APESTAR ENTERPRISE LTD

APESTAR DESIGN STANDARD

Minimum rules for every solar and battery system we design, quote or install. Written after real failures in the field, in plain language, so a customer can check them too.

01

REFILL

THE PANELS MUST REFILL AN EMPTY BATTERY IN ONE DAY

The array must carry the day's load and put a fully drained battery back in one day of sun. If it cannot, the design is rejected.

$$\text{Panels needed (kWp)} = (\text{daily load} + \text{usable battery}) \div 4.5 \text{ sun hours} \times 1.3 \text{ weather margin}$$

Usable battery is 80% of its rated size. The 1.3 margin covers dust, heat and cloudy days.

Worked example. A home uses 5.65 kWh a day and has a 5.1 kWh battery (4.1 kWh usable). Needed: (5.65 + 4.1) ÷ 4.5 × 1.3 = **2.8 kWp**, so **five** 620 W panels. Three panels (1.86 kWp) give about 6.3 kWh a day against 9.7 kWh needed: the battery empties on one bad night and never recovers. That system was installed in Ibadan in September 2026. This rule exists so it cannot happen again.

Why: sizing panels from the daily load alone quietly assumes the battery is already full.

02

START

AT LEAST FOUR PANELS IN SERIES ON A 48 V SYSTEM

The panel string must stay above the inverter's start voltage when the panels are hot.

A typical 48 V inverter needs about 120 V to start charging. Panel voltage drops as panels heat up: on a hot roof the cells run near 70 °C, roughly 10–15% below the label figure.

PANELS IN SERIES (620 W)	VOLTAGE, COOL	VOLTAGE, HOT ROOF	STARTS CHARGING?
3	~124 V	~108 V	**No, only in bright sun**
4	~166 V	~145 V	Yes
5	~207 V	~180 V	Yes, comfortably

This is a voltage limit, not a wattage limit: adding panels side by side does not fix it. The wiring (for example "5S1P": five in series, one string) is written on every quote and handover record. The string's open-circuit voltage on a cold morning (10 °C) must also stay under the inverter's maximum.

03
MATCH

MATCH THE PANELS TO WHAT THE BATTERY CAN TAKE

A single 5 kWh lithium battery accepts roughly 2.5 kW of charge. Once the array satisfies Rules 1 and 2, a second battery helps the customer more than extra panels. We recommend storage before more modules.

04
RESERVE

COMMISSION WITH A RESERVE, NEVER AT THE FLOOR

- Battery type set to lithium, with the battery and inverter confirmed to be communicating.
- Low-battery cut-off set at **20%**, never the factory default. A system allowed to run to its own protection point strands the customer and wears out the battery.
- Before leaving site, the charge level shown on the inverter must match the battery's own screen. If they disagree, communication is not really working.

05
RECORD

EVERY INSTALLATION GETS A HANDOVER RECORD

Each system is handed over with a certificate the customer keeps, carrying a unique registration number and a QR code. It lists:

- Location, captured on site
- Serial numbers of the inverter and every battery; panels by model and count
- Panel, inverter and battery size, and the wiring
- Photos of the array, wiring, battery and inverter label
- The checks against Rules 1, 2 and 4
- The technician, and the customer's own confirmation

Never weaken these rules to hit a price. If a customer cannot afford a compliant system, we make the battery and the load expectation smaller together, so the panels can still refill the smaller battery. An under-built system turns one price objection into months of complaints.

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