

Phase Balancing Recommendation (Sezibwa)

Recommendation for re-assigning Sezibwa's single-phase customers across the three phases of the SRNE three-phase inverter, to fix a severe load imbalance. Uses meter IDs; the site operator maps these to customers.

Current state (the problem)

From meter_100's per-phase energy and per-customer voltage matching (all high-confidence), the current assignment and daily load is:

Phase	Load (kWh/day)	Share	Customer meters (kWh/day)
L1	10.4	50 percent	002 (5.7), 003 (4.5), 008 (0.1), 011 (0.1)
L2	5.1	25 percent	009 (2.3), 007 (1.6), 010 (1.2)
L3	5.3	25 percent	006 (2.7), 005 (2.1), 004 (0.5)

Total site load about 20.7 kWh/day, so the ideal is about 6.9 kWh/day per phase. **L1 carries half the site** while L2 and L3 carry a quarter each.

Root cause: the two largest consumers, meter 002 (5.7) and meter 003 (4.5), are both on L1. Together they are 10.2 kWh/day, which already exceeds a balanced phase on its own.

Meter reference (Modbus address, serial, customer initials)

Initials only (no full names, per the customer-data rule). Modbus address is the meter's slave address; serial is the physical meter serial.

Meter	Modbus addr	Serial	Customer (initials)	Phase	kWh/day
meter_002	2	200326019929	NP	L1	5.7

Meter	Modbus addr	Serial	Customer (initials)	Phase	kWh/day
meter_003	3	200326020101	KFH	L1	4.5
meter_004	4	200326020199	AB	L3	0.5
meter_005	5	200326020128	KFH	L3	2.1
meter_006	6	200326020209	WS	L3	2.7
meter_007	7	210302003356	JN	L2	1.6
meter_008	8	200326019807	PO	L1	0.1
meter_009	9	250902040373	DK	L2	2.3
meter_010	10	250902040216	SN	L2	1.2
meter_011	11	250902040311	(unmapped)	L1	0.1

Note: KFH holds two meters (003 and 005), currently split L1/L3. Names are looked up live from the customer database by serial; the logical-to-service-ID map in the logger config had 009/010 transposed, so the serial is treated as authoritative.

Why phase balance matters

1. **Voltage quality.** L1 carries roughly twice the current of L2/L3, so it has the largest voltage drop. Customers on L1 see the lowest voltage (dimmer lights, more appliance stress) while L2/L3 sit high. Balancing evens the voltage across customers.
2. **Backup capacity.** The SRNE is a three-phase inverter with a per-phase output limit. During a grid outage (battery backup), an overloaded L1 can hit its per-phase limit and trip or brown out even though L2 and L3 have spare capacity and the total is within the inverter rating. Balancing maximises the backup the site can actually deliver.
3. **Losses.** Imbalance drives neutral current and extra I²R losses in the distribution.

Note: this does **not** affect the battery arbitrage or solar economics. The three-phase inverter time-shifts the site's *total* energy across all phases, so the savings analysis is unchanged. Phase balancing is a separate power-quality and backup-reliability issue.

Recommendation (minimal moves)

Two re-connections fix most of it:

1. **Move meter 003 (4.5 kWh/day) from L1 to L2** — this is the key move, separating the two big loads (002 and 003).
2. **Move meter 009 (2.3 kWh/day) from L2 to L3** — rebalances L2 after taking on 003.

Result:

Phase	Before	After 2 moves
L1	10.4 (50 percent)	5.9 (28 percent)
L2	5.1 (25 percent)	7.3 (35 percent)
L3	5.3 (25 percent)	7.6 (37 percent)

The max-minus-min spread drops from 5.3 to 1.7 kWh/day.

Optional third move for near-perfect balance: also move meter 004 (0.5) from L3 to L1, giving L1 6.4 / L2 7.3 / L3 7.1 (31 / 35 / 34 percent), spread 0.9.

If only one change is possible, do move 1 (003 off L1): it removes the worst of the imbalance on its own.

The calculation

- Total daily energy about 20.7 kWh across three phases, so ideal is $20.7 / 3 = 6.9$ kWh/day per phase.
- Current spread (heaviest minus lightest): $10.4 - 5.1 = 5.3$ kWh/day.
- After the two moves: $7.6 - 5.9 = 1.7$ kWh/day.
- After the optional third move: $7.3 - 6.4 = 0.9$ kWh/day.

Loads are from the same meter data used across the Sezibwa economic analysis (meter_100 aggregate plus per-customer meters, over the March to August 2026 window). Note that meters 003 and 005 belong to the same customer (two service points); moving 003 to L2 leaves that customer with one meter on L2 and one on L3, which is fine.

Data provenance

Underlying data: the aggregate meter meter_100 plus the 10 customer sub-meters, over **2026-03-19 to 2026-08-10**, from the modbus energy-logger archive (sources: pi-direct and nextcloud-import), i.e. the pre- and early-OpenEMS period. Load basis is a conservative 21.3 kWh/day.

Note (2026-08-20): the site has since migrated to **OpenEMS**, which is now the live source. OpenEMS-sourced daily figures from mid-August show inconsistencies (the aggregate roughly doubled exactly at the source switchover, and on some days the customer-meter sum exceeds the aggregate), so they are treated as a data-quality issue to resolve before use; this analysis stays on the validated archive. Phase assignments reflect the wiring as observed up to about May 2026 and should be re-verified against the current OpenEMS setup if any connections have been changed.

