Market Strategy: Targeting Sudan’s Off-Grid and Commercial Solar Sectors

Off-Grid Electrification · Diesel Replacement · Local Production

Content Partner: J. v. G. technology GmbH

Turnkey solar module production lines — since 1997

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Technical Overview: Sudan’s Off-Grid and Commercial Solar Market Strategy

Created as part of the PVKnowHow Knowledge Network

Prepared by J.v.G. Technology GmbH

European specialists in turnkey solar module production lines

Sudan's Energy Challenge

Structural Energy Deficit

- Grid coverage remains limited to major urban centres
- Estimated electrification rate below 40% nationally
- Rural and peri-urban populations largely unserved
- Industrial and agricultural sectors face chronic power shortfalls

Economic & Social Consequences

- Unreliable power suppresses productivity across all sectors
- High energy costs reduce competitiveness of local businesses
- Diesel dependency creates volatile operating expenditure
- Energy insecurity is a primary barrier to economic development

⚠ Sudan's energy deficit is structural — not cyclical. Addressing it requires scalable, locally anchored infrastructure solutions.

Massive Solar Irradiation Potential

World-Class Resource

- Sudan and East Africa receive among the highest global solar irradiation levels
- Average GHI consistently above 5.5 $kWh/m^2/day$ across the region
- Low cloud cover and dry seasons extend peak generation hours

Underutilised Asset

- Installed solar capacity remains a fraction of technical potential
- Vast land availability suitable for utility-scale and distributed generation
- Strong irradiation aligns with peak agricultural and commercial demand cycles

Strategic Implication

- Solar is the lowest-cost new generation technology available in the region
- Resource quality justifies investment in local production infrastructure
- Proximity of resource and demand eliminates long transmission requirements

Grid Instability & Diesel Dependency

Grid Instability — Operational Reality

- Frequent outages measured in hours per day across most regions
- Voltage fluctuations damage industrial and commercial equipment
- Grid expansion investment has not kept pace with population growth
- Transmission infrastructure is aging and under-maintained

Diesel Dependency — Cost Structure

- Diesel generators are the primary backup power source across all segments
- Fuel cost typically USD 0.25–0.40/kWh — 3–5× the cost of solar generation
- Import dependency exposes operators to currency and supply chain risk
- Diesel replacement by solar delivers immediate and measurable savings

ⓘ The diesel-to-solar substitution economics are compelling at current fuel prices — creating a commercially self-sustaining driver for solar adoption independent of policy support.

Why Local Manufacturing Matters

Supply Chain Resilience

- Imported modules subject to long lead times, port delays, and currency exposure
- Local production ensures consistent module availability for project pipelines
- Reduces dependency on international logistics and foreign exchange volatility

Cost Competitiveness

- Elimination of import duties, freight, and handling costs on finished modules
- Lower landed cost of locally produced modules versus CIF imports
- Enables price points accessible to off-grid and rural market segments

Economic Development Multiplier

- Direct job creation in skilled and semi-skilled manufacturing roles
- Technology transfer to local workforce through turnkey production partnerships
- Retains value-added activity within the domestic economy

Market Opportunity in Off-Grid Regions

Scale of Unmet Demand

- Tens of millions of people in Sudan and East Africa lack reliable electricity access
- Off-grid solar systems represent the fastest viable path to electrification
- Demand is distributed across households, farms, clinics, and small enterprises

Commercial Viability

- Off-grid users already spending significant sums on diesel, kerosene, and batteries
- Solar systems offer lower total cost of ownership versus incumbent energy sources
- Pay-as-you-go and lease models expand addressable market to lower-income segments

First-Mover Advantage

- Local module manufacturing is at an early stage in the region
- Early market entrants can establish brand, distribution, and cost leadership
- Regulatory and infrastructure gaps favour vertically integrated operators

Rural Distribution Strategy

1

Hub-and-Spoke Logistics

Regional distribution hubs serve as warehousing and staging points for last-mile delivery to rural installers and dealers

2

Local Dealer Network

Trained local dealers and microentrepreneurs act as sales and service points — reducing distribution cost and increasing market penetration

3

After-Sales Infrastructure

Local manufacturing enables faster warranty fulfilment and spare parts availability — critical for sustaining consumer confidence in off-grid markets

An effective rural distribution model is as strategically important as production capacity — local manufacturing only creates value if modules reach end users efficiently.

Agricultural Solar Applications

Solar Irrigation — Core Application

- Solar-powered water pumps replace diesel-driven irrigation systems
- Eliminates recurring fuel cost for smallholder and commercial farmers
- Enables year-round cultivation independent of seasonal rainfall
- System sizes range from 1 kWp (smallholder) to 100+ kWp (commercial farm)

Additional Agricultural Uses

- Solar cold storage reduces post-harvest losses for perishable crops
- Grain processing and milling powered by solar reduces fuel dependency
- Poultry and livestock facilities benefit from reliable solar-powered ventilation
- Agri-processing enterprises represent a high-value commercial solar segment

Agricultural solar applications combine strong commercial economics with direct food security and rural income benefits — making them a priority deployment segment.

Commercial & Industrial Market Demand

C&I Segment Profile

- Hotels, hospitals, factories, and telecom towers operate continuous loads
- High diesel consumption makes them the most cost-sensitive solar buyers
- System sizes typically 50 kWp to several MWp per site

Economic Driver

- Solar LCOE in the region is materially below diesel generation cost
- Payback periods for C&I solar systems typically 3–5 years
- Energy cost savings directly improve operating margins and competitiveness

Bankable Demand

- C&I buyers represent creditworthy, contracted offtake for local manufacturers
- Long-term power purchase agreements (PPAs) provide revenue visibility
- Pipeline of C&I projects supports baseline demand for local module production

Telecom Infrastructure

- Telecom towers are among the largest diesel consumers in off-grid areas
- Mobile network operators actively procuring solar hybrid systems
- Standardised system sizes enable repeatable, scalable module supply contracts

EPC & Installer Partnerships

Strategic Channel Partners

EPC contractors and system integrators are the primary route to market — local module supply strengthens their cost position and delivery reliability

Installer Capacity Building

Training programmes for local installers expand the qualified workforce needed to absorb growing module volumes and maintain installed systems

Reliable Local Supply Advantage

EPC firms and installers benefit from shorter lead times, lower logistics costs, and technical support from a locally anchored manufacturer

Local Production Advantages

Cost Structure

- No import duties or freight costs on finished modules sold domestically
- Local labour costs significantly below European or Asian manufacturing benchmarks
- Semi-automated lines optimise the balance between labour and capital intensity

Quality & Customisation

- Modules designed and tested for regional climate conditions
- Ability to produce formats and wattages aligned with local system specifications
- Quality control managed on-site by trained local personnel

Turnkey Manufacturing Concept

- An experienced European turnkey provider delivers complete production line setup
- Includes equipment supply, installation, commissioning, and staff training
- Ramp-up to commercial production achievable in under 12 months

Key Project Data

20–50...	**<12M**	**Semi**	**EA**
Production Scale	**Ramp-Up Period**	**Automation Level**	**Target Region**
Target annual output capacity for a semi-automated solar module production line	Time from line commissioning to commercial production — under 12 months	Semi-automated production line — optimised for regional labour and capital conditions	Sudan and East Africa — high-irradiation, high-demand, low-electrification markets

Scale: 20–50 MW · Investment: Semi-automated production line · Line type: Semi-automated solar module production · Ramp-up: <12 months · Region: Sudan / East Africa · Source: PVKnowHow / J.v.G. Technology GmbH

Operational Requirements & Workforce

Facility Requirements

- Production hall: approximately 2,000–4,000 m^2 depending on line configuration
- Stable power supply for production equipment — solar hybrid backup recommended
- Temperature and humidity control for lamination and cell stringing processes
- Proximity to road logistics infrastructure for inbound materials and outbound modules

Workforce Profile

- Core production team of 30–80 operators depending on shift model
- Technical staff trained on-site by European turnkey provider during commissioning
- Quality control and testing roles require structured certification pathways
- Management team requires familiarity with supply chain and EPC customer requirements

A proven turnkey manufacturing concept includes comprehensive workforce training — reducing the technical risk associated with establishing production in a new market.

Implementation Timeline

1 **Phase 1 — Feasibility & Site Preparation (Months 1–3)**

Market and site assessment; facility identification; local partner and regulatory engagement; equipment specification finalised with turnkey provider

2 **Phase 2 — Equipment Procurement & Logistics (Months 3–6)**

Production line ordered from European turnkey provider; import and customs clearance arranged; facility civil works and utilities preparation completed

3 **Phase 3 — Installation & Commissioning (Months 6–9)**

Equipment installed and commissioned by turnkey provider technical team; initial production trials conducted; quality benchmarks validated

4 **Phase 4 — Workforce Training & Ramp-Up (Months 9–12)**

Local operators trained on all production processes; output scaled to commercial volumes; quality management system established and operational

5 **Phase 5 — Commercial Operations (Month 12+)**

Full commercial production commenced; distribution partnerships activated; local module supply to EPC, C&I, and off-grid market segments begins

Strategic Conclusion

1

Market Conditions Are Structurally Favourable

High irradiation, low electrification, and diesel dependency create durable, commercially self-sustaining demand for solar across all market segments in Sudan and East Africa

2

Local Manufacturing Is a Structural Advantage

Producing modules in-region eliminates import cost, logistics risk, and supply chain uncertainty — creating a materially lower cost base versus imported alternatives

3

Proven Turnkey Concept Reduces Entry Risk

An experienced European turnkey provider delivers a complete, field-proven production solution — enabling commercial ramp-up in under 12 months with trained local personnel

Source: PVKnowHow / J.v.G. Technology GmbH · www.jvg-thoma.com · www.pvknowhow.com

About the Content Partner

J. v. G. technology GmbH — The DESERT Company

Founded in 1997 in Bavaria, Germany. Family-owned engineering company specializing in turnkey solar module production lines.

More than 90 factory projects delivered worldwide.
On-site team training included — no prior manufacturing experience required.

Key areas:

Turnkey PV manufacturing lines | DESERT Technology® | TÜV-certified module designs | Factory planning to production

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