PLANNING BEYOND LCOE: Tariff comparison alone is insufficient to assess the strategic role of gas in power system reliability and industrial growth in Southern and Eastern Africa

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Executive Summary

Power systems across Southern and Eastern Africa face a shared challenge: rapid demand growth, increasing industrial loads, and rising penetration of variable renewable energy, all within grids that lack sufficient firm, dispatchable capacity. While solar and hydropower remain critical pillars of the regional energy transition, experience across the region demonstrates that tariff comparisons based on nominal energy cost alone fail to capture the full system and economic value of reliable generation.

Natural gas–fired generation plays a critical role in addressing this gap. By providing dispatchable, high-availability, grid-stabilizing power, gas assets underpin system reliability, protect economic output, and enable industrialization. We seek to discuss the role of gas in the regional electricity mix, explain why reliability-adjusted valuation is essential for sound planning and investment decisions, provide quantitative cost comparisons, and offer targeted policy recommendations to integrate gas strategically into balanced, sustainable energy portfolios.

1. Regional Power System Context

Many countries in the region operate with tight supply-demand balances, where available capacity frequently falls below peak demand. This results in:

- Load shedding
- Suppressed demand
- Reduced industrial productivity
- Higher system operating risk

Reliability indicators across several markets remain well outside planning targets, with prolonged outage durations and frequent interruptions materially affecting economic activity. Importantly, reported demand figures often understate true system needs, as unreliable supply suppresses consumption and discourages investment. As reliability improves, latent demand from households, commerce, and industry quickly materializes, widening the effective supply gap.

For instance, South Africa experienced severe load shedding in recent years, with 335 days affected in 2023, leading to economic losses estimated at R2.8 trillion (approximately USD 150 billion at prevailing rates). This improved to 83 days in 2024, with costs dropping to R481 billion, highlighting the ongoing fragility despite progress. In Zambia and Zimbabwe, droughts have exacerbated the issue, causing blackouts of up to 21 hours daily in 2024 due to low water levels at shared hydropower facilities.

2. Limitations of Tariff-Only Comparisons

Hydropower

Large hydropower projects provide low-cost energy on a nominal basis but are inherently:

- Hydrology- and climate-dependent
- Subject to seasonal and multi-year variability
- Limited in firm capacity contribution during dry periods

Recent experience at major regional dams, including those along the Zambezi River system such as Kariba, has demonstrated how drought conditions can sharply reduce available generation, exposing systems to acute supply risk despite high installed capacity. In 2024, Lake Kariba reached critically low levels (around 12-13% full), forcing power cuts and devastating economies in Zambia and Zimbabwe. During the 2015-2016 drought, Kariba's generation fell by 75%, contributing to widespread blackouts. The El Niño-driven drought in 2024 further slashed Zambia's hydropower output from 3,777 MW to 1,040 MW, underscoring the vulnerability of hydro-dependent systems.

Solar

Solar PV offers rapid deployment and low marginal energy costs but it is:

- Intermittent and non-dispatchable
- Dependent on daylight and weather
- Reliant on storage or backup to meet peak or industrial demand

Diesel / HFO

Thermal liquid fuel plants provide firm power but at:

- Very high operating cost
- Significant foreign exchange exposure
- Poor long-term economic efficiency

Comparing these technologies purely on headline tariffs obscures the system costs of intermittency, backup, curtailment, and instability, which are ultimately borne by utilities, industries, and economies.

3. The System Value of Gas-Fired Generation

Gas-to-power assets provide a combination of attributes that are critical to modern power systems:

- Firm, dispatchable capacity
- High availability (>90%)
- Fast ramping and flexible operation
- Frequency control and voltage support

- Predictable fuel supply and operating profile

On a firm capacity and reliability-adjusted basis, gas-fired generation is typically:

- More cost-effective than diesel/HFO
- Highly competitive once the system costs of variable renewables are fully accounted for
- Essential for maintaining grid stability as renewable penetration increases

Gas therefore functions not as a competitor to renewables, but as a system enabler, allowing hydro and solar to be integrated safely and efficiently. In Africa, natural gas already accounts for 43% of electricity production and is seen as a transition of fuel to complement renewables, supporting electrification and industrial growth. Africa's untapped reserves (13% of global) can provide low-emissions energy access, with gas emitting half the CO_2 of coal. Demand is projected to rise 82% by 2050, with gas comprising 30% of the mix.

Quantitative Cost Comparisons

Levelized Cost of Electricity (LCOE) provides a standardized metric for comparing generation costs over a project's lifetime. Global and regional data from 2024–2025 show:

- **Global Weighted Average LCOE (2024, IRENA)**: Onshore wind: USD 0.034/kWh Utility-scale solar PV: USD 0.043/kWh Hydropower: USD 0.057/kWh Fossil fuel alternatives (e.g., new coal or gas): USD 0.073–0.085/kWh or higher
- **Regional Insights (Middle East & Africa, 2025 projections)**: Single-axis tracker solar PV: as low as USD 0.037/kWh Onshore wind: USD 0.050–0.070/kWh Gas-fired combined-cycle: typically, USD 0.077–0.130/kWh (varies with fuel prices)

These nominal LCOE figures favor renewables on pure energy cost. However, they understate system-level realities: variable renewables require backup, storage, or overbuild to deliver firm capacity, while hydropower's firm contribution drops sharply in dry years.

To address this, planners should adopt a **reliability-adjusted LCOE (RA-LCOE)** that explicitly incorporates reliability-adjusted valuation, firm capacity contributions, and operational constraints (including curtailment risk). The following formula is recommended:

$$\text{RA-LCOE} = \frac{\text{LCOE}_{\text{standard}}}{(1 - \bar{C}) \times \bar{CC}}$$

Where:

- **LCOE_standard** = classical plant-level LCOE (capital + O&M + fuel, discounted over lifetime)
- **C** = average lifetime curtailment rate (fraction of potential output lost due to grid constraints or oversupply)

- **CC** = average lifetime capacity credit (firm capacity factor / Effective Load Carrying Capability – the technology's contribution to system reliability and peak coverage)

This formulation directly penalizes high curtailment and low firm capacity, producing a higher (more realistic) cost per reliable, usable kWh delivered.

Practical outcomes in Southern/Eastern African contexts:

- Dispatchable gas / large hydro / battery storage → CC ≈ 0.85–0.98, C ≈ 0–5% → RA-LCOE close to standard LCOE
- Solar PV → CC ≈ 0.10–0.30, C ≈ 5–30% (at higher penetration) → RA-LCOE often 2–4× standard LCOE
- Wind → CC ≈ 0.15–0.45, C ≈ 5–25% → RA-LCOE 1.5–3× standard LCOE

In grids with tight margins, load-shedding costs (e.g., South Africa's 2023 crisis: ~USD 150 billion equivalent in economic losses) further underscore why RA-LCOE provides a more honest basis for comparing technologies when reliability and delivered energy matter.

Many analysts (IEA, NREL, Lazard, CATF) recommend moving beyond simple LCOE to RA-LCOE/VALCOE for regions with growing variable renewables, as "cheap" power plants can create costly system problems.

Planning Framework for Growing Systems:

- **LCOE** → Initial technology screening
- **RA-LCOE** → Capacity adequacy decisions
- **VALCOE** → Final portfolio and investment strategy

Best practice: Don't approve generation based on LCOE alone.

4. Enabling Industrialization and Mining Growth

The region is experiencing accelerating demand from energy-intensive sectors, particularly mining and mineral processing, including uranium, rare earths, graphite, rutile, titanium, niobium, and other critical minerals.

These industries require:

- Continuous, high-quality power
- Tight voltage and frequency control
- Minimal interruption risk

Frequent outages or instability render such operations uneconomic, directly undermining export revenues and investment pipelines. Firm power is therefore not optional—it is foundational infrastructure for industrial growth.

Gas-fired generation provides the reliability backbone required to unlock this demand and support value-added industrial activity. Africa's critical minerals sector is expanding, with countries like the Democratic Republic of Congo leading in cobalt and copper mining, but unreliable power hinders processing and exports.

5. Planning and Governance: The Role of System Operators

As generation capacity expands and system complexity increases, power system operators must have a formal seat at the planning table.

System and market operators are the stakeholders who:

- Manage real-time stability
- Handle congestion, curtailment, and outages
- Balance variable renewables with firm capacity

Without operator input, planning decisions risk optimizing for nominal capacity or tariff outcomes while creating operational instability and hidden system costs.

Effective power sector planning should therefore:

- Incorporate reliability-adjusted valuation
- Reflect firm capacity contributions
- Explicitly account for operational constraints and curtailment risk
- Empower system operators as core decision-makers alongside policymakers and investors

6. Policy Recommendations

To integrate natural gas effectively while advancing a just energy transition, governments, regional bodies (SADC, EAPP), and partners should adopt these streamlined policies, aligned with the African Union's Energy Transition Strategy, Agenda 2063, and regional master plans:

1. **Develop harmonized regional gas master plans:** Establish frameworks for supply, cross-border infrastructure, pricing standards, and hydrogen-ready networks, building on existing SADC Gas Plan principles.
2. **Position gas as a time-bound transition fuel:** Include natural gas in national IRPs as a bridge to renewables, with explicit phase-down timelines linked to maturing storage and green hydrogen technologies. Prioritize domestic use and offer incentives for projects that support renewable integration.
3. **Strengthen IPP and private investment frameworks:** Streamline competitive tendering, licensing, and bankable PPA structures for gas-fired projects. Introduce PPP incentives, tax relief, and currency-hedging mechanisms to attract capital and enable dual-fuel capability.
4. **Adopt reliability-adjusted planning metrics:** Mandate system operator participation in energy planning. Use firm capacity, dispatchability, and grid stability metrics alongside

LCOE, while accounting for curtailment and operational constraints. Strengthen regional power pools (SAPP, EAPP) to deliver balanced portfolios.

5. **Enforce minimum grid code compliance standards:** Require all new renewable projects (wind, solar, small hydro) to meet at least **ENTSO-E Type C+** (or equivalent regional standard) for advanced fault ride-through, reactive power, and frequency response. Require all firm/dispatchable plants (gas, large hydro) to meet at least **ENTSO-E Type D** (or equivalent) for full grid-forming capability, black-start support, and inertia provision. These mandatory requirements will safeguard system stability as variable renewable penetration grows.

6. **Improve financing access and ESG alignment:** Develop ESG guidelines for gas projects (methane abatement, CCS readiness). Advocate for concessional finance, credit enhancements, FX risk mitigation tools, and capacity building in regulation, negotiation, and local content.

7. **Align with inclusive transition objectives** Coordinate gas deployment with renewable expansion, energy efficiency goals (e.g., 50% productivity gain by 2050 per AfEES), clean cooking programs, and targeted support.

These focused recommendations balance energy security, affordability, equity, and sustainability, positioning natural gas as a strategic enabler of industrialization and grid resilience on Africa's low-carbon pathway.

7. Conclusion

Gas-fired power plays a strategic and irreplaceable role in the region's electricity systems. While its nominal tariff may appear higher than hydro or solar on a pure energy basis, this comparison is incomplete and misleading.

When evaluated correctly—on the basis of firm capacity, reliability, speed of delivery, and economic enablement—gas emerges as:

- A cost-effective alternative to liquid fuels
- A stabilizing complement to renewables
- A critical enabler of industrialization
- A form of reliability insurance for national grids

Sustainable power sector development in the region will not be achieved through tariff minimization alone, but through balanced portfolios that prioritize reliability, resilience, and long-term economic growth—guided by pragmatic, forward-looking policies.

What's your experience with standard LCOE planning? Connect with us to discuss energy project development opportunities in Sub-Saharan Africa and how we can work together to close the energy access gap