ALCAP GROUP

ALCAP EDUCATIONAL DOCUMENT | FUNDAMENTALS

Understanding Electricity

Voltage, current, power, energy, AC, DC, and the electrical system in plain language

Electricity becomes easier to manage when its core quantities are kept separate. This guide builds a practical mental model for reading equipment ratings, discussing electrical loads, and connecting technical measurements to energy cost.

WHAT YOU WILL LEARN

- The difference between volts, amps, watts, and watt-hours
- Why power is not the same as energy
- How AC, DC, single-phase, and three-phase systems differ
- Which measurements answer common operational questions

PRACTICAL. INDEPENDENT. DECISION-FOCUSED.

Written for South African commercial and industrial energy users. Prepared July 2026 | Version 1.0

01 | THE ESSENTIALS

Build the right mental model

Think of an electrical system as a controlled path that moves charge and transfers energy. The quantities below describe different parts of that process; they are related, but they are not interchangeable.

Voltage (V)

Electrical potential difference - the push that can drive current through a circuit. Equipment must be connected to a supply within its rated voltage range.

Current (A)

The rate of flow of electrical charge. Conductors, breakers, switches, and transformers have current limits because current creates heating and magnetic effects.

Power and energy

Power (W or kW) is the rate of doing work at an instant. Energy (Wh or kWh) accumulates power over time. A 10 kW load running for 3 hours uses 30 kWh.

CORE RELATIONSHIPS

For a simple DC or resistive circuit: **Power (W) = Voltage (V) x Current (A)**.
For energy: **Energy (kWh) = Average power (kW) x Time (hours)**. AC and three-phase calculations also depend on phase and power factor.

A QUICK REFERENCE

Term	What it answers	Typical unit
Voltage	Is the electrical push at the expected level?	V or kV
Current	How heavily is the circuit or equipment loaded?	A
Power	How fast is energy being used right now?	W, kW, MW
Energy	How much electrical work accumulated over time?	Wh, kWh, MWh

02 | PUT IT TO WORK

Turn understanding into action

Use the question you are trying to answer to choose the right measurement. This prevents common errors such as comparing a kW inverter rating with a monthly kWh bill.

1. **Define the question**
   Cost, equipment loading, capacity, quality, and resilience each require different data.
2. **Confirm the unit**
   Write the unit next to every number. A missing unit is an early warning that a comparison may be invalid.
3. **Add the time dimension**
   Instantaneous power cannot explain monthly energy without operating hours or interval data.
4. **Check the electrical context**
   Record AC or DC, voltage, number of phases, frequency, and whether the value is per phase or total.
5. **Measure safely**
   Use correctly rated instruments and qualified people. Never infer safety from a zero display alone.

ILLUSTRATIVE EXAMPLE: A MOTOR LOAD

A motor drawing an average 15 kW for 8 hours uses approximately 120 kWh. Its supply current depends on voltage, phase, efficiency, and power factor, so current cannot be calculated accurately from kW alone without those details.

A GOOD DECISION LOOKS LIKE

- Equipment ratings are compared using compatible quantities and operating conditions.
- Monthly cost discussions separate consumption, demand, fixed charges, and power quality.
- Measurements include timestamps, units, location, and operating state.

03 | CHECKLIST AND NEXT STEPS

Use this before you proceed

[ ]	Record the supply voltage, frequency, and phase configuration.
[ ]	List major loads with kW or kVA ratings and expected operating hours.
[ ]	Separate instantaneous readings from accumulated energy values.
[ ]	Note whether ratings are input, output, nominal, or maximum.
[ ]	Check that protection and cable ratings suit the actual load.
[ ]	Use interval data when timing and peaks matter.

RED FLAGS

- Treating kW and kWh as the same quantity
- Adding per-phase values without confirming the measurement convention
- Assuming nameplate power equals actual power at all times
- Working on live equipment without appropriate competence and controls

PLAIN-LANGUAGE GLOSSARY

AC	Alternating current, where direction and magnitude vary periodically.
DC	Direct current, which flows with a consistent polarity.
Frequency	Number of AC cycles per second, measured in hertz (Hz).
Load	Equipment or a system that consumes electrical power.
Three-phase	Three coordinated AC waveforms used for efficient power delivery.

SOURCES AND FURTHER READING

- U.S. EIA - Electricity explained
- U.S. DOE - Electricity 101
- U.S. DOE - Electricity Industry Primer

IMPORTANT NOTE

This document is for general education only. It is not a substitute for a site assessment, electrical design, tariff review, safety study, or professional advice. Use the latest applicable standards, utility rules, municipal requirements, and manufacturer instructions. Work on electrical systems must be performed by suitably qualified and authorised persons.

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