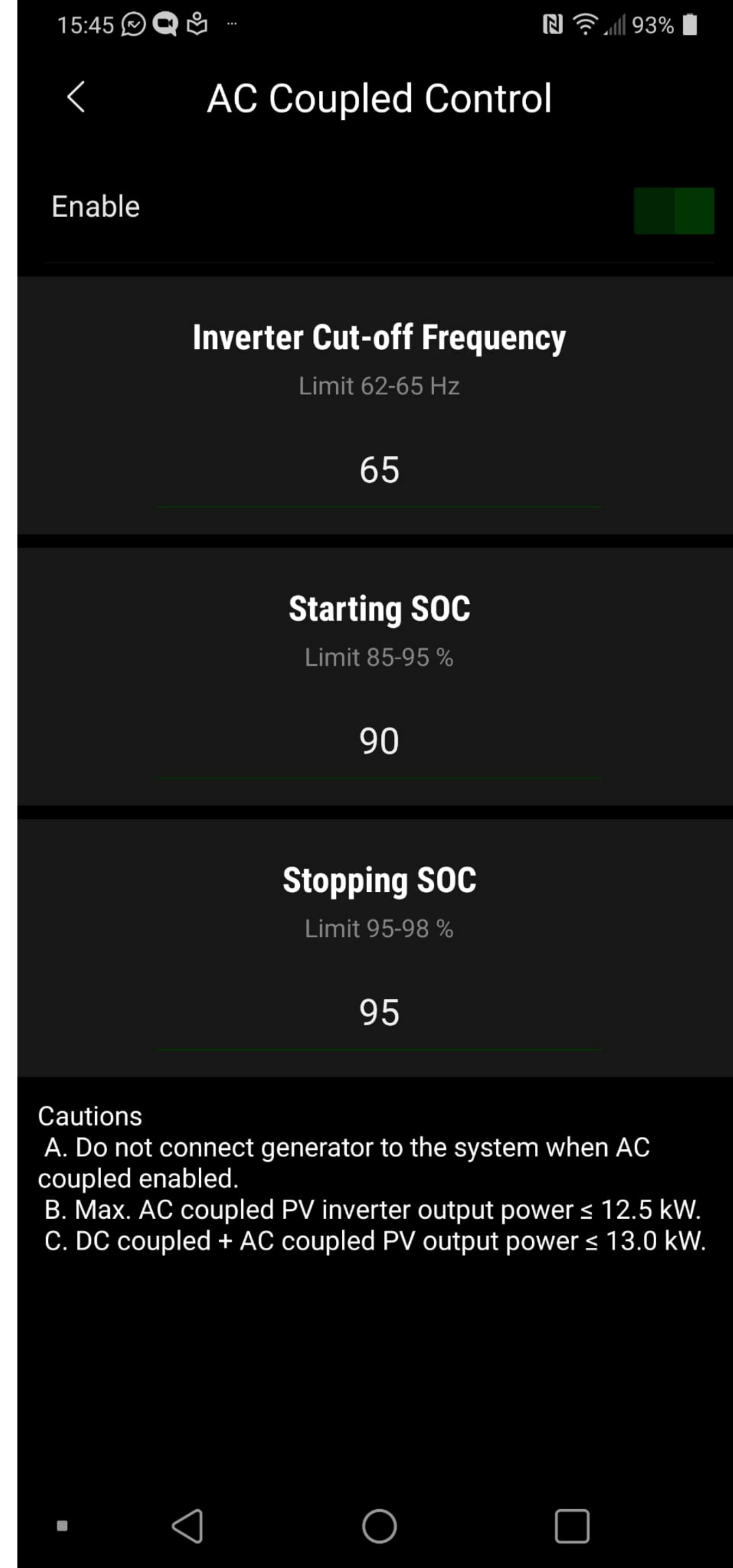
Supply Must Meet Demand

Supply meets Demand

Energy Must Flow Somewhere

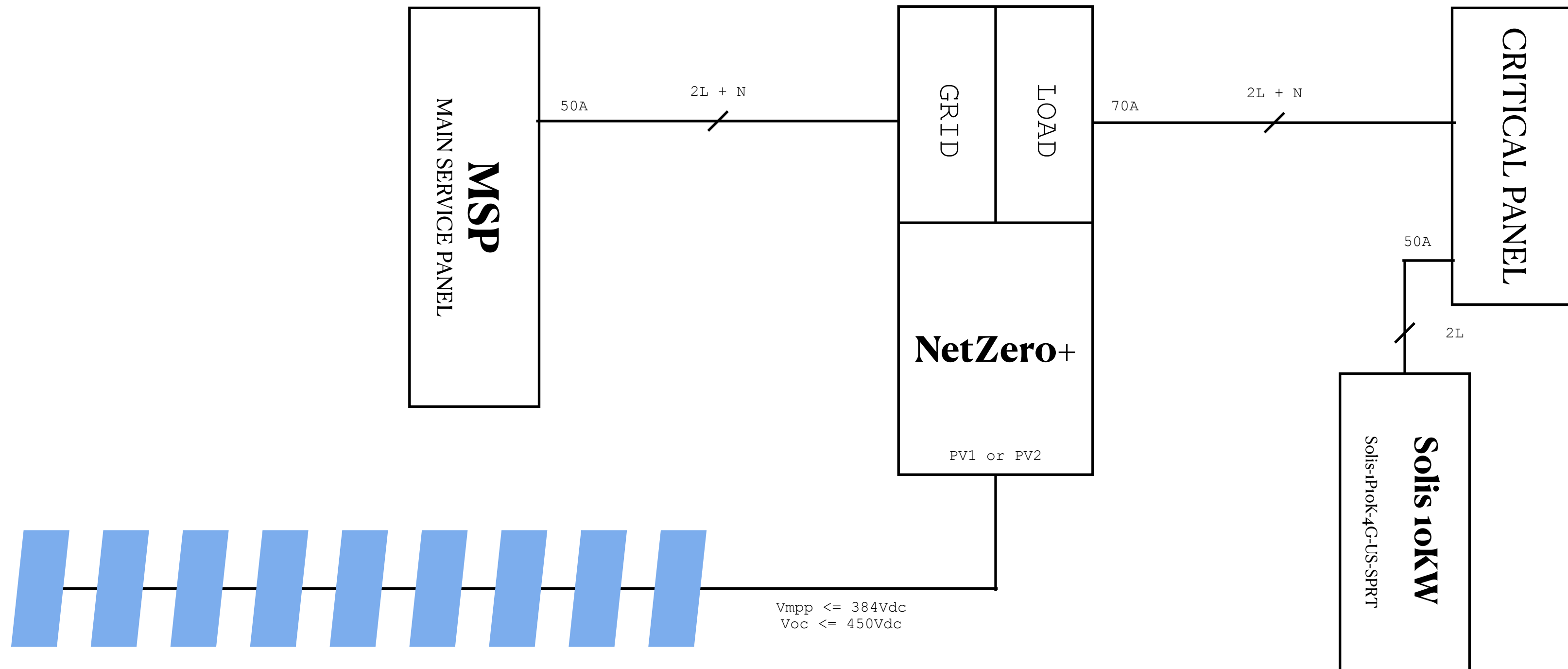
- Supply and demand must be balanced when NetZero+ is the VF source (meaning grid service is disrupted)
- Once battery reaches 100% (or 95% above, APP configurable), NetZero+ will adjust the frequency to reduce the output from grid tied inverter(s).
- NetZero+ will maintain the frequency above 62.5 Hz until the battery SOC falls below 90%. NetZero+ will then return the frequency to 60 Hz so that grid tied inverter can resume production.
- The idea is to balance the supply (from grid tied inverter(s)) and the demand (on the critical panel).
- NetZero+ may keep the frequency higher to prevent grid tied inverter(s) from producing energy at full capacity. Since the f-w curve is different among all different inverter vendors, the outcome may differ from one case to the other. Ultimately, NetZero+ will try hard to keep the grid tied inverter(s) producing energy while maintaining the stability of the power network.

- *Setting->AC Coupled Control*
- Please turn enable this feature if you have grid tied inverter(s) attached to LOAD
- For classical, non CA Rule 21 grid support inverter (previously known as grid interactive inverter), leave the Cut-off Frequency at 65Hz.
- For all CA Rule 21 complaint inverter (UL 1741SA or CEC listed Grid Support Inverter), you may set the Cut-off frequency lower by matching the setting on the grid-tied inverter.

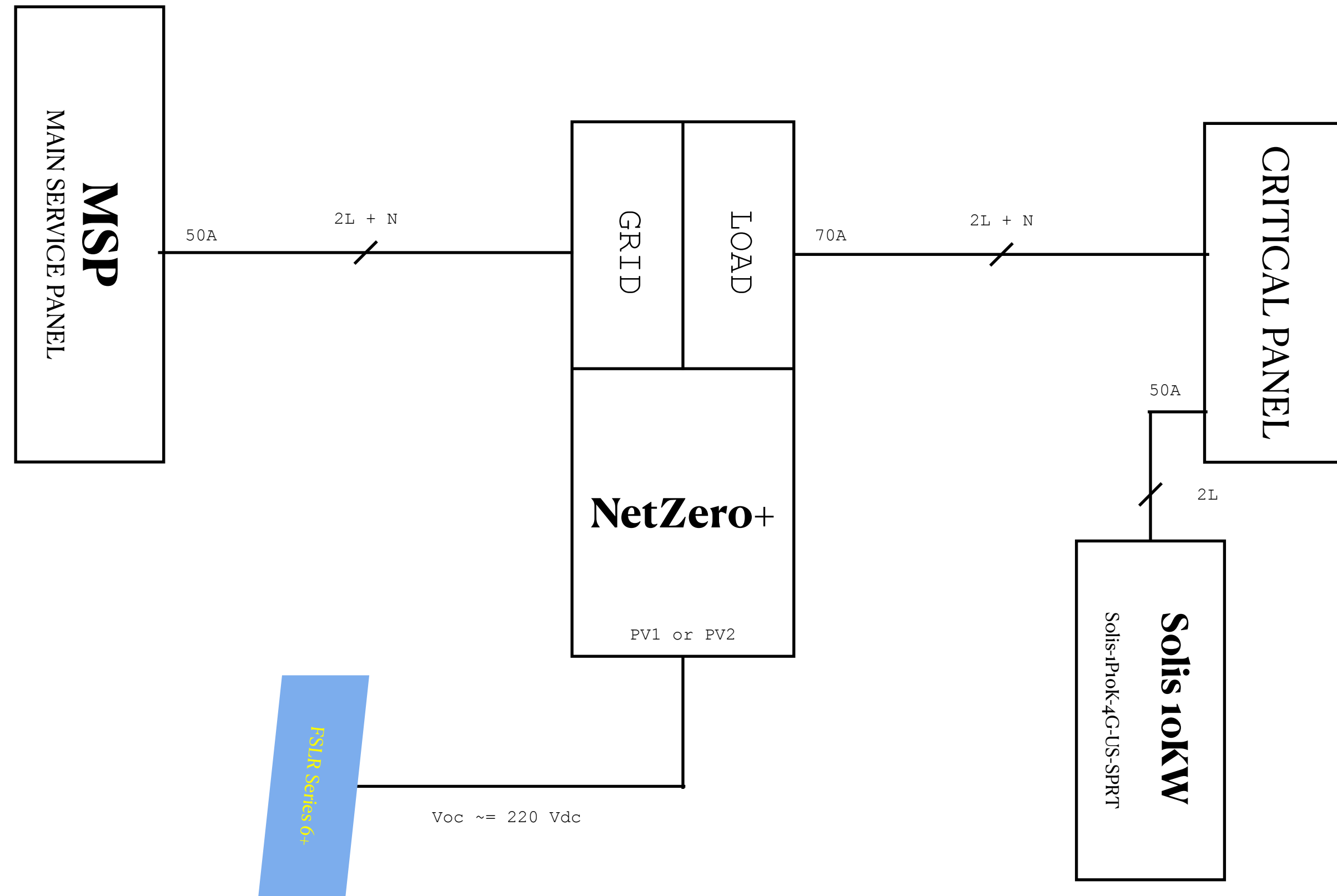


Mixed Mode

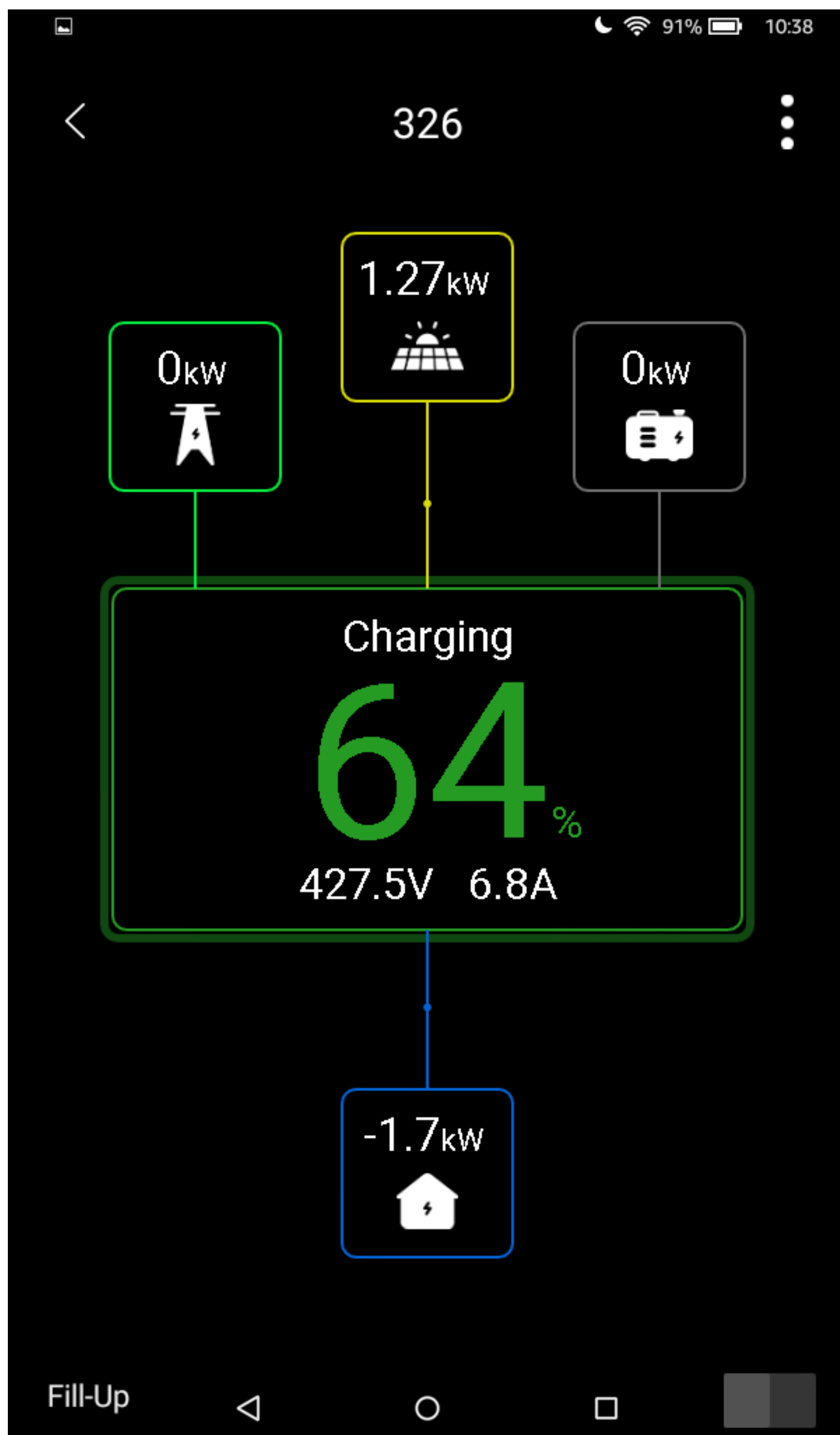
Wake Up Battery Module



Directly connected PV panels can wake up the battery even after it is completely depleted the night before.



Directly connected PV panels can wake up the battery even after it is completely depleted the night before.



1. NETZERO+ WILL CHARGE FROM ITS DIRECTLY CONNECTED PV PANEL FIRST
2. THE TOTAL CHARGING RATE IS CONTROLLED BY BATTERY MANAGEMENT SYSTEM (BCMS)
3. THE MAXIMUM CHARGING RATE CAN NEVER EXCEED 13KWDC
4. IN THE EXAMPLE HERE
5. DIRECTLY CONNECTED PV CONTRIBUTES 1.27 KW
6. THE GRID TIED INVERTER, MINUS THE LOCAL DEMAND, CONTRIBUTE 1.7 KW
7. $427.5 \text{ V} \times 6.8\text{A} = 2907 \text{ W}$
8. $2907 - 1270 = 1637 \text{ W}$
9. $1637/1700 = 96.29\%$
10. NOTICE THE RATIO IS HIGHER.

Thank You
For Making The World Greener

Rev 1.0	Add comments from John Klein to help users better understand how AC Coupled works in NetZero+.
Rev 1.1	Add support for 450V Open Circuit voltage and use FSLR Series 6 to wake up the battery after the battery is completely exhausted.
Rev 1.2	Add description on how to enable the AC Coupled Control by using NetZero APP