More Panels, Fewer Technicians

What the Kenyan Solar Boom Is Getting Wrong

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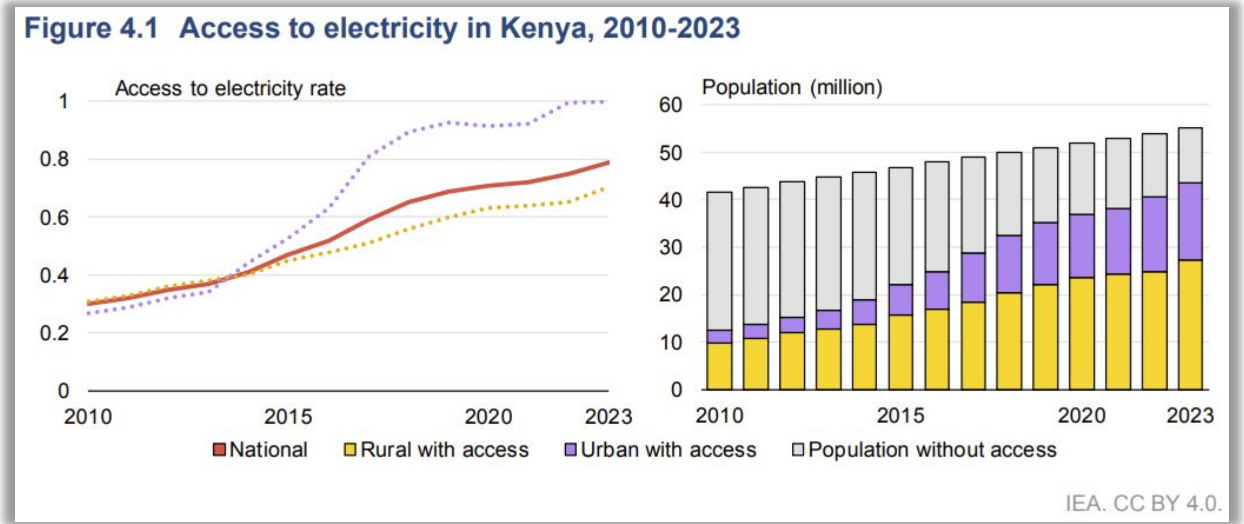
Kenya has connected most of its population



Average monthly outage duration:

9.15 hrs

- EPRA target: 3.25 hrs
- Exceeded every year 2022-24

Among the highest electricity prices in Africa

$0.23 per kWh

- The global average is $0.174 per kWh

- National electricity access rate – **79% in 2023** with **urban areas @ near universal** and **rural areas @ 70%**
- The new question is not whether people have a connection — it's what quality of service that connection delivers.
- Note: 'can be connected' is counted as a connection in national statistics — which inflates access figures.

Source: IEA(2024), Access to Electricity; IEA (2024), Kenya 2024: Energy Policy Review; EPRA Energy & Petroleum Statistics Report, June 2025

Electricity models in Kenya - household level

FINANCIAL MODEL — Who carries the risk. Who provides capital.

Grid (KPLC)

State-backed. Capital from government and development finance. User pays a tariff. Risk sits on a utility balance sheet.

Minigrids

Developer CAPEX, often grant-funded or blended finance. Recurring tariff revenue. Risk centralised on developer.

PAYGo solar

Consumer finance. Micro-loans aggregated into securitisable assets. Risk sits with consumer finance funds during repayment.

Nanogrids

Self-financed. Lump-sum cash from harvest income, savings, chamas. **100% of financial risk privatised** to the household. No safety net.

TECHNICAL MODEL — Where engineering competence sits in the chain.

Grid (KPLC)

KPLC engineers, trained and institutionally accountable. The user makes no technical decision. Engineering is invisible to the consumer.

Minigrids

Developer sources qualified personnel. Mirrors the KPLC model — engineering competence sits with the operator, not the user.

PAYGo solar

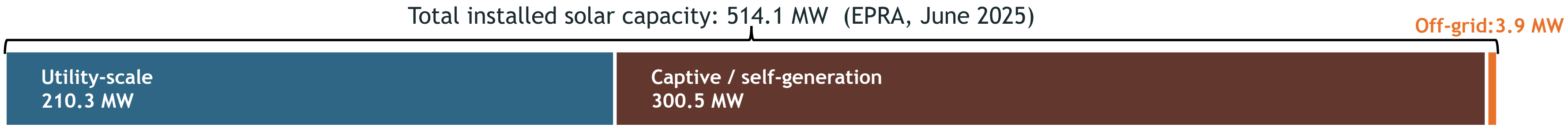
Pre-sized by engineers at source. The kit arrives already decided. User installs or an agent installs — no design decision required.

Nanogrids

This is the only model where **technical competence is fully decentralized** to the end user. Engineering falls entirely on whoever the household can find. That person may have no qualification.

Nanogrids are also called **"component based solar systems"** – which was a mouthful, so we renamed them.

Solar in Kenya - numbers and classification - 1



Breaking down the 514.1MW:

- 210.3 MW utility-scale
- 300.5 MW captive / self-generation
- 3.9 MW off-grid (disclosed, licensed)

The **captive category** includes energy installed by grid-connected customers generating their own power, classified as:

- Factories,
- Malls
- Commercial buildings
- Middle-income residential.

The **off-grid category** captures only:

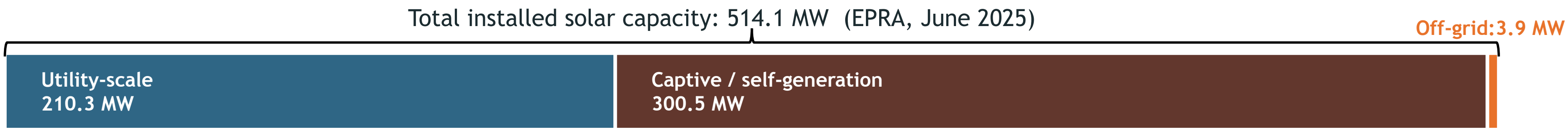
- What was disclosed to the regulator. These are systems installed by licensed technicians.
- Of those, what's recorded are the installed systems that were reported
- For this reason, the real scale of nanogrid deployment is unknown.

The on-grid / off-grid classification groups:

- Is based on **engineering logic** rather than **consumer behaviour**, which is what regulations need to target.

Source: EPRA Energy & Petroleum Statistics Report, June 2025; EnDev/SNV Kenya PUE Policy Action Plan, 2021; SurgePV, 2026; TechTrendsKE, 2026

Solar in Kenya - numbers and classification - 2



Further on classification:

C&I installation ≠ Middle-income residential

A C&I installation:

- Commissioned as a formal installation through a contractor
- Goes through permitting
- Is likely grid-tied with no battery.

The acquisition process shares little with a household nanogrid — despite potentially sharing a grid connection.

Middle-income residential ≈ Rural household

- Ask friends for recommendations.
- Visits a shop.
- Rely on whoever is recommended to size the system.
- Find a technician through word of mouth.
- Makes a price-driven rather than eng-driven decision.

The urban household likely lands a better technician more often.

- Not because the process is different, but because licensed technicians are concentrated in Nairobi.

Why is this important? Our work is precisely about **closing that gap.**

Making engineering regulations legible and effective at the consumer level by accounting for behaviour.

And this is a good example of data displaying one such instance. We encounter them all the time

Who uses nanogrids — and why?

Who

Households

Rural and peri-urban, but increasingly urban too as per discussed EPRA data – previous slide.

87.9% of surveyed households in Machakos and Makueni were not connected to KPLC. Farmers, smallholders, families across the income spectrum.

Small businesses

MSMEs — shops, workshops, poultry farms, water kiosks. Solar as productive-use power for pumping, cooling, refrigeration, machinery. Study currently underway.

Social amenities

Schools, health clinics, hospitals. Reliability of supply is critical — outages have direct consequences for patient care and learning. Study currently underway.

Why - for households

The stated reasons

- 56% — no grid access in their area
- Backup for Kenya Power outages
- Reducing electricity bills
- Productive use: pumping, refrigeration, machinery

It’s not just economic

- **Health & safety** — escaping kerosene smoke in the home
- **Children's education** — reliable light after dark
- **Security** — consistent outdoor lighting
- **Financial logic** — one household was spending KES 26,000/month on a generator.
    - They paid KES 14,000 once for solar.

Question: Do you think that system was good quality? Why?

Sources: Sunsafe Baseline Data Report (2024) — household data, Machakos and Makueni (n=290); PREO project (unpublished data, 2026) — small business and social amenity data

Who finances nanogrids — and how does that shape quality?

How nanogrids are financed

98.86% of surveyed households paid cash upfront.

Income is typically seasonal:

Lump-sum from crop harvest, livestock sales, or chama pooling. A KES 40,000 system represents months of accumulated savings.

This means two things:

- Purchase happens when cash is available and the decision tends to default to the lowest price.
- Reason being the price is the only quality signal the buyer can read.

For government and development-funded installations:

Procurement goes through formal channels — but only as far as the certified workforce subcontract qualified personnel.

What that means for quality

The lemon market.

When buyers can't assess quality, price wins. Low-quality, undersized systems undercut properly designed ones on price and dominate the market.

The time lag of failure.

Systems fail months after purchase — breaking the psychological link between the design decision and the outcome. Users learn 'batteries die quickly,' not 'that technician undersized my system.'

Capital destruction.

When a KES 40,000 system fails in 12 months, the capital is gone. There is little salvage value for a sulphated lead-acid battery. The household may not repurchase for years or may purchase an even cheaper, more poor-quality system.

This is not a story about households making bad decisions.

It is a story about a market that gives them limited ways to make good ones.

Sources: Sunsafe Baseline Data Report (2024) (n=290); Wambugu et al(2024); Haushofer & Shapiro (2016, 2018); Harrington & Wambugu (2021)

Solar in Kenya - licensed technicians

What the ecosystem looks like from a technician vantage point

55M+ people *KNBS, 2019*	**12M** households in Kenya *30% without a grid connection*	**7.4M** small businesses *Kenya Bankers Assoc., 2021*	**837** licensed solar PV technicians *<10% women* *EPRA, 2024*

≈ 1 licensed installer per 14,300 households and **≈ 1 per 8,800 small businesses**

Aggregated **≈ 1 per 23,000 potential solar users**

36-38% of rural Kenyan solar nanogrids fail prematurely due to incorrect sizing by an unqualified installer workforce.

Cross & Murray, 2018 · Harrington & Wambugu, 2021

The nanogrid acquisition journey for households - 1

How do households get their nanogrids installed?

01

Hear about it

61.4% from friends & family. Others are radio, retailers, observation.

02

Ask around

53.8% don't seek formal information. Word of mouth dominates.

03

Visit a shop

89.7% buy from an electrical shop. Retailer sizes the system.

04

Find an installer

70% use a technician. 12.8% install themselves.

05

Live with Failure

34.8% report problems to the seller. The rest just live with it.

- 98.97% of surveyed households could not name EPRA as the licensing body for solar technicians before prompting.
- 65% of those still didn't know EPRA after prompting.

Question: How would you acquire a solar system for yourself right now?

The nanogrid acquisition journey for households - 2

Who sells and installs nanogrids?

Retailers

First point of technical consultation for most households.

Sizing is experience-based, inventory-driven, and adjusted for what the customer can pay.

- 81.8% of customers ask follow-up questions about the recommendation
- But they can't evaluate the answer

Licensed technicians

Required overall.

However, it is mostly used for government and development-funded installations or formally governed systems.

- 406 of 837 are in Nairobi.
- Machakos: 5.
- Makueni: 1.

Informal technicians (unlicensed)

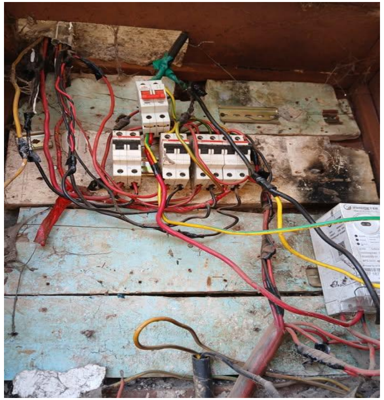
Dominate the market by volume.

Enter through informal apprenticeship or self-teaching. Unaware of sizing, charge controller selection, and integrated system design.

- 65% of customers don't ask for certification
- 77% of technicians say customers don't know certification exists

Question: Where would you buy a solar system for yourself right now?

The consequences

Sizing failures:

Panel, battery, and load don't match. Dead batteries, brown-outs, false confidence in system capacity.

Safety failures:

No ventilation. No charge controller. No fuses. 50% of surveyed technicians had witnessed a solar-related accident or fire.

Battery failure:

Batteries are 40–60% of CAPEX. Theoretical lifespan: 5-7 years. Field failure rates in tropical contexts exceed 80% within 3–5 years. Actual in rural areas: 1–3 years.

Normalised failure:

"Batteries are meant to last a year." This is what we're hearing in the field.

Leaving the technical realm...

The social recommendation system

- Users can't evaluate quality, so they ask their neighbours.
- They ask for systems 'like my neighbour's.'
- Word of mouth is the dominant information channel (61.4%) — but neighbours can't evaluate quality either.

The trust deficit

- Suspicion of upselling means rational advice from a qualified technician gets dismissed.
- A cheaper quote from an unqualified individual wins.
- A belief that "nothing will happen" means people won't report bad installations, if they can identify it

Sizing is a balancing act

- Sizing requires accounting for tropical solar variability, battery degradation, load diversity, and climate zone.
- Technicians use rules of thumb because the expansive methods are mentally expensive.
- "Size what the customer can afford" is the dominant heuristic

The e-waste problem

- Batteries failing at scale. No collection infrastructure. No disposal pathway.
- Kenya's 2024 EPR regulations exist on paper — people keep failed batteries or dump them in pits
- The solar boom will be accompanied by an e-waste crisis we are not prepared for.

What can we do?

01 Funnel information within the system

- Replace word-of-mouth with verified technical information.
- Standards live in KEBS documents people don't read. They need to be embedded in the tools people use.

02 Create trusted intermediaries

- Informed buyers can drive sellers to improve quality or exit.
- Providing information on why and how to identify qualified technicians can change purchase behaviour.

03 Lessen technician mental load

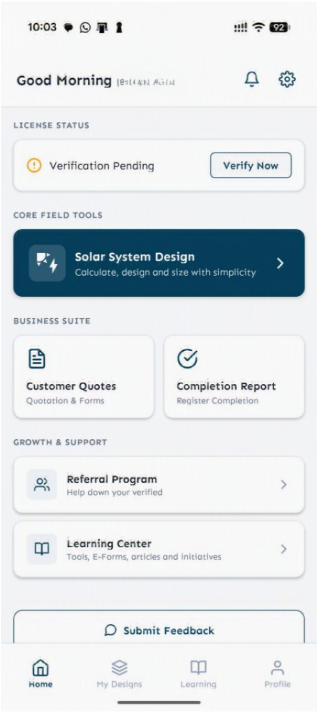
- Sizing correctly requires accounting for tropical solar variability, battery physics, load diversity.
- This should be a tool's job, not a mental arithmetic exercise done on-site with a customer waiting.

04 Circularity and tracking to end-of-life

- Every installation should leave a record: what was installed, by whom, with what components.
- This is the data infrastructure that makes EPR compliance and e-waste management possible.

What we are doing: Sunsafe

Building an intermediary between users and technicians.



Sizing tool

Installer enters loads. App handles the arithmetic — panel, battery, controller, fuse, all sized to spec. No guesswork.

Information access for users

Sunsafe online centre: What components do, how to maintain, how to notice problems. Addresses the questions users ask retailers.

Visibility for the ecosystem

QR-coded product verification. Digital installation records. Every install leaves a trail — components, technician, site, commissioning checks.

Find a technician

Connects users to licensed, verified installers. The aim? Informed consumers seeking verified technicians push unlicensed operators to formalise.

REACH-PSM: solving the problem upstream

- Sunsafe and workforce interventions work on the installation side.
- REACH works upstream — on what the product is before it reaches the installer.

The climate model

- The nanogrid quality problem starts upstream of the installer.
- Accounting for varying conditions at manufacturing can help solve that - what happens to a panel in Garissa, Kisumu, Mombasa, Kinangop, Kitui etc?
- Under REACH we are building a climate model for perovskite testing across Kenya's techno-climatic zones.
- The model will be transferred to PV generally.

01

Circular economy by design

- Perovskite modules under REACH are designed for circularity from the start.
- Optimised end-of-life processing, material recovery, minimal waste.
- Designing for circularity upstream changes what arrives in the market
- And what stays out of landfill when it fails.

02

Community co-design

- Standards created for test conditions elsewhere do not automatically fit conditions in Makueni or Machakos.
- The gap between the spec and the field is where failures concentrate.
- REACH builds community co-design into the product development process — needs assessments, use-case validation, deployment context.
- This presentation is one element of it

03

Thank you from REACH-PSM Team

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