

Quantum-Safe Encryption for Grid Communications

ANMD-MRS15-149 · Grid & Energy Cybersecurity Technologies

A Global Sustainability Due Diligence & Market Research Study

History 2020–2024 · Base Year 2025 · Forecast 2025–2032 · Outlooks 2035 / 2040 / 2050 · Currency US\$

WHY THIS REPORT

Quantum-safe encryption for grid communications future-proofs critical infrastructure against the quantum threat — the post-quantum cryptography (PQC) modules, quantum key distribution (QKD), crypto-agility platforms, hybrid classical-PQC and quantum-safe gateways that protect grid data against 'harvest-now, decrypt-later' attacks. With NIST PQC standards finalised and long-lived grid data at risk, utilities are beginning the migration to quantum-resistant cryptography. This decision-grade study sizes the global market three ways — value, units and endpoints — across solution type, form factor and application, across seven regions and four scenarios to 2032, with outlooks to 2050.

SUSTAINABILITY & SDG IMPACT — THE ANMD LENS

Sustainability is this report's backbone, not an afterthought. Quantum-safe encryption protects the long-term integrity and resilience of energy infrastructure against an emerging existential threat.

Mapped Sustainable Development Goals:

SDG 7 Affordable & Clean Energy	SDG 9 Industry, Innovation & Infrastructure	SDG 11 Sustainable Cities & Communities	SDG 12 Responsible Consumption & Production	SDG 16 Peace, Justice & Strong Institutions
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Measurable sustainability outcomes assessed:

- Long-term resilience of critical energy infrastructure
- Protection of long-lived grid data against future attack
- Migration-readiness and crypto-debt as a material risk
- Quantum-safe accessibility for smaller utilities assessed

Framework alignment: Double materiality mapped to GRI, SASB, ISSB, TCFD, TNFD, CSRD and the EU Taxonomy, with greenwashing and SDG-washing screens applied throughout.

WHAT'S INSIDE AT A GLANCE

53 Chapters	9 Report Parts	7 Regions Covered	40+ Country Markets
2025–32 Forecast Horizon	4 Forward Scenarios	25+ Companies Profiled	5 SDGs Mapped

REPORT COVERAGE

Geographic scope: North America, Europe, Asia Pacific, Latin America, Africa, Middle East and Rest of World — with named country intelligence. North America leads PQC and crypto-agility; Europe drives QKD and PQC libraries; Japan and quantum specialists add depth; other regions assessed on their own merits.

- Protection against 'harvest-now, decrypt-later' quantum attacks
- NIST-standardised PQC, QKD and crypto-agility approaches
- Hybrid classical-PQC migration for long-lived grid data
- Migration-readiness, standards integrity and access as material risks

MARKET OVERVIEW

From classical encryption to quantum-resistant infrastructure — where crypto-agility, not any single algorithm, defines durable grid security.

Quantum-safe encryption is moving from research to early migration. Demand is driven by the harvest-now-decrypt-later threat, finalised NIST PQC standards and crypto-agility mandates across North America, Europe and Asia Pacific. The market is read three ways — value, units and endpoints — and forecast under four scenarios, each region reported separately.

- **North America leads PQC and crypto-agility** — the United States, anchored by SandboxAQ, QuSecure, Inc., Quantum Xchange and Palo Alto Networks, Inc. across software and migration platforms
- **Europe drives QKD and PQC libraries** — Switzerland, the UK and Germany, with Thales S.A., ID Quantique SA, Utimaco GmbH and PQShield Ltd across hardware and cryptography
- **Crypto-agility is the differentiator** — the ability to migrate and swap algorithms — not any single algorithm — defines durable quantum readiness
- **Solution type segments the value** — PQC modules, QKD, crypto-agility platforms, hybrid classical-PQC and quantum-safe VPN/gateways

REGIONAL OUTLOOK

Across seven reporting regions, the report separates leading markets from high-growth and emerging ones — each profiled in full rather than aggregated into Rest of World.

Region	Stage	Lead Country Markets & Drivers
North America	PQC & crypto-agility leader	United States — SandboxAQ, QuSecure, Quantum Xchange
Europe	QKD & PQC-library hub	Switzerland, UK, Germany — ID Quantique, PQShield, Utimaco
Asia Pacific	QKD strength	Japan — Toshiba quantum key distribution
Middle East	Emerging	Israel, UAE — sovereign quantum-safe investment
Latin America	Frontier	Brazil — early quantum-safe interest
Africa	Frontier	South Africa — research & early adoption

KEY MARKET DRIVERS & RESTRAINTS

Drivers	Restraints
<ul style="list-style-type: none"> • Harvest-now-decrypt-later threat • Finalised NIST PQC standards • Long-lived critical-data protection • Crypto-agility & migration mandates • Sovereign & defence-grade security 	<ul style="list-style-type: none"> • Early-stage migration & maturity • Performance & integration overhead • Legacy-system crypto migration • QKD cost & distance limits • Standards-evolution uncertainty

SEGMENTATION SNAPSHOT

By Solution Type	PQC modules · quantum key distribution (QKD) · crypto-agility platforms · hybrid classical-PQC · quantum-safe VPN / gateways
By Form Factor	Software / library · hardware module · network appliance
By Approach	PQC · QKD · hybrid
By End User	Utilities · grid operators · energy companies · ISOs / RTOs
By Business Model	Hardware sales · SaaS subscription · managed services
By Application	Generation · transmission & distribution · grid edge

TECHNOLOGY & APPLICATION FINDINGS

Where the category is differentiating fastest — the technology and application fronts that separate leaders from followers:

- **PQC modules** — NIST-standardised algorithms protect grid data against future quantum attack
- **Crypto-agility** — platforms enable discovery, migration and algorithm-swapping at scale
- **QKD & hybrid** — physics-based and hybrid approaches serve the highest-assurance links

TABLE OF CONTENTS — PARTS & CHAPTERS

The full report is organised into nine parts across 53 chapters, listed below. Detailed sub-headings, country tables and directories are provided in the full report.

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- › Chapter 3. Executive Intelligence and Decision Dashboard
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COMPETITIVE & INVESTMENT SNAPSHOT

The competitive field spans crypto and PQC specialists, QKD vendors and security majors. Deal activity — PQC partnerships, crypto-agility acquisitions and QKD pilots — signals a market forming around standards-based, agile quantum-safe migration.

Representative players profiled in the full report:

Thales S.A. · ID Quantique SA · Toshiba Corporation · SandboxAQ · Palo Alto Networks, Inc. · Utimaco GmbH · PQShield Ltd · and 20+ further profiled players.

Investment intelligence: venture, infrastructure, development, climate and blended finance, green bonds and sustainability-linked loans — culminating in a bankability assessment and a conditional investment view.

KEY QUESTIONS THIS REPORT ANSWERS

- How large is the global quantum-safe encryption market, and how fast will it grow to 2032?
- Which regions, countries and segments offer the strongest risk-adjusted opportunity?
- Which technologies and architectures reshape the addressable market and the cost curve?
- Who leads, and where is the competitive and patent white space?
- Is the investment case bankable — and under what conditions?
- How does the category align with the SDGs and disclosure regulation?

WHY ANMD — THE DIFFERENCE

Most market studies stop at units and revenue. This report is built as a sustainability due diligence instrument — fusing market sizing with ESG, SDG, climate and natural-capital intelligence and a decision-ready bankability view in a single architecture.

- **Triangulated sizing** — every market read three ways so value, volume and the physical-unit views reconcile rather than conflict.
- **Region-honest forecasting** — Latin America, Africa and the Middle East reported in full, never hidden inside Rest of World, every forecast resolved to the 2025 base year.
- **Integrated evidence base** — company, patent and project databases linked to the analysis, with published-filing patents and FTO treated as an indicator, not a legal conclusion.
- **No-fabrication discipline** — every estimate carries a data-confidence rating and disclosed sources; gaps are flagged for further diligence, never filled with invented numbers.
- **Anti-greenwashing rigour** — SDG-washing and greenwashing screens plus claim-substantiation checks built into the ESG and project analysis.
- **Decision-first structure** — 9 Parts and 53 Chapters culminating in stakeholder playbooks and a clear, conditional investment view.

WHO SHOULD BUY THIS REPORT

Utilities, grid operators, energy companies, ISOs/RTOs, security vendors, investors and policymakers, and strategic corporate planners and decision-makers.

Access the Full Report

The complete report delivers all 53 chapters in full, with every sub-heading, country table, company and patent directory, forecast model and due diligence checklist.

Purchase at www.anewmarketdynamics.com · Standard & Premium licences · Single-Site (SSL) and Global-Site (GSL) options at checkout.

Want the Complete Detailed Table of Contents?

This prospectus lists the nine parts and 53 chapters. The complete detailed table of contents — every sub-heading, country table, exhibit, company and patent directory and annex — is available on request to registered users. To receive it, register with your official company email at www.anewmarketdynamics.com. The full detailed table of contents will be sent directly to your registered company email address.