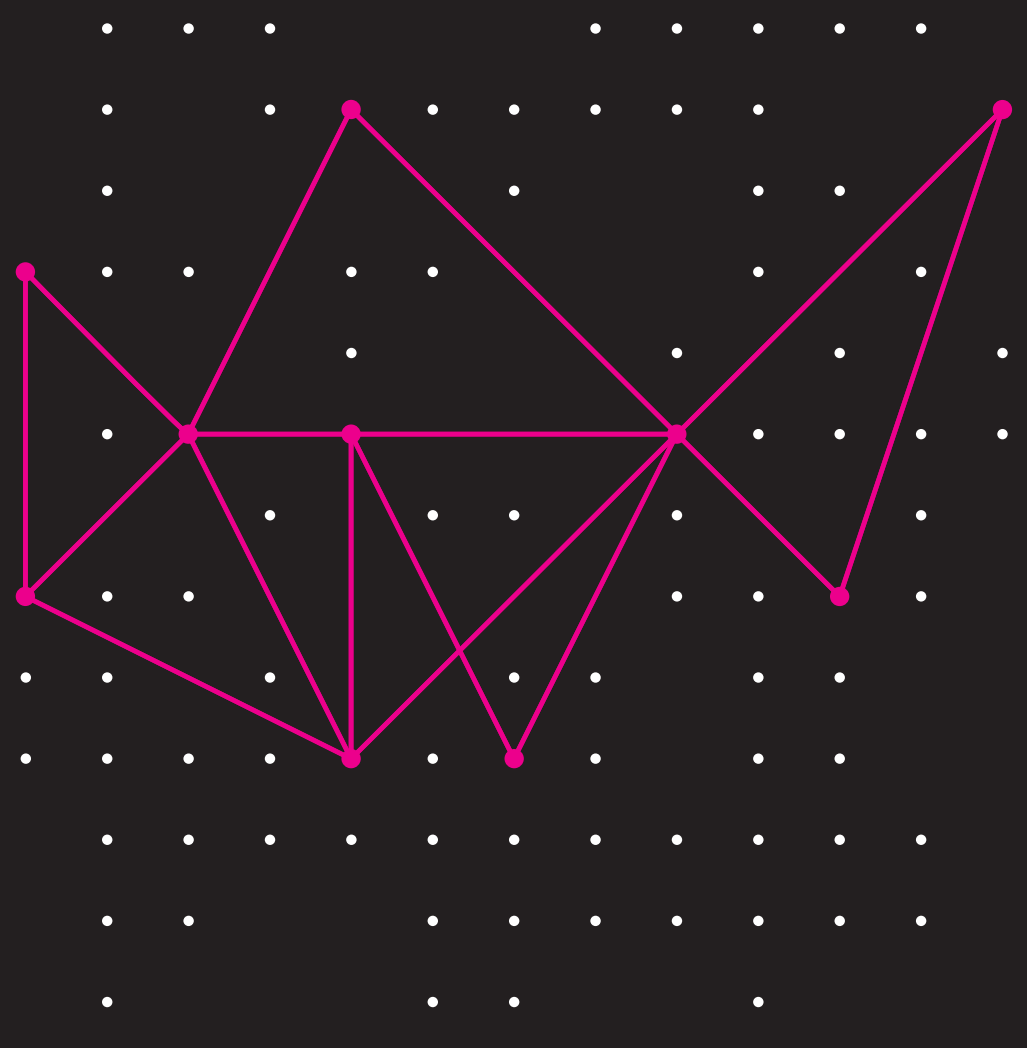
LUMI AI Factory



AI, Supercomputing, and Quantum: Europe's Next Competitive Frontier

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Director, Technology Programs

CSC – IT Center for Science

Impact of AI on Economy, Finance and Supervision
Helsinki, 11 November 2026

Compute is strategic: where Europe stands

Sources disagree on the magnitudes but agree on the direction.

United States

Market-led scale

- Far ahead in private AI investment
- Most AI supercomputing, mostly company-owned
- Leads private quantum funding

China

State-led scale

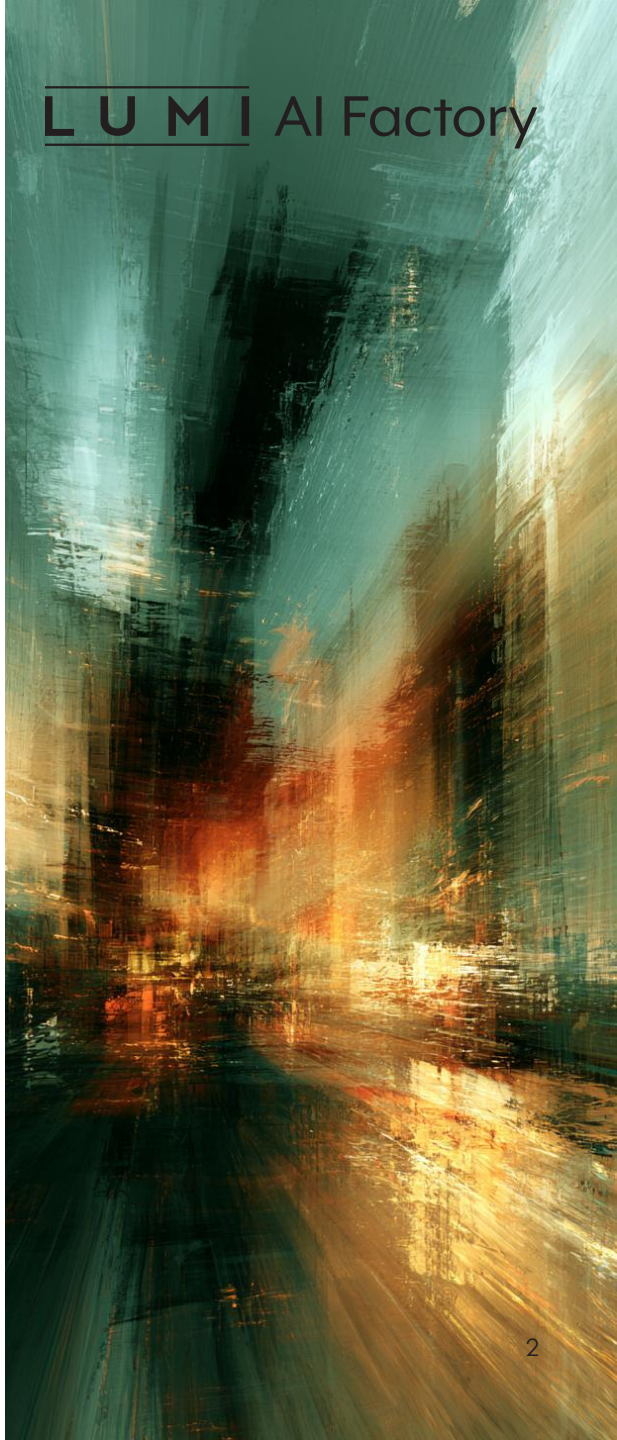
- Large state-directed investment
- Most public AI supercomputers
- Leads in AI publications and patents

Europe

Public infrastructure and research

- World-class public supercomputing (EuroHPC)
- Strong research and quantum hardware
- Less private capital and AI compute

Europe's lever is shared public infrastructure. The question is how fast industry and the public sector put it to work.



Three technologies, one infrastructure

Already in finance: supercomputing and AI together

Monte Carlo simulation on supercomputers

A neural network learns pricing and risk from it

Thousands of times faster, similar accuracy

Next: quantum joins the same pattern

Supercomputers
Large-scale simulation and data processing

AI
Analysing data and optimising complex workflows

Quantum
Tasks where quantum methods open new possibilities

Division of labour in the LUMI AI Factory's hybrid platform



Europe’s response: from strategy to legislation

Oct 2022
EuroHPC selects six sites for its first quantum computers

Apr 2025
LUMI AI Factory launched, one of the EU’s first AI Factories

Jul 2025
Quantum Europe Strategy; EuroHPC remit to cover AI Gigafactories and quantum

18 Nov 2026
Quantum Act proposal scheduled

2027
LUMI-IQ quantum platform tightly integrated with AI in the LUMI AI Factory



The Quantum Act (in preparation)

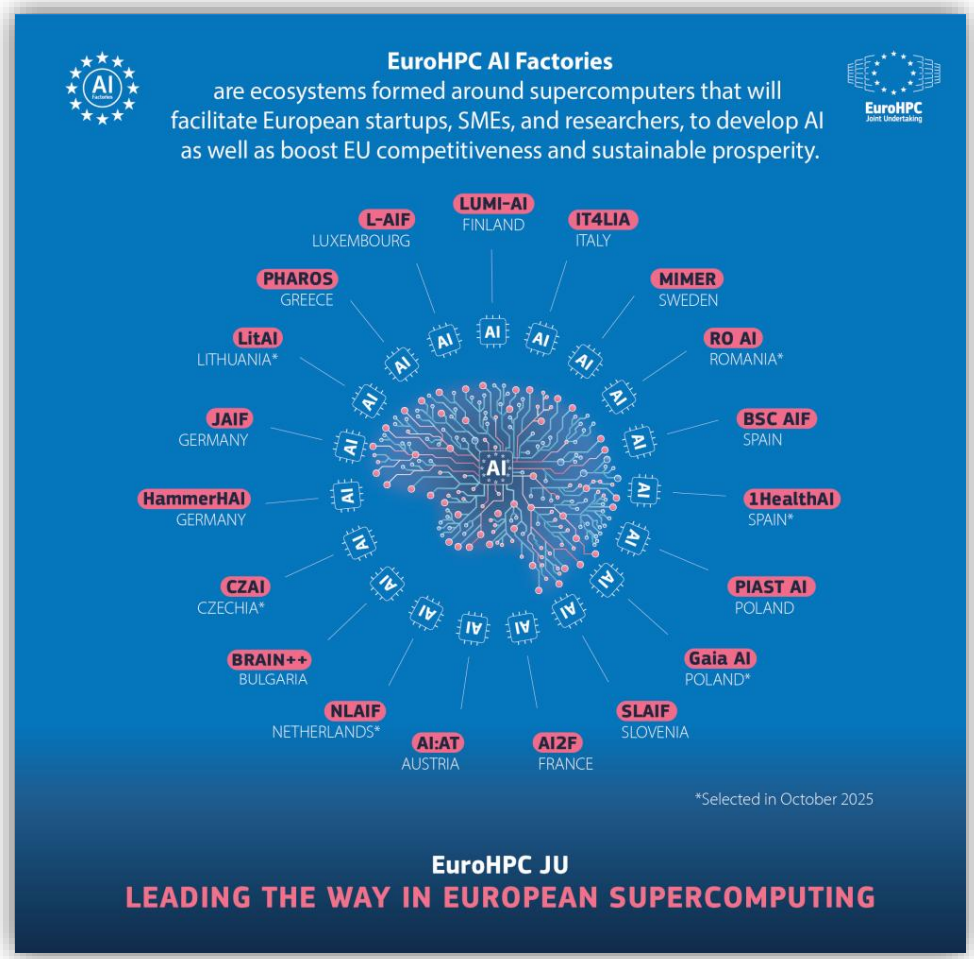
From lab to market
Focus on turning research into competitive products

European procurement
Public contracts reserved for EU-controlled suppliers and reciprocal partners

Quantum-safe purchasing
Critical-sector public purchases to be ready for quantum-safe encryption

EU promotes AI innovation

- European Commission launched the AI Innovation Package in January 2024 to support European startups and SMEs in the development of trustworthy AI
- A series of competitive calls for AI Factory proposals – first seven announced in December 2024 and further six in March and six in October 2025
- AI Factory = **compute** + **data** + **talent**
- AI Factories focus on certain **AI ecosystems and communities in** alignment with **national AI strategies**



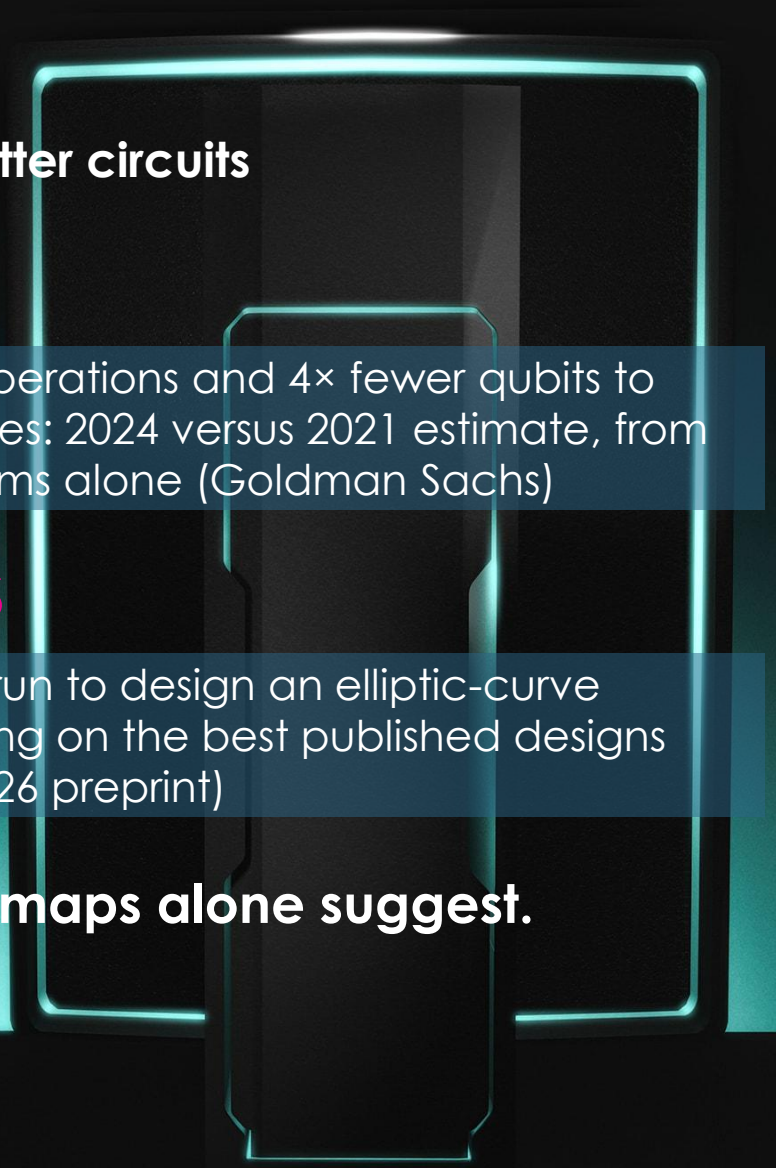
MISSION

To create a comprehensive and accessible service infrastructure that empowers Companies, the public sector, and academic users to develop innovative AI models and applications.

The road is getting shorter from both ends

Hardware: LUMI-IQ as part of the LUMI AI Factory

2027	**IQM Halocene H4**: 150 physical qubits, early error correction
2028	Real-time error correction
2029	**IQM Halocene H5**: advanced logical-qubit capabilities



Algorithms: better circuits

16×

fewer costly operations and 4× fewer qubits to price derivatives: 2024 versus 2021 estimate, from better algorithms alone (Goldman Sachs)

53 hours

for a single AI run to design an elliptic-curve circuit improving on the best published designs (Anthropic, 2026 preprint)

Timelines could move faster than hardware roadmaps alone suggest.

Hosted and operated in Europe

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Location
EuroHPC compute infrastructure is hosted in Europe

Ownership
The infrastructure is fully owned by European entities

Funding
Jointly funded by the EuroHPC Joint Undertaking and participating European states

Supply chain
The LUMI-IQ quantum computing platform delivered by IQM Quantum Computers, a European manufacturer

What it means in practice

- Data under EU jurisdiction
- Operations under European control
- A European hardware supply chain for the quantum system
- Free-of-charge access routes for start-ups, SMEs and academic researchers

HPC in action: climate risk for central banks

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Climate Digital Twin – part of Destination Earth

≈5 km

global resolution, compared with ≈100 km in typical global climate simulations

- Simulations for 1990–2049, plus storylines that replay real extremes in warmer climates
- Runs on LUMI and MareNostrum 5; machine-learning components coming

ECB climate-risk demonstrator

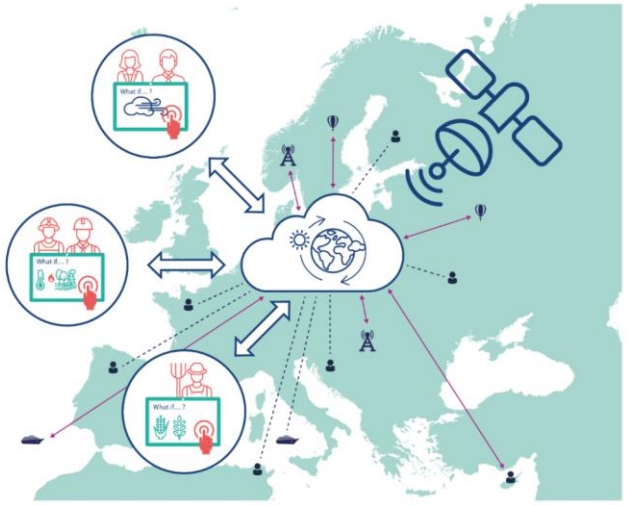
Heat, drought and floods

Crop yields

Food prices

Inflation and financial stability

- Indicators and scenarios that quantify this chain, focused on agriculture



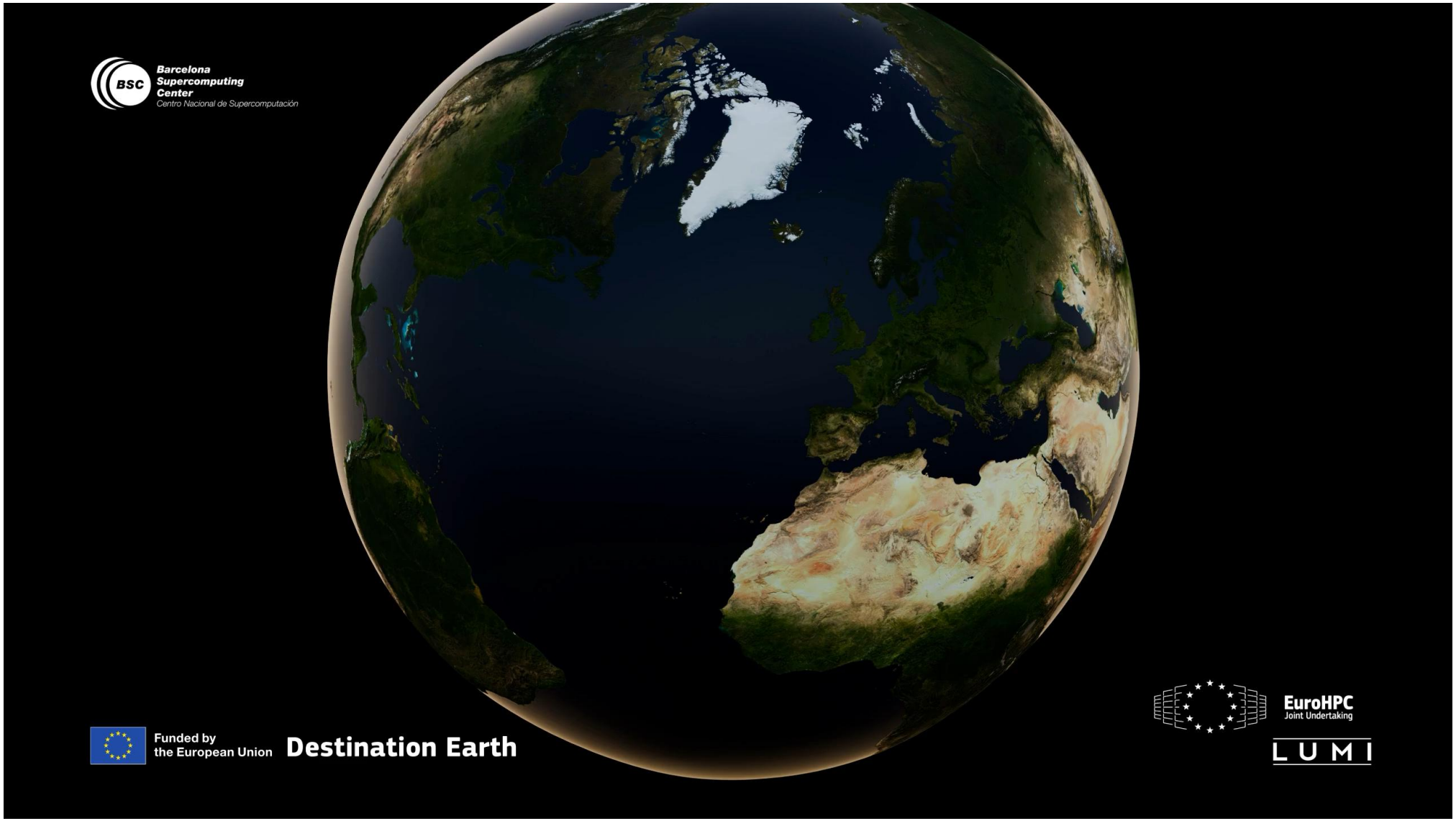
SUERF
The European Money and Finance Forum

SUERF Policy Brief
No 1559, September 2026



Simulating a climate digital twin at 5-10 km resolution

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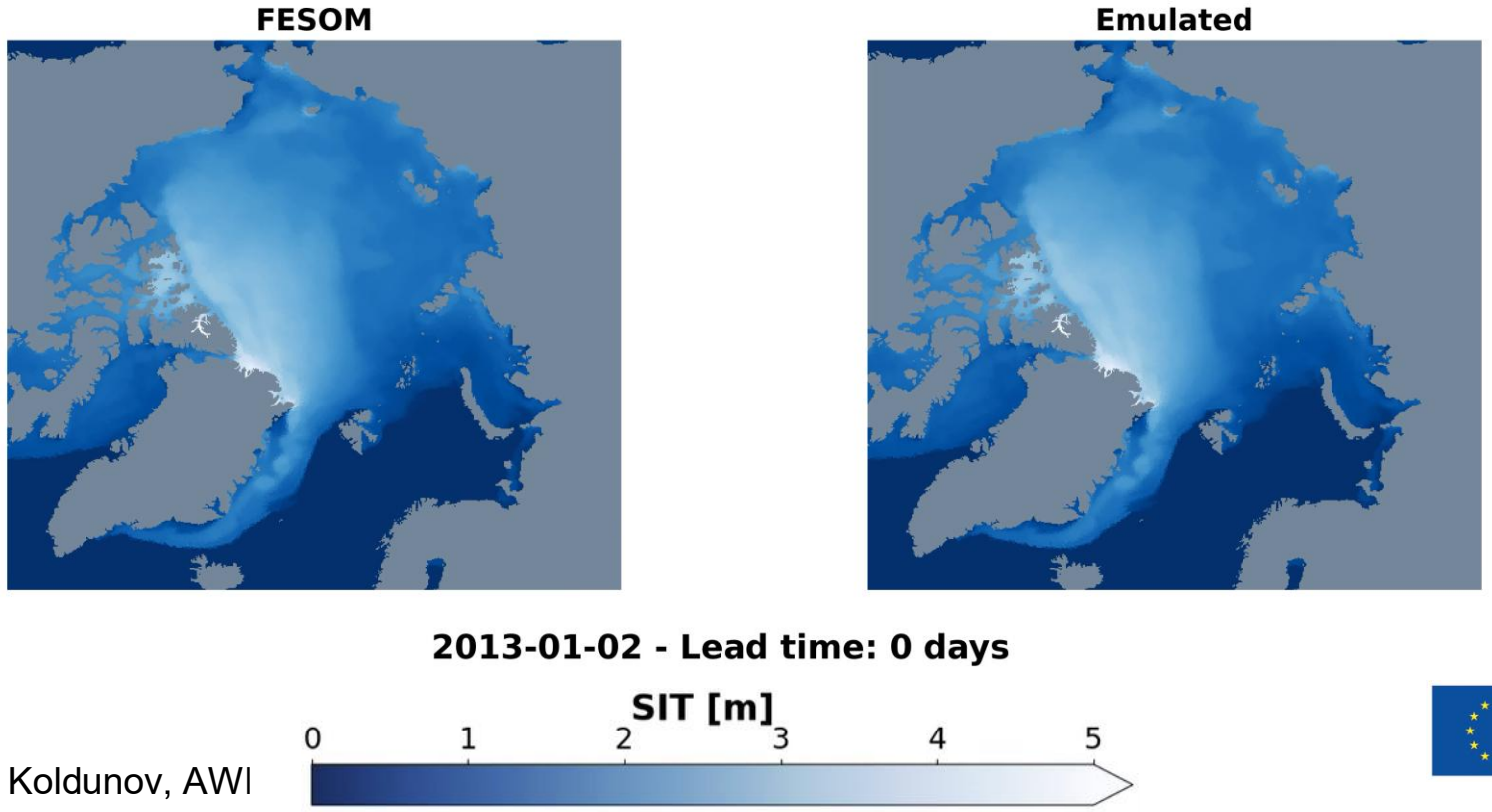


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TerraDT – developing an AI emulator for sea ice

Stable and realistic predictions of sea ice thickness and concentration achieved with the AI emulator at seasonal to multi-annual timescales

Map-based graphical user interface will enable users to explore effects of future sea ice conditions on shipping routes and coastal/offshore construction



Figures from Nikolay Koldunov, AWI

Funded by the European Union

Three application families for finance

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Faster simulation

Pricing, risk and stress testing

Proven speed-up; needs error-corrected machines



Patterns in high-dimensional correlations

Fraud and AML, credit, tail dependence

Promising hypothesis; unproven on real data

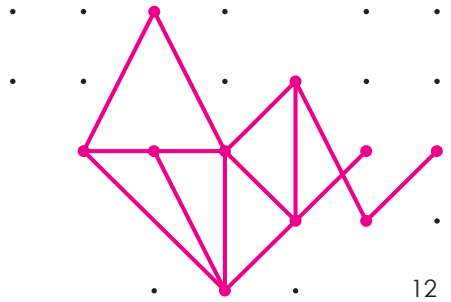


Constrained optimisation

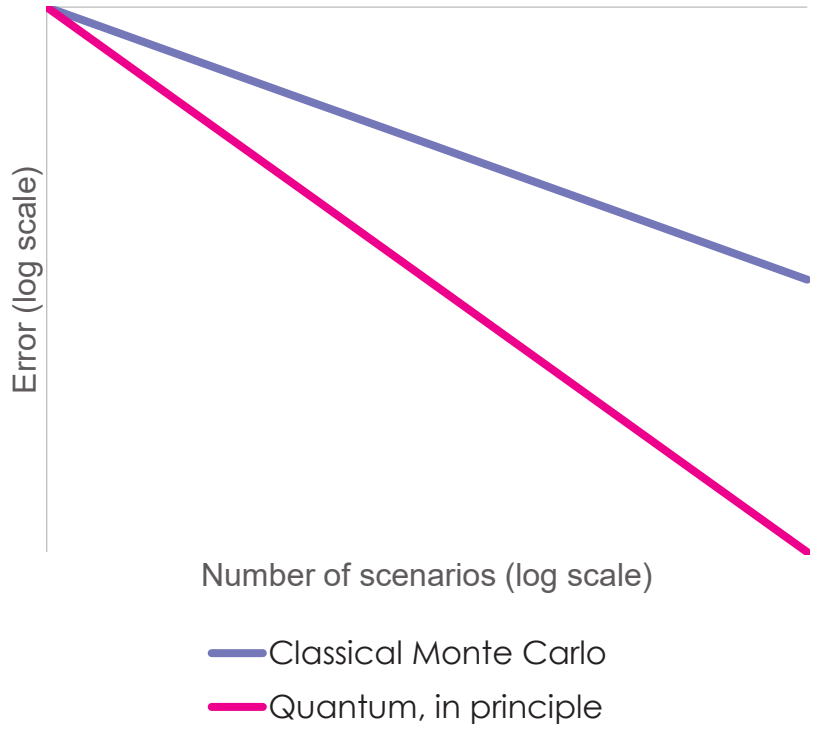
Portfolios, collateral, netting

Heuristic methods; no proven advantage yet

Available today: quantum-inspired methods on classical hardware, and hybrid testing against the best classical baselines



Simulation: pricing, risk and stress testing



Illustrative scaling, not a benchmark

Today: error shrinks with the square root of the number of scenarios – 100× more runs for 10× more accuracy

Quantum, in principle: error shrinks in direct proportion – 10× more runs for 10× more accuracy

The price tag: several thousand error-corrected qubits, returning a price in about a second to beat today's hardware

Where it matters: stress testing, counterparty risk (XVA), value at risk

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Patterns in high-dimensional correlations

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The intuition

Quantum states describe joint probabilities over many variables at once. The hypothesis: quantum models may find structure that classical models miss, or need far more data to find.

Candidates in finance

- Fraud and AML: many weak signals combined
- Credit risk with interacting factors
- Tail dependence and contagion in stress scenarios
- Synthetic scenarios that keep joint behaviour
- Compound climate risks

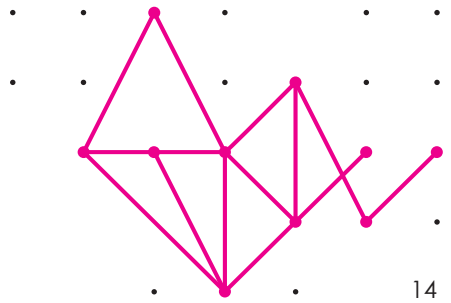
Theory: it is possible

A purpose-built problem where a quantum model provably beats any classical learner (Liu et al., Nature Physics, 2021)

Practice: data narrows the gap

With enough data, classical models often match quantum ones, even on quantum-tailored problems (Huang et al., Nature Communications, 2021)

For model validation: demand reproducibility and strong classical baselines



What is usable now



Quantum-inspired methods

Tensor-network techniques from quantum physics, running on classical hardware today



Side-by-side testing

Run quantum methods on Q50 next to the best classical methods on LUMI, and see which wins



Skills and problem formulation

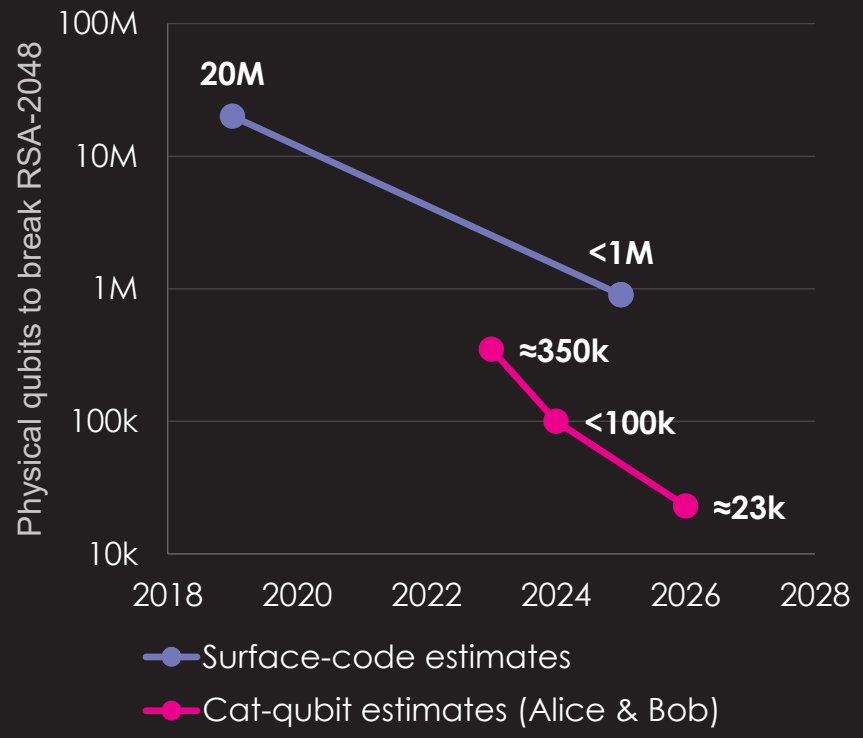
Teams that can frame problems for quantum will be ready when the hardware is



An honest local precedent

OP Lab and CSC, 2021: a quantum housing-price estimate close to the classical one, and an honest “not yet”

The threat to today's cryptography



Harvest now, decrypt later: long-lived confidential data is already exposed today

Falling from both ends: better algorithms and better hardware

AI accelerates this too: an AI-designed circuit for elliptic-curve arithmetic, the core of attacks on elliptic-curve cryptography

Timeline uncertain, but the trend runs one way

Regulation is already moving

EU post-quantum migration roadmap

End 2026
National transition plans in place

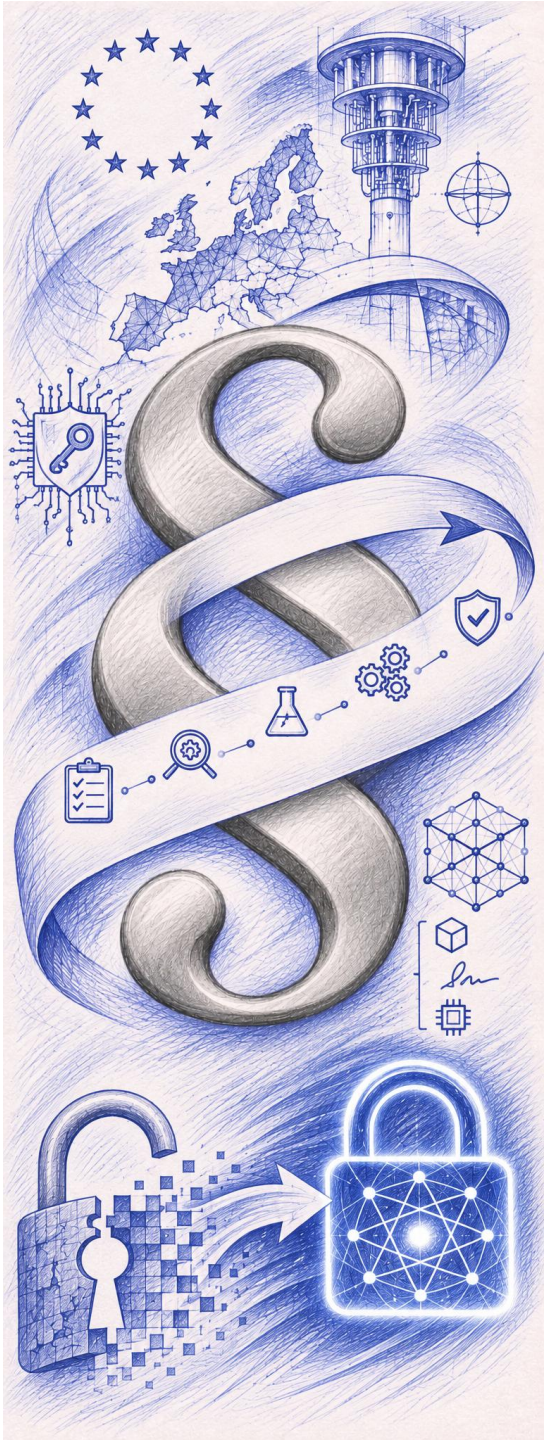
End 2030
High-risk use cases migrated

End 2035
Medium-risk use cases migrated

DORA
ICT risk standards require cryptography that can be updated as cryptanalysis develops; quantum threats are named explicitly

Project Leap, Phase 2
Post-quantum signatures on TARGET2 work, with significant performance differences: migration needs planning

Quantum Act, reported draft
Critical-sector public purchases to be ready for quantum-safe encryption



AI, HPC, and quantum as part of the solution

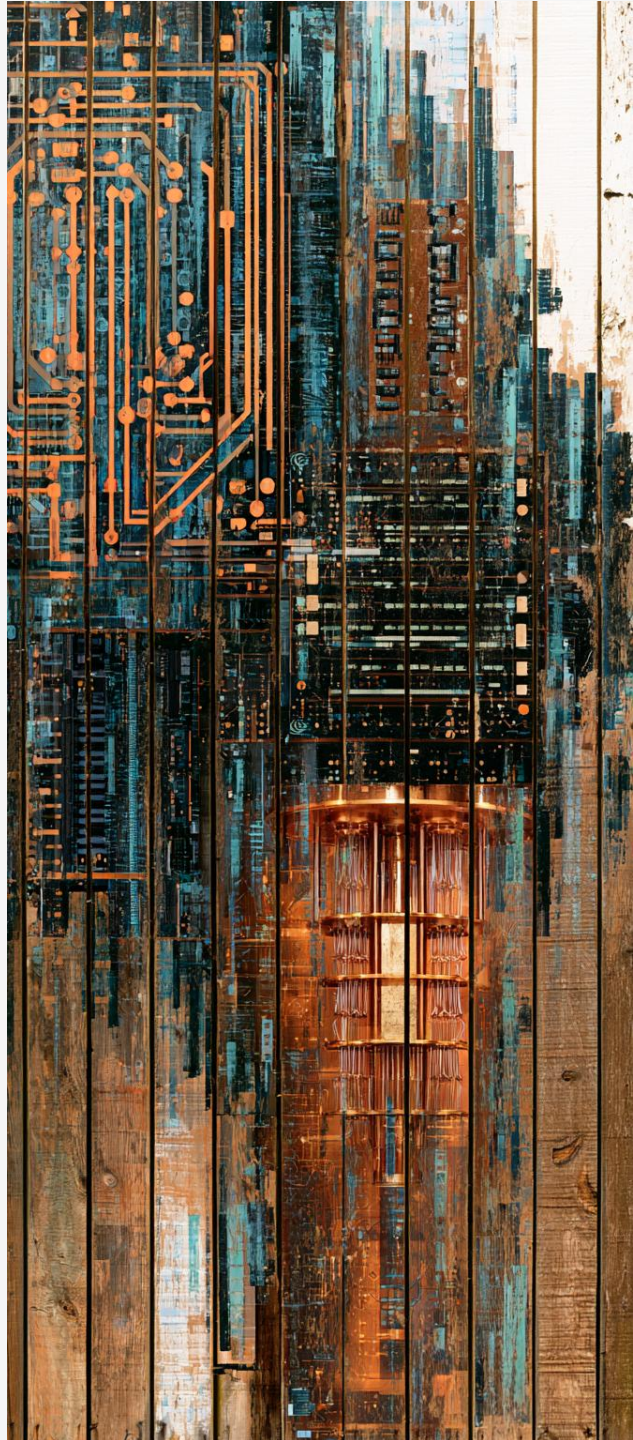
AI finds the cryptography
The inventory is the first and hardest step; industry already uses AI to map cryptography across large codebases

AI helps rewrite it, under human review
Research: works for basic refactoring and needs domain fine-tuning; not yet reliable for secure migrations on its own

HPC tests the new standards
Continuous cryptanalysis and performance testing at scale. In 2022 a NIST-process candidate fell to a classical attack on a single PC

Quantum expertise
People who run quantum hardware can give a realistic view of how fast the threat is approaching

Quantum communication: longer-term; most likely a step towards a future quantum internet.



What this room can do – and how to work with us

Finance stakeholders

Central banks, supervisors, and financial institutions

- Experiment early, against strong classical baselines
- Build quantum literacy into model development and validation
- Start the crypto migration: inventory now
- Public bodies: act as launch customers, as the Quantum Europe Strategy invites

Europe's shared infrastructure

- Supercomputers, AI Factories, and quantum computers across Europe
- Access calls for industry, the public sector, and research
- Free support for start-ups and SMEs; quantum computers open through the same route

Example: LUMI AI Factory in Finland, with the LUMI-IQ quantum computer from 2027

Getting started: a pilot workload, a benchmark against current methods, or a joint workshop



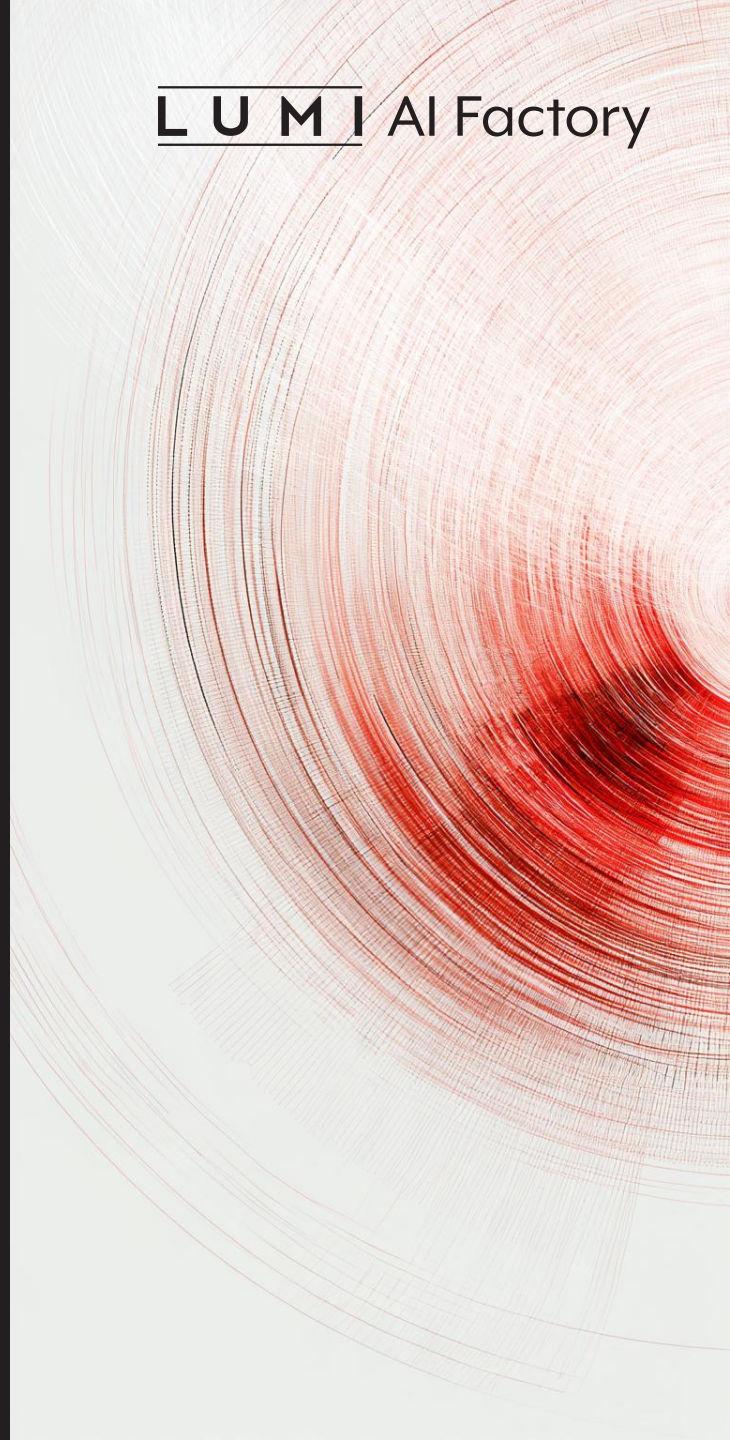
Three take-home messages

1 **Compute is strategic infrastructure.**
Europe has built it, time to use it.

2 **Quantum for finance is real, but uneven.**
Compare to classical baselines.

3 **Quantum timelines are shortening from both ends.**
Start the crypto migration now.
Quantum advantage may come sooner than later.

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