

QWAV Strategy v2.4: The Energy-Standard Playbook — Consortium Governance, Verified Precedents, and the JPCUB Road to a Quantum Computing Energy Benchmark

Rowan Brad Quni-Gudzinis

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Author: Rowan Brad Quni-Gudzinis | **ORCID:** 0009-0002-4317-5604 | **Date:** 2026-08-12 | **License:** QNFO-ULA | **Status:** Published v2.4.1

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Abstract

Quantum computation is known to possess theoretical energy-consumption advantages over classical computation — Meier and Yamasaki proved an exponential energy advantage on Simon's problem (arXiv:2305.11212), and Fellous-Asiani et al. demonstrated full-stack resource-efficiency optimization regimes distinct from computational-advantage regimes (PRX Quantum 4, 040319). No standard measurement instrument yet exists to make these advantages comparable across platforms. This paper argues that QWAV's JPCUB (Joules-per-Solution) metric can become that instrument — not by competing as a vendor product, but by following the proven playbook of energy benchmarks that became industry standards: SPEC's SERT server-efficiency benchmark (2007–2011), the Green Grid's PUE metric (2007–2011), and MLPerf's consortium-governed energy benchmarks (2018–2021). Section 2 documents these precedents with verified sources. Section 3 analyzes the existing quantum consortium landscape — QED-C (Quantum Economic Development Consortium), IEEE, NIST — and identifies the specific gap JPCUB fills. Section 4 presents the consortium governance model adapted from these precedents. Section 5 maps the grant-funding pipeline to verified programs. Section 6 pre-registers seven falsifiable predictions. The conclusion is that QWAV's highest-leverage strategy is to seed a standards body around JPCUB using the SPEC/Green Grid playbook, rather than to sell benchmarking as software.

Keywords: QWAV, JPCUB, joules per solution, energy benchmarking, quantum computing, consortium, standards, SPEC, Green Grid, PUE, MLPerf, QED-C

1. Introduction

1.1 The Strategic Question

QWAV possesses a validated technical contribution: the JPCUB metric, defined as total system energy per correct answer, provides a physics-grounded benchmark for computational platforms. The JPCUB Competitive Landscape v2.0 (<https://papers.qnfo.org/papers/jpcub-competitive-landscape/>) ranks 17 quantum platforms, and the Qudit Advantage paper (<https://papers.qnfo.org/papers/qwave-qudit-advantage/>) demonstrates the metric's discriminative power.

The strategic question is not whether JPCUB is technically sound. It is: **how does a single independent researcher turn a metric into a standard?** This paper answers that question by examining how previous energy-efficiency metrics became standards, and by designing a consortium model based on those verified precedents.

1.2 Why This Matters Now

Three forces converge in 2026:

1. **Theoretical validation exists.** Quantum energy advantage is no longer speculative — it is proven for specific problems (Simon's problem, arXiv:2305.11212) and shown to extend to full-stack resource efficiency (10.1103/prxquantum.4.040319).
2. **Energy is becoming a procurement criterion.** The EU Energy Efficiency Directive recast and enterprise ESG mandates are making energy efficiency a technology-procurement factor, as documented in the server-energy-benchmarking literature (10.1007/978-3-031-85634-1_11).
3. **No standard exists.** The quantum industry's own needs assessments (10.1109/te.2022.3153841, 10.1140/epjqt/s40507-021-00114-x) identify benchmarking and standards as unmet industry needs.

The entity that defines the standard before the industry coalesces around alternatives owns the metric.

2. Verified Precedents: How Energy Benchmarks Became Standards

The following precedents are documented with sources verified live (2026-08-12) via OpenAlex and arXiv. They constitute the playbook.

2.1 SPEC and SERT: The Server Energy Benchmark Consortium (2007–2011)

SPEC (Standard Performance Evaluation Corporation) is a non-profit consortium founded 1988 by computer vendors and universities to define fair benchmarks. Its SPECpower committee developed SERT (Server Efficiency Rating Tool) — the design of which is documented in "The design and development of the server efficiency rating tool" (10.1145/1958746.1958769).

The playbook SPEC followed:

1. **Neutral stewardship:** SPEC is a consortium, not a vendor. Its benchmarks carry weight because no single vendor controls them.
2. **Workload standardization:** benchmarks define specific workloads (for SERT: CPU, memory, storage, network) with measured energy.
3. **Open membership:** vendors join to shape benchmarks they will be measured against — inclusion prevents fork.
4. **Ratified methodology:** benchmarks are published, peer-reviewed, and versioned.

Relevance to JPCUB: SERT is the closest classical analog to JPCUB — an energy-efficiency benchmark governed by a neutral consortium, adopted by an industry that could have each built its own. The 2025 literature (10.1007/978-3-031-85634-1_11) confirms server energy benchmarks remain an active field.

2.2 The Green Grid and PUE: The Metric That Became the Standard (2007–2011)

The Green Grid — a global consortium of IT companies founded 2007 — defined PUE (Power Usage Effectiveness), the data center energy metric. The metric's definition is documented in "PUE: The Green Grid metric for evaluating the energy efficiency in DC" (10.1109/intlec.2011.6099718). PUE became the de facto industry

standard within five years, cited in the US Data Center Energy Usage Report (10.2172/1372902) and used globally.

Why PUE won:

1. **Simplicity:** a single dimensionless ratio (total facility power / IT equipment power) — easy to compute, easy to compare.
2. **Consortium ownership:** defined by a neutral body, not a vendor.
3. **Regulatory capture:** once cited in government reports, it became the procurement standard.

Relevance to JPCUB: PUE's trajectory from consortium metric to regulatory standard is the template. JPCUB is more complex than PUE (it requires workload definition and energy measurement), but the adoption path is identical: neutral definition → industry adoption → regulatory citation.

The PUE metric family has since evolved (AxPUE, arXiv:1310.6502; xPUE, arXiv:2503.07124), demonstrating that a successful energy metric spawns an ecosystem of extensions — a further validation of the "define the metric first" strategy.

2.3 MLPerf and MLCommons: The Modern Open Benchmark Consortium (2018–2021)

MLCommons is an open engineering consortium (founded 2018) whose MLPerf benchmarks became the industry standard for ML performance. Crucially for JPCUB, MLPerf Tiny (arXiv:2106.07597) explicitly **measures accuracy, latency, AND energy** for ultra-low-power systems — the collaborative effort of more than 50 organizations. The MLCommons harness architecture is documented in MLHarness (arXiv:2111.05231).

The modern playbook additions:

1. **Speed:** MLPerf achieved standard status in ~3 years (2018–2021), much faster than SPEC's decade. The modern standard-setting cycle is shorter.
2. **Energy is a first-class metric:** MLPerf Tiny's inclusion of energy in its core benchmarks validates the JPCUB premise that energy-per-task is a necessary benchmark dimension.
3. **Open governance:** MLCommons publishes methodology and welcomes membership — transparency is the trust mechanism.

2.4 Lessons for JPCUB

Lesson	SPEC/SERT	Green Grid/PUE	MLPerf	JPCUB Application
Neutral ownership	✓	✓	✓	JPCUB Consortium (not QWAV product)
Open membership	✓	✓	✓	Academic + industry + regulatory tiers
Published methodology	✓	✓	✓	JPCUB P0 protocol (https://papers.qnfo.org/papers/joules-per-solution-metric/)
Workload standardization	✓	—	✓	Define benchmark workloads per platform
Energy as core metric	✓	✓	✓	JPCUB IS energy-per-solution
Speed to standard	10+ yrs	~5 yrs	~3 yrs	Target: 3–5 years

The synthesis: JPCUB combines SERT's energy-benchmark rigor with PUE's metric-simplicity adoption path and MLPerf's modern speed. No existing quantum benchmark does this — the quantum industry's needs assessments identify this exact gap (10.1109/te.2022.3153841).

2.5 Mandatory Symmetry: What External Literature Supports and Constrains

Where External Literature Supports [The Consortium-Governed JPCUB Standard]

1. **Energy benchmarks become standards through neutral consortia, not vendor products.** The SPEC SERT design paper (10.1145/1958746.1958769) documents a consortium-governed server energy benchmark adopted by an industry of competing vendors. The Green Grid PUE metric (10.1109/intlec.2011.6099718) became the de facto data-center energy standard within five years under consortium ownership. MLPerf Tiny (arXiv:2106.07597) shows the modern pattern — more than 50 organizations collaborating on a benchmark that measures accuracy, latency, AND energy.
2. **Quantum computation has provable energy advantages worth benchmarking.** Meier and Yamasaki rigorously prove an exponential energy-consumption advantage of quantum over classical computation for Simon's problem (arXiv:2305.11212). Fellous-Asiani et al. introduce the Metric-Noise-Resource (MNR) methodology and identify quantum energy advantage in parameter regimes distinct from computational advantage (10.1103/prxquantum.4.040319).
3. **The quantum industry itself identifies benchmarking standards as an unmet need.** QED-C's industry assessment (10.1109/te.2022.3153841) and applications review (10.1140/epjqt/s40507-021-00114-x) document that the quantum industry needs shared metrics and benchmarks.
4. **A standard energy metric spawns an ecosystem.** The PUE family has grown (AxPUE, arXiv:1310.6502; xPUE, arXiv:2503.07124), validating the "define the metric first" strategy.

Where External Literature Constrains or Contradicts [The Consortium-Governed JPCUB Standard]

1. **The proven quantum energy advantage is problem-specific, not universal.** Meier and Yamasaki prove the exponential advantage for Simon's problem — a query-complexity model — not for all computational tasks (arXiv:2305.11212). JPCUB's claim to be a general-purpose energy benchmark must be workload-conditional: a JPCUB ranking is meaningful only for the benchmark workloads defined, not as a universal platform ordering.
2. **Quantum energy advantage is regime-dependent.** Fellous-Asiani et al. find the quantum energy advantage holds "in regimes of parameters distinct from the commonly considered quantum computational advantage" (10.1103/prxquantum.4.040319). This constrains the strategic assumption that energy advantage and computational advantage coincide; JPCUB must measure energy advantage as an independent axis, not assume it tracks speedup.
3. **PUE's success owed partly to simplicity.** PUE is a single dimensionless ratio computed from two power measurements (10.1109/intlec.2011.6099718). JPCUB requires workload definition, correct-answer verification, and energy measurement — a higher adoption barrier than PUE. The strategy must price this complexity cost into the adoption timeline.
4. **No constraining evidence found against consortium governance itself.** The SPEC, Green Grid, and MLCommons records show no case where a neutral consortium failed to establish an energy benchmark; the constraining evidence above concerns JPCUB's measurement semantics and adoption complexity, not the governance model.

[NO FURTHER CONSTRAINING EVIDENCE FOUND]

3. The Quantum Consortium Landscape

3.1 What Already Exists

Body	Founded	Scope	Gap JPCUB Fills
QED-C (Quantum Economic Development Consortium)	2019	Quantum industry growth, workforce, benchmarks	No energy-efficiency benchmark standard; JPCUB could be its energy benchmark working group
IEEE Quantum	2019	Quantum engineering standards	Performance metrics under discussion but no energy standard
NIST	—	Post-quantum crypto, measurement science	Energy benchmarking is a measurement-science gap
ISO/IEC JTC 1	—	Formal standards	Slow-track (years); consortium standards feed in later

Key insight: QED-C already exists as the quantum industry consortium with a benchmarking mission (documented in its applications paper 10.1140/epjqt/s40507-021-00114-x and needs assessment 10.1109/te.2022.3153841). **QWAV does not need to create a consortium from scratch — it needs to seed an energy-benchmarking working group within the existing ecosystem, or create a focused JPCUB consortium that partners with QED-C.**

3.2 The Strategic Choice: Three Options

Option	Description	Trust	Speed	Control
A. Seed QED-C energy WG	Propose JPCUB as the energy benchmark standard within QED-C's existing benchmark program	High (existing body)	Medium (bureaucracy)	Low (JPCUB becomes one of many)
B. Independent JPCUB Consortium	Create SPEC-style neutral body with JPCUB as founding standard	High (fresh, focused)	Fast	High (JPCUB is the founding standard)
C. Vendor product	Sell JPCUB benchmarking as software (v2.2/v2.3 approach)	Low (vendor conflict)	Medium	High (but adoption-limited)

Recommendation: Option B with Option A as a parallel track. Create the JPCUB Consortium as a focused, SPEC-style neutral body (fast, high control, high trust) while simultaneously proposing JPCUB to QED-C's benchmarking program (leverage existing ecosystem). Option C remains the monetization layer — the certification service the consortium operates.

3.3 Why NOT a QWAV Product

The v2.2/v2.3 strategy treated JPCUB as a vendor differentiator. The precedent evidence shows this is the wrong frame: every successful energy benchmark (SERT, PUE, MLPerf Tiny) was owned by a neutral consortium, not a vendor. A single-vendor benchmark carries an inherent conflict of interest — the 2025 server-benchmarking literature (10.1007/978-3-031-85634-1_11) and the quantum needs assessments (10.1109/te.2022.3153841) both treat benchmarks as neutral infrastructure.

4. JPCUB Consortium Governance Model

4.1 Membership Tiers (adapted from SPEC + MLCommons)

Tier	Annual Dues	Voting	Benefits	Target
Academic	€0 (in-kind validation)	1 vote	Publication credit, early data access	5–15 institutions
Industry — Hardware	€2K–10K scaled	1 vote	JPCUB-Verified badge eligibility, metric input	3–8 vendors
Industry — End-User	€1K–5K	1 vote	Procurement tools, benchmark workload definition	3–10 orgs
Regulatory Observer	€0 (invited)	0 votes	Standards pathway input	1–3 bodies

4.2 Governance Bodies

1. **Steering Committee** — one rep per tier + secretariat (QWAV, tie-break). Ratifies metric changes, membership, certification.
2. **Technical Working Group** — open to all members; develops measurement methodology; reviews benchmark data.
3. **Certification Board** — independent; approves JPCUB-Verified badges.

4.3 Launch Sequence

Milestone	Timeline	Gate
M0: JPCUB Protocol v1.0 ratified	Month 1–3	Protocol published (exists: https://papers.qnfo.org/papers/joules-per-solution-metric/); charter drafted
M1: Founding members	Month 3–6	≥3 LOIs (≥1 academic, ≥1 industry)
M2: Charter ratified	Month 6	All founding members sign
M3: First certification	Month 9–12	≥1 JPCUB-Verified badge
M4: QED-C partnership	Month 6–12	JPCUB proposed as QED-C energy benchmark standard

5. Grant-Funding Pipeline (Verified Programs)

The v2.3 grant landscape contained fabricated amounts. This section lists only programs verified to exist (via public program descriptions), with honest uncertainty about amounts.

5.1 Priority Pipeline

Program	Funder	Verified?	Fit
QED-C programs	QED-C (industry consortium)	✓ (10.1140/epjqt/s40507-021-00114-x documents the consortium)	High — energy benchmark WG funding
EU Quantum Flagship / Horizon Europe	European Commission	✓ (flagship program is documented public knowledge)	High — consortium grant as coordinator
NWO Open Competition ENW	Dutch Research Council	✓ (public program)	High — single-PI research on JPCUB methodology
Quantum Delta NL	Dutch National Growth Fund	✓ (public program)	Medium-High — NL-based quantum software

Program	Funder	Verified?	Fit
NLnet / NGI	NLnet Foundation	✓ (public program)	Medium — open benchmarking tooling
Sloan Foundation	Sloan	⚠ verify eligibility	Medium — energy/public-interest
Simons Foundation	Simons	⚠ verify eligibility	Medium — p-adic foundations

Honest framing: Grant applications are a pipeline to be pursued, not a revenue projection. The consortium model's first-year funding is more likely to come from small grants (NLnet, NWO) and member dues than from a €5M flagship award. The strategy does not depend on any single grant.

5.2 Grant Strategy

- Year 1:** NLnet (€5–50K) + NWO (€200–400K) for JPCUB protocol development + consortium bootstrap. Member dues phase in.
- Year 2:** QED-C partnership or Quantum Delta NL (€50–500K) for certification framework. EU Flagship as coordinator only if LOIs exist.
- Year 3:** Sustainability from certification + dues; grants fund protocol evolution.

6. Falsifiable Predictions (Pre-Registered)

Timestamped 2026-08-12. Audit dates as specified.

ID	Prediction	Check Date	Disconfirmation Condition	Strength
GTM-1	JPCUB cited in ≥ 1 external academic paper or industry report (non-QNFO)	2027-02-12	Zero external citations	STRONG
GTM-2	≥ 1 formal letter of intent from a potential consortium member	2027-02-12	Zero LOIs	STRONG
GTM-3	JPCUB Protocol Specification v1.0 published and externally citable	2027-02-12	No published spec	STRONG
GTM-4	≥ 3 institutional consortium members with signed charter	2027-08-12	< 3 signed members	STRONG
GTM-5	JPCUB proposed to QED-C (or other quantum consortium) as energy benchmark	2027-02-12	No proposal submitted	MODERATE
GTM-6	≥ 1 grant awarded (any recognized funder)	2027-08-12	Zero grants awarded	MODERATE
GTM-7	≥ 1 JPCUB-Verified badge issued	2028-02-12	Zero badges	MODERATE
GTM-8	Quantum energy advantage (Meier-Yamasaki class) experimentally demonstrated by any group	2028-08-12	No experimental demonstration	WEAK (field-level)

Note on GTM-8: This prediction is field-level — it tests whether the energy-advantage literature (arXiv:2305.11212, 10.1103/prxquantum.4.040319) is empirically realized. It is a calibration indicator, not a JPCUB gate.

7. Financial Model (Estimates, Not Projections)

7.1 Revenue Streams (Year 1–3)

Stream	Year 1	Year 2	Year 3
Grants	€5K–50K	€50K–250K	€50K–300K
Member dues	€0–6K	€10K–50K	€30K–100K
Certification fees	€0	€2K–10K	€10K–50K
Consulting	€0–10K	€10K–50K	€20K–100K
Total	€5K–66K	€72K–360K	€110K–550K

7.2 Cost Structure

Item	Annual	Notes
Cloud infra	€500–2K	Current ~€50/mo
Consortium ops	€5K–15K	Charter, meetings, platform
Travel	€3K–8K	2–4 conferences
Founder stipend	€40K–80K	Below market for quantum researcher
Total	€48.5K–105K	

Sustainability is achievable at the lower bound of Year 2. The model is lean by design.

8. Risk Assessment

Risk	Likelihood	Impact	Mitigation
Consortium fails to reach critical mass	Medium (50%)	Critical	Academic-first tier (zero cost); QED-C partnership parallel track
QED-C or IEEE defines its own energy benchmark first	Medium (40%)	High	Speed (MLPerf playbook); propose JPCUB INTO QED-C early (GTM-5)
Grants rejected	Medium (40%)	High	Apply to ≥5 programs; small grants first; model does not depend on any single grant
Founder bandwidth	High (90%)	Medium	Consortium distributes work; grants fund stipend
JPCUB measurement challenged	Low (20%)	High	Open methodology (P0 protocol), academic validation tier
Incumbent vendors fork the metric	Medium (40%)	Medium	Inclusion-first membership (SPEC playbook)

9. Conclusion

The v2.2/v2.3 strategy treated JPCUB as a vendor product. The evidence assembled in this paper shows that is the wrong frame. Every energy benchmark that became a standard — SERT, PUE, MLPerf Tiny — was owned by a neutral consortium, not a vendor. The theoretical foundation for quantum energy advantage now exists (arXiv:2305.11212; 10.1103/prxquantum.4.040319). The quantum industry's own needs assessments identify benchmarking standards as an unmet need (10.1109/te.2022.3153841; 10.1140/epjqt/s40507-021-00114-x).

The strategy is therefore:

1. **Seed the JPCUB Consortium** — a SPEC-style neutral body with JPCUB as its founding standard (fast, high-control, high-trust).
2. **Partner with QED-C** — propose JPCUB as the energy benchmark within the existing quantum consortium ecosystem (leverage, not reinvention).
3. **Fund through verified grants + member dues** — NLnet, NWO, Quantum Delta NL, QED-C programs; no dependence on any single grant.
4. **Monetize through certification** — JPCUB-Verified badges as the consortium's service, not QWAV's product.

Eight pre-registered predictions anchor this strategy in falsifiable terms. If the consortium has fewer than three members by 2027-08-12 (GTM-4), the model is falsified and QWAV should pivot to grant-only research. If the predictions hold, QWAV becomes the steward of the quantum energy standard — a position built on the same playbook that made PUE and MLPerf the standards of their industries.

Declarations

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Conflicts of Interest: The author is the founder of QWAV and the creator of the JPCUB metric. This strategy is written from the perspective of the QWAV entity.

Data Availability: All external claims are cited with DOIs or arXiv identifiers verified live (2026-08-12) via OpenAlex and arXiv APIs. Market figures are explicitly labeled as estimates.

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Author: Rowan Brad Quni-Gudzinis (ORCID: 0009-0002-4317-5604). This document was drafted with AI assistance and reviewed by the author.

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