

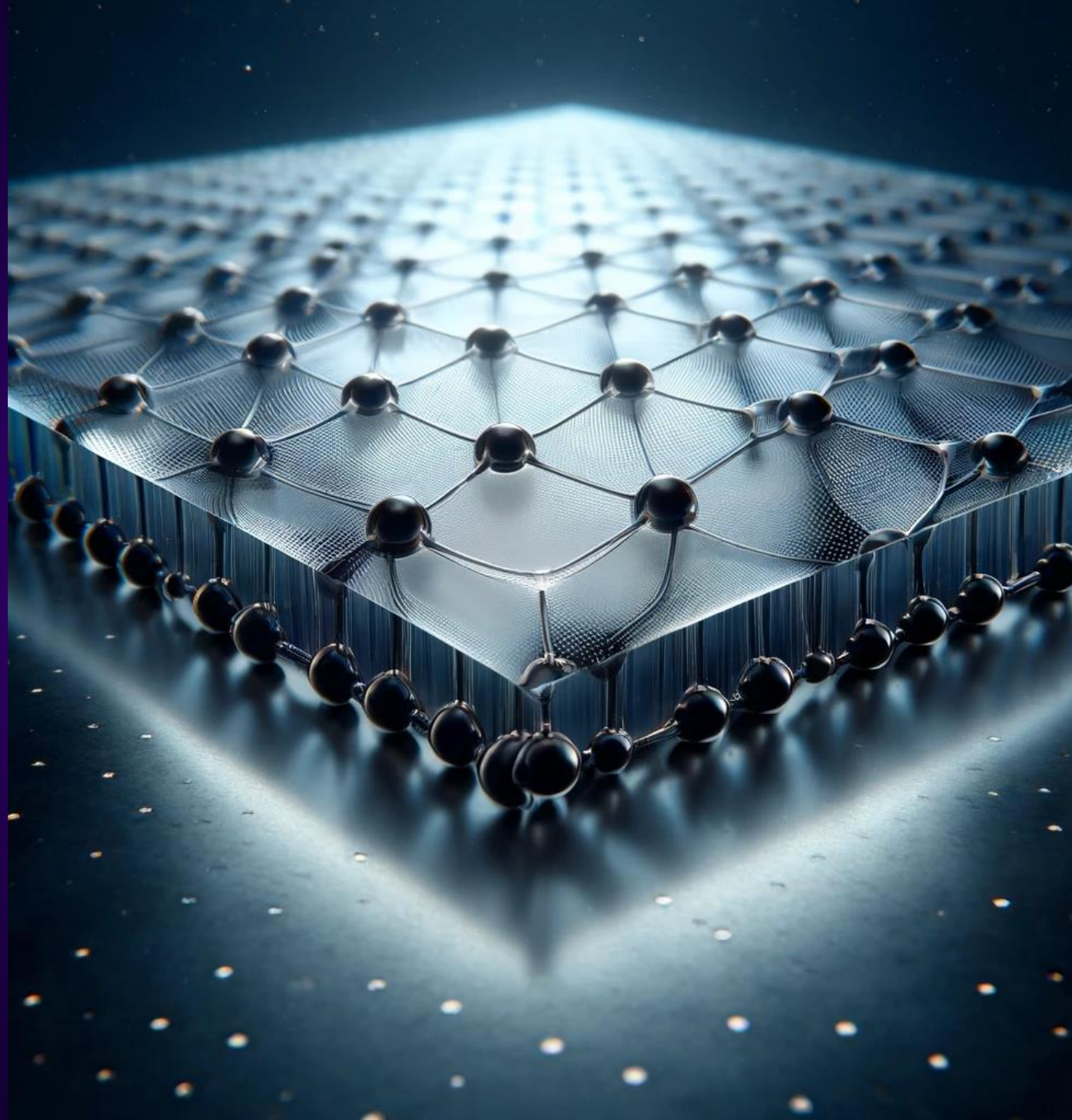


2D Generation



# Transformational Semiconductor Solutions for Generative AI, Data Centres, Cybersecurity And Beyond

Presentation – October 2024





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# Compelling AI and Semiconductor Thematic



**Transformational AI and Semiconductor Opportunities**

Proposed Acquisition of leading semiconductor IP business – 2D Generation



**Surge in Defence and Cyber Security Activities**

Expansive growth in the defence and cyber security sectors has generated significant opportunities



**Reliance on Data Centres to Enable High Performance Computing**

Amplified by generative AI, driving demand for specialised semiconductor products and technological services



**Leveraging Demand for Our Services**

Our expertise in cyber threat protection, regulatory compliance, and IT security management is more relevant than ever



**Sustained Revenue Growth**

Continuously enhancing products to meet demand in high-growth sectors, fostering long-term client reliance in our data security ecosystem



Enabling the next generation of high-performance, energy-efficient solutions for AI and data centres.



2D Generation

2D Generation is partner in the EU's ConnectingChips consortium with research partners including NVIDIA, IMEC, Valeo, Applied Materials, NXP, and Unity



Chipsjü



nvidia

imec

Valeo

AT&S



# Rapid Industry Expansion

Dedicated to taking advantage of the **explosive growth of AI and semiconductors** by applying AI's learnings in data centres, AI and cybersecurity:

- Advances are at breakneck speeds and investment is skyrocketing. The AI market will total USD 15.7 trillion by 2030 with an annual compound growth rate of 26.4% from 2020 to 2027. <sup>1</sup>
- In 2023, the annual global spend on data centers surpassed US\$200 billion<sup>2</sup> with 2 new data centres being built every day.
- Demand for solutions powering AI is soaring.
- Compromising energy supply globally.

1. <https://www.pwc.com/gx/en/issues/artificial-intelligence/publications/artificial-intelligence-study.html>  
 2. <https://www.gartner.com/en/newsroom/press-releases/2024-07-16-gartner-forecasts-worldwide-it-spending-to-grow-7-point-5-percent-in-2024>



## Why data centres are a bottleneck for the AI boom

By Peter Thal Larsen

October 15, 2024 5:33 PM GMT+11 · Updated 4 days ago



## The Sydney Morning Herald

### The \$5 trillion monster: Nvidia just became the world's most valuable company

Subrat Patnaik and Carmen Reinicke

Updated June 19, 2024 – 6:22am, first published at 5:55am



### Data centers fuel AI and crypto but could threaten climate, experts say

Data centers' energy usage is expected to soar in the coming years, experts say.

By [Max Zahn](#)

April 20, 2024, 8:08 PM





# The Biggest Age of Computing....Comes at a Cost

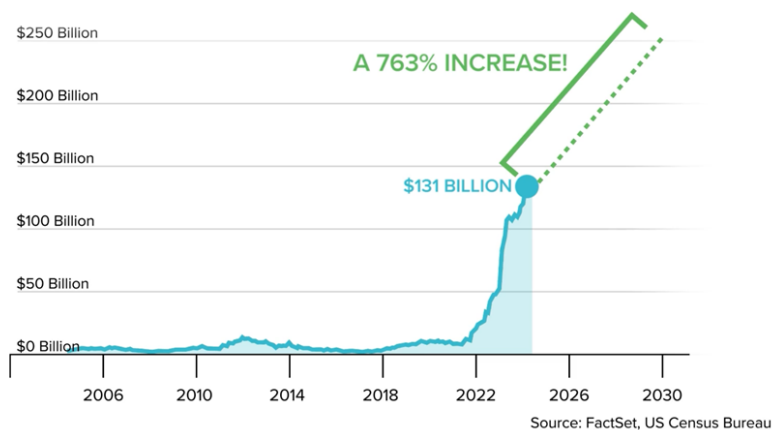
Why we need the next generation of semiconductor technology in three graphs

### PROJECTED GROWTH RATE OF DATA CENTERS VS OTHER HYPERGROWTH TRENDS

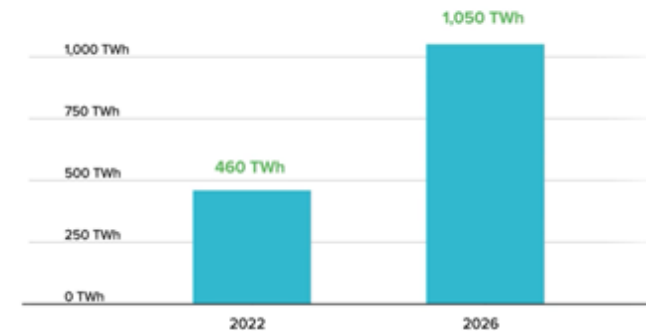


Sources: Datacenterknowledge.com, 5

A PROJECTED **\$1 TRILLION** IS EXPECTED TO BE SPENT ON DATA CENTERS IN THE NEXT 5 YEARS



### GLOBAL DATA CENTER ELECTRICITY DEMAND EXPECTED TO **DOUBLE** BY 2026



\*Projections by the International Energy Agency

This explosion of data and generative AI being applied to it means more efficient semiconductors are critical for industry growth.

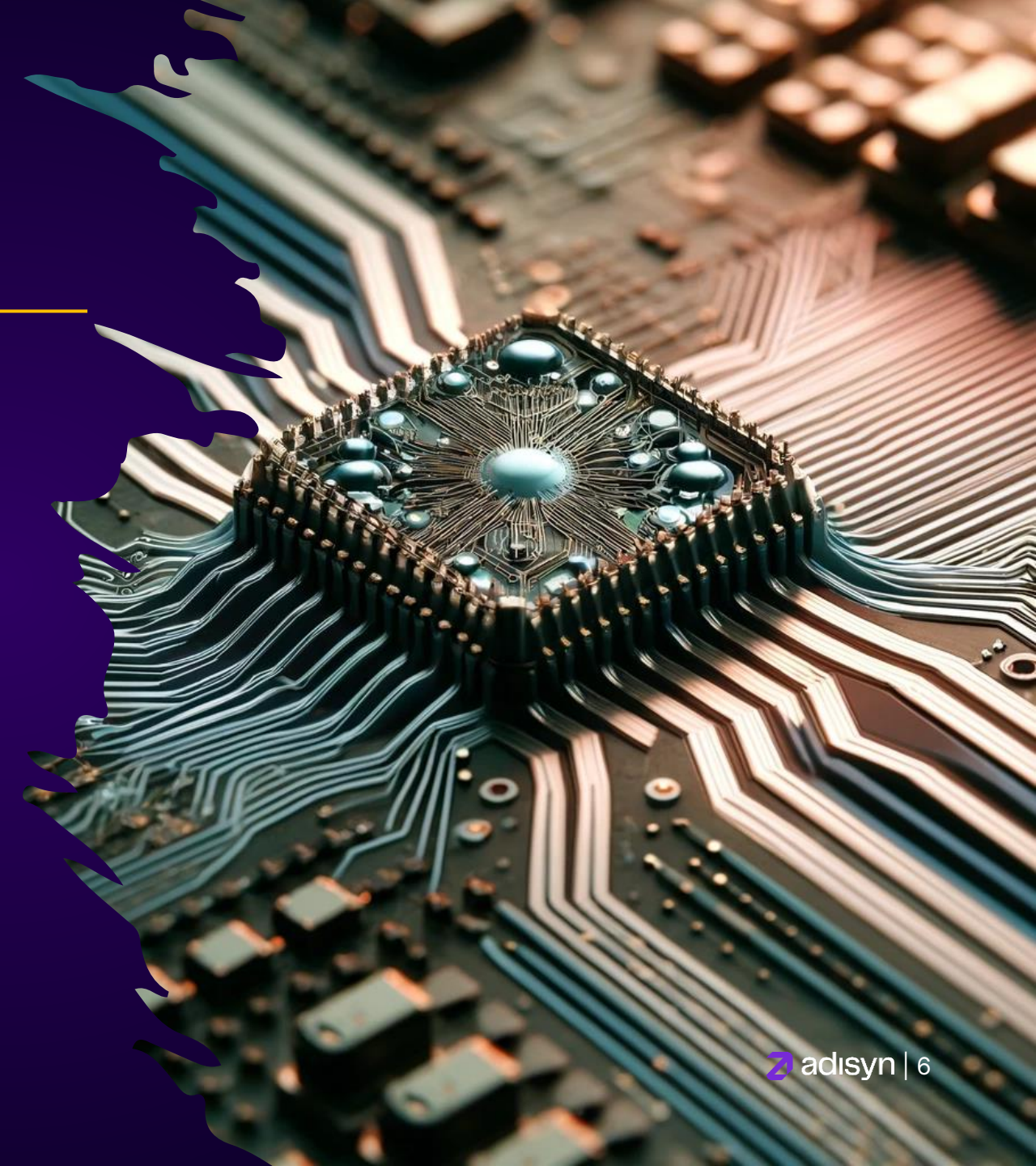


# What is an 'Interconnect'?

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2D Generation's innovative technology centres around the aim of improving the performance and capabilities of the interconnect.

- An interconnect in a semiconductor refers to the conductive pathways that connect different components or regions within an integrated circuit (IC).
- These interconnects are crucial for the functionality of the IC as they facilitate the flow of electrical signals between transistors, capacitors, resistors, and other elements on the chip.
- Interconnects can be made of various materials, typically metals like aluminium or copper, and they can be implemented in different layers within the semiconductor structure.
- As ICs have become more complex, with smaller and more densely packed features, the design and materials used for interconnects have evolved to address issues such as resistance, capacitance, and signal integrity but have reached scalability limitations.





# Enabling 'More Moore'

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*"With each new technology generation, routing congestion and a dramatic signal delay (resulting from an increased resistance-capacitance (RC) product) become more and more problematic..."\**

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- For advanced process nodes, the 'Interconnect' is a bottleneck:
  - Limiting clock and data transfer rates... 'FORCED SPEED LIMITATION'
  - Consumes a lot of power... 'COMPETING FOR ELECTRICITY'
  - Major source of heat generation... 'ADVANCED PERFORMANCE CAN BE ACHIEVED. MANY MORE TRANSISTORS CAN BE ADDED'
- "To continue scaling beyond the 2nm node, major breakthroughs in interconnect and contact design, as well as process technologies, are necessary." (Applied Materials website)
- Graphene based solutions for the 'INTERCONNECT' are well defined, BUT UNTIL NOW THERE IS NO VIABLE SOLUTION
- From IMEC's paper on Graphene for interconnects in 2021:  
*"While this study focuses on graphene transfer, a more 'elegant' way of depositing graphene would be direct growth on the metal template of interest. Growing high-quality graphene requires however high growth temperatures (900-1000°C) and can as such not be applied on interconnect-type of metals."*

+ Moore's Law is the principle that the speed and capability of computers can be expected to double every two years, as a result of increases in the number of transistors a microchip can contain

\* <https://www.imec-int.com/en/articles/promise-hybrid-graphenemetal-structures-advanced-interconnects>



# Atomic Layer Deposition

Despite efforts, significant breakthroughs in this domain are still elusive

- The Atomic Layer Deposition (ALD) market is experiencing substantial growth. Major industry players, such as ASM International NV (ASMI), Applied Materials Inc. (AMAT), Tokyo Electron Limited (TEL) and Lam Research Corporation (LAM), have dedicated R&D teams focusing on Plasma Enhanced Chemical Vapor Deposition (PECVD), particularly for graphene deposition.
- Enter 2D Generation. With its groundbreaking innovation enabling in-situ ALD graphene deposition at low temperatures, 2D Generation is positioned uniquely within the industry. This focus on graphene integration sets 2D Generation apart, presenting a disruptive potential that could reshape the landscape of semiconductor manufacturing.
- The interconnect field emerges as a critical technological barrier hindering industry progress. Overcoming this challenge is perceived as the "Holy Grail" within the industry, promising accelerated rates and continued miniaturisation. Industry giants recognize that the entity with a viable solution stands to gain a substantial competitive advantage.
- This technological breakthrough holds the potential to revolutionise production devices, enabling faster and more advanced chip manufacturing compared to competitors.





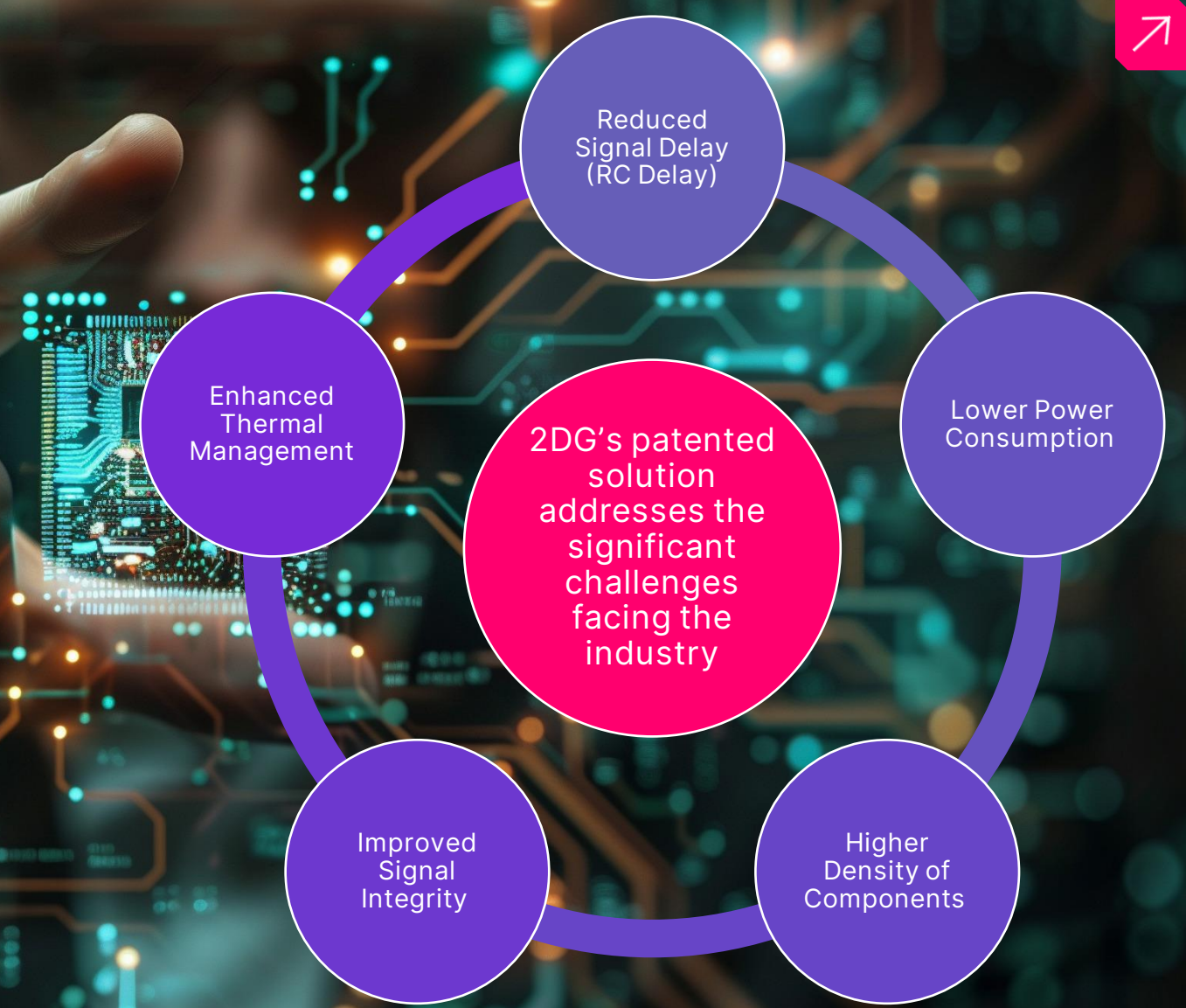
## 2D Generation's Advantages

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- ✓ Unique and patented process
- ✓ Atomic Layer Deposition (ALD) based
- ✓ Forming graphene directly on the wafer
- ✓ Use of patented precursors
- ✓ Low-temperature process at below 280°C (previously only possible at 1000 degrees) – a giant leap forward.
- ✓ Compatible with current manufacturing limitations – fab friendly
- ✓ An addition of a tethering group is designed to increase adhesion to silicon oxide, metals, and other optional surfaces
- ✓ Can be applied using existing industrial processes and equipment – no retooling.



# Enabling the Next Generation of Chipsets





# 2D Generation's IMEC Agreement



Imec founded in 1984 is one of the world's leading R&D hubs for nano and digital technologies. Imec employs around 5,000 expert scientists from more than 95 countries, unique infrastructure that includes a 2.5-billion-euro 300mm semiconductor pilot line. Among Imec's business partners are most of the manufacturers, suppliers, and fabless companies in the semiconductors industry including:



2D Generation has signed a strategic cooperation agreement with Imec to validate the company technology in two aspects:

- 1. Physical tests of the graphene coating of several materials (metals and non-metals) and several usages (surfaces, structured wafers, and diffusion barrier).
- 2. Simulation to explore the benefits of the technology in a relevant context for product applications.



# 2DG's European Project – CONNECTINGCHIPS



## ConnectingChips Collaboration

- It is accepted throughout the semiconductor world that the next generation of artificial intelligence capable chips are critical to advance AI. However, as it stands now, the semiconductor industry's catchcry of 'more Moore's' is under threat.
- The advance to further miniaturisation, i.e. lower energy and less heat is being curtailed by the current limitations of the 'interconnector'.
- Interconnects are currently coated in metal, usually copper, gold, or aluminium. This inhibits miniaturization and the associated benefits. It has been known industry-wide for some time that replacing metal with graphene is a viable solution. However, this bonding process was only able to be done at 1000 degrees centigrade, basically cooking the chipset.
- Enter 2DG's simple and elegant solution. 2DG uses an Atomic Layer Disposition machine, or ALD, to bond graphene to interconnects at 300 degrees or less. This does not damage the chipset. The solution is recognised as critical to the industry, the semiconductor industry.
- It is so critical that 2D Generation is partnering with the likes of NVIDIA, Valeo, IMEC, Applied Minerals, NXP, and AIX-TRON via the ConnectingChips Undertaking, a program run in the EU for the semiconductor industry focused on the next generation of AI solutions.

## 2D Generation Key Objective's

- Leverages Graphene's exceptional properties to improve semiconductor technology.
- 2DG will develop pioneering low-temperature ALD techniques for depositing Graphene directly onto semiconductor materials.
- Enhances performance in interconnects, coatings, and capping layers, addressing impedance, resistivity, and heat dissipation challenges
- Leverage the relationships within the ConnectingChips consortium to the benefit of 2D Generation and AI1.



# Working with the Best

- Key Objective – “The CONNECTINGCHIPS ambition is to establish the next generation of AI computing and autonomous vehicles infrastructure based on SiP development.”
- The high level objective of CONNECTINGCHIPS is the development of power efficient high performance electronic, photonic, power, and RF chips and System on Chips (SoC) and their integration into System in Package (SiP) modules.

## Project Scope:

Total budget: 110M€

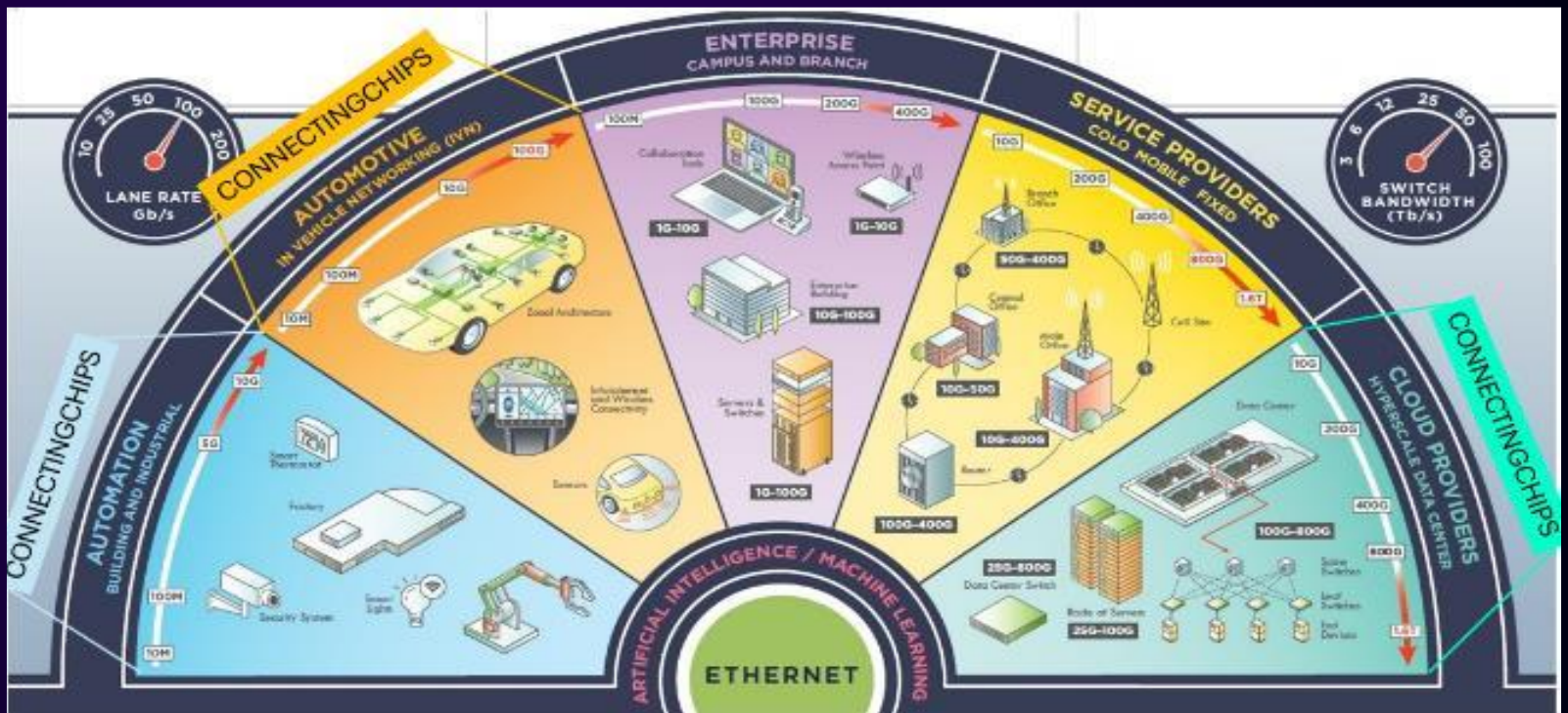
Total European grant: 32 M€

Additional grants from the country’s innovation authorities – The Israeli Innovation Authority doubles the European grant.

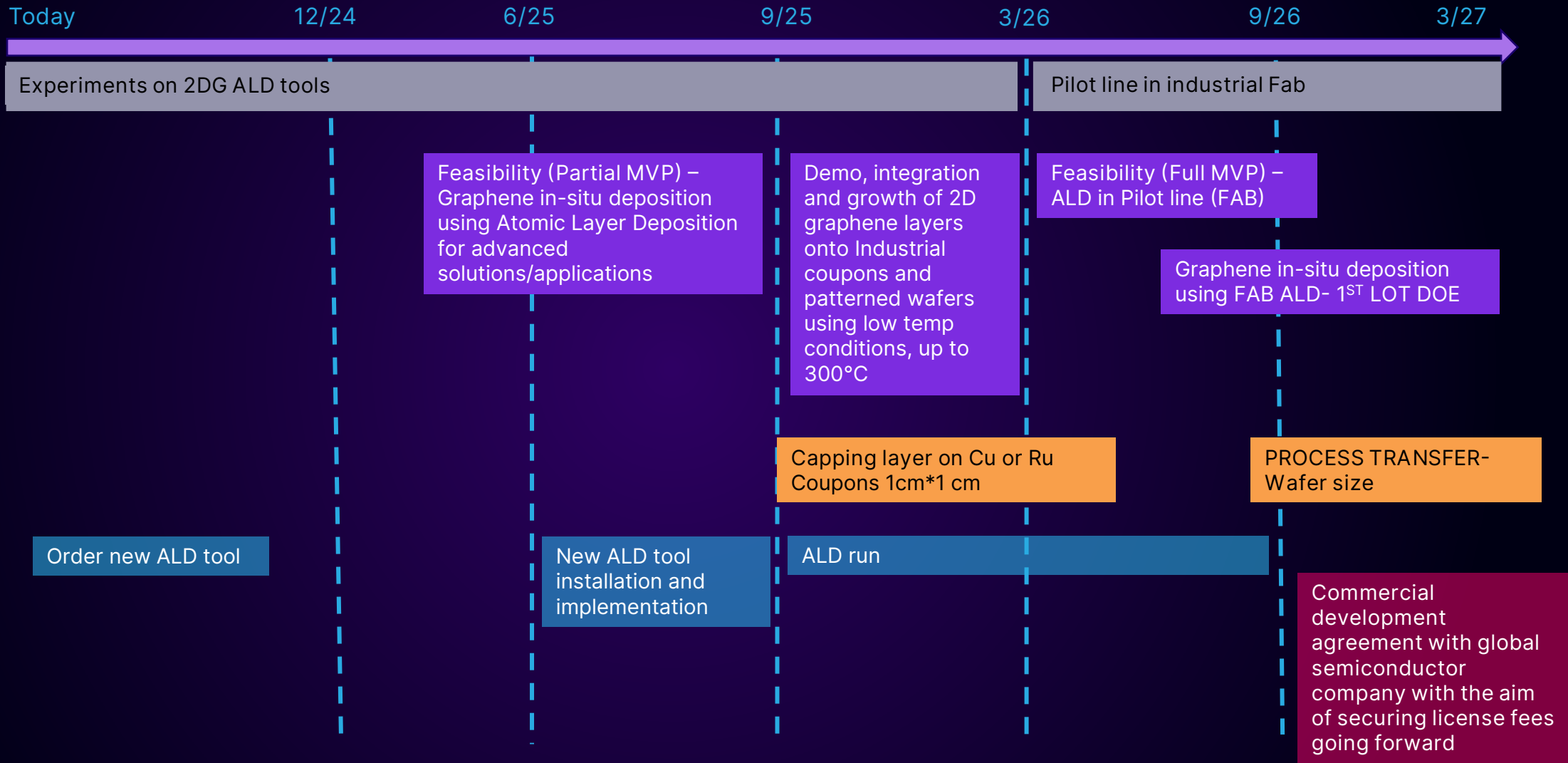
Partners: 65 top companies and institutions (10 countries)

Start: Q1 2025

2D Generation requires a grant of 200K € from Horizon Europe Chips (IA) + grant of 200K € from the Israeli Innovation Authority (approved)



# 2DG Road Map: Significant Catalysts Delivering Value



# Appendix: Intellectual Property

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## Four Patent Families:

1. GRAPHENE COATED NON-METALLIC SURFACES, DEVICES AND METHOD THEREOF – directed to the technologies used for conductive diffusion barrier, and other applications
2. GRAPHENE COATED METALLIC SURFACES, DEVICES AND METHOD OF MANUFACTURE THEREOF – directed to the technologies used for conductive capping layer, and other applications
3. METHOD OF MANUFACTURE OF GRAPHENE COATED SURFACES BY ATOMIC OR MOLECULAR LAYER DEPOSITION – directed to graphene manufacture by ALD
4. GRAPHENE METAL COMPOSITE – directed to graphene layers interlayered with metal layers including coatings of patterned surfaces

## Each patent application is directed to four aspects of the invention:

1. METHODS - novel processes for manufacturing the graphene coated surfaces
2. MATERIALS – unique proprietary materials used in each process
3. PRODUCT – exhibiting unprecedented properties and qualities of surfaces coated by graphene
4. DEVICES – made of the product including interconnects, nano- electro mechanical devices and transparent electrodes

# 2D Generation's Strong Technological Team Compliments AI1



**ARYE KOHAVI**  
CEO

Arye is an Israeli entrepreneur and innovator. He was the founder, president & Co-CEO of Water-Gen, which develops water-from-air and air dehumidification technologies. Kohavi holds a MBA (Finance) and a BA in Economics and Accounting, both from the Hebrew University in Jerusalem.

- Arye has been chosen as one of the world's 100 Leading Global Thinkers, and one of the world's top innovators of 2014, by "Foreign Policy" magazine.
- Water-Gen, founded by Arye, was chosen as one of the World's 50 Most Innovative Companies, by "Fast Company" magazine.
- As part of Israel's 70th anniversary celebrations, the Israeli Ministry of Economy and Ynet readers chose Water-Gen as one of the "Nine Greatest Israeli Inventions of All Times".
- Water-Gen's Genny was chosen as one of the world's 100 Best Inventions of year 2019, by TIME magazine.



**MIRI KISH DAGAN**  
VP R&D

Miri Kish - Dagan was the VP R&D and the CTO of Raicol crystals that specializes in the manufacture of high-quality nonlinear optical crystals and electro-optic devices. Miri led the development from inception to prototype in semiconductors, medical, military, and space applications.

- Miri has over 19 years of experience with engineering processing, technologies and R&D management in fabrication and tool installation. Prior to Raicol, Miri served at Suron as VP of R&D engineering, and in various positions at Tower semiconductors.
- Winner of the Pioneering Women Award for groundbreaking achievements in the high-tech sector given to her by the Israeli Hi-Tech Association and the Manufacturers Association of Israel.
- Miri received her MSc and BSc in Material Engineering from Ben-Gurion University in Israel.



**PAUL RICH**  
TECHNOLOGY LEADER

Paul Rich has more than 35 years of experience in the semiconductor industry.

- Paul was the Vice President for Technology and Engineering at SPTS Technologies, where he managed the product development team until December 2022. SPTS develops and manufactures advanced wafer processing solutions for the world's leading semiconductor and microelectronic device manufacturers.
- Mr. Rich graduated from Bath University in 1987 with a B.Sc in Physics. He has published numerous technical articles and has several patents relating to plasma processing.



# 2DG's World Class Advisory Board



**EPHIE KOLTIN**

Ephie has vast management experience in senior executive positions; integration of complex systems within – development, operations and business strategy, in Israel and abroad.

23 years at TowerJazz Semiconductors as Business Unit Manager, VP Business Development & Strategic Marketing, Fab General Management, and COO.

2017 – PRESENT  
Arkal Automotive, CEO

2015 –2017  
Synergy cables, CEO

2014 –2016  
Phoenicia Flat Glass Industries, Active Chairman

1993 – 2014  
TowerJazz Semiconductors, From Process engineer to COO



**KEVIN CROFTON**

Kevin has many years of experience in the semiconductor industry. Today Kevin is the CEO of the Comet Group.

He has established himself in the semiconductor industry in numerous awards and positions such as the author of many important technical articles, member and Vice Chairman of the SEMI International Board of Directors and winner of the MEMS Industry CEO of the Year 2013.

2020 – 2022  
Comet Group (traded in SIX Swiss Stock Exchange), CEO

2017 – 2020  
Orbotech, Corporate EVP

2004 – 2014  
SPTS Technologies (UK), currently part of KLA. Several roles include EVP & Chief Operating Officer.  
2014 - Present  
President



**2D Generation**



# Thank you

## Contact Details



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