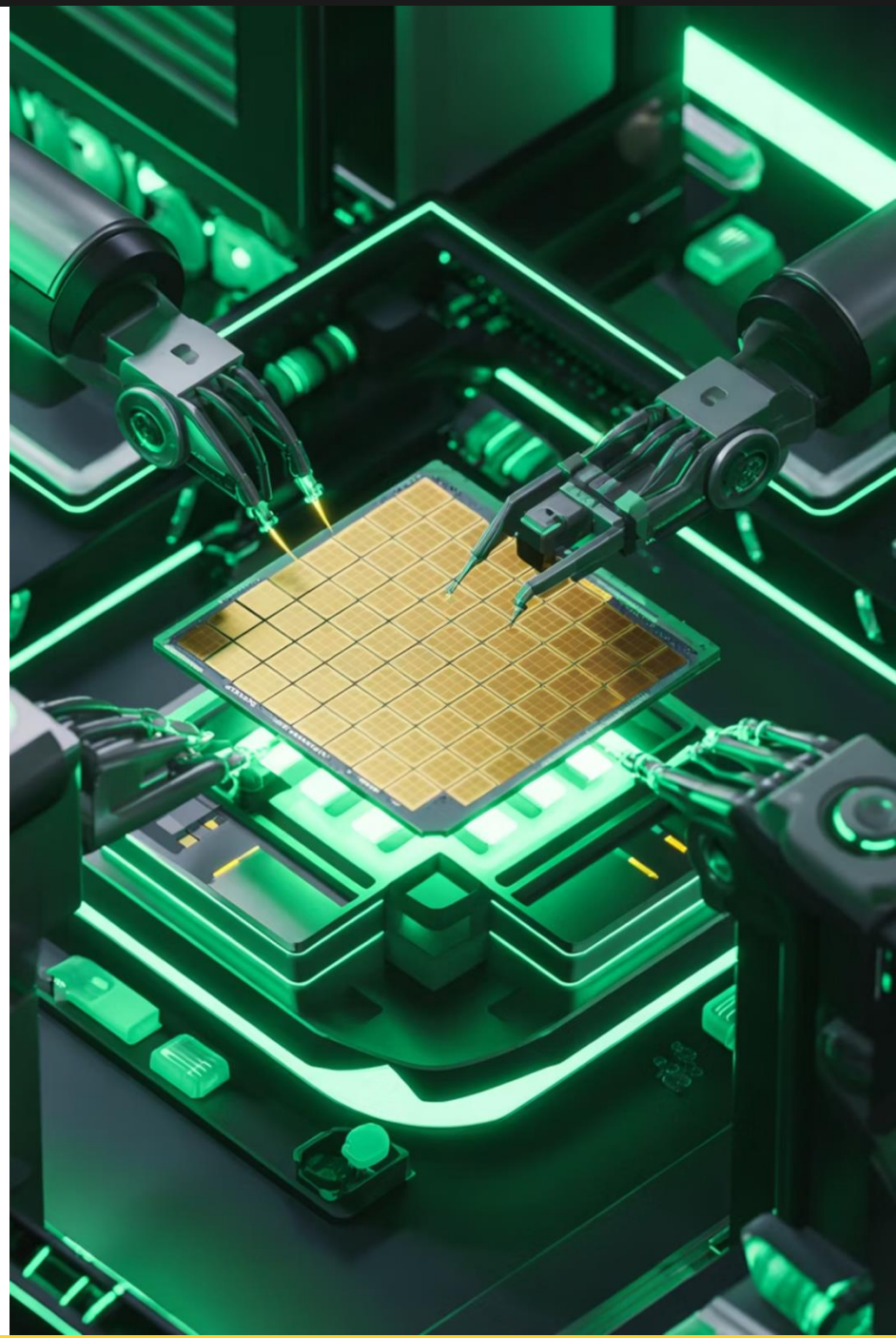
LNOI PHOTONIC MANUFACTURING

FROM LAB TO FAB: THE INDUSTRIALIZATION OF LNOI FOR AI COMPUTE

The journey from laboratory-grade lithium niobate on insulator research to foundry-grade mass production — the manufacturing challenges, breakthroughs, and roadmap ahead.



THE HIDDEN BOTTLENECK: THE ENERGY WALL

AI compute demand is surging at 8× per year, driven by ever-larger models — yet the physical foundations supporting this growth are hitting fundamental limits.

Bandwidth Lock

Communication remains locked to the chip perimeter, capping total achievable bandwidth regardless of internal compute density.

CMOS at Its Limit

Conventional silicon processors have exhausted their roadmap — node shrinks now yield diminishing returns.

Infrastructure Strain

Data-center energy demand will overwhelm existing power grids, making current scaling trajectories unsustainable.

Oligopoly Risk

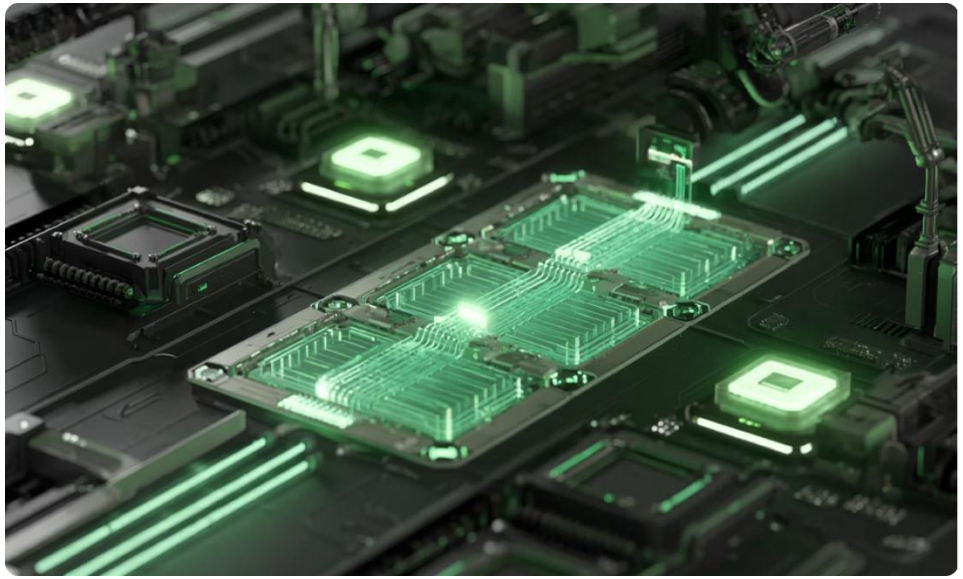
Limited production capacity concentrates power among a handful of foundries, creating supply-chain vulnerability.

AI compute demand is surging 8× per year — the energy wall is here

THE LNOI ANSWER

CHAPTER 1 · THE ANSWER

Lithium Niobate on Insulator (LNOI) offers a fundamentally different approach to photonic compute — one that sidesteps the energy wall through physics, not brute force.



Passive Compute

Tens of thousands of operations replaced by one passive component.

Non-linear AI

Enables non-linear algorithms software codes with a fraction of the parameters.

50× Fewer Transfers

50× fewer data transfers — drastically reduces data-movement energy.

30× Less Energy

30× less energy — each operation executed in a single optical step by improved SW/HW integration

Tight Bends

50 µm bend radii vs. centimeter-scale — enables ultra-compact circuits.

LNOI delivers 50× fewer transfers and 30× less energy based on improved SW/HW-Integration

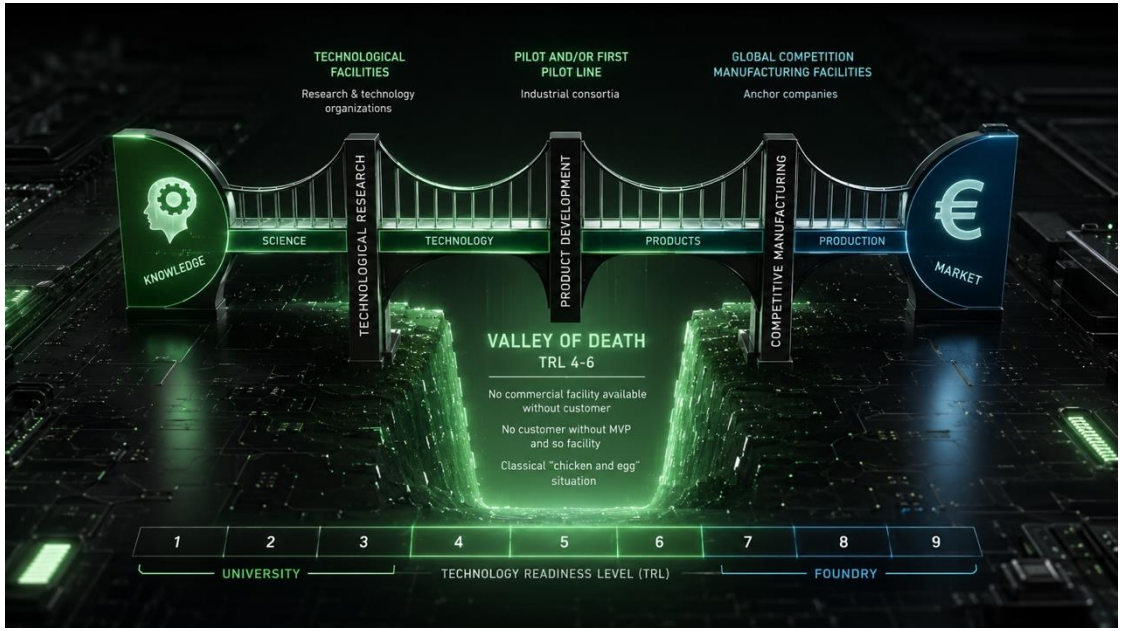
THE MANUFACTURING WALL

CHAPTER 2 · THE BARRIER

Despite its promise, LNOI faces a critical industrialization barrier. Lithium is **forbidden in CMOS foundry lines**, trapping the technology in research environments. Transitioning to high-volume production requires overcoming the notorious "Valley of Death" between prototype and fab.

The Valley of Death

The gap between research-grade fabrication and foundry-compatible flow is where most photonic startups fail — without standardized PDKs and foundries, scaling is impossible.



Lithium Banned

Lithium is forbidden in CMOS foundry lines, trapping the technology in research-grade environments.

CMOS Tool Gap

The gap between research-grade fabrication and a foundry-compatible flow is where most photonic startups fail.

Missing PDKs

No standardized Process Design Kits exist, so external designers cannot build production-ready circuits.

Most photonic startups die in the Valley of Death

BREAKTHROUGH:
A MANUFACTURING PATH BY Q.ANT

THE BREAKTHROUGH

Q.ANT has forged a strategic partnership with IMS (Institute for Microelectronics Stuttgart) to bridge the Valley of Death.

Strategic Partnership

Q.ANT and IMS combine startup agility with institute-grade fabrication infrastructure.

Volume Secured

Low- and medium-volume capacity is locked for GEN2 chips and all future generations.

PDK Development

A full Process Design Kit on LNOI lets external designers build circuits, with conversion to 200mm.

Foundry-Ready Scaling

The standardized flow enables fast transfer to a high-volume foundry partner for mass production.

Q.ANT + IMS bridge the VoD— volume secured for GEN2 and all next Generations

ADVANCED FABRICATION TECHNIQUES

FABRICATION

LNOI manufacturing leverages standard semiconductor equipment — proven, compatible, and production-ready.

RIE & Deposition

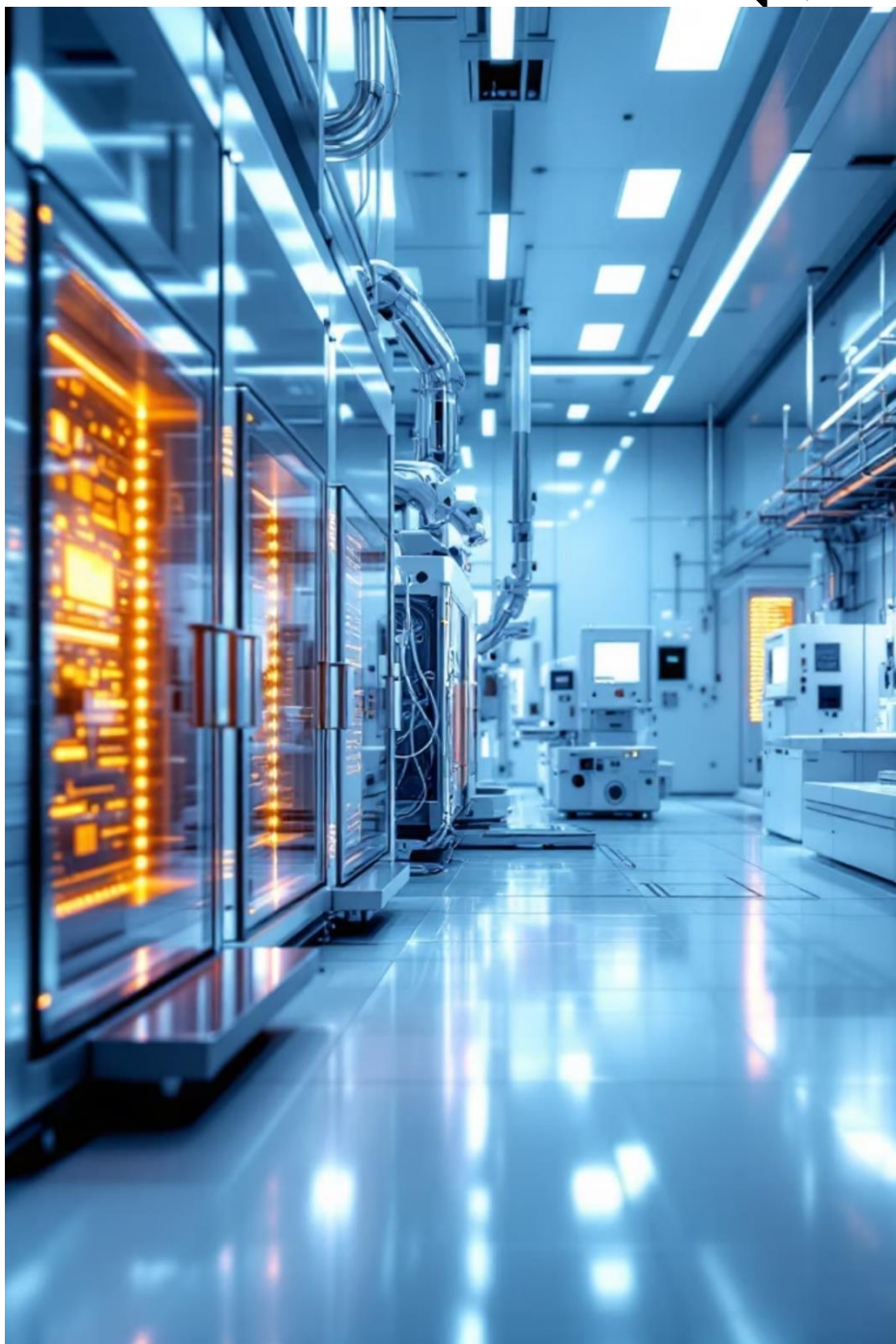
Reactive Ion Etching, CVD, and ALD provide precise material removal and layer-by-layer film growth for waveguides and electrodes.

i-Line Lithography

365 nm i-line lithography enables fast, accurate patterning at industrial throughput — no EUV-class infrastructure required.

CMP Planarization

Chemical-Mechanical Polishing delivers atomically flat surfaces essential for co-packaged optics and heterogeneous integration.

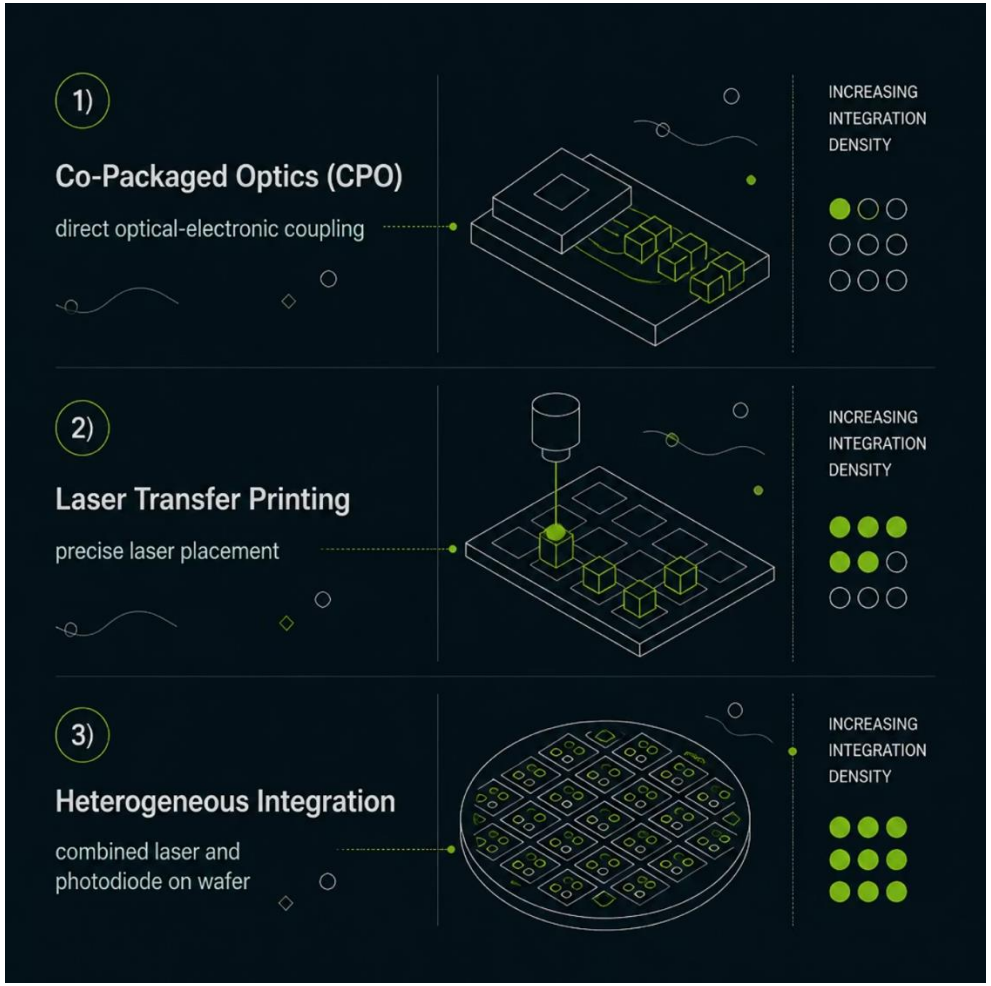


Standard semiconductor equipment — no exotic tooling

SCALING THROUGH 3D INTEGRATION – OUTLOOK

INTEGRATION

Moving beyond planar 2D layouts, LNOI photonic circuits integrate directly with electronics through advanced 3D chip-on-wafer assembly techniques.



The Payoff

100× bandwidth density
through full optical compute and nonlinear AI algorithms

Industrial-scale control
power, thermal, and fiber-attach challenges managed at scale

No interconnect bottleneck
Direct integration eliminates the interconnect bottleneck between photonics and electronics

3D integration is the architectural key to unlocking LNOI's full performance potential at production scale.

3D integration unlocks 100× bandwidth density

THE ROADMAP TO HIGH VOLUME

THE ROADMAP

The path from low-volume fabrication to foundry-grade mass production runs through partnerships and assembly standardization.

1

OSAT Partnerships

Partnering with Outsourced Semiconductor Assembly & Test leaders to standardize assembly and ensure industry-grade quality control.

2

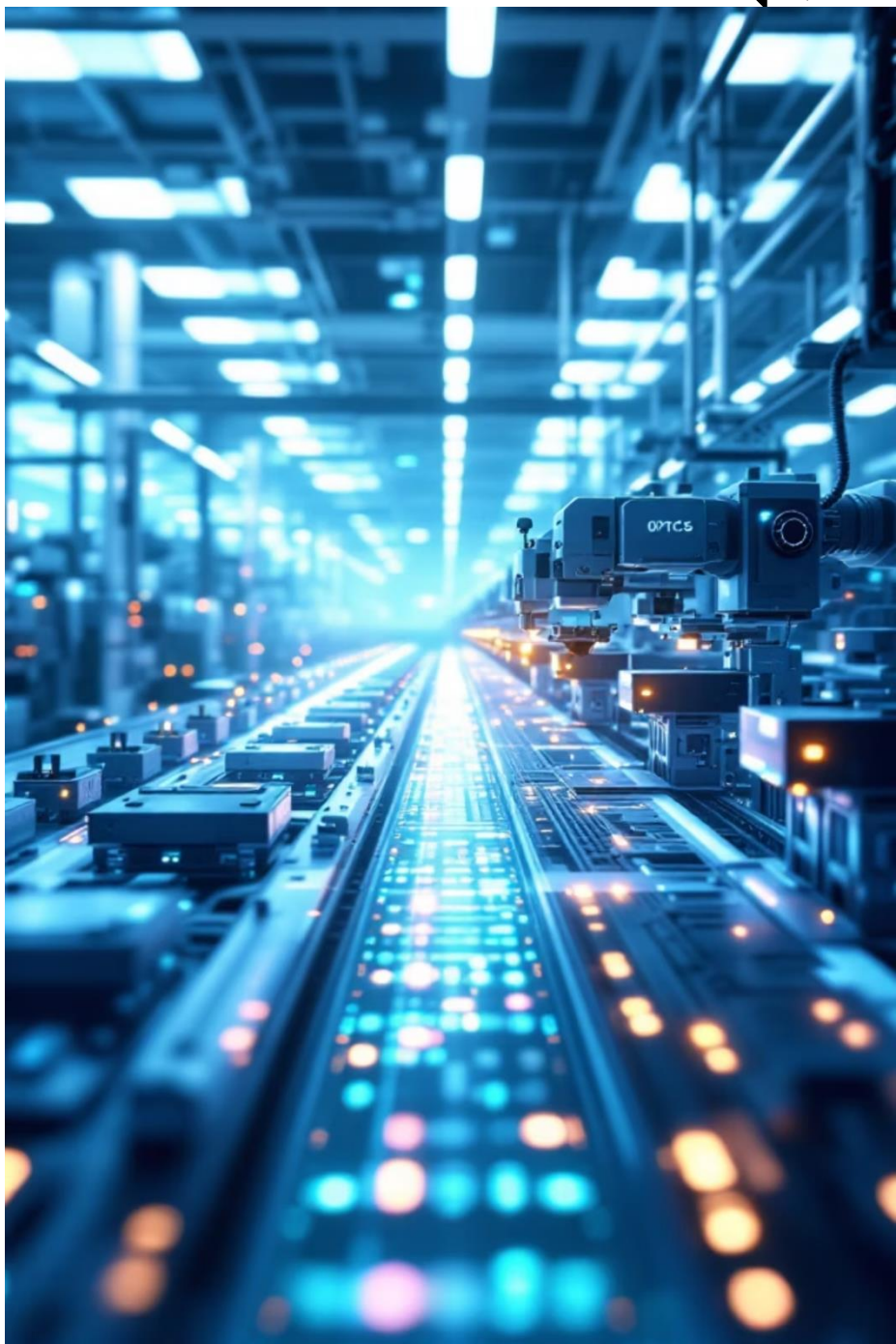
Pluggable Fiber Attach

Standardized “pluggable fiber-attach units” bring assembly-line speed to a traditionally manual, slow, error-prone process.

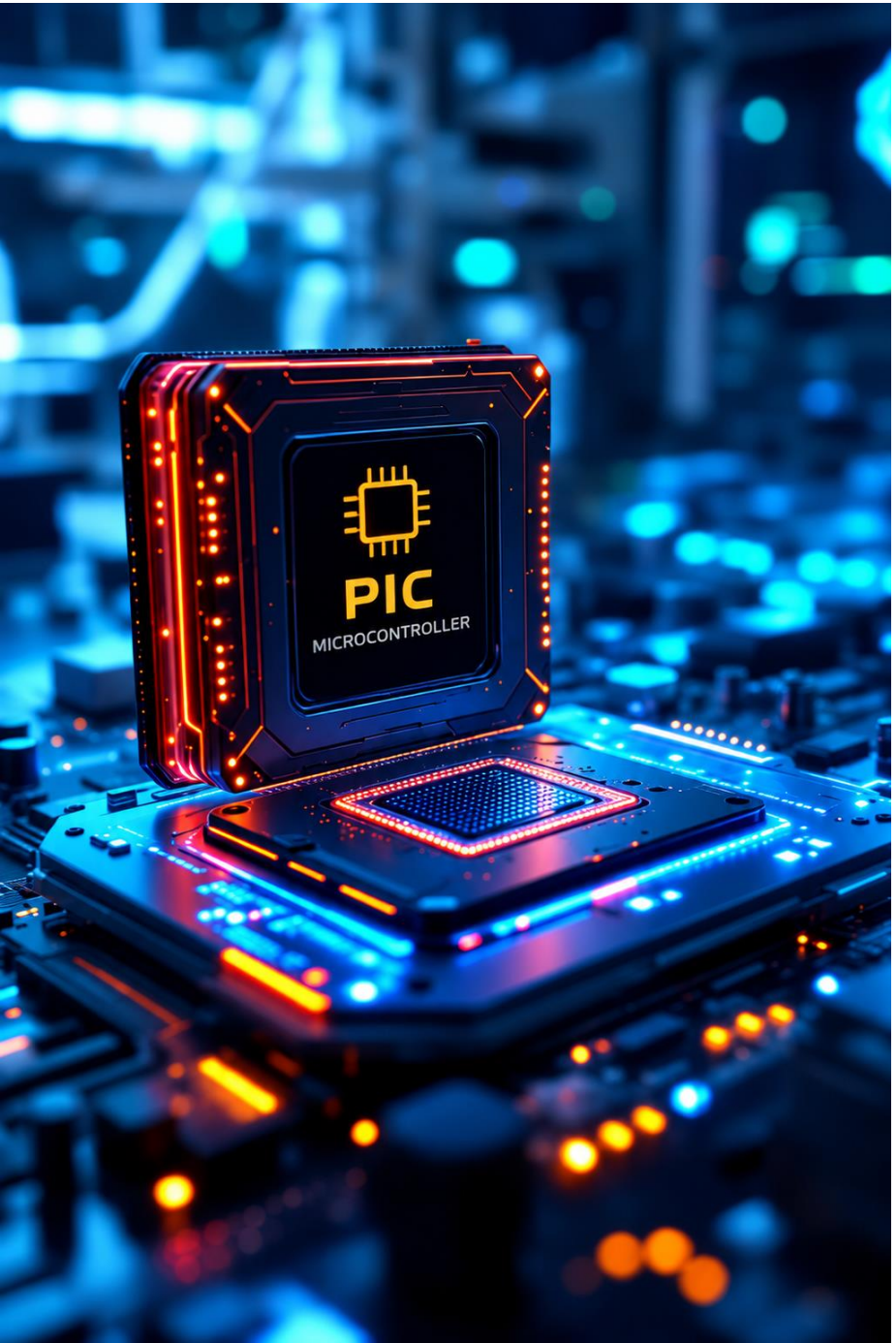
3

200 / 300 mm Scaling

Driving down cost-per-bit by migrating to 200mm and 300mm foundry-grade wafers — matching silicon's economies of scale.



From low volume to 200 / 300 mm foundry-grade mass production



STRATEGIC REALITY CHECK

REALITY CHECK

The transition from “physics experiment” to “commercial product” is complete. What remains is ecosystem orchestration.

The Complete Ecosystem

- **Design flow:** PDK-enabled circuit design
- **Wafer fabrication:** LNOI-specific foundry processes
- **Characterization:** automated testing & qualification
- **Packaging:** 3D integration and fiber attach
- **Server assembly:** final module integration

Built in-house and extended through foundry partners for volume.

The Current Race

Moving photonic integrated circuits closer to the GPU is the defining challenge.

As model sizes explode, the power-delivery wall becomes the primary constraint.

The company that solves photonic proximity wins.

The company that solves photonic proximity wins

THE PHOTONIC FUTURE IS NOW

CONCLUSION

LNOI is the platform.

No longer a material of the future — it is the platform to solve the energy wall today. The science is proven, the fabrication flows exist, and the ecosystem is forming.

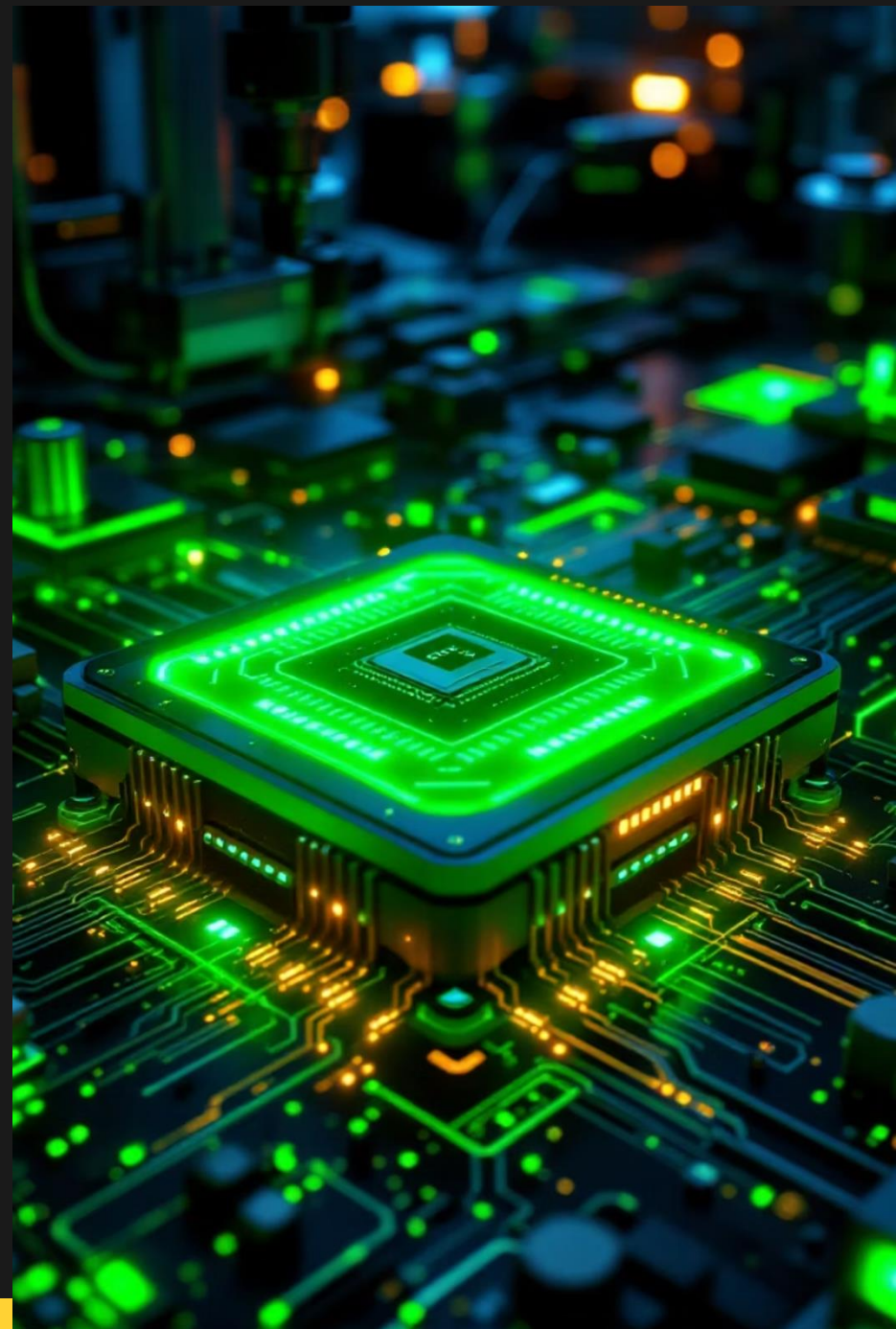
The Window is Closing

AI bandwidth demands will double again within months. Organizations that wait risk being locked out of photonic supply chains entirely.

Act Now

Adopt production-grade photonic platforms today to survive the AI bandwidth explosion and secure a competitive position in the photonic era.

LNOI is the platform to solve the energy wall today



Let’s Q.ANT it

Let’s do energy-efficient high-performance computing

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