Speaking at

Understanding the UK semiconductor ecosystem Part 2



Professor Chee Hing Tan

CHIMES^2 Research Lead

Centre for Heterogeneous Integrated MicroElectronic & Semiconductor Systems (CHIMES^2)

11 November 2026
9am to 11am (GMT)

Online

UKRI Innovate UK | Business Connect

Innovation and Knowledge Centre in Heterogeneous Integrated MicroElectronic & Semiconductor Systems (CHIMES^2)

Global Innovation Network on Semiconductors, Understanding the UK Semiconductor Ecosystem Webinar 2: 11th Nov 2026

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Co-Director (Research) CHIMES^2

CHIMES^2
Centre for Heterogeneous Integrated MicroElectronic and Semiconductor Systems

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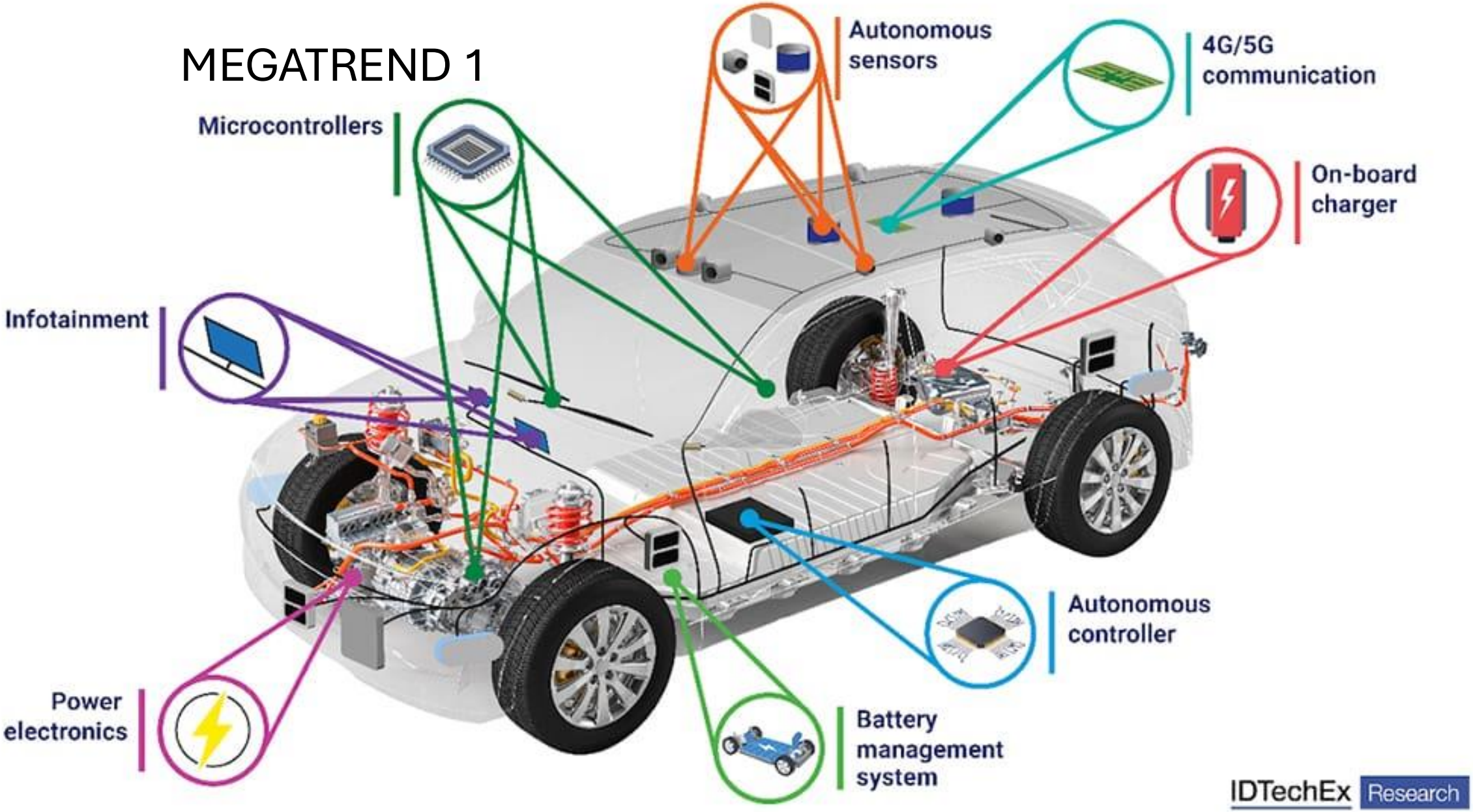
MEGATREND 1



IDTechEx Research

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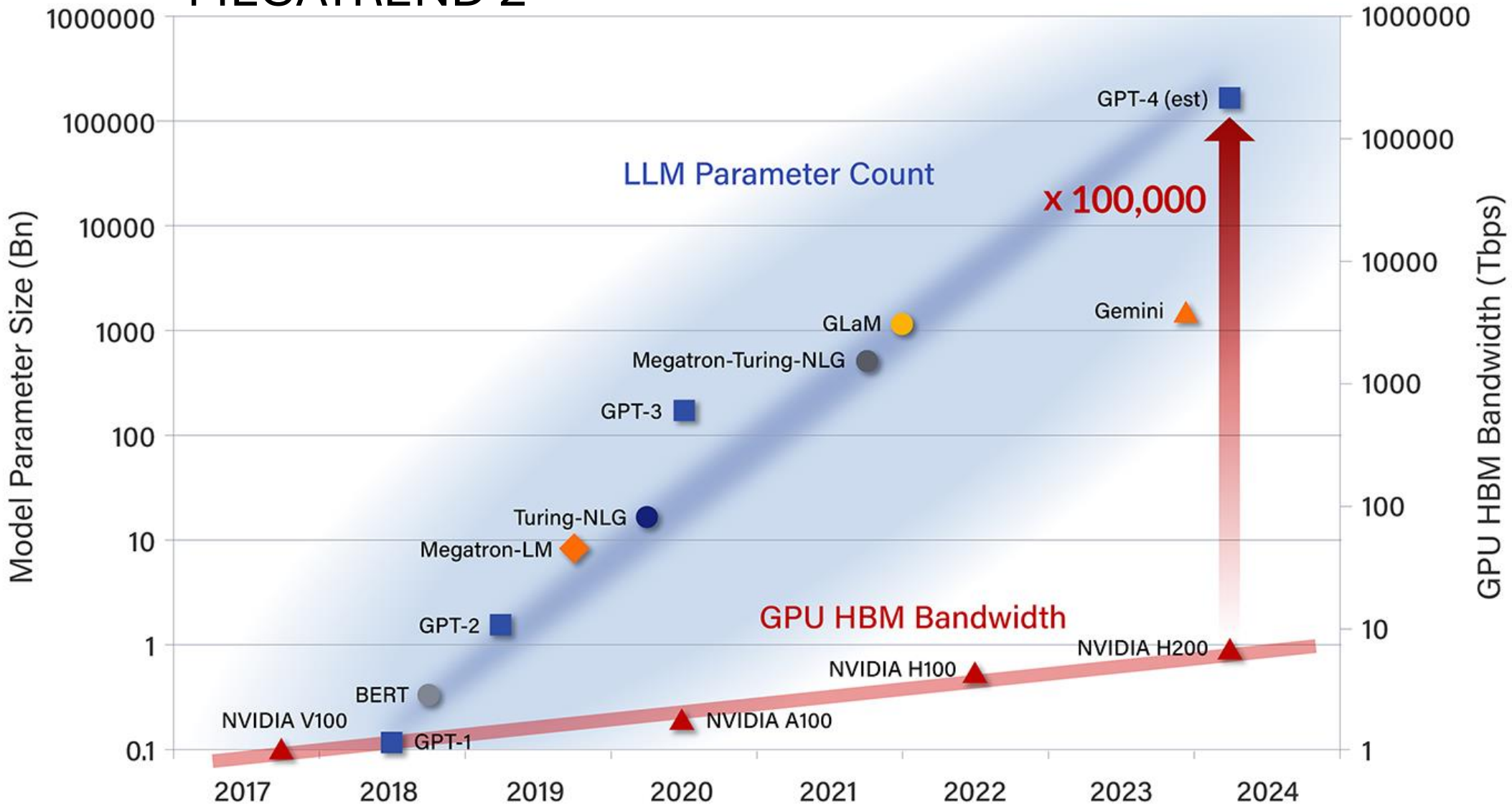
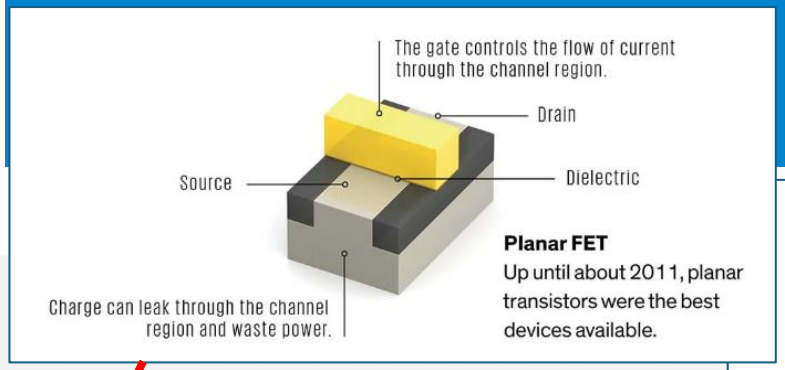
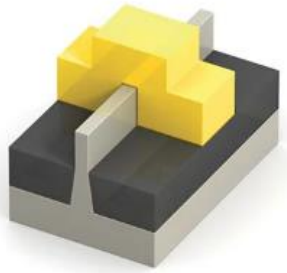
MEGATREND 2


Model Parameter Size (Bn)
GPU HBM Bandwidth (Tbps)
1000000
100000
10000
1000
100
10
1
0.1
2017
2018
2019
2020
2021
2022
2023
2024
LLM Parameter Count
x 100,000
GPU HBM Bandwidth
GPT-4 (est)
Gemini
GLaM
Megatron-Turing-NLG
GPT-3
Turing-NLG
Megatron-LM
GPT-2
BERT
GPT-1
NVIDIA V100
NVIDIA A100
NVIDIA H100
NVIDIA H200

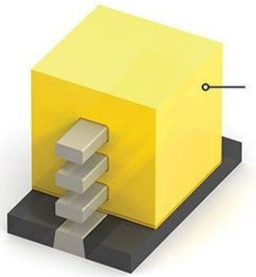
SEMICONDUCTOR TREND



Planar FET
Up until about 2011, planar transistors were the best devices available.



FinFET
Surrounding the channel region on three sides with the gate gives better control and prevents current leakage.

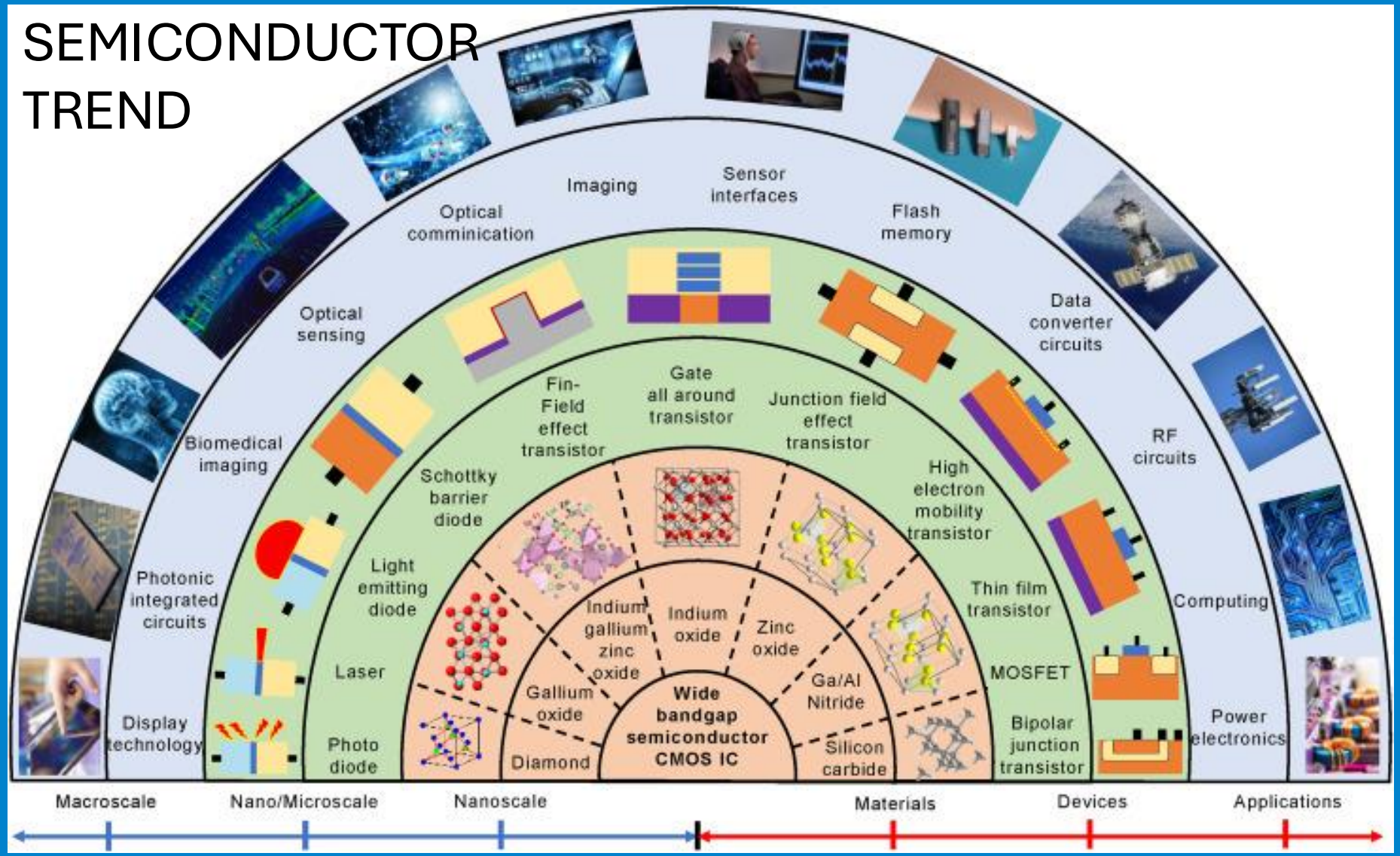


Atomic layer deposition builds the metal gate so that it completely surrounds the channel regions.

3µm 1.5µm 1.2µm 1.0µm 0.8µm 0.6µm 0.5µm 0.35µm 0.3µm 0.25µm 0.18µm 0.13µm 90nm 65nm 45nm 40nm 28nm 20nm 16/12nm 7nm 5nm 3nm 2nm A16 A14

1987 1988 1989 1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028

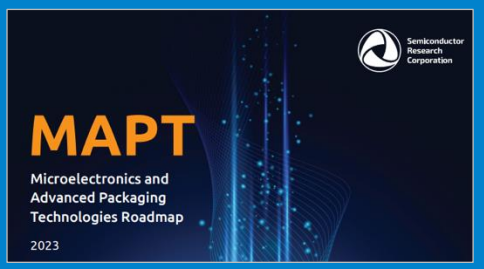
SEMICONDUCTOR TREND



SEMICONDUCTOR TREND

Silicon chips + Wide/Narrow Bandgap chips = Heterogeneous Integration

Roadmaps







Keeping Abreast of Opportunity is Hard……
Plus: optics in the package – co-packaged optics switches now shipping, up to 70% lower power than pluggables (TrendForce, Jul 2026) · AI-assisted multi-die design entering the flow

Source: J. Darlington, CHIMES[2] (TechWorks 2026); image credits as original · Roadmaps: SRC MAPT (2023); IEEE EPS Heterogeneous Integration Roadmap (2024 ed.); AENEAS/EPoSS/INSIDE ECS SRIA 2026

UK Semiconductor Interventions

Department for Science, Innovation & Technology

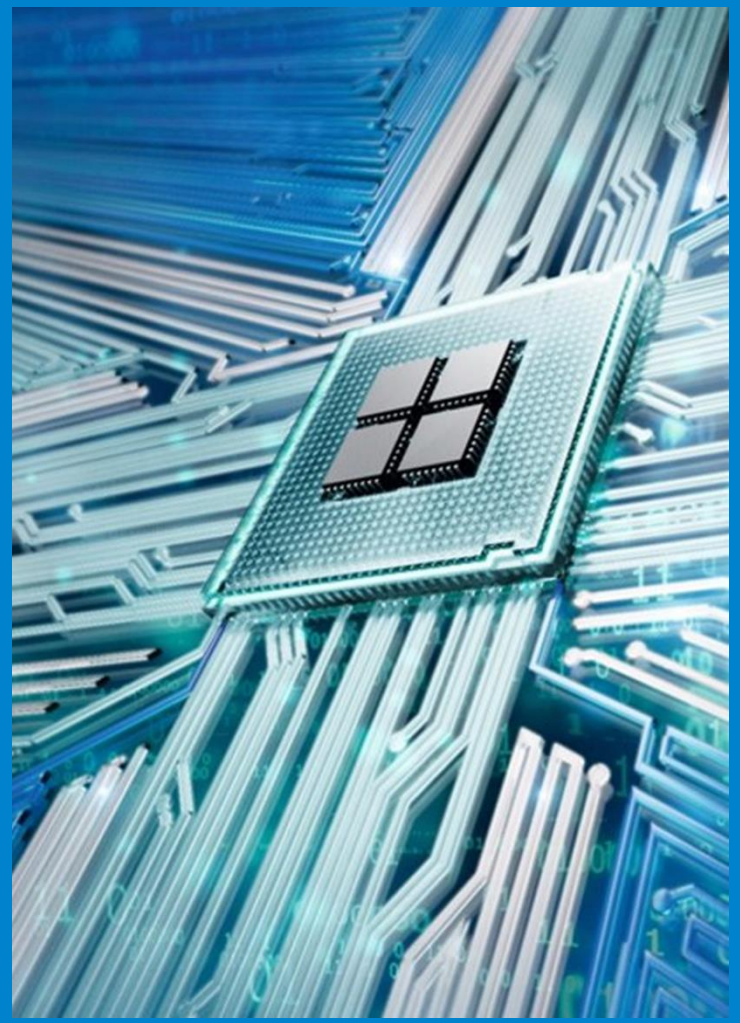
Build an ecosystem that can support companies through the lifecycle from research to start up to scale up – creating future champions and a strong talent base to attract investment

1. **Skills and talent**: STEP programme – Undergraduate bursaries, schools outreach programme, MSc conversation course and chip design course, delivered in partnership with UK ESF

2. **Innovation**: **Innovation and Knowledge Centre (IKCs)**; Digital Security by Design (CHERI), R&D investment through UK Research & Innovation (UKRI); New UK Semiconductor Centre

3. **Business support:** Access to finance (National Wealth Fund, British Business Bank, Innovate UK, startup incubation (ChipStart UK)

4. **International collaboration:** European Chips Joint Undertaking, R&D collaboration with US, Japan, Taiwan



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REWIRE

Next-generation Power Semiconductors

NeuroWare
THE UK INNOVATION & KNOWLEDGE CENTRE IN NEUROMORPHIC COMPUTING HARDWARE

Neuromorphic computing hardware

Innovation and Knowledge Centres

CORNERSTONE

Silicon Photonics

CHIMES²
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CSIT
CENTRE FOR SECURE INFORMATION TECHNOLOGIES
QUEEN'S UNIVERSITY BELFAST

Cybersecurity

CHIMES²

Our vision

To make the UK a global leader in designing advanced semiconductor systems using heterogeneous integration.

Why CHIMES²?

- Reduce development cost and complexity
- **Access shared design tools and expertise**
- Collaborate across the UK Semiconductor System
- Accelerate innovation from research to application

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CHIMES² Academic and Industrial Partners

11 universities + RAL





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CHIMES² : users

Integration pull from above, manufacturing push from below — CHIMES² is the bridge.

OUR CUSTOMERS →

End-users benefit from heterogeneous integration once integrators have used it

OUR FOCUS →

Bridging integration adoption with foundation manufacturing — the design knowledge layer

OUTSIDE CHIMES² →

Manufacturing pathway integration — CHIMES² targets but does not own

INTEGRATION ADOPTION

Integrators · system builders · end-user applications

CHIMES²

Integration architectures, methods, workflows, tools

Knowledge curation for the benefit of UK industry and academia

MANUFACTURING CAPABILITY

Foundation components · interposers · process modules

PULL

PUSH

Integration (GLUE)

Background IP arrives in three loose collections — chiplets, tools, process steps. CHIMES² integrates the first two; targets the third.

BAG OF CHIPLETS



ASSEMBLED INTEGRATION



CHIMES² OWNS

Reference designs and workflows. The integration sits inside CHIMES² Knowledge.

BAG OF TOOLS



INTEGRATED WORKFLOW



CHIMES² OWNS

Reference designs and workflows. The integration sits inside CHIMES² Knowledge.

BAG OF PROCESS STEPS



MANUFACTURING PATHWAY



CHIMES² TARGETS

Realised by a pathway integrator. CHIMES² targets but does not manufacture.

Given the chiplets — how are they integrated?

CHIMES² assumes chiplets exist. The integration question is what physical assembly strategy carries them — from a familiar FR4 board to advanced 3D stacking.

ASSEMBLY-BASED — chiplets brought together physically

1 FR4 PCB



FR4 board · packaged chips

Off-the-shelf packaged components on a printed circuit board. The baseline — cheap, well-understood, generous routing.

2 Bare-die Multi-Chip Module (MCM)



Bare dies · common substrate

Multiple bare dies on a common substrate, wire-bonded or flip-chip. Higher density than FR4 without going to interposer.

3 Novel interposer



Dies · interposer · substrate

Bare dies on a custom interposer (silicon, glass, organic) giving high-density routing between them. The chiplet sweet spot.

4 2.5D integration



Silicon interposer · TSVs

Dies side-by-side on a silicon interposer with through-silicon vias. High-bandwidth interconnect for HPC, GPUs, AI accelerators.

5 3D die stacking



Vertical stack · TSVs / hybrid bond

Dies vertically stacked, connected by TSVs or hybrid bonding. Extreme density: HBM, logic-on-logic, sensor stacks.

ALTERNATIVE

6 Monolithic



Single die · multiple functions

All functions on one die. Same logical integration; very different physical strategy. Different commitment on yield, modularity, time-to-market.

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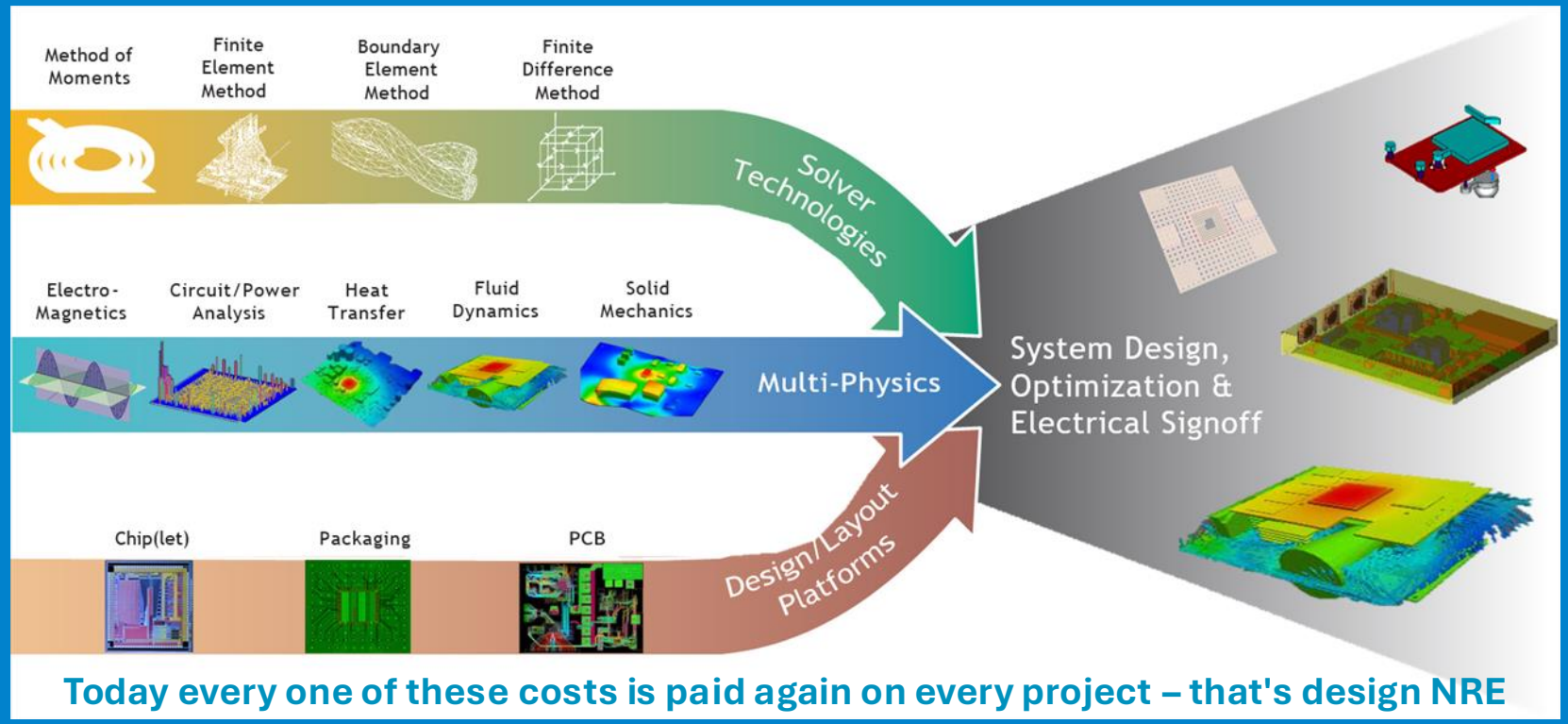
Design, Verification & Validation: to meet the need

Partitioning is a system decision · the physics interacts · V&V tools still converging

Remember there is a *lot* of software in product too!



Linking Design to integration and Assembly -> Dealing with known good die?

Source: Cadence © 2026 Cadence Design Systems, Inc. All Rights Reserved

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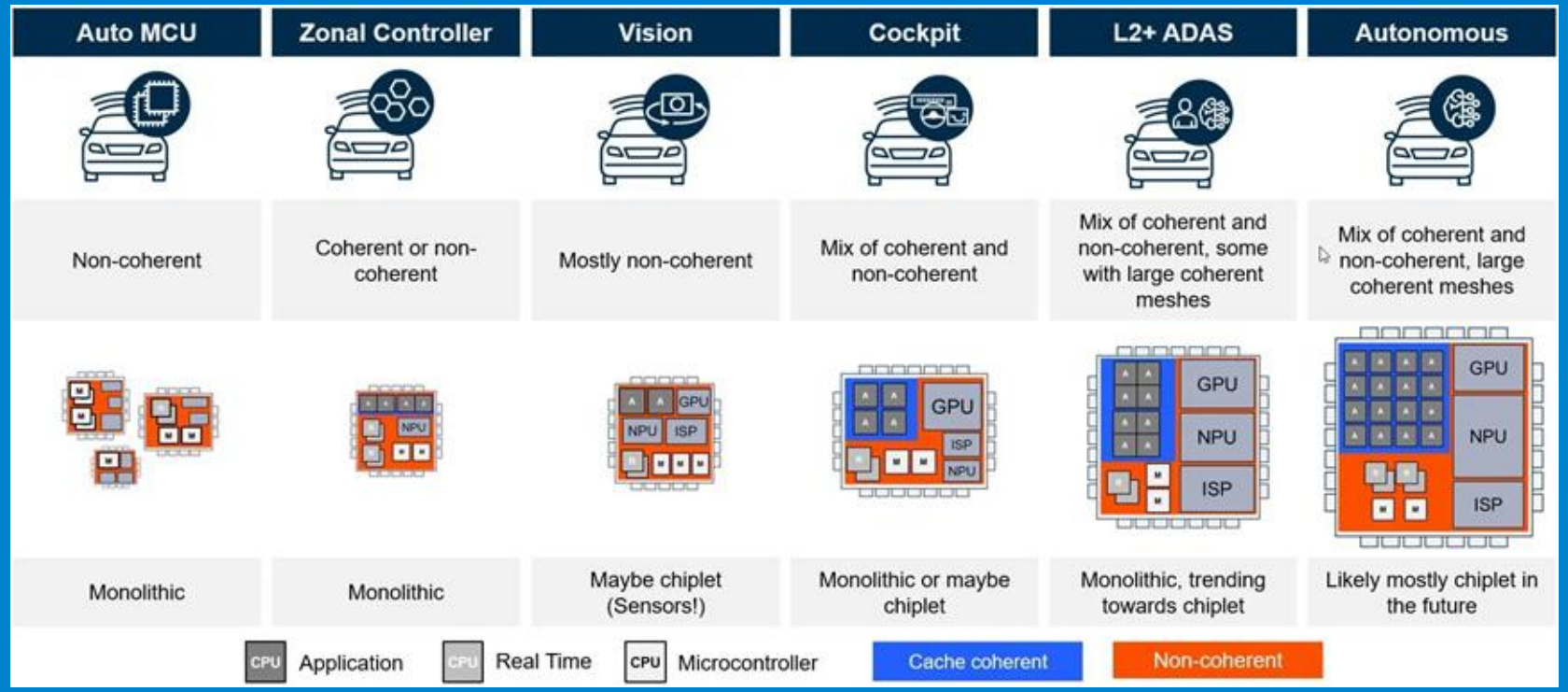
Evolution of chips in Automotive



- **Volkswagen** and **MobileEye** announced that they are intensifying their relationship for automated driving.
- **Arm** announced their latest Automotive Enhanced products with the theme "Enabling the AI Vehicle on Arm."
- We at **Arteris** announced that we expanded our "Automotive Solutions for Armv9 Architecture CPUs."
- The **Automotive Computing Conference** in Detroit saw several engaging keynotes, including Mercedes' FranÇois Piednoël on "Standardization for Automotive Computing Hardware," illustrating the concept of an "Autonomous Drive Unit" (ADU) as an approach away from the classic assembly of computing blocks to fully leveraging today's heterogeneous architectures.
- **IMEC** held a meeting of the **Automotive Chiplet Alliance**, focusing precisely on the aforementioned heterogeneous chiplet architectures.
- **GSA** and **McKinsey** held their 2024 Automotive Workshop on "Enabling technologies (incl. chiplets) for Central Computing in Next-Gen Automotive E/E Architectures."
- Automotive was a key theme for **Synopsys** at their user group **SNUG** in Silicon Valley.

https://semiengineering.com/automotive-semiconductor-march-madness-2024/

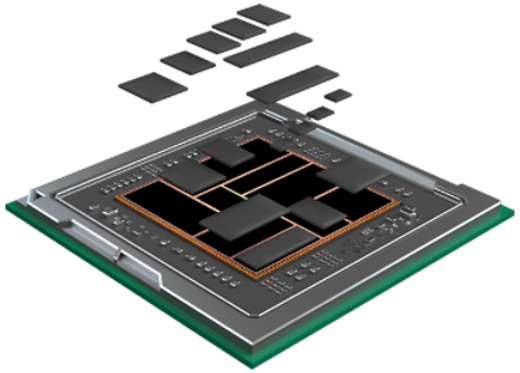
In the past:

IP is process independent
Complete the layout and fabricate
What do we do about packaging?

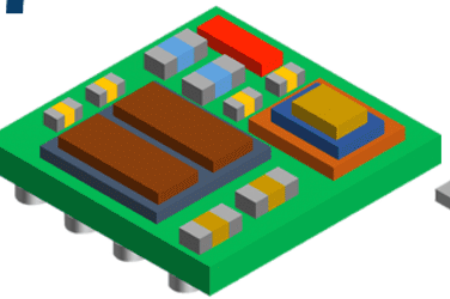
Now:

Chiplets integration in HI is no longer process independent
Co-design from the start, new design approaches
New integration methods
New modelling for linking different designs
New inspection and test method

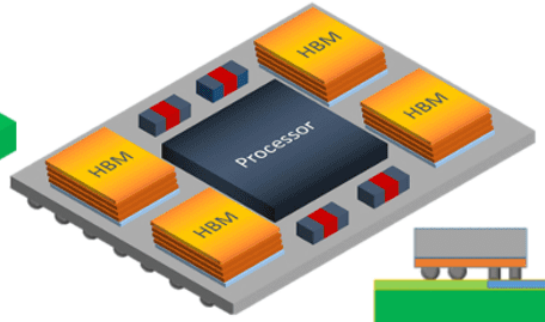
Challenges in Heterogenous Integration



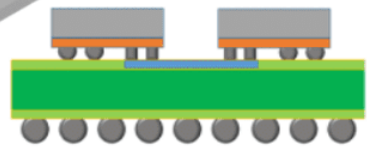
Heterogeneous Integration



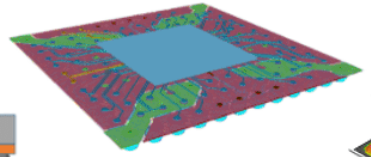
System in Package (SiP/MCM)



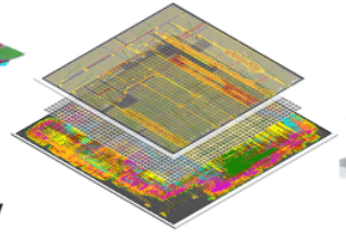
2.5D-IC (Silicon/RDL Interposer)



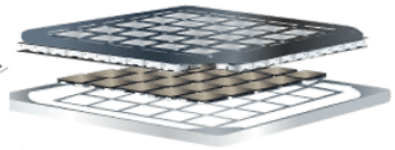
Interconnect Bridges



Ultra-High-Density RDL (FOWLP)



Silicon Stacking



3D System-on-a-Wafer



Co-Packaged Optics

1990 2010 2012 2015 2018 2020 2022

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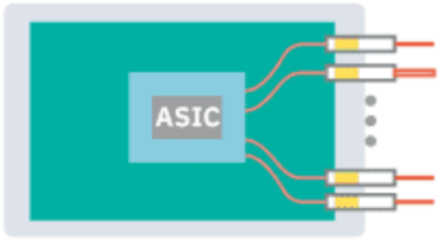
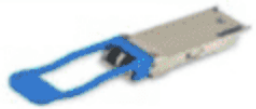
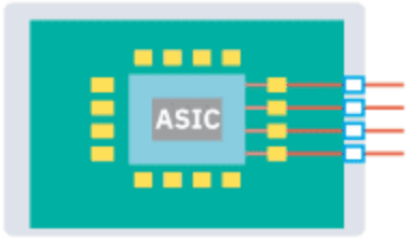
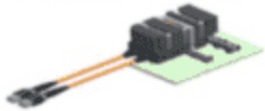
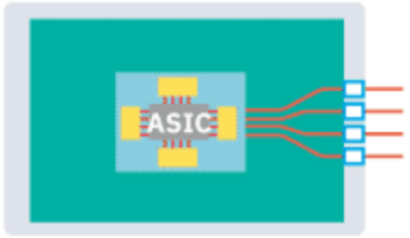
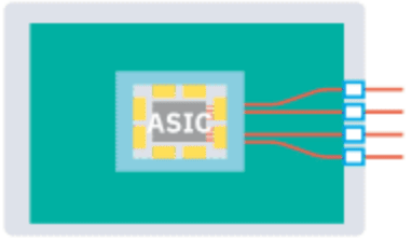
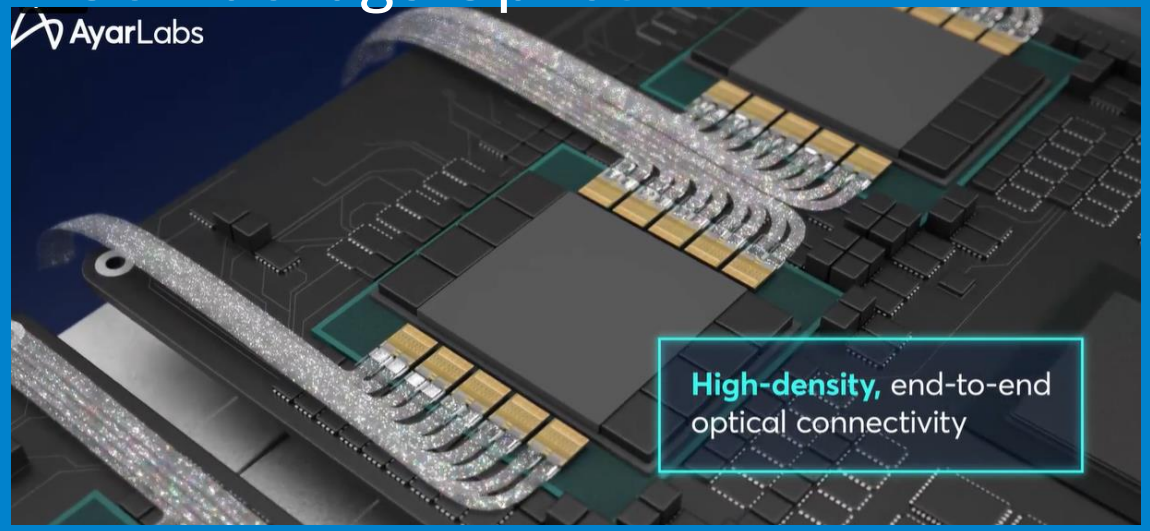
Challenges in Heterogenous Integration

Top View	Side View	Package	Engine Data Speed
	**Pluggable Transceiver Optics** 	QSFP 	**QSFP (Quad Small Form-factor Pluggable)** 100/400/800G
	**On-Board Optics** 	BGA/LGA OE 	**OE (Optical Engine)** 800G/1.6T
	**co-Packaging Optics** 	Advanced Packages	3.2/6.4/12.8T
	**Optical I/O** 	Advanced Packages	6.4/12.8T & beyond

Higher bandwidth / Lower power

https://semiengineering.com/transforming-test-for-co-packaged-optics/

Co-Package Optics



AyarLabs TeraPHY: 8Tbps bandwidth, 16 wavelengths
https://ayarlabs.com/

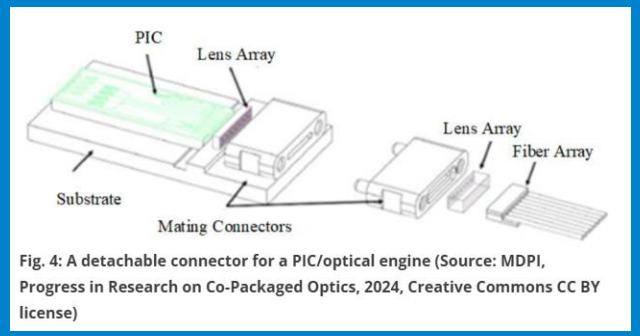
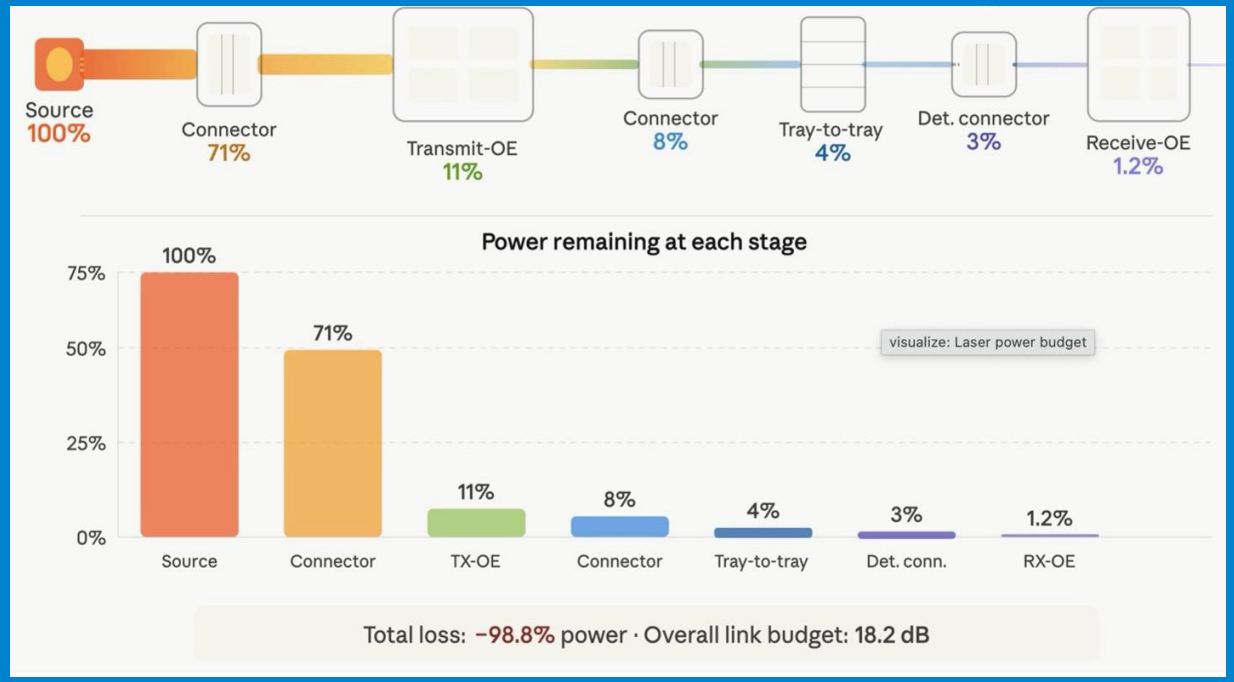
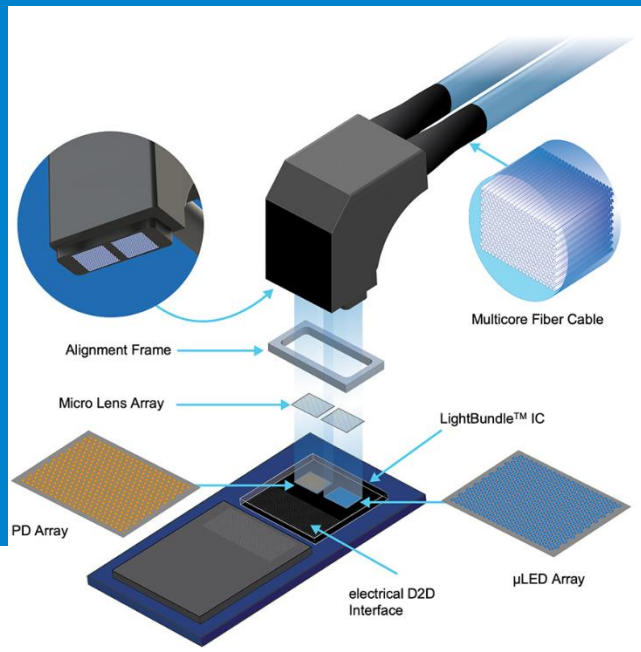


Fig. 4: A detachable connector for a PIC/optical engine (Source: MDPI, Progress in Research on Co-Packaged Optics, 2024, Creative Commons CC BY license)



https://semiengineering.com/cpo-will-dominate-scale-up-link-budgets-for-db-and-are-key/

Avicena LightBundle: using array of LEDs and photodiodes to eliminate power intensive SerDes
https://avicena.tech/avicena-technologies/



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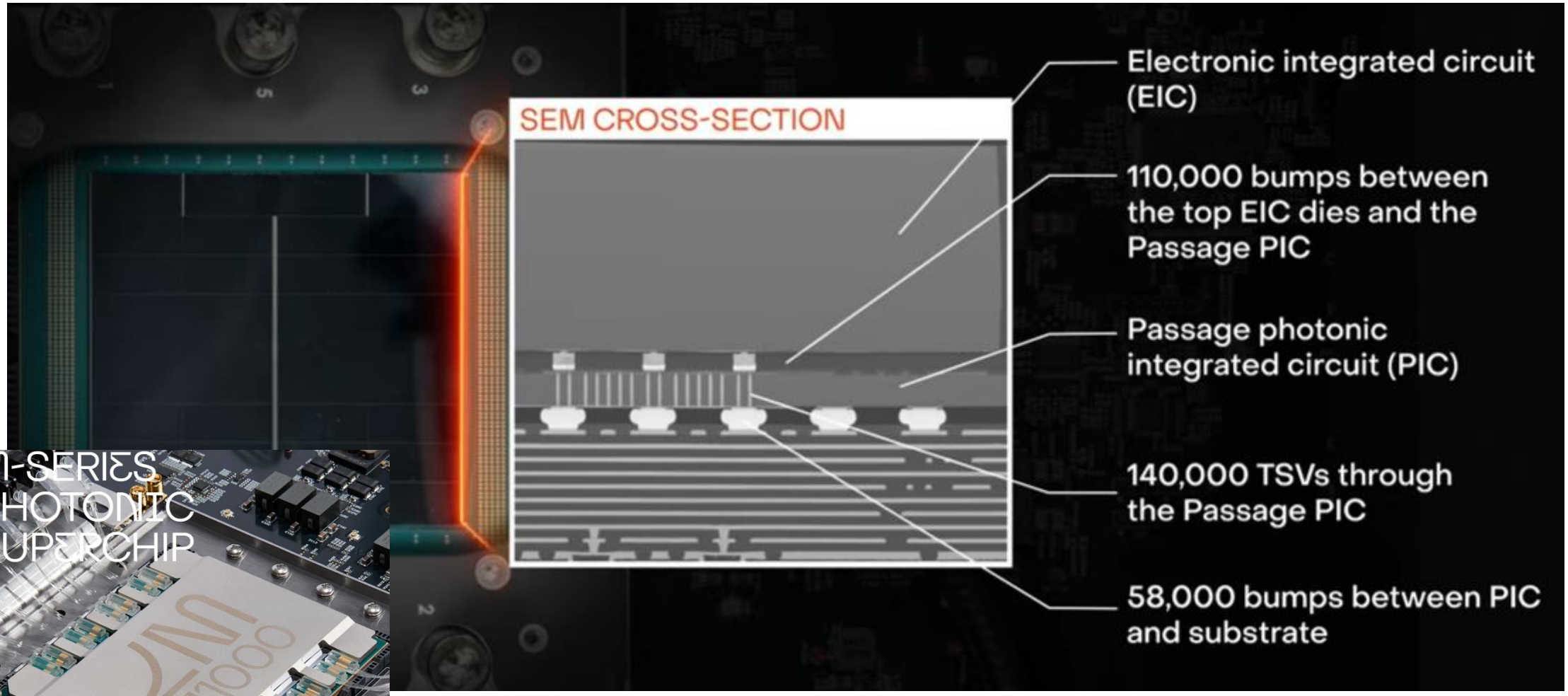

LightMatter Passage M1000: 256 fibers, supporting a total I/O bandwidth of 114 Tb/s
8 wavelengths per fiber, 3D photonic chip-on-wafer

https://lightmatter.co/products/m1000/

Knowledge to help innovators integrate effectively

CHIMES² serves three kinds of component innovator plus the integrator who pulls them together — targeting a manufacturing pathway that may itself embody a novel step.

DESIGN-IP INNOVATOR

Components

Brings novel devices, circuits, or larger IP blocks that need to be demonstrated in an integration.

TOOL INNOVATOR

Design tools

Brings novel design tools or tool components that need to be exercised in a real workflow.

MANUFACTURING INNOVATOR

Process modules

Brings novel manufacturing steps that need to slot into a wider pathway and prove themselves at integration.

CHIMES²

INTEGRATOR

Pulls components into a working integration on a target manufacturing pathway

Manufacturing pathway = the abstract route (fab → assembly → packaging).

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Thank you

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Speaking at

Understanding the UK semiconductor ecosystem Part 2



Antony Murphy

Head of Photonics

Advanced Manufacturing Innovation Centre (AMIC)

11 November 2026
9am to 11am (GMT)

Online

UKRI Innovate UK | Business Connect

Northern Ireland Photonics: Building an Ecosystem for Scale



Dr Antony Murphy
Head of Photonics
AMIC



Sharon Cousins
Photonics Sector Lead
Invest NI

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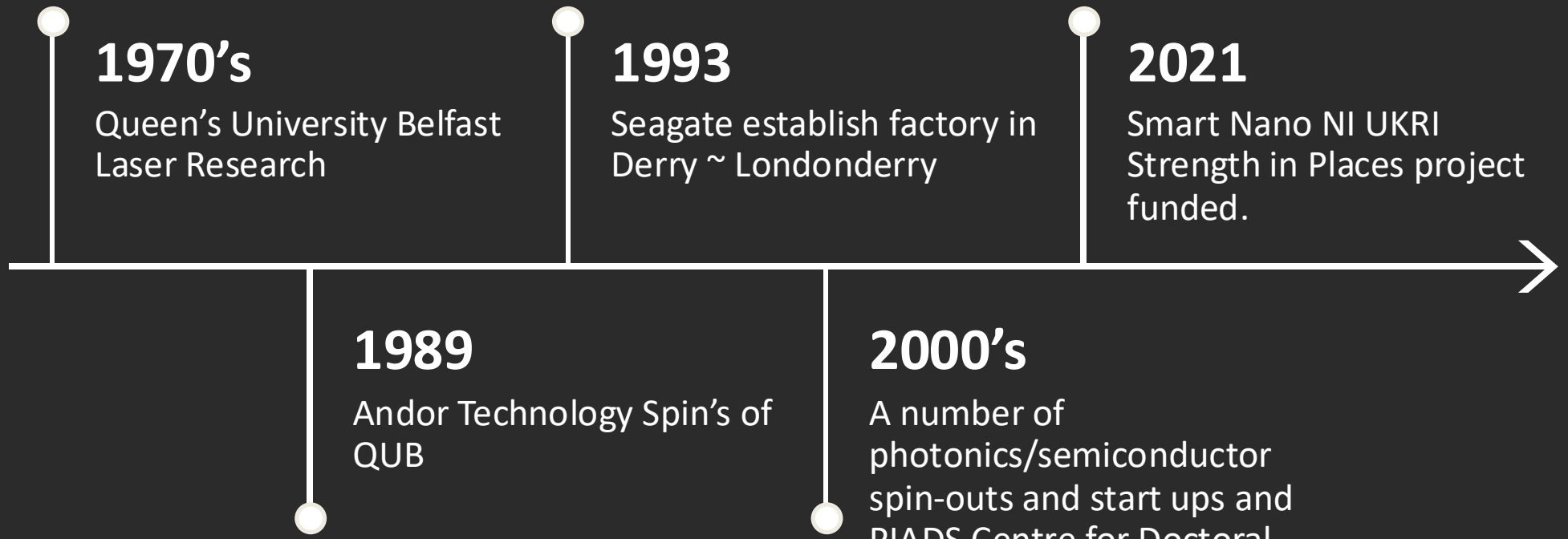
ADVANCED MANUFACTURING INNOVATION CENTRE

Invest Northern Ireland

50 Years of Photonics in NI

How Decades of Innovation Created Today's Opportunity



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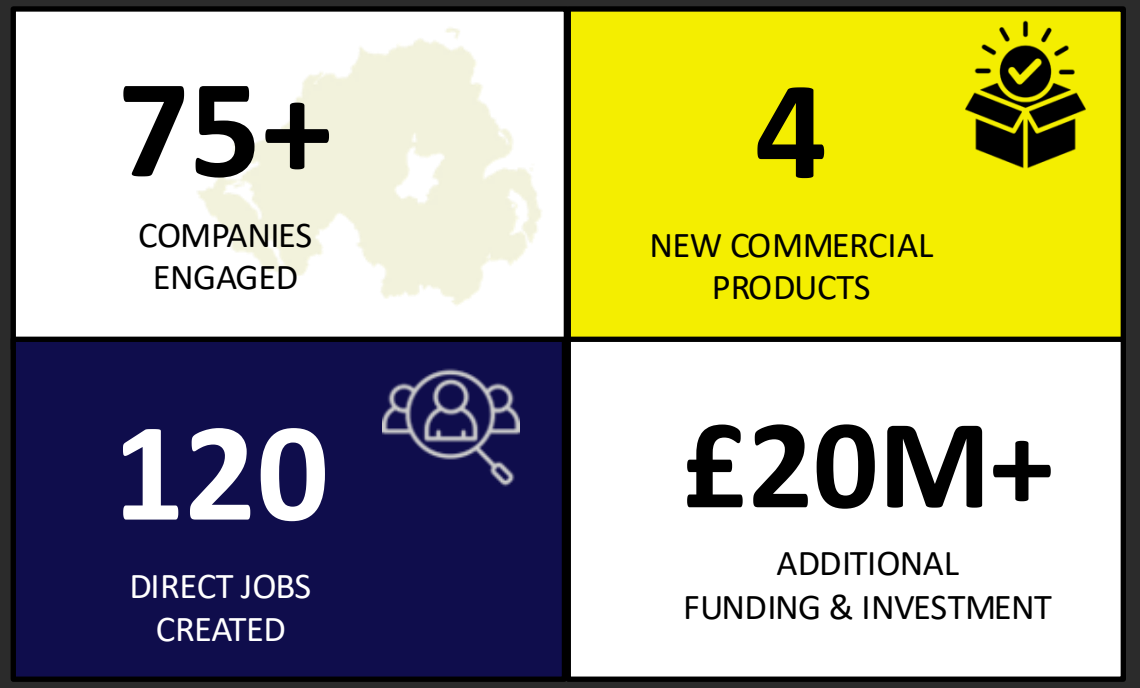
ADVANCED MANUFACTURING INNOVATION CENTRE

Invest Northern Ireland

Smart Nano NI

Creating the Foundations and the Catalyst for a Connected Photonics Ecosystem

- £63.9M programme including £42.4M UKRI Strength in Places funding.
- Led by Seagate Technology and launched in 2021 as a major regional innovation initiative.
- Consortium spanning industry, academia and skills providers across Belfast and Derry~Londonderry.
- Developed advanced capabilities in nanotechnology, integrated photonics and smart manufacturing.
- Accelerated the development of new technologies for healthcare, communications and data storage markets.
- Focused on advanced prototyping, manufacturing scale-up and industry-academic collaboration.



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ADVANCED MANUFACTURING INNOVATION CENTRE

Smart Nano NI
A Strength in Places Fund project

Invest Northern Ireland

Northern Ireland Photonics Innovation Cluster

Connecting Capability, Collaboration and Growth

- Established in October 2025 through Invest NI's Cluster Acceleration Programme and managed by Rachel Doherty.
- Bringing together companies, universities, government and innovation organisations across the photonics value chain.
- 60+ members including 34 SMEs, creating Northern Ireland's first dedicated photonics cluster.
- Delivered 14 cluster meetings, 4 industry workshops and participation in major events including Photonics West and Photonics Means
- Supporting new business opportunities with 6 member collaborations/supply chain projects and 3 collaborative R&D projects secured to date.



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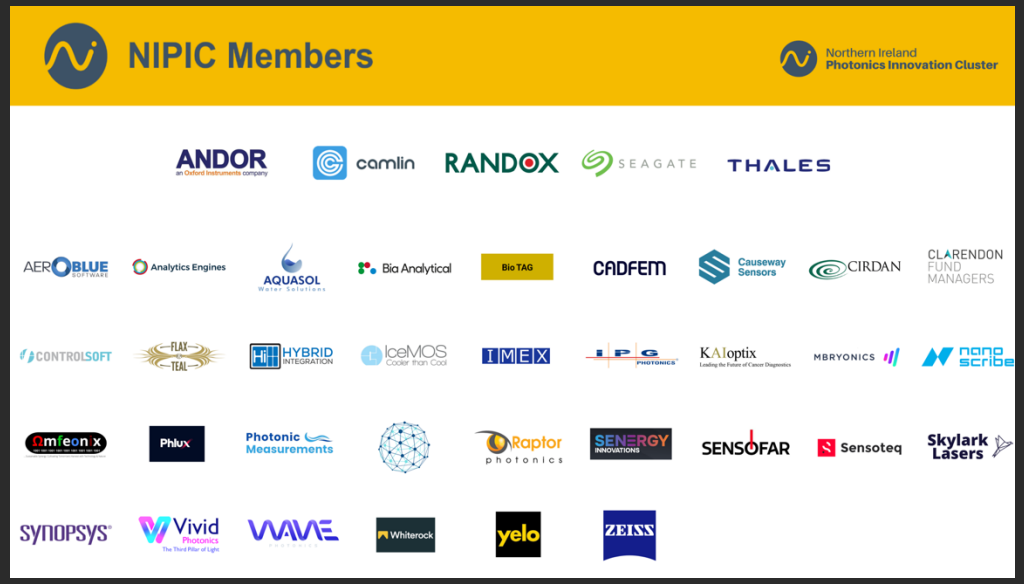
ADVANCED MANUFACTURING INNOVATION CENTRE

Northern Ireland Photonics Innovation Cluster

Invest Northern Ireland

Northern Ireland Photonics Innovation Cluster

Connecting Capability, Collaboration and Growth





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Northern Ireland **Photonics Innovation Cluster**

Invest Northern Ireland

NI's Growing Innovation Ecosystem

Coordinated investment in Research, Skills, Infrastructure and Innovation

PeacePlus

- SPEAR

Cross-border initiative accelerating photonics and semiconductor innovation through research collaboration, skills development and industry engagement (UU, ATU and Tyndall).

- NWCAM2

Advancing digital manufacturing and engineering innovation through applied research, SME support and workforce development across the North West region (UU).

City Deals

- AMIC

Providing open-access innovation infrastructure for advanced manufacturing and photonics scale-up.

- iReach Health

Driving innovation in connected health, diagnostics and digital healthcare technologies.

- Momentum One Zero

Creating a regional testbed for digital technologies, connectivity and data-driven innovation.

- Centre for Digital Healthcare

Accelerating digital health innovation through industry, clinical and academic collaboration

QUEEN'S UNIVERSITY BELFAST

ADVANCED MANUFACTURING INNOVATION CENTRE

Invest Northern Ireland

AMIC

Northern Ireland's new Advanced Manufacturing RTO

- £100M investment through the Belfast Region City Deal to accelerate innovation and industrial transformation.
- Our new home is the Factory of the Future which officially opened in October 2026.
- Four capability pillars:
    - Digital Factory
    - Sustainable Polymers & Composites
    - Smart Design
    - Photonics
- Open-access innovation centre supporting companies from concept through to industrial deployment.
- Focus sectors include advanced manufacturing, aerospace, defence, life & health sciences, digital technologies and semiconductors.



QUEEN'S UNIVERSITY BELFAST

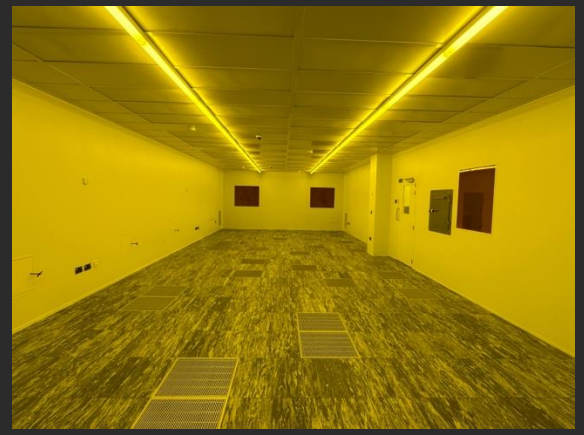
ADVANCED MANUFACTURING INNOVATION CENTRE

Invest Northern Ireland

AMIC Photonics

Enabling the Next Generation of Semiconductor and Photonic Technologies

- Significant investment in open-access cleanroom infrastructure (600m^2) and specialist photonics equipment (£10M+).
- Capabilities focusing on **semiconductor wafer processing**, **device fabrication** and **advanced characterisation**.
- Research and innovation programmes focused on metamaterials, advanced functional surfaces and biophotonics.
- Developing expertise in photonic device design, packaging and integration.
- Supporting translation from academic research through to prototype and pilot-scale manufacturing.
- Collaborating with industry to accelerate commercialisation of photonics-enabled technologies.





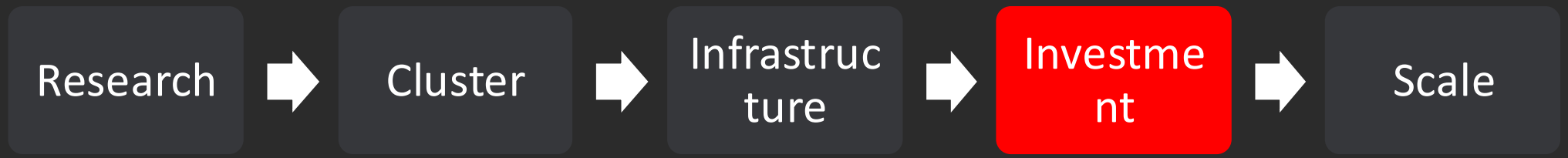
QUEEN'S UNIVERSITY BELFAST

ADVANCED MANUFACTURING INNOVATION CENTRE

Invest Northern Ireland

Building the Ecosystem for Scale

Accelerating the Next Phase of Growth



- There are several unique funding opportunities for Photonics companies looking to set up in Northern Ireland.
- Sharon, the Sector Lead for Photonics in Invest Northern Ireland is the best point of contact for understanding the funding and investment landscape.

Speaking at

Understanding the UK semiconductor ecosystem Part 2



Sharon Cousins

Client Manager & Photonics Sector Lead

Invest Northern Ireland

11 November 2026
9am to 11am (GMT)

Online

UKRI Innovate UK | Business Connect

Invest Northern Ireland

Delivering a regionally balanced, productive, sustainable, and prosperous economy.



Invest NI Overview

Our Vision

Invest NI is recognised as NI's leading economic development agency, instrumental in driving a balanced, sustainable, productive, and prosperous Northern Ireland economy through unlocking the potential of businesses across the region.

Our Mission

To work with businesses to accelerate their growth by increasing external sales and innovation, creating good quality jobs, boosting productivity and skills, growing inward investment and reducing carbon emissions.



Our Support

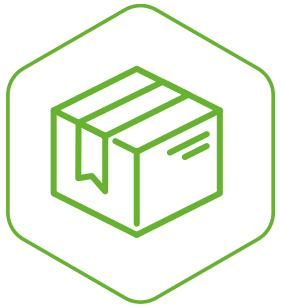
- We support businesses at every stage, from local entrepreneurs and small start-ups to large companies and international investors.
- Our support is tailored to business needs and includes advice, mentoring and finance.



Entrepreneurship and Start-up support



Innovation and R&D funding



Export development and market expansion



Leadership and training

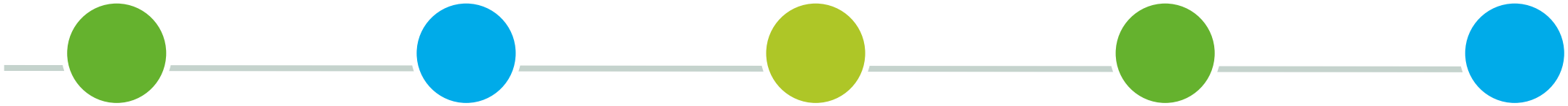


Green economy solutions

Support for every stage of the growth journey

- Supporting indigenous businesses to grow and compete internationally
- Connecting businesses with research expertise and innovation support
- Attracting international investment into Northern Ireland

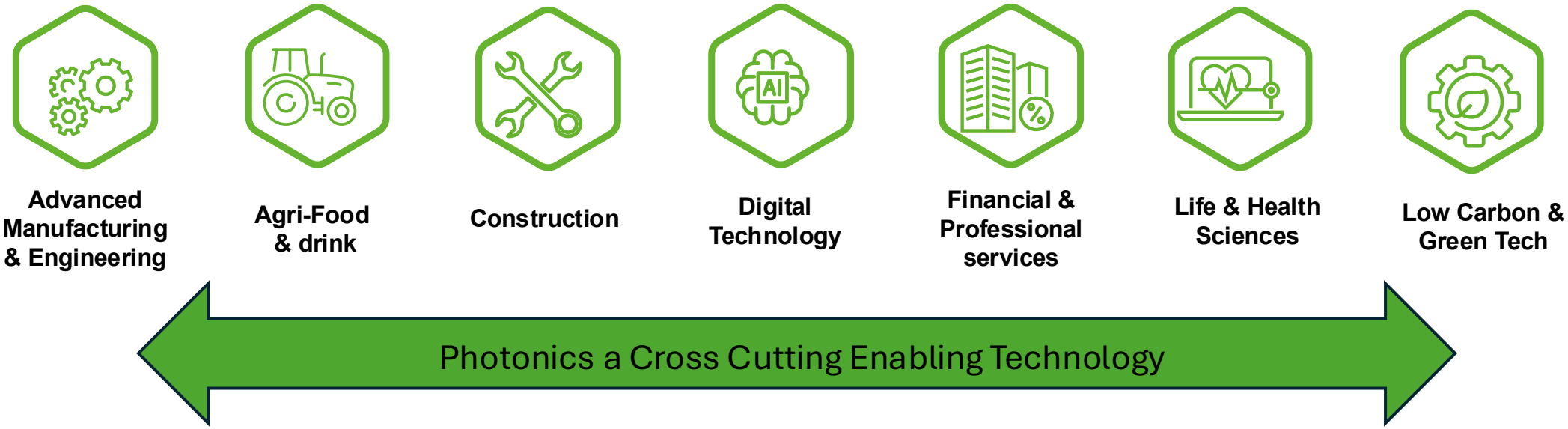
Start with the business need, then identify the most relevant support route.



Build the team	Invest in capability	Solve technical challenges	Innovate and develop	Build skills and export
SFA Employment · GAP	SFA Capital · MIS	TAU · TDI	Innovation Voucher · R&D	SAG · Skills for Growth · TAG

The right route depends on company size, project additionality, commercial impact and appraisal.

Our support helps drive sustainable growth and creates quality jobs and economic activity in every corner of our economy.



NI Photonics and Laser Capability Matrix Report October 2025.

- Northern Ireland already has significant assets
- Globally competitive industry anchors and SMEs
- Strong Academic Base
- Key Sector Alignment – Data Storage, Defence, Space, BioPhotonics, Energy, Imaging & Sensing

Northern Ireland Photonics – Reasons to Invest

Reason to invest	Details
Location	Northern Ireland is the only part of the UK which shares a land border with an EU Country and has good connectivity.
Talented People	Strong academic results with government, business and academia working together to build skills that global companies need to succeed
Competitive Operating Costs	Northern Ireland is one of the most cost-effective regions in the UK
Unique GB & EU Market Access	This Dual Market Access puts Northern Ireland in the highly advantageous position of being the only region in the world able to trade goods freely with both GB and EU markets.
Supportive, Connected Business Environment	Invest NI is the region's economic development agency supporting companies to establish and expand successful operations in Northern Ireland.
Track Record	More than 1500 international companies have established operations in NI. Over 60% of new investors have re-invested in NI.
Innovation	Northern Ireland has a rich heritage of manufacturing excellence, entrepreneurial spirit, and innovation
A UK base to design, integrate and scale photonics	Northern Ireland has established strengths in photonics, including lasers, photonic integrated circuits, sensing and advanced manufacturing with strategic assets and continued government focus.

Northern Ireland has a rich legacy of manufacturing excellence and entrepreneurial spirit, and it is this, combined with a skilled workforce, culture of innovation, strong local supply chain, and strategic access to global markets that makes it a compelling opportunity for forward-thinking investors.

Northern Ireland Photonics - Punching above its weight

NI's photonics productivity is around 43% higher than the UK photonics benchmark

Metric	Northern Ireland	UK Benchmark	What it tells us
Photonics	2990 jobs	84,800 jobs	NI represents c3.5% of UK Photonics Employment
Annual Output	c£600m	£18.5bn	NI represents c3.2% of UK Photonics Output
GVA per employee	£144,560	£101,000+	NI is around 43% higher than the UK photonics benchmark

Small cluster. High value. Global potential.

What is the NI Enhanced Investment Zone (EIZ)?

£150m
UK Government funding

10 years
2025/26 to 2034/35

£90m / £60m
Capital / resource

NI-wide
Productivity focus

- Focused on productivity growth in Advanced Manufacturing, with particular emphasis on photonics and biotechnology
- Private sector co-investment key deliverable
- DfE is the accountable department
- Invest NI leads significant areas of delivery with industry, education and research partners
- Not restricted to specific locations

Ambition: What is the EIZ aiming to achieve?

1. Higher productivity
2. More private investment
3. Innovation & technology adoption
4. Stronger advanced manufacturing
5. Competitive photonics & biotech clusters
6. Skills aligned to industry need
7. Good-quality employment
8. Long-term NI economic impact