

Q-SMEC: Quantum-Superconducting Magnetic Energy Containment for Energy-Efficient and Cyber-Resilient Infrastructure

NIKET North America LLC — October 2025

Status: Proprietary (Shareable without NDA). No enabling design secrets disclosed.

1) Executive summary

Q-SMEC is a materials-centric platform coupling quantum-enhanced sensing, AI/edge control, and advanced energy-handling materials to improve data-center efficiency and electromagnetic resilience.

Industry baselines: Global data-center electricity use is 1–1.5% of world electricity ($\approx 240\text{--}415$ TWh, 2022–2024). Cooling's share spans 7–30% depending on efficiency. U.S. demand could reach 6.7–12% by 2028.

Inventor claims (unverified): 10–100 \times improvements in signal-to-noise and energy containment; step-change SWaP-C; manufacturable via 3D printing + ALD; anti-tamper and cyber-resilient design.

Offer: Jointly test these claims against standard metrics (PUE, IT energy, cooling energy, power-train losses, availability, EMC/EMI immunity).

2) Problem framing and motivation

Load growth: AI accelerates data-center electricity demand; IEA projects strong growth.

Inefficiency loci: IT silicon losses, cooling, and power-delivery losses dominate site energy.

U.S. studies show rising loads despite efficiency gains.

EM threat surface: EMC robustness is now mandatory for smart-grid and IT systems.

3) Concept overview: Q-SMEC architecture

Three cooperative layers:

1. Quantum-enhanced sensing layer – picotesla/nanotesla sensitivity; comparable to NV-diamond and SQUID benchmarks.

2. AI + edge control layer – Physics-informed neural networks (PINNs) fuse sensor telemetry with physical models.

3. Advanced materials & energy layer – Superconducting/quantum-compatible thin films and printable structures minimize losses.

Constraint: Current superconductors need cryogenic or sub-ambient operation; “room-temperature” claims remain unverified.

4) Technical characteristics

Materials & fabrication: Thin films (atomic-layer deposition) and additive routes (printed superconductors) are emerging and feasible.

Quantum model and digital twin: PINN-guided digital twins constrained by Maxwell's equations predict EM losses and control parameters.

Interfaces: Compatible with SCADA/BMS via standard telemetry; EMC aligned with IEC 61000 standards.

5) Data-center use case (AWS-relevant)

Baseline metrics: Power Usage Effectiveness (PUE) and equipment-level energy distribution.

Evaluation proposal:

- Benchmark field sensitivity/noise vs. NV/SQUID data.
- Compare AI controllers (PINN vs. PID) for cooling and power optimization.
- Verify material loss reduction and EMI resilience.

Savings figures are targets, not established results.

6) Measurement plan

KPIs: Δ PUE, Δ IT energy, Δ cooling kWh, Δ power-train losses, availability, EMC compliance.

Test duration: 90 days across seasonal profiles.

Success gates: Statistically significant reductions with no SLA or EMC degradation.

7) Readiness and standards

Readiness: TRL mapping (NASA definitions).

Standards targets: IEC 61000 (EMC/EMI), Green Grid PUE, DOE/ENERGY STAR energy reporting.

Risks: Cryogenic constraints, immature additive manufacturing, unverified high- T_c claims.

Mitigations: Focus on ALD-proven materials; exclude speculative superconductors.

8) Collaboration framework

Phase I – Requirements and baseline plan (4 wks)

Phase II – Lab prototypes (8–12 wks)

Phase III – Edge control pilot (8 wks)

Phase IV – Material pilot (12–16 wks)

Phase V – Integrated demo (12 wks)

Deliverables: PUE deltas, energy reductions, EMC pass/fail results.

9) Appendices (references and facts)

- Global/U.S. data-center energy: IEA, DOE, LBNL 2024.
- Quantum sensor benchmarks: NV/SQUID sensitivity (fT–nT/ $\sqrt{\text{Hz}}$).
- Fabrication feasibility: ALD thin films, printed superconductors.
- PUE definition: Green Grid WP#49; ENERGY STAR coordination.
- TRL definitions: NASA TRL table.