



National
Semiconductor
Roadmap



**Semiconductor
Sector Service
Bureau**

OCTOBER 2026

Shaping Australia's Semiconductor Future

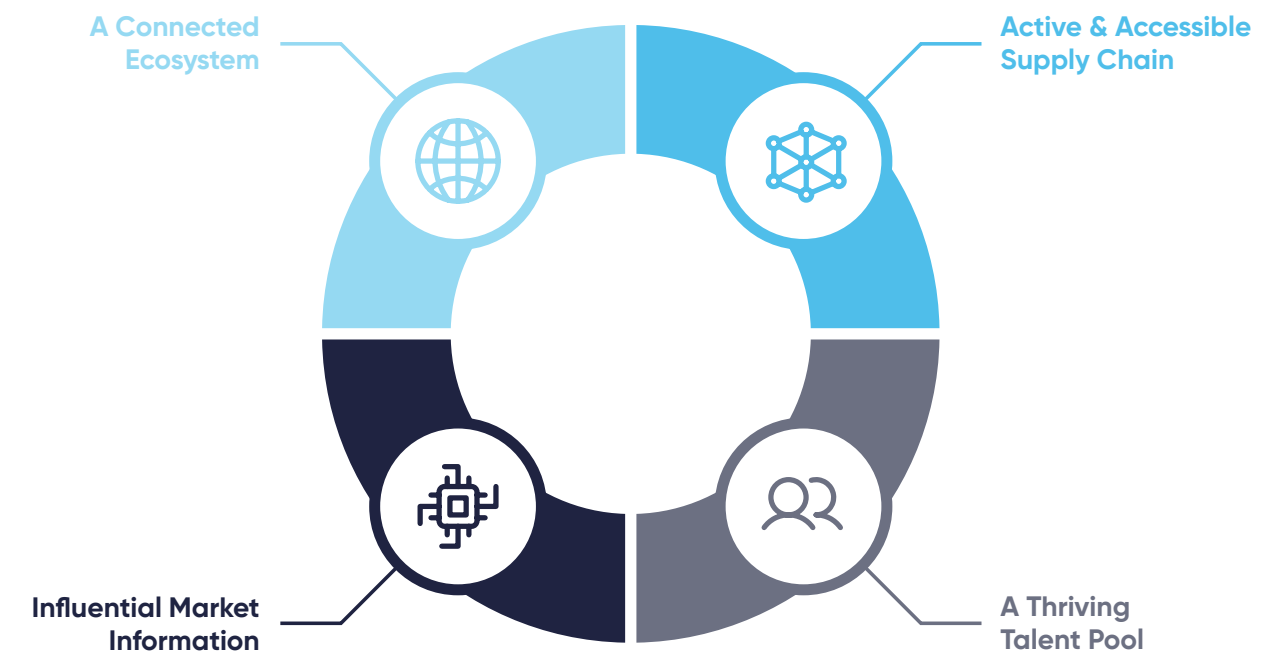
Strengthening Australia's semiconductor capability, competitiveness
and supply chain resilience

About

The Semiconductor Sector Service Bureau (S3B) is Australia's only industry hub for the semiconductor sector. Established with funding from the Office of the NSW Chief Scientist and Engineer, S3B supports the growth and development of the semiconductor sector across NSW and nationally. S3B is hosted as a joint venture between the University of Sydney, Macquarie University and the University of New South Wales, in partnership with CSIRO, and the Australian National Fabrication Facility.

S3B's vision is to grow and build a thriving, globally connected semiconductor sector in Australia and increase economic impact. Our areas of focus build capability, foster connections, and help advance Australia's position as a competitive contributor to the global semiconductor ecosystem.

FIGURE: S3B FOCUS AREAS



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Foreword

Australia has been part of the semiconductor story for longer than many realise. AWA Ltd began manufacturing transistors in 1958. Australian semiconductors were central to the first commercial implanted pacemaker in 1969 and the first commercial cochlear implant in 1982. In the 1980s, CSIRO helped build national capability in integrated systems, leading to Australia's first fabless semiconductor company, Austek Microsystems. During this period, groundbreaking photovoltaic research also produced world-leading solar cells. By the 1990s, Australia was not only contributing to established semiconductor technologies but opening new frontiers in photonics and silicon-based quantum computing, creating capabilities that continue to shape the nation's semiconductor story today.

These accomplishments reflect the ingenuity, determination and ambition of the people behind them. They should be recognised for what they are: a genuine national capability, built over decades and worthy of continued investment and growth.

Few technologies have become as pervasive, or as essential to modern life, as semiconductors. They underpin almost every sector of the economy, from energy, health and communications to defence, transport and advanced manufacturing. They are the foundation of the digital economy and increasingly sit at the centre of economic competitiveness, national security and strategic relationships between nations. As artificial intelligence, electrification and quantum technologies continue to advance, the world's reliance on semiconductors will only deepen.

A strong semiconductor sector has become a defining feature of advanced, technologically sophisticated economies. The nations that design, make and integrate semiconductor technologies are often those that create high-value industries, attract investment, strengthen resilience and help shape the technologies the rest of the world adopts. Governments across North America, Europe and Asia recognise this reality and are investing accordingly. At the same time, they are seeking trusted partners with distinctive capabilities that complement their own. Australia is well placed to be one of those partners, with internationally recognised research strengths, innovative companies and an established presence in global supply chains.

This Roadmap sets out a shared vision for the sector to unite behind. It is the first time that industry, research, education and government have spoken collectively about where Australia's semiconductor sector could be by 2040 and what it will take to get there. The vision is of an Australia that designs, develops and manufactures technologies on which the world depends; an Australia that is a trusted contributor to global supply chains and a valued partner in emerging technologies.



The benefits extend far beyond the sector itself. It will also support the technologies Australians depend on every day. Success will mean highly skilled, well-paid jobs in every state and territory, a more complex and resilient economy, and greater opportunities for Australian companies to grow and compete internationally. It will strengthen Australia's capacity to contribute to advances in healthcare, clean energy, communications, defence and other fields that improve lives and support national prosperity. It will also help ensure that Australian discoveries are translated into Australian businesses, enabling the next generation of engineers, scientists and founders to build their careers and their companies here.

Realising this vision will require strategic investment. That investment must be patient, deliberate and concentrated where Australia can build genuine depth and compete globally, rather than spread thinly across every opportunity. It will require leadership from governments, industry and research institutions that are prepared to make long-term commitments and sustain them beyond a single budget cycle. It will also require a coordinated national effort, with the Commonwealth, states and territories, industry and research organisations working towards a common goal.

This Roadmap asks something of everyone with a stake in Australia's technological future. Governments should recognise semiconductors as the strategic capability they have become and invest with conviction. Industry and investors should back Australian capability and build for the long term. Universities and research institutions should continue to translate discoveries into commercial outcomes. And for our international partners, Australia stands ready to be a serious, reliable and trusted contributor to the global semiconductor ecosystem.

This Roadmap has been shaped by the people and organisations who contributed through our ongoing engagements as well as targeted consultations, and I thank each of them for their expertise, insights and commitment. I also thank the S3B Board, the Roadmap Strategic Advisory Group, Deloitte Access Economics and the Rozetta Institute for their contribution. In particular, I would like to acknowledge Dr Nadia Court, S3B's inaugural Director, whose leadership initiated this important work.

Australia's semiconductor sector has already demonstrated what it can achieve through innovation, vision and determination. This Roadmap sets out a pathway to something greater: a future in which Australia's innovations continue to shape the world, while delivering greater economic prosperity, industrial capability and national resilience at home. With sustained commitment and a shared national purpose, Australia is well placed to realise that future.

Matthew Worsman

DIRECTOR

Semiconductor Sector Service Bureau

Executive Summary

THIS ROADMAP SETS OUT A PLAN TO REALISE A SINGLE NATIONAL VISION

By 2040, Australia’s specialised semiconductor capabilities enable the growth and competitiveness of priority sectors, strengthen national resilience, and participation in global supply chains.

We start from a stronger position than most recognise

Australia’s semiconductor sector is made up of more than 200 organisations, ranging from startups, small and medium-sized enterprises (SME), and large domestic anchor firms to university-linked ventures and research organisations. In 2025, the sector generated close to \$1 billion in semiconductor-related revenue contributed \$820 million in total value added to the economy and supported around 5,790 full time equivalent jobs.¹

The sector is specialised and design-led, built on research depth and the engineering-intensive work of integrating semiconductor technology into higher-value products. Capability is spread across the country, with each state and territory contributing distinct strengths. Australian firms are also deeply integrated into global value chains, developing technologies for global markets and drawing on offshore capability to manufacture and scale.

Semiconductors are the engine of an advanced, complex economy

Global semiconductor sales reached around US\$792 billion in 2025², the highest on record, driven by artificial intelligence, electrification and digital infrastructure. Much of the value is realised downstream, in clean energy, transport, healthcare, advanced manufacturing, communications and defence. These are the industries on which Australia’s future growth and security depend. Production of the most advanced chips remains concentrated in a small number of facilities overseas, and pandemic-era shortages showed how quickly disruption flows through to the products that depend on them. For Australia, the economic case and the strategic case call for the same response.

Australia has to keep pace

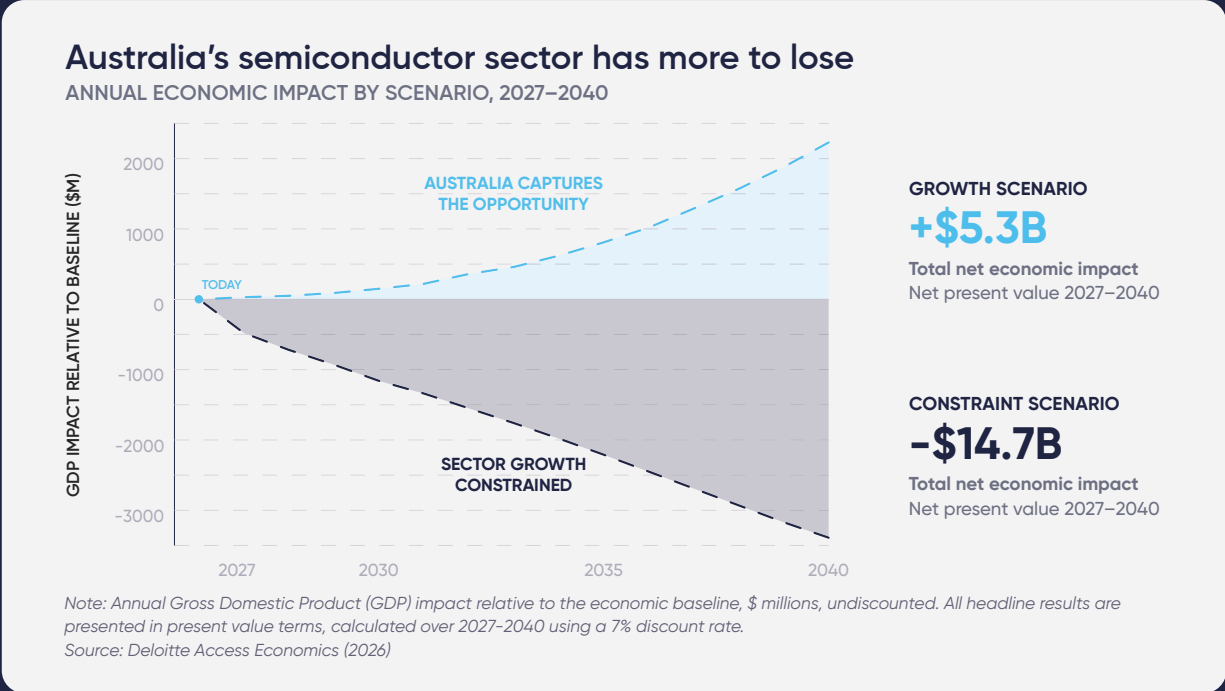
Since 2020, governments around the world have committed more than US\$500 billion to semiconductor development, building the capabilities they want and securing the partnerships they need. Australia cannot hold its position by standing still while others invest at that scale.

The sector has set a shared direction for Australia’s semiconductor future. More than 200 stakeholders contributed to the consultation for this Roadmap, and their message has been

consistent. They want Australia to specialise in areas of existing strength rather than pursue end-to-end capability. They identified a shortage of industry ready talent and experienced mid-career professionals, a funding cliff between research and commercial scale, and gaps in the pilot-scale infrastructure that links research to low-volume production. They want stronger connections and improved access into trusted global supply chains. Above all, they want national leadership: a long-term strategy, stable policy settings and a coordinating body to bring together capability spread across jurisdictions and institutions.

Australia must choose its path

Australia can step forward and build on capability developed over decades, or step back and let others continue to capture the benefits. Deloitte Access Economics (DAE) estimates that if the sector matches the growth of comparable international ecosystems, it could triple its output by 2040 and support around 10,000 additional jobs across the economy, a gain of \$5.3 billion in present value terms. If sector constraints go unaddressed, the economy could instead lose \$14.7 billion and almost 12,500 jobs. The gap between the two paths is around \$20 billion in present value terms to 2040.³ This Roadmap makes the case for growth.



Building on our strengths

The Roadmap prioritises four capability focus areas where Australia can build a comparative advantage and become internationally consequential:

- » Materials: semiconductor-grade inputs from Australia’s critical minerals base, and advanced materials
- » Technologies: quantum, photonics, power and radio
- » Manufacturing services: advanced packaging and heterogeneous integration, and metrology, characterisation and test
- » Products and applications: device design, and system integration into higher-value products

Capability is built through specific actions and investments across five priority pathways designed to overcome the major challenges raised by stakeholders, and to ensure Australian breakthroughs are scaled here, where they create greater value and make the economy more resilient to future shocks.

The time to act is now

The recommendations form a package. The first steps need decisions rather than new capital: a shared national ambition, a whole-of-government semiconductor policy and strategy, and a national industry body. Government and the sector can take these steps now. The investments that follow have longer lead times, but every year of delay makes the growth path harder to reach.

The economic stakes are substantial. Failure to scale and coordinate the semiconductor sector will constrain growth in emerging technology-intensive industries, increase reliance on overseas supply chains, and limit Australia’s ability to capture value from future waves of innovation. Other governments have made their choice. Australia has the capability to make its own, and it should make it now.

VISION 2040

Australia’s specialised semiconductor capabilities enable the growth and competitiveness of priority sectors, strengthen national resilience, and participation in global supply chains.

Capability Focus Areas

Materials

Semiconductor-grade inputs from Australia’s critical minerals base, and advanced materials

Technologies

Quantum, photonics, power and radio

Manufacturing Services

Advanced packaging and heterogeneous integration, and metrology, characterisation and test

Products and applications

Device design, and system integration into higher-value products

Priority Pathways and Recommendations

Provide national sector and policy coordination

IMMEDIATE ACTIONS:

- » Adopt a whole-of-sector ambition
- » Introduce whole-of-government semiconductor policy and strategy
- » Establish a national industry body

Building a skilled semiconductor workforce

IMMEDIATE ACTIONS:

- » Establish a National Industry Ready Talent Pathway Framework

TARGETED INVESTMENTS:

- » Establish an international Talent Attraction Program

Develop market access, investment and partnerships

IMMEDIATE ACTIONS:

- » Collaborate on critical mineral refining and processing for chips

TARGETED INVESTMENTS:

- » Develop an international engagement strategy

Create value and resilience through commercial outcomes

TARGETED INVESTMENTS:

- » Establish a National Semiconductor Innovation and Translation Centre

Build strategic infrastructure and global integration

TARGETED INVESTMENTS:

- » Develop pilot scale and low-volume manufacturing capability
- » Provide enduring support for national advanced packaging capabilities
- » Support development of ANSTO semiconductor capabilities

Key Markets

Artificial intelligence

Compute, memory and photonic interconnect for AI hardware

Energy transition

Power semiconductors for grids, storage and electric vehicles

Defence

Trusted, secure electronics for defence and aerospace platforms

Data centres and digital infrastructure

High-speed networking, photonics and wireless communications

Advanced manufacturing

Sensors, power and control systems for industrial production

Health

Devices and sensors for medical technology and diagnostics

Quantum technologies

Devices and control electronics for quantum computing and sensing

Contents

About S3B	3
Foreword	4
Executive Summary	6
Contents	10
Part 1. Introduction	12
1.1. About this Roadmap	12
Part 2. Semiconductors	14
2.1. From evolution to transformation	14
2.2. The global semiconductor value chain	18
Part 3. The Australian semiconductor sector	20
3.1. A capability base spread across the country	22
3.2. The role of semiconductors in the economy	29
3.3. The strategic importance of domestic semiconductor capability	35
Part 4. Australia’s semiconductor opportunity	39
4.1. Investing in Australia’s future economy	40
4.2 Stepping back	43
4.3. A clear choice for action	44

Part 5. Capability focus areas	45
5.1. Materials	47
5.2. Technologies	52
5.3. Manufacturing services	60
5.4. Products and applications	64
Part 6. Priority pathways	70
6.1. Provide national sector and policy coordination	72
6.2. Building a skilled semiconductor workforce	73
6.3. Develop market access, investment, and partnerships	77
6.4. Create value and resilience through commercial outcomes	78
6.5. Build strategic infrastructure and global integration	82
6.6. Putting the Roadmap into action	84
Appendix A: Glossary of terms and Semiconductor Value Chain Definitions	87
A.1 Key Technical and Industry Terms	87
A.2 Semiconductor Value Chain Definition	90
Appendix B: Australia’s semiconductor capability areas	91
B.1 Materials	91
B.2 Technologies	94
B.3 Manufacturing services	96
Appendix C: References and Sources	98

Part 1

Introduction

Semiconductors underpin the technologies, systems and services that contemporary societies rely on every day. They are the materials that enable the precise control of electrical currents behind all digital processing. They are the building blocks inside the electronic devices and systems that power modern homes, workplaces, industries and public infrastructure.

Advances in semiconductor products and technologies support progress across the sectors and capabilities that matter most to Australia — clean energy, transport, healthcare, advanced manufacturing, communications, defence and digital services. Emerging fields such as AI, quantum and robotics all depend fundamentally on semiconductor devices, materials and manufacturing technologies.

Semiconductors are critical not only as a stand-alone field, but as a foundation for much of what will shape Australia's future. Despite this however, Australia has no current national policy, strategy or plan for the sector.⁴ S3B responded to a call for action from the sector to develop Australia's first National Semiconductor Roadmap.

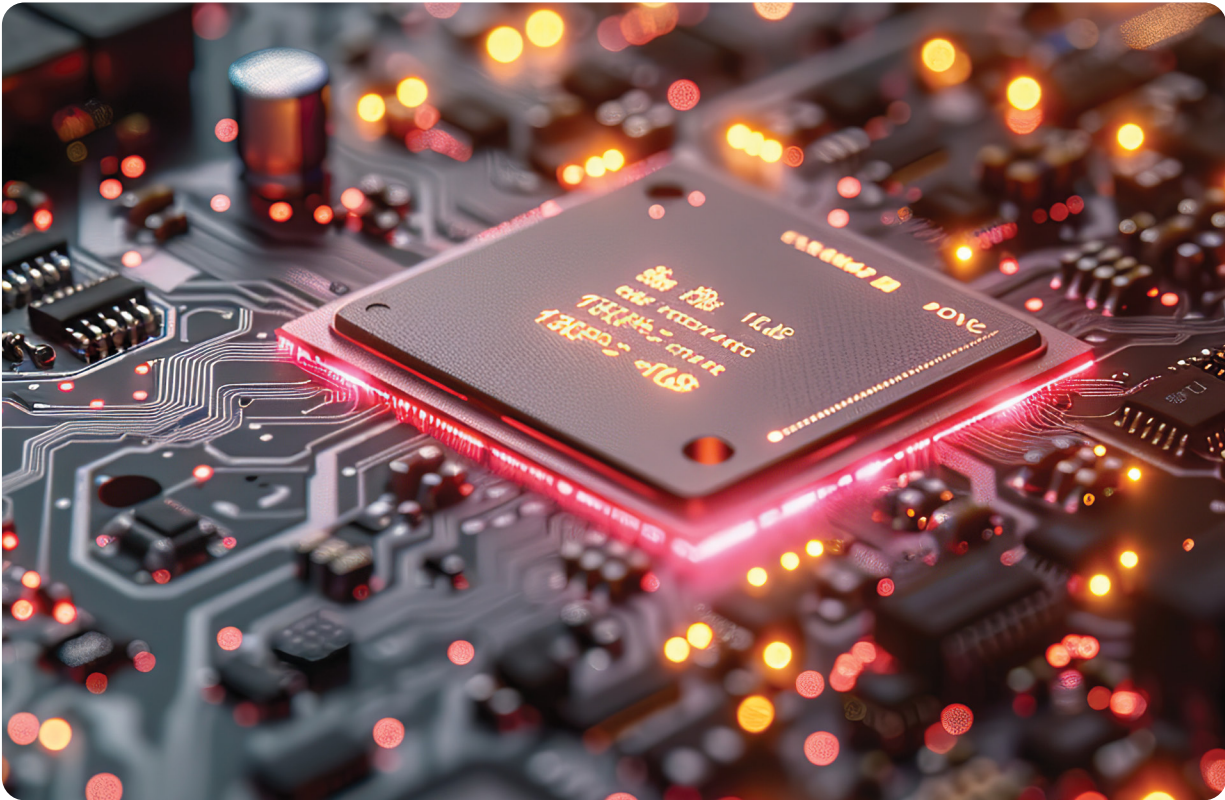
This Roadmap is an industry-led, evidence-based plan designed to guide policy and capability development. It takes a long-term view, recognising that national capability is built over decades, through sustained investment in infrastructure, workforce and international partnerships. It sets out an ambitious yet achievable vision for Australia's semiconductor future that will require leadership, coordination and action to realise.

1.1. About this Roadmap

This Roadmap provides a shared direction to support a more cohesive, resilient and globally competitive semiconductor sector. It is grounded in evidence and informed by the sector's voice.

The Discussion Paper, *Shaping Australia's Semiconductor Future*, released by S3B in July 2026 established a national baseline of Australia's semiconductor sector, identified key capabilities, structural constraints on scale and value capture, global supply chain dynamics and national resilience, and put forward strategic themes for consultation. It drew on quantitative analysis undertaken by DAE and insights developed through S3B's consultation with participants across the Australian semiconductor ecosystem.

Over 200 stakeholders contributed their feedback during the consultation period (6–31 July 2026) helping to validate the sector strengths, gaps, opportunities and constraints and inform the ambition and priorities set out in this Roadmap.⁵



A broad cross section of the national semiconductor sector participated via a range of engagement channels. Industry, research and education stakeholders accounted for the majority of national online survey responses and direct submissions, while Australian Government and state and territory departments and agencies were strongly represented in targeted consultations.

DAE was commissioned by S3B to support the development of a capability framework used to assess where Australia has a competitive advantage across the value chain and model potential economy-wide effects of alternate scenarios out to 2040 using their in-house regional general equilibrium model (DAE-RGEM). Economic figures cited throughout this Roadmap are drawn from that work unless otherwise attributed.

S3B is grateful for the expert advice and guidance provided by its Board, and Roadmap Strategic Advisory Group, comprising representatives from across industry, research, academia, and government. Additional technical support was provided by the Rozetta Institute, an independent innovation accelerator focused on catalysing collaboration and impact. S3B also acknowledges the contributions of Scientell and all organisations featured as case studies in the Roadmap.

Part 2

Semiconductors

Semiconductors are materials that sit between electrical conductors and insulators, allowing the flow of electrical current through a circuit to be precisely controlled. This property is the backbone of all electronic devices to control or modify electric signals.

"Semiconductor devices" are components of an electronic circuit that use the controllable electrical conductivity property of semiconductor material to switch, amplify, convert or detect electrical signals.

Semiconductor devices fall broadly into four categories:

- » **DISCRETE DEVICES:** which perform one function, like the individual diodes converting alternating current voltage to direct current voltage in home appliances.
- » **INTEGRATED CIRCUITS (IC):** a single chip combining multiple functions – such as the Central Processing Units (CPUs) and Graphics Processing Unit (GPUs) used in computing.
- » **SENSORS AND ACTUATORS:** convert physical properties into electrical signals (sensors) or electrical signals into mechanical motion (actuators) – for example, biosensors that monitor glucose or heart rate, or actuators used in surgical robotics.
- » **OPTOELECTRONIC DEVICES:** which are used to emit, detect, convert or modulate photons, such as the photovoltaic cells used in solar generation and the light-emitting diodes (LEDs) used in lighting and displays.

Semiconductor devices are manufactured using a range of semiconductor materials, selected according to the performance, reliability, and application requirements of the device. Silicon remains the predominant material for discrete devices and IC, including diodes, transistors, CPUs, and GPUs, due to its established manufacturing infrastructure and favourable electrical properties. Other materials, including germanium, and compound semiconductors such as gallium arsenide, gallium nitride, indium phosphide and silicon carbide, are used where specific performance characteristics, such as operating temperature and conductivity is required. Similar material systems are also fundamental to sensors and actuators, enabling the detection and control of physical parameters such as light, temperature, pressure, and motion. Optoelectronic devices commonly incorporate compound semiconductors such as gallium arsenide, indium gallium nitride, and perovskites which support the efficient generation and detection of light.

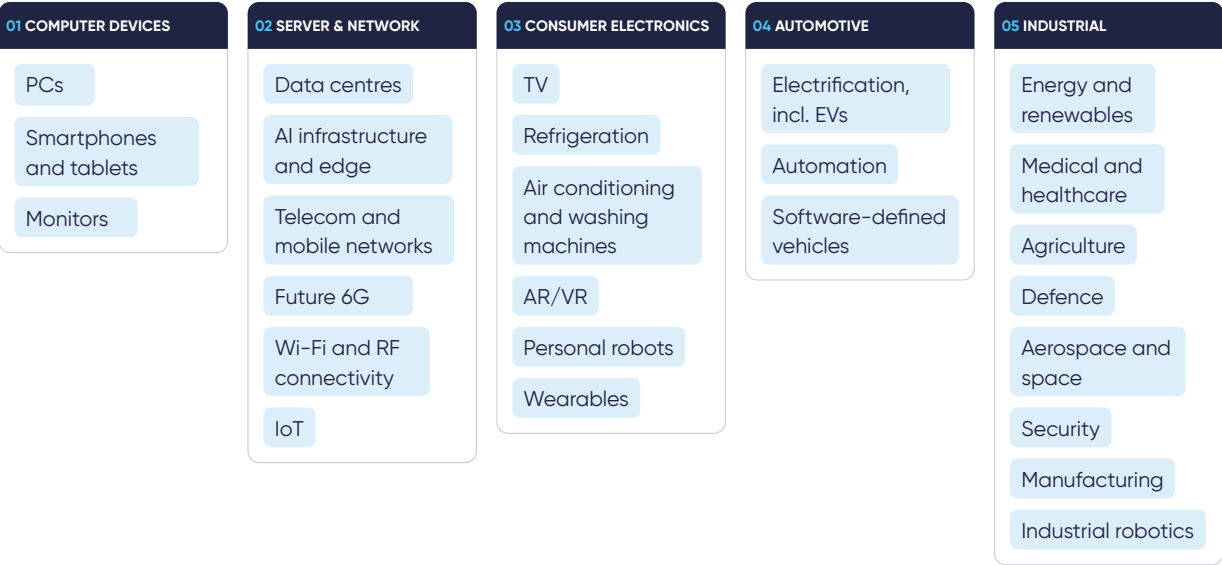
2.1. From evolution to transformation

The first semiconductor device capable of amplifying and switching electrical signals – the transistor – was demonstrated at Bell Laboratories in 1947. It replaced bulky and fragile vacuum tubes at a fraction of the size and cost. A decade later, the integrated circuit allowed multiple

transistors to be fabricated together on a single piece of silicon, leading to commercial microprocessors in 1971. The modern integrated circuit today places billions of transistors onto a chip the size of a fingernail.

Today – less than a century since their invention – semiconductor devices are now embedded throughout virtually every sector of the global economy (Figure 2.1).⁶ A glossary of terms and semiconductor value chain definitions is provided at Appendix A.

FIGURE 2.1: KEY GLOBAL MARKET CATEGORIES



The development of the integrated circuit has followed Moore's Law for more than fifty years. Transistor density is doubling approximately every two years and driving sustained gains in computational performance alongside falling cost and energy consumption per unit of output.⁷ While conventional transistor scaling has slowed in recent years, the industry is increasingly pursuing performance and efficiency gains through advanced packaging, chiplet architectures, specialised accelerators and system-level integration.

These improvements have been reliable enough for other industries to plan around and benefit from. Products, business models and whole sectors have been built on the assumption that the next generation of chips will be faster, cheaper and less power-hungry than the last. The graphics processing unit illustrates the point. Designed to render images for gaming, GPUs now train and run artificial intelligence (AI) models in data centres, process sensor data in autonomous vehicles and defence systems, and accelerate compute-intensive workloads in medical imaging – markets that did not exist, or did not use this class of device, when it was first developed.



The semiconductor’s rapid economic ascent has changed the posture of governments towards the industry. What was once a predominantly market-driven sector is now shaped by strategic competition, national policy and security considerations. Pandemic-related shortages, geopolitical tension and disruption to critical inputs and logistics have reinforced how dependent modern economies are on complex, globally distributed supply chains, and how poorly those supply chains were understood.

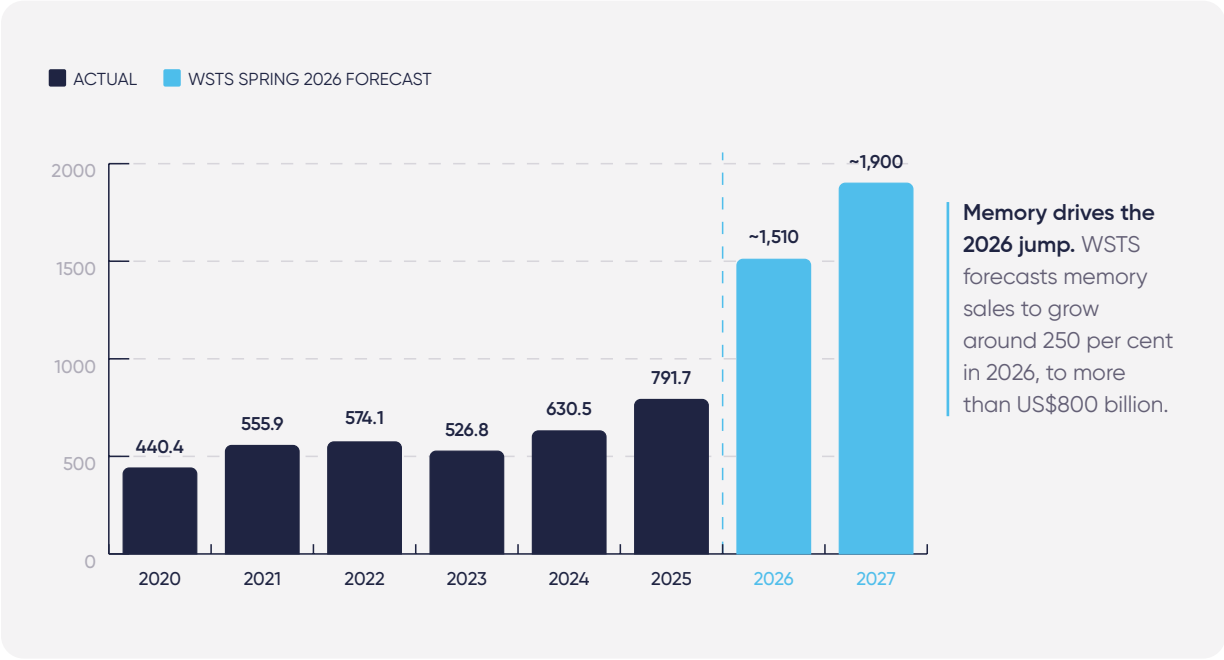
Structural drivers of future demand

The global semiconductor industry has entered a period of unprecedented accelerating growth and demand. Global semiconductor sales reached US\$791.7 billion in 2025, an increase of 25.6 per cent on 2024, according to the Semiconductor Industry Association – the industry’s highest annual sales on record. Forecasts for the remainder of the decade have been revised upward repeatedly through 2025 and 2026 as demand associated with AI infrastructure has continued to exceed expectations, with current forecasts putting the global market at around US\$1.5 trillion in 2026 and US\$1.9 trillion in 2027. Chart 2.1 shows the historical and forecast sales trajectory.

This growth is not evenly distributed. It is concentrated in memory, computing and AI-infrastructure-related segments, and it is occurring alongside sustained government investment internationally.⁸

Three structural trends are expected to sustain demand growth for semiconductor capability over the medium to long term, each aligning with sectors identified as national priorities for Australia. Figure 2.2 summarises them.

CHART 2.1: GLOBAL SEMICONDUCTOR SALES, HISTORICAL (2020–2025) AND FORECAST (2026–2027)



Sources: Semiconductor Industry Association, annual global semiconductor sales releases (World Semiconductor Trade Statistics data), 2021–2026; World Semiconductor Trade Statistics, Spring 2026 forecast, June 2026.

FIGURE 2.2: DRIVERS OF DEMAND

01
Energy transition

Decarbonised generation, electrified transport and renewable infrastructure all run on power electronics. Silicon carbide and gallium nitride are displacing silicon in inverters, grid storage and EV drivetrains.

KEY DEVICES AND USES

- » SiC and GaN power devices
- » Solar inverters
- » Grid-scale storage
- » EV drivetrains

Australia holds upstream advantages in several required raw materials

02
Digitalisation of industry

Advanced manufacturing, precision agriculture, autonomous logistics and industrial robotics need embedded semiconductors built for conditions outside consumer electronics

KEY DEVICES AND USES

- » Sensors
- » Edge processors
- » Communication devices
- » Power management ICs

03
Expansion of digital infrastructure

Australia’s data centre market has grown substantially, most of it in the past five years. AI infrastructure is expected to drive continued expansion to the end of the decade

KEY DEVICES AND USES

- » AI processors
- » Memory
- » Power management ICs

Source: S3B analysis based on Semiconductor Sector Service Bureau, Shaping Australia's Semiconductor Future, Discussion Paper, July 2026, p. 19.

The shifting design and fabrication economics

Alongside this demand growth, the underlying economics of semiconductor production have shifted. Physical fabrication at the leading edge has consolidated into a small number of global foundries, with facility costs for advanced nodes commonly reported in the tens of billions of US dollars. Replicating this physical capacity domestically is not viable for a market of Australia’s scale, and would carry material risk of capital misallocation without resolving the underlying supply chain vulnerabilities it is intended to address.

At the same time, the upstream phases of the industry – design, simulation, architecture and prototyping – have become substantially more accessible. Three factors account for this shift. First, open instruction set architectures, such as RISC-V, have removed proprietary licensing costs that previously constituted a significant upfront barrier to chip development. Second, electronic design automation tools are drawing on AI to automate increasingly complex design tasks, while cloud-based computing allows smaller design teams to run verification and simulation workloads on demand rather than maintaining dedicated infrastructure. Third, shared manufacturing arrangements – multi-project wafers (MPW), under which multiple designs from different stakeholders are fabricated together on a single wafer – have reduced the cost of physical prototyping from millions of dollars to the tens of thousands.

The effect is a bifurcation in the global industry. Mass-market, general-purpose silicon at the frontier remains concentrated in a small number of capital-intensive facilities. Domain-specific and niche applications – including compound semiconductor power devices, quantum control systems, radio frequency devices and specialised sensors – depend less on access to leading-edge physical fabrication, and more on architecture, materials selection and design capability.

This has direct implications for how sovereign capability should be understood in a semiconductor context. Sovereign capability does not require the capacity to manufacture every component domestically. It requires the capacity to design, adapt, audit and integrate trusted

semiconductor technology into critical national systems – including defence platforms, energy infrastructure, telecommunications and medical devices – and to re-engineer components for alternative foundries or substrates where supply is disrupted.



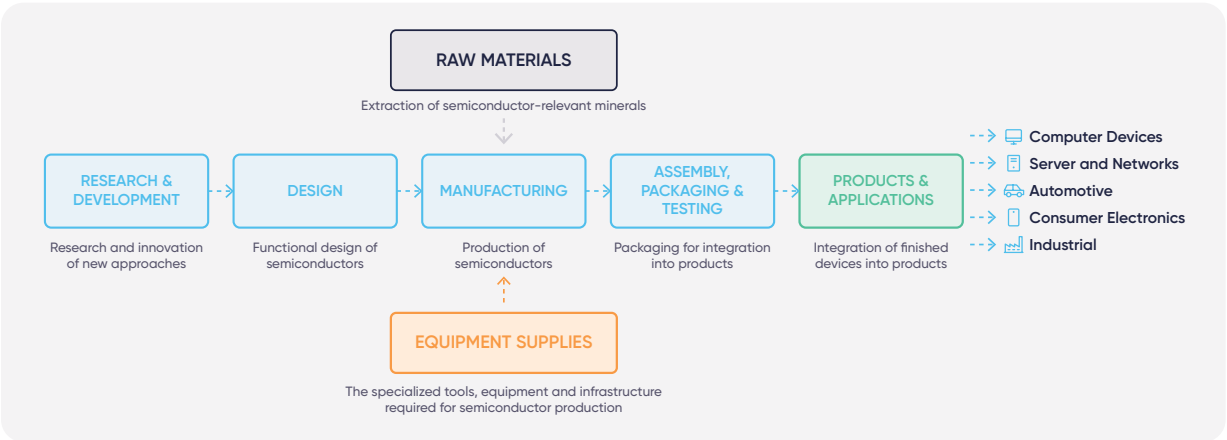
Australia’s existing capability is well positioned to capitalise off this shift in the economics of semiconductor production. The domestic semiconductor ecosystem is already substantially design-led and largely fabless, with recognised strengths in quantum, photonics, power semiconductors and advanced communications research.⁹ The reduced cost of translating this research into export-ready hardware provides a more direct pathway to commercialisation than existed previously.

2.2. The global semiconductor value chain

The semiconductor industry supports the production of goods through one of the most globally distributed supply chains in manufacturing.¹⁰ No single company, and no single economy has the complete semiconductor supply chain on its own.

The semiconductor value chain divides the key activities into seven segments. Raw materials and semiconductor-grade inputs supply the physical substrates; equipment suppliers provide the specialised tools and infrastructure on which manufacturing depends; research and development (R&D) generates new approaches and materials; design and intellectual property (IP) translates these into the functional architecture of a device, and licenses the building blocks other designers use; manufacturing produces the physical semiconductor; assembly, packaging and testing prepares it for integration; and products and applications integrates finished devices into end products. Output flows into five broad end-markets: computer devices, server and networks, automotive, consumer electronics, and industrial.

FIGURE 2.3: THE SEMICONDUCTOR VALUE CHAIN



In contrast, the design segment which sets a device’s requirements and architecture and validates it on a test bench – accounts for roughly half of semiconductor value added, but only 10–15 per cent of physical capital expenditure. Manufacturing, which etches the designed circuit onto a silicon wafer through a large number of advanced processes, is the inverse: around one-quarter of value added but almost two-thirds of capital expenditure.¹¹

Differences in capital intensity, skill intensity and margin have driven the industry toward specialisation rather than vertical integration. Fabless companies such as Nvidia, Qualcomm, AMD among them – design chips and outsource manufacturing entirely, often spending 25 per cent or more of revenue on R&D. System companies such as Apple and Tesla design chips for their own products rather than to sell as standalone components. IP vendors – Arm, Synopsys, Cadence – design and license the functional building blocks (“IP cores”) that shorten other companies’ design cycles. Pure-play foundries, led by Taiwan Semiconductor Manufacturing Company (TSMC), manufacture chips to order for all of the above. Integrated Device Manufacturers (IDMs) such as Intel and Samsung still handle design and manufacturing in-house.¹²

The global value chain’s fragmentation is compounded by a high degree of self-reliance within the industry itself. The Organisation for Economic Co-operation and Development (OECD) analysis of Inter-Country Input-Output data shows that roughly half of the intermediate inputs used globally in semiconductor production are components sourced from within the semiconductor industry itself, while approximately one-third of intermediate outputs are sold on to other semiconductor firms for further processing.¹³ In the making of a semiconductor device, it can move back and forth between firms multiple times – as bare wafers, as unpackaged die, as packaged components – before reaching a final product. This layered, iterative structure means a disruption at one node rarely stays contained to that node; it propagates both upstream and downstream through the same industry that caused it.

Not surprisingly, half of the stakeholders consulted for this Roadmap (51%) reported at least a moderate impact from supply chain constraints. Among those affected, lead times for materials or components were the most commonly cited difficulty at 55 per cent, followed by limited supplier choice (39%), access to assembly, packaging and testing services (34%), and the high cost of fabrication or prototyping (32%). This pattern points to availability and continuity of supply, rather than price, as the binding constraint.

Fabrication was identified as the single greatest area of supply chain risk, at 35.4 per cent, consistent with a sourcing profile concentrated in the United States and Taiwan, with European suppliers the strongest secondary base for equipment and fabrication services and China a source of some materials and inputs. Because Australia’s industry is overwhelmingly fabless, it relies heavily on these partners for any fabrication, packaging and scale, and for access to tools, services and specialised inputs. Improving access to trusted and diversified supply chains was rated very important or critical by over half of respondents.

Specialisation, intra-industry interdependency, concentration and limited substitutability – together describe an industry that is both indispensable and structurally fragile. For Australia, this creates a particular vulnerability, with its dependence on offshore semiconductor capabilities leaving it highly exposed to disruption. Governments around the world are responding by making deliberate choices about where to build domestic capability, trusted partnerships and strategic redundancy across semiconductor supply chains. Since 2020, cumulative government commitments to semiconductor development globally are estimated to exceed US\$500 billion.

Part 3

The Australian Semiconductor Sector

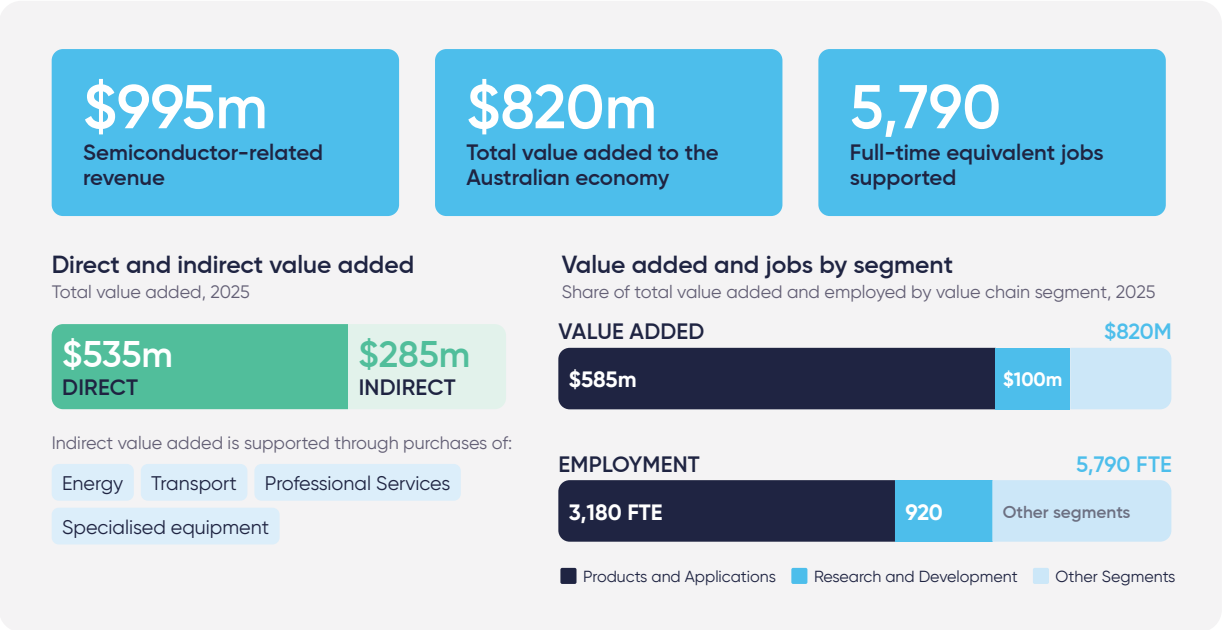
Australia’s semiconductor sector is made up of over 200 organisations including startups, SMEs, university-linked ventures, specialist engineering teams and research organisations – with several large domestic anchor firms operating at scale.

It is specialised, design-led and largely fabless. It is built around research depth, device and system design, and the engineering-intensive work of adapting and integrating semiconductor technology into higher-value products.

Photonics, quantum technologies, compound semiconductors, radio design and photovoltaics account for the majority of the domestic research and IP base in the semiconductor ecosystem. Commercial activity follows the same pattern: a relatively small number of firms have proven their technology in international markets, most of them design-led and reliant on offshore manufacturing.

In 2025, the sector generated close to \$1 billion in semiconductor related revenue, contributed \$820 million in total value added to the Australian economy and supported 5,790 total full-time equivalent (FTE) jobs.¹⁴ Of the total value added, \$535 million is generated directly by semiconductor firms and organisations, and \$285 million is supported indirectly through their purchases across the broader supply chain – energy, transport, professional services and specialised equipment. Total value added is concentrated in two segments. Products and Applications – organisations that specify, design, adapt or integrate semiconductor-enabled subsystems into higher-value products – is estimated to have contributed \$585 million in total value added and 3,180 FTEs, making it both the largest segment and the largest employer. This indicates the relative maturity of Australia’s downstream activity. R&D is estimated to have contributed a further \$100 million, on a much smaller employment base of 430 FTEs.

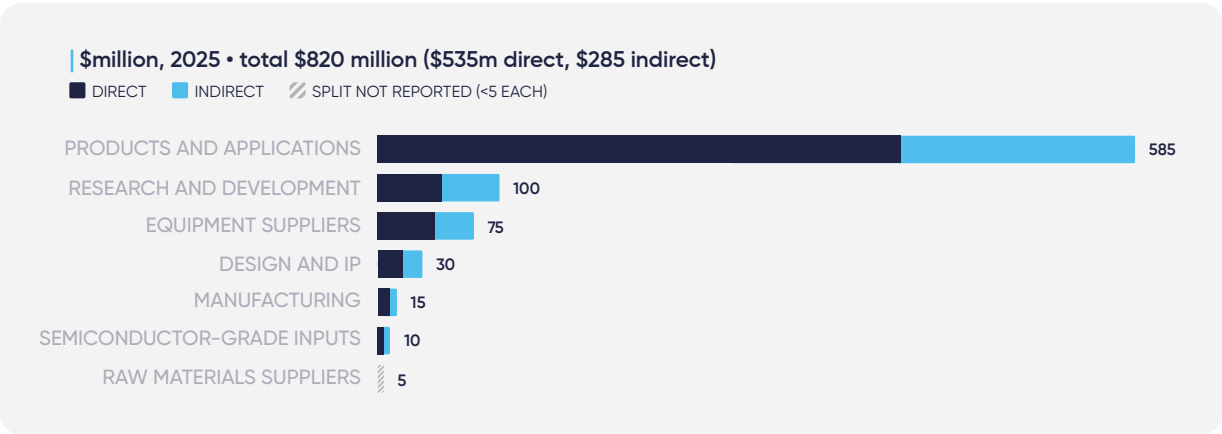
CHART 3.1: AUSTRALIA'S SEMICONDUCTOR SECTOR IN 2026



Source: Deloitte Access Economics, (2026) Note: Values rounded to the nearest \$5 million

Midstream activities in the value-chain – manufacturing and assembly, packaging and testing – represent a relatively small share of current activity. This is consistent with the structure described above, and with the position of other fabless-heavy advanced economies. Australia’s activity carries a lower capital risk profile than manufacturing-led models, and it shapes where it can most credibly compete if the sector is supported to grow. Chart 3.2 shows the distribution of value added across segments.

CHART 3.2: VALUE ADDED BY VALUE CHAIN SEGMENT (\$ MILLION, 2025)



Source: Deloitte Access Economics, (2026) Note: Values rounded to the nearest \$5 million

The markets that Australia’s semiconductor sector serve are concentrated in industrial and server and network market categories (see figure 2.1). Industrial is the largest end-market, cited by 34 per cent of consultation respondents and rising to 40 per cent when respondents were asked which markets matter most to their future operations. Within the industrial category, energy and renewable transition and aerospace lead at 64 per cent each, followed by defence and manufacturing at 59 per cent each, and medical and healthcare at 46 per cent. Server and network is the fastest-growing category, currently sitting at 23 per cent but rising to 35 per cent given future demand. Data centres and AI infrastructure dominated the Server and Network category, cited by 80 per cent of respondents.

3.1. A capability base spread across the country

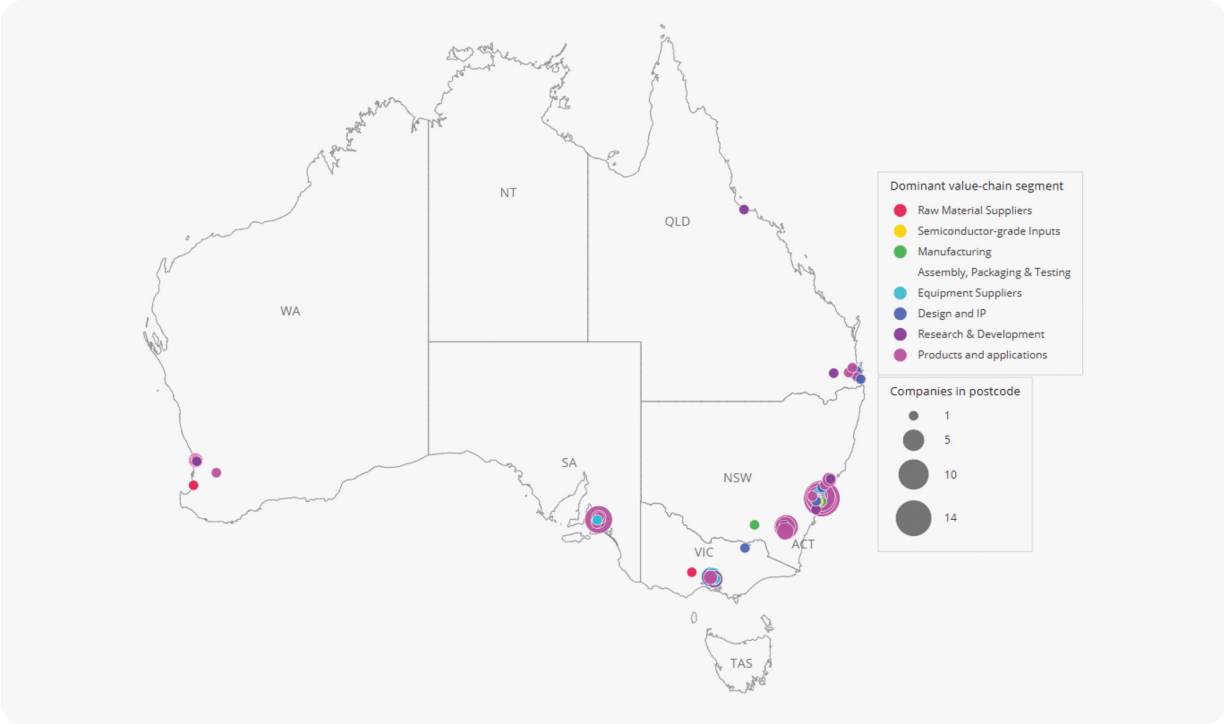
Semiconductor activity is spread across the country, concentrated in the capital cities (see Figure 3.1 and Table 3.1). Each jurisdiction has developed in a direction shaped by its research and industrial base, and the priorities of successive governments. New South Wales (NSW), in particular, Sydney, holds the largest and most commercially mature hub of activity. Victoria (VIC), South Australia (SA) and Queensland (QLD) represent the next largest concentrations of organisations, each supporting a mix of firms and institutions across multiple value chain segments. Smaller clusters are also present in Western Australia (WA) and the Australian Capital Territory (ACT).

To date, there has been no national framework or mechanism to coordinate activity, nor represent it. Across Australia's education landscape, universities are currently providing largely introductory-level exposure to foundational science, technology, engineering and mathematics (STEM) knowledge, rather than comprehensive, semiconductor industry aligned training. Specialised semiconductor training is fragmented and inconsistent, concentrated in a small number of programs at individual institutions, often as electives within broader degrees. As a multidisciplinary industry, the sector draws from a broad STEM talent pool that is also in demand across many other sectors.

Unlike leading semiconductor economies, Australia lacks a nationally coordinated pathway providing comprehensive, industry-aligned training across the semiconductor value chain. Industry currently plays a critical role in skills development, with internships, graduate positions and on-the-job training providing talent entering the sector with significant hands-on experience.

Figure 3.1 provides a snapshot of states and territory capability focus areas, supported research and infrastructure and the limited pockets of specialised education offerings available through Australia's major universities.

FIGURE 3.1: CLUSTERING OF AUSTRALIA'S SEMICONDUCTOR ECOSYSTEM BY VALUE CHAIN SEGMENT AND STATE/TERRITORY



Source: Deloitte Access Economics, (2026)

TABLE 3.1: SNAPSHOT OF SEMICONDUCTOR CAPABILITY BY JURISDICTION

CAPABILITY FOCUS	RESEARCH AND INFRASTRUCTURE	EDUCATION AND TRAINING
NEW SOUTH WALES		
NSW is home to 53 per cent of national semiconductor organisations and the most commercially mature and diverse activity in the ecosystem. University ecosystem drives a significant share of relevant R&D and activity, most notably in photonics and quantum technology. Design and IP and products and applications capability is also strong in system-on-chip and package work for wireless and communications, spanning low-power connectivity for internet-of-things (IoT) devices, high-volume wireless networking silicon, millimetre-wave beamforming for 5G, and neuromorphic processor architectures. New commercial advanced packaging capabilities include the Advanced Manufacturing Readiness Facility (AMRF) Semiconductor Advanced Packaging Facility being built to support a cross-section of priority tech industries.	The University of New South Wales (UNSW), Sydney, the University of Sydney, Macquarie University and The University of Technology Sydney (UTS) host research centres, specialist laboratories and fabrication infrastructure in quantum technologies, photonics, integrated circuit design, advanced materials and micro- and nanofabrication. These labs also provide industry aligned PHD positions.	NSW anchors national training capability with: » UNSW Sydney's Bachelor of Engineering (Quantum Engineering) – a semiconductor devices degree and the only quantum degree available nationwide that is built on an electrical engineering foundation, including an IC design elective. » University of Sydney offers one of the few fabrication-focused electives available across the country providing students with cleanroom exposure. It also hosts the Australian Research Council (ARC) Training Centre for Future Leaders in Quantum Computing.
VICTORIA		
VIC hosts 16 per cent of the nation's activity – densely networked around semiconductor-adjacent research, along with design and IP and products and application capabilities in quantum technologies, nanofabrication infrastructure, photonics and medical technology. Its university ecosystem hosts enabling infrastructure and translational capability driving activities such as nanofabrication-enabled optical components and implantable and bionic devices, for high-value sectors like med tech & space. Recent investment has added Royal Melbourne Institute of Technology (RMIT) Discovery to Device facility for semiconductor medical devices and Quantum Brilliance's quantum diamond foundry in Melbourne, which opened in 2025.	Monash University's Melbourne Centre for Nanofabrication and RMIT's Micro Nano Research Facility bring together diverse and high-quality multidisciplinary micro and nano technology research, provide cleanroom and testing facilities and specialist process engineering capability. The university ecosystem also hosts key research centres.	Education offerings are limited to two key institutions: » RMIT's Master of Engineering (Electrical and Electronic Engineering) features a dedicated semiconductor fabrication elective with cleanroom demonstrations. » Swinburne University offers an IC design elective.

QUEENSLAND		
QLD hosts 10 per cent of semiconductor organisations nationally with activity centred around two distinct areas of capability – compound semiconductors device design and quantum photonics. highly relevant to sectors like energy, defence and space and communications. Related investments include, PsiQuantum and Chipstart AU along with the newly opened CSIRO Queensland Advanced Photonics Packaging Centre.	The University of Queensland and Griffith University both host research centres and facilities dedicated to photonics, electronics and micro and nanotechnology and emerging commercial capabilities.	Relevant knowledge and specialised expertise are limited to: » Griffith University – includes an IC design elective offering. Also, provides postgraduate research pathways through its Queensland Quantum and Advanced Technologies Research Institute. » The University of Queensland offers master courses that cover semiconductor topics that provide pathways into advanced research. An undergraduate nanotechnology specialisation provides exposure to materials science, nanotechnology and research projects.
SOUTH AUSTRALIA		
SA comprises 10 per cent of Australia's semiconductor ecosystem with core capability in defence-linked firms and activity focused on building broader advanced manufacturing and testing capabilities. Related investments have supported the design and development of high-reliability, sovereign-manufactured electronics to support defence and space industries.	Adelaide University provides core semiconductor-relevant research infrastructure and expertise across materials science, physics and engineering. In addition, Flinders University provides a hub of nanotechnology research and education.	Adelaide University offers an IC design elective, and its Master of Engineering (Materials) addresses semiconductors through elective units. It also hosts the ARC Training Centre for Current and Emergent Quantum Technologies.
WESTERN AUSTRALIA		
WA's ecosystem is largely anchored in raw materials and capability strength at the upstream end of the value chain. It is home to Australia's only silicon manufacturer, a minerals base that includes high-purity alumina, rare earths and graphite, and mining engineering depth. The Alcoa gallium recovery project with United States and Japanese partners is designed to supply around 10 per cent of global demand. Beyond the mining sector, Western Australia also holds expertise in specialised sensor technology for agricultural applications.	The University of Western Australia (UWA) holds recognised strength in mining engineering and hosts the ARC Industrial Transformation Training Centre in Critical Resources for the Future, to drive research into critical minerals and sustainable mining. It also has expertise in specialist fields of semiconductor optoelectronics, micro- and nano- electro-mechanical-systems, and advanced sensors.	The University of Western Australia's Master of Professional Engineering (Electrical and Electronic) includes an IC design elective. Curtin University's Electrical and Electronic Engineering major has embedded systems engineering specialisation including dedicated training in semiconductor devices and IC design. This is the only embedded systems major offered nationwide.

AUSTRALIAN CAPITAL TERRITORY		
The ACT hosts national science and research institutions, coordinating fundamental research, standards and national measurement for the broader ecosystem. This includes the Commonwealth Scientific and Industrial Research Organisation (CSIRO), headquartered in Canberra, works across quantum technologies, photonics and critical minerals, and the National Measurement Institute maintains the country's peak physical measurement standards.	The Australian National University (ANU) is a key node in the semiconductor ecosystem, with infrastructure and facilities that host various research organisations focused on optics, photonics, nanoelectronics and semiconductor material science. Facilities like the Heavy Ion Accelerator Facility support Australia's only experimental nuclear physics program and enable industry projects in space and defence. UNSW Canberra also hosts a variety of relevant research infrastructure, primarily for defence-related projects.	ANU's Photonics Systems minor includes semiconductor fabrication, one of the few opportunities nationally for students to gain exposure to fabrication processes. In addition, ANU offers two Master courses that cover semiconductor topics that provide pathways into advanced research.

Source: Deloitte Access Economics, 2026.



Discovery to Device Facility
Image courtesy of RMIT University



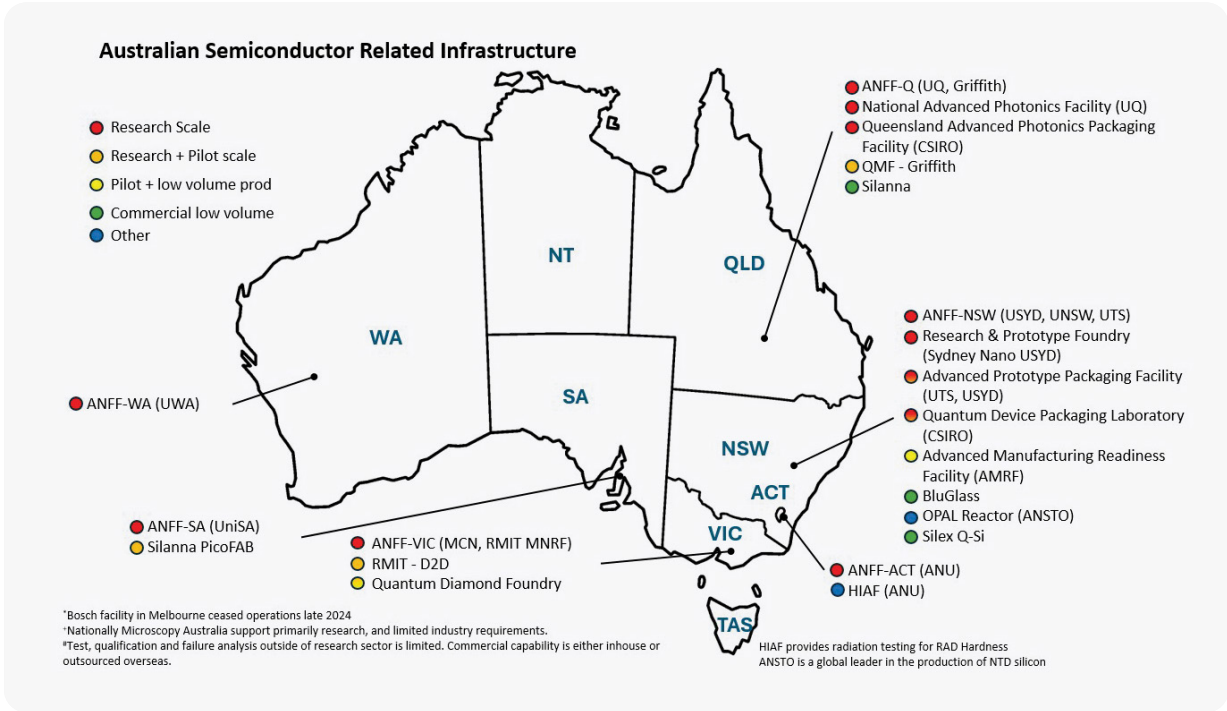
The Queensland Advanced Photonics Packaging Facility (Q-APP)
Image courtesy of CSIRO

Australia’s semiconductor ecosystem is supported by shared research infrastructure and ecosystem-enabling institutions. National and university-based facilities provide access to specialised equipment, cleanrooms, fabrication tools and technical expertise for device development, materials research, characterisation and prototyping across multiple technology areas. These facilities provide the practical foundation for research capability, collaboration and some hands-on semiconductor experience for early career talent, while creating entry points for startups and emerging firms.

Australia’s principal public fabrication asset – the Australian National Fabrication Facility (ANFF) is a particularly important part of this foundation, and operates across a national network of nodes at universities and research institutions. Its distributed model provides shared access to micro and nanofabrication infrastructure and process expertise that no single state could sustain alone and supports the broader science and advanced manufacturing community. CSIRO, Australian Nuclear Science and Technology Organisation (ANSTO) and the university research system operate the same way.

Australia’s core semiconductor infrastructure is mapped in the figure below. It clearly highlights the national capability base that exists in research, experimentation and prototype development, along with the gap in commercial, pilot-scale and production-oriented infrastructure.

FIGURE 3.2: AUSTRALIA'S SEMICONDUCTOR RELATED INFRASTRUCTURE



Source: S3B, 2025.

CASE STUDY

ANFF

The research infrastructure behind Australia’s semiconductor spinouts

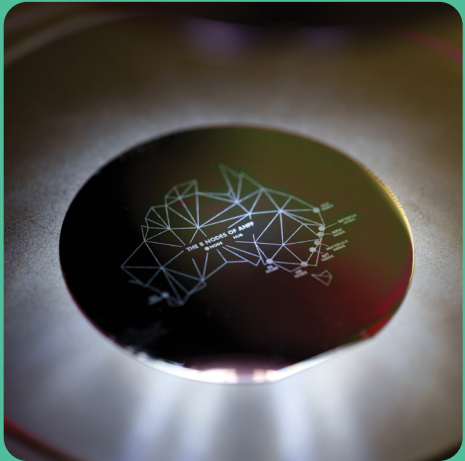


Image courtesy of Andrew Beveridge / ANFF

For nearly two decades, researchers developing semiconductor technologies have relied on the ANFF – a federally, state and university-funded ‘one-stop-shop’ that brings together the specialist equipment and technical expertise needed to build early-stage devices.

ANFF was founded in 2007 through the Australian Government’s National Collaborative Research Infrastructure Strategy (NCRIS) to give researchers and industry open access to suites of micro and nanofabrication equipment that would otherwise be difficult for a single entity to obtain and maintain on their own.

Dr Jane Fitzpatrick, Chief Executive Officer of ANFF said the organisation’s value lies as much in its people as its tools. “That ability to provide the people, as well as the tools and specialist infrastructure, the whole ecosystem really, is the thing that sets ANFF apart.”

ANFF operates through a network of nodes across Australia, which each have specialised capabilities ranging from microfluidics to quantum devices. This approach avoids unnecessary duplication, while ensuring deep specialist expertise. It employs over 120 engineers and scientists across the country whose job is to help clients use their infrastructure and tools. One company that has flourished from that support is QuantX Labs, a South Australian spinout from the ANFF-OptoFab Node.

The company uses photonics, quantum sensors and advanced fabrication techniques to develop products that can provide precise timing, even without access to satellite GPS signals.

This is particularly useful in defence, navigation and communications. However, these products require components that are extremely difficult to prototype without dedicated fabrication facilities.

QuantX Labs started as university research, spending years building its technology through ANFF's network before it became a commercial spinout. QuantX Labs relied on the capability of the ANFF-OptoFab Node, which enables companies and researchers to fabricate optical fibres, link components together, or mount detectors directly onto chips.

ANFF can provide researchers with the "ability to get their concept out of their head, turn it into a real-world device, test it and then see if it actually works."

QuantX Labs isn't alone, with many companies making the same journey from university cleanroom to commercial spinout through ANFF's network. Some researchers and companies rely on multiple ANFF Nodes along the way, drawing on different specialisations. "The national network of state and territory nodes allows Australia to have differentiation, as well as foundational technology capability which is really important, especially for a country of our size," Dr Jane Fitzpatrick said.

ANFF has helped build the talent and capability to support the sector today and will provide a platform for the much-needed expertise as we grow the sector. But what still doesn't really exist in Australia: enabling pilot-scale or low-volume production infrastructure.

Research infrastructure is about the freedom to experiment. Once a company knows what it wants to build and needs to make quantities of it, ANFF's setup cannot provide what the company needs, requiring different infrastructure and operating conditions.

"Australia needs technology infrastructure and capability that runs at a pilot-scale – providing companies with the ability to manufacture small volumes. That's the stepping stone between research infrastructure and a major foundry and is where Australia can build capability," Dr Jane Fitzpatrick said.



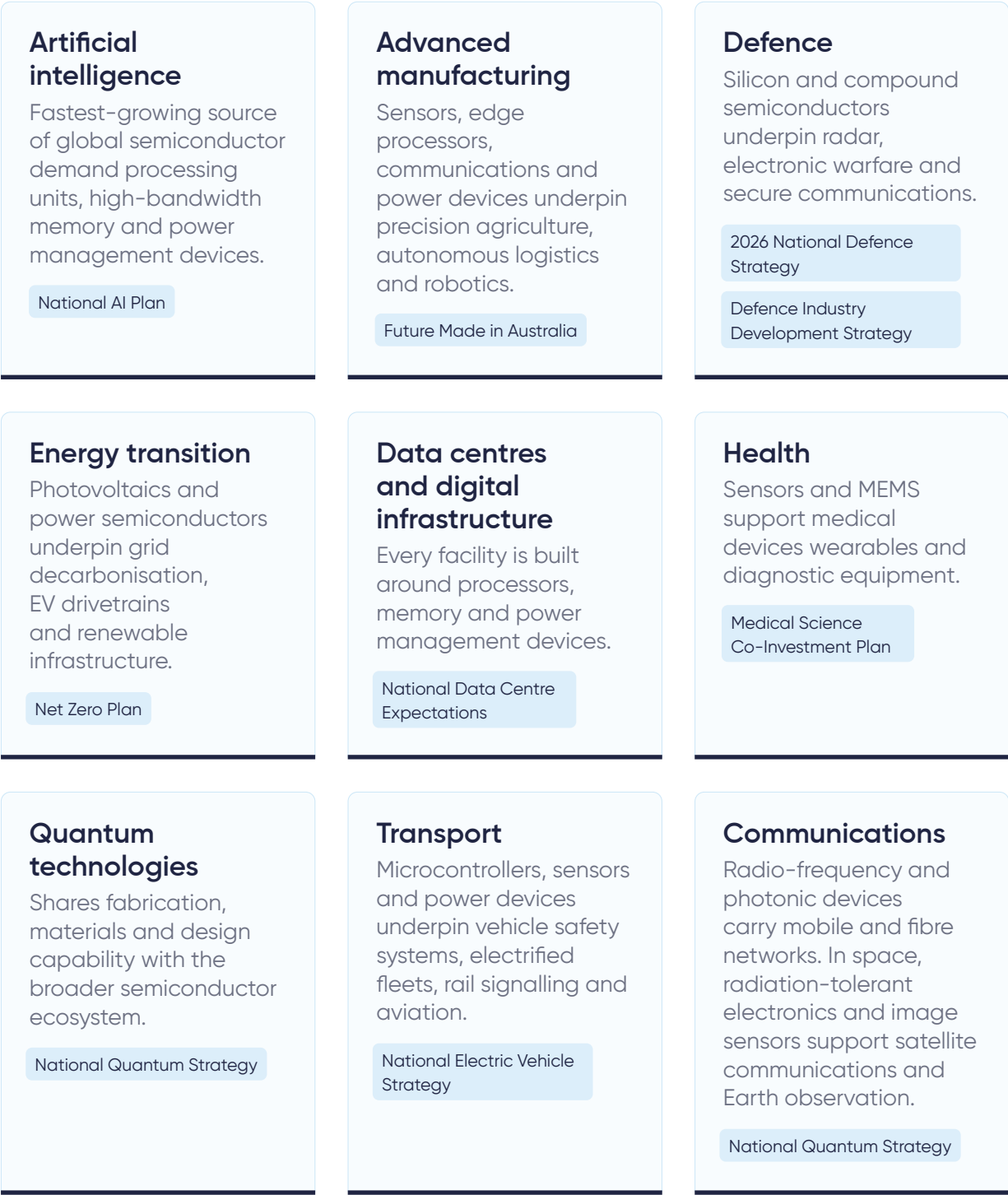
ANFF-OptoFab
Image courtesy of Andrew Beveridge / ANFF

3.2. The role of semiconductors in the economy

The nature and ability of a country's contribution to global semiconductor value chains is a marker of its broader technical and industrial depth. In economic terms, semiconductors function as a general-purpose technology: a foundational input whose continuous improvement generates productivity gains across the many sectors that depend on it, rather than within a single industry. The literature on general-purpose technologies identifies three defining characteristics: pervasiveness across the economy, sustained potential for technical improvement, and the capacity to raise the returns to innovation in the sectors that use them.¹⁵

The dependence runs across several sectors named explicitly in Australian government priority frameworks, as set out in Figure 3.3.

FIGURE 3.3: WHERE SEMICONDUCTORS ARE USED ACROSS THE ECONOMY



Source: S3B analysis based on Department of Industry, Science and Resources, "List of Critical Technologies in the National Interest", 19 May 2023.

The value generated by the semiconductor sector is captured substantially by the industries that depend on it. The private return to investment in semiconductor capability is systematically lower than the return to the economy as a whole, and individual firms have correspondingly limited incentive to invest at the scale that would maximise national benefit.

Semiconductor development is among the most knowledge-intensive activities in the global economy, and the returns to that activity extend well beyond the firms generating them. Economic research on R&D spillovers has consistently found that the social returns to R&D – the benefits captured by the wider economy – exceed the private returns captured by the firms undertaking it, often by a wide margin, with the gap greatest in high-technology sectors.¹⁶

Capturing these spillovers, however, is not automatic. It depends on a country maintaining sufficient domestic capability – often termed absorptive capacity – to recognise, understand and apply externally generated knowledge.¹⁷ This is a central rationale for sustaining domestic semiconductor research, design and engineering capability even in segments where Australia does not undertake large-scale manufacturing: the capacity to absorb global technological progress depends on maintaining a credible domestic base from which to do so.

Studies of learning effects in semiconductor manufacturing have found that firms learn substantially from their own cumulative production, but also benefit meaningfully from spillovers generated by production elsewhere in the world. These spillovers are particularly important for countries entering or expanding within the value chain.¹⁸ While international estimates of the broader employment effects of semiconductor activity vary by study and jurisdiction, they consistently point in the same direction. Analysis prepared for the Semiconductor Industry Association for example, estimated that each direct semiconductor role supports a further 5.7 jobs across the broader economy – a multiplier placing the sector in the top sixth of all detailed industries by this measure.¹⁹ Separate research on the employment effects of the United States' CHIPS and Science Act found that indirect job creation in upstream and related sectors ran at roughly twice the rate of direct job creation in the semiconductor sector itself.²⁰

CASE STUDY

MILLIBEAM

Australian semiconductor company at the frontline of defence



Rakurai - handheld counter-UAS
Image courtesy of MILLIBEAM

New semiconductor technology, designed and built in Australia, could help soldiers defend against hostile drones with smaller, lighter counter-drone systems.

Military technologies are rapidly evolving, transforming the nature of modern warfare. With over 80% of casualties in the Ukraine-Russia war attributed to drone operations, finding ways to stop hostile drones is becoming increasingly important for defence.

One way to do this is through vertically-integrated counter-drone technology. This often works by jamming the radio frequencies that drones rely on to navigate and communicate with their remote pilots.

However, current counter-drone technologies are often heavy, have narrow coverage, and require two hands to operate. As a result, they cannot be deployed to every soldier, and instead require a dedicated, trained specialist who must be in the right place to see the drone when it appears.

Australian semiconductor company, MILLIBEAM, is developing new technologies to address this challenge. Their counter-drone platform, RAKURAI (Japanese for thunderbolt), relies on proprietary semiconductor technologies and is designed to be small, lightweight and inexpensive enough to be deployed to every soldier, without diminishing performance.

“Drone technology is changing rapidly. Counter-drone technology needs to keep up just as fast,” Dr Venkata Gutta, CEO and Founder of MILLIBEAM said.

While many counter-drone technologies exist, what makes MILLIBEAM unique is its bottom-up engineering approach.

Dr Venkata Gutta explained that the company is building vertically integrated platforms that are engineered from the ground up, from the semiconductor device to the entire system. This results in a device that weighs only 1kg, much less than comparable systems that weigh up to 8kg.

"The industry has traditionally worked by buying off-the-shelf semiconductor and electronic components and putting them together. But if you want low power consumption and low weight, you need to innovate at the semiconductor device level," Dr Venkata Gutta said.

"Commercial-off-the-shelf components limit flexibility and the system architectural improvements needed to bring about significant reduction in size, weight and cost. "

MILLIBEAM also currently sells semiconductor products (RF/mmWave chips and packaged antennas) beyond a field-deployable platform like RAKURAI to the global civilian market with customers worldwide. The components are used in a variety of applications, from space satellites to communications, helping it remain resilient to market changes.

As a company that designs and manufactures its products in Australia, MILLIBEAM believes one of the biggest opportunities is to create a local foundry to bolster national resilience.

"There could be a pathway for a small, local foundry that keeps operating even if the global foundry supply chains are disrupted, and that can support defence and sovereign needs," Dr Venkata Gutta said.

"Semiconductors are critical to national resilience. So, if resilience is a key priority, building this capability has to be part of the equation."



Image courtesy of Millibeam

CASE STUDY

Silanna UV

Lighting the way for ultraviolet disinfection in industry

Australian-made ultraviolet LED technology could provide a safer, more energy-efficient way to kill harmful bacteria and viruses in industrial environments.

Across healthcare, manufacturing and food production, keeping products and processing environments free from harmful microbes is a constant challenge. In the event of contamination, the costs can be astronomical.

One way of controlling such events is the use of ultraviolet-C (UVC) light – a type of high-energy radiation that kills germs and bacteria by destroying their DNA. Historically, UVC light was generated using mercury arc lamps but it is gradually being phased out due to it's toxicity, high lamp energy consumption and use with harsh, environmentally unfriendly chemicals such as heated hydrogen peroxide to be effective.

To stay ahead of these changes, we need new and effective ways to produce UVC light.

Australian semiconductor manufacturer Silanna UV, headquartered in Queensland, is pioneering the solution by developing LEDs, that produce the shortest UVC wavelength commercially available in the world.

UVC LEDs offer many benefits over mercury lamps: they use less power and can be switched on and off quickly. They are made using a combination of key semiconductor materials, including aluminium nitride and gallium nitride, through Silanna's patented 'short-period superlattice' technology.

"In the visible light industry, the lights in your room used to be incandescent bulbs, and now they're all LEDs. The same is about to happen in the UVC world, where they're going to transition from a heated, wet chemical environment to a completely dry, low-energy solution," Dr Robbie Charters, Vice President – Operations at Silanna UV explained.

Silanna's UV LEDs can operate in harsh environments, such as cold, damp conditions where bacteria, including Listeria, can be difficult to control.

While the company outsources some of its fabrication overseas, the international market isn't always a good answer. One of the major challenges Silanna faces as a smaller company has been finding foundries that will produce the lower volumes it needs.

"Foundries typically have to run at 90% capacity to make money. The potential to be bumped by one of their big customers is very large and very real," said Dr Robbie Charters.



Silanna engineers at the company's Brisbane epitaxial wafer manufacturing facility, where advanced processes are used to develop next-generation ultraviolet LED technology
Image courtesy of Silanna UV

With no common facility for low-volume production in Australia, Silanna has had to build its own facility in Brisbane to expand its capability beyond prototype development.

The Brisbane facility brings more in-house fabrication capability to improve supply-chain resilience, but Silanna said access to a commercial semiconductor fabrication facility (fab) in Australia with scalability to higher volume production would make a major difference.

"The facility would need to be commercially run by semiconductor professionals who understood the market, with reliable processes, predictable timelines, demonstrated yields and internationally competitive costs."

In terms of opportunities, Silanna believes Australia could build on the things it already does well.

"Australia has existing strengths and expertise in areas that we can target and grow manufacturing capability in."

3.3. The strategic importance of domestic semiconductor capability

The scale and interdependence of the global semiconductor supply chain has led governments abroad to describe semiconductors not merely as an industrial input, but as a keystone technology – one whose disruption has consequences disproportionate to its direct size. The United States Department of Energy, in its 2022 assessment of semiconductor supply chain risk for example, described conventional semiconductors as "essential to the operation of nearly every electronic device, including those central to decarbonisation such as electric vehicles, industrial and building systems, and electricity generation."

Analysis by Semiconductor Industry Association and Boston Consulting Group has found that the globally integrated, geographically specialised semiconductor supply chain delivers substantial cost efficiencies relative to a fully self-sufficient model, but that this efficiency comes with concentration risk: more than fifty points in the global value chain are dependent on a single region for more than 65 per cent of global supply, and advanced logic fabrication below 10 nanometres is concentrated almost entirely in Taiwan and South Korea.²¹ The OECD has separately found that semiconductors account for a small share of the value of final electronics products but exhibit low substitutability, meaning a disruption in chip supply has effects disproportionate to the value of the chips themselves.²²

Australia is a near-total importer of semiconductor devices, a position that persisted without serious challenge for decades on conventional grounds of comparative advantage. During the pandemic-era shortage however, Australian entities reliant on semiconductor devices experienced substantial delays for components that had previously been available within weeks.²³ Most technologies on the Australian Government's List of Critical Technologies in the National Interest depend, directly or indirectly, on the same concentrated supply chain.²⁴ The aftermath of the pandemic continues in part – due to two factors. The exponential growth and demand for the global semiconductor industry has stressed the supply chain in terms of semiconductor costs, lead times and component availability, and the small size of our firms and their volume means they are quickly de-prioritised.

Sovereign capability does not require the capacity to manufacture every component domestically – a goal neither realistic nor efficient for an economy of Australia's scale. It does require Australia to become more resilient to supply disruption, so that critical national systems keep operating when access to overseas components is constrained. The strategic case is an argument for targeted capability in the segments where Australia can credibly compete and where trusted access matters most, not an argument for self-sufficiency.

Reflecting the growing strategic importance of semiconductors, comparable economies have moved to national strategies backed by substantial public investment. Table 3.2 summarises these responses.

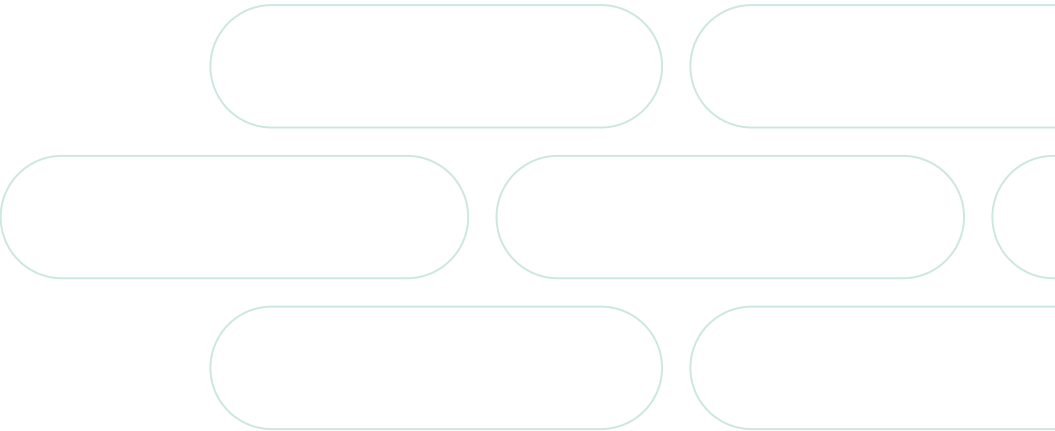
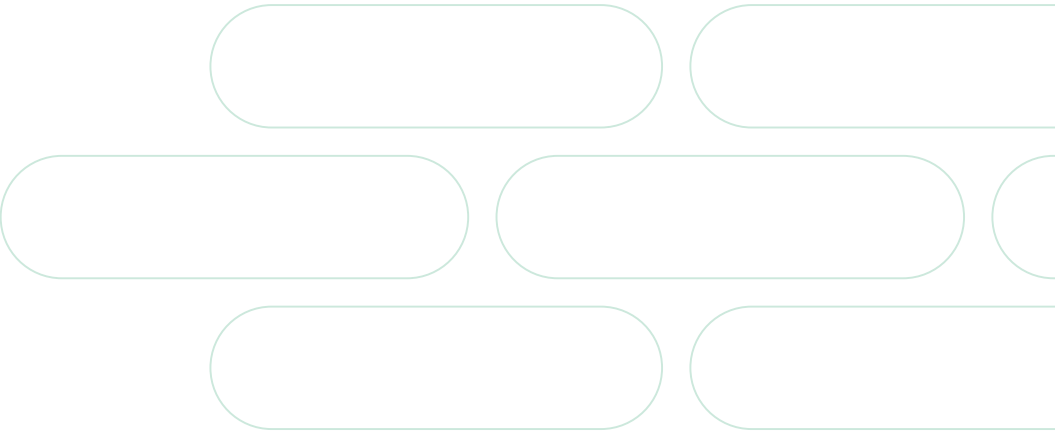


TABLE 3.2: GLOBAL SEMICONDUCTOR STRATEGIES

ECONOMY	STRATEGY OR INSTRUMENT	PUBLIC COMMITMENT	FOCUS
UNITED STATES ^{25,26}	CHIPS and Science Act (2022); One Big Beautiful Bill Act (2025)	US\$52.7 billion appropriated for FY2022–FY2027, including US\$39 billion in manufacturing incentives and US\$11 billion for R&D. The advanced manufacturing investment tax credit rose from 25 to 35 per cent for property placed in service after 31 December 2025	Onshoring leading-edge manufacturing; R&D
CHINA	National IC Industry Investment Fund, Phase III (2024)	Registered capital of RMB 344 billion	Self-sufficiency across equipment, materials and manufacturing
TAIWAN	Taiwan Chip-based Industrial Innovation Program (2023); Statute for Industrial Innovation, Article 10-2 (2023)	NT\$300 billion over 2024–2033. Separately, tax credits of 25 per cent for forward-looking R&D and 5 per cent for advanced-process equipment	Generative AI and chips; IC design talent; heterogeneous integration
SOUTH KOREA ^{27,28}	K-Chips Act (2023, amended 2025); semiconductor support package (2025); Semiconductor Special Act (2026)	Facility investment tax credits rose from 15 to 20 per cent for large and medium-sized enterprises and from 25 to 30 per cent for SMEs. The support package is ₩33 trillion, up from ₩26 trillion announced in May 2024. The Semiconductor Special Act establishes a dedicated special account, proposed at ₩2.6 trillion in the 2027 Budget	Memory leadership; mega-clusters and supporting infrastructure
JAPAN ^{29,30}	Semiconductor and Digital Industry Strategy (2021, revised 2023); AI and Semiconductor Industry Strengthening Framework (2024)	More than ¥10 trillion in public support to FY2030, with a target of more than ¥50 trillion in combined public–private investment over ten years	Leading-edge logic (Rapidus); attracting foreign fabs (TSMC Kumamoto)
EUROPEAN UNION ³¹	European Chips Act (2023); Chips Act 2.0 (proposed June 2026)	More than €43 billion in policy-driven public investment to 2030, of which €3.3 billion is from the EU budget; the balance is mainly member-state aid	Manufacturing, pilot lines and supply monitoring
INDIA ³²	India Semiconductor Mission (2021); ISM 2.0 (2026)	ISM: ₹76,000 crore, with fiscal support of up to 50 per cent for fabs, assembly and test, and design. ISM 2.0: ₹1,27,500 crore, approved by Cabinet in July 2026	Fabs, assembly and test, design; equipment and materials under ISM 2.0
SINGAPORE	NSTIC R&D Fab (2025); RIE Flagship in Semiconductors (2026)	About S\$500 million for the NSTIC R&D fabrication facility, operating from 2027; S\$800 million for the RIE Flagship	Advanced packaging, advanced photonics, power electronics

MALAYSIA ³³	National Semiconductor Strategy (2024)	At least RM25 billion in fiscal support; target of at least RM500 billion in investment in Phase 1; 60,000 high-skilled engineers	Moving from assembly and test into IC design, advanced packaging and equipment
UNITED KINGDOM	National Semiconductor Strategy (2023)	Up to £200 million over 2023–2025 and up to £1 billion over the following decade	Design and IP, compound semiconductors, R&D
IRELAND	Silicon Island: National Semiconductor Strategy (2025)	No fixed envelope. Aims to secure a leading-edge fab in a regional location, two trailing-edge foundries and an advanced packaging facility; more than €70 million earmarked for participation in EU pilot lines	Fabrication, advanced packaging, design, R&D
VIETNAM	Semiconductor Industry Development Strategy to 2030, vision to 2050 (2024)	No dedicated fiscal envelope. Targets at least 50,000 engineers and graduates across the value chain by 2030	Design, packaging and test; foreign investment attraction
THAILAND	National Strategy for the Semiconductor and Advanced Electronics Industry (2026)	No fixed fiscal envelope; delivered through BOI tax incentives, grants and low-interest finance. Targets about US\$80 billion in cumulative investment by 2050 and 86,600 skilled workers by 2030	Advanced packaging and test; power semiconductors, photonics and sensors; front-end readiness
SPAIN ³⁴	PERTE Chip (2022)	€12.25 billion in public investment to 2027 from NextGenerationEU funds, of which €9.35 billion is for fabrication plants	Fabs, design, R&D, chips fund
CANADA	Semiconductor Challenge Callout (2022)	C\$150 million from the Strategic Innovation Fund, increased to C\$250 million in March 2023	Photonics, compound semiconductors, packaging

Note: Headline figures are not directly comparable. Some are authorised appropriations, some mobilisation targets, some registered fund capital, and some uncapped tax credits.



Australia has begun to engage with this architecture. It is a signatory to the Pax Silica Declaration, signed in December 2025 with Japan, South Korea, the United Kingdom, Singapore, Israel and the United States, which commits partners to cooperate on strategic technology supply chains – including compute and semiconductors, minerals refining and processing, and advanced manufacturing.

Australia is also a member of the diplomatic partnership, the Quad, alongside India, Japan and the United States. The Quad launched a Semiconductor Supply Chain Initiative in 2021 to map capacity and identify vulnerabilities across members' supply chains, and in 2024 finalised a memorandum of cooperation establishing a Semiconductor Supply Chains Contingency Network to address supply chain risks jointly.

As allied countries build out supply chains deliberately structured to reduce single-region dependence, they are creating demand for exactly the specialised, trusted capability Australia is positioned to supply. The window for establishing a role and meaningfully participating in those chains is open while they are still forming, but it will not stay open indefinitely. The strategic task is to convert these commitments into investment security, co-investment and supply chain access – an outcome that requires sustained, deliberate effort rather than passive participation.

Part 4

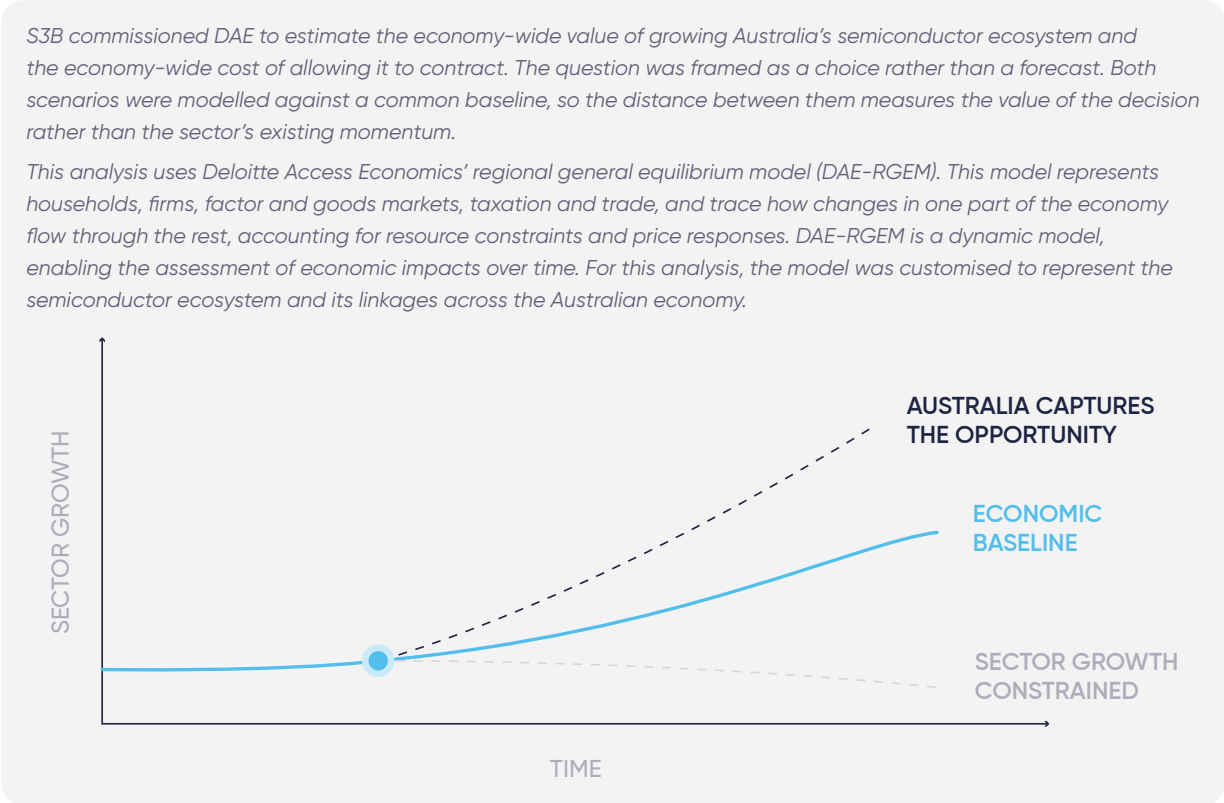
Australia's Semiconductor Opportunity

The future of Australia's semiconductor sector is a choice we need to make as a nation. Australia can either choose to build on the semiconductor capability, expertise and talent we have developed over decades, and invest in a future that is synonymous with being an advanced and complex economy; or we can step back and allow others to reap the benefits.



This section estimates the economic consequence of that choice using insights provided by DAE and their regional general equilibrium model (DAE-RGEM). Figure 4.1 summarises the modelling approach.

FIGURE 4.1: APPROACH TO COMPUTATIONAL GENERAL EQUILIBRIUM (CGE) MODELLING



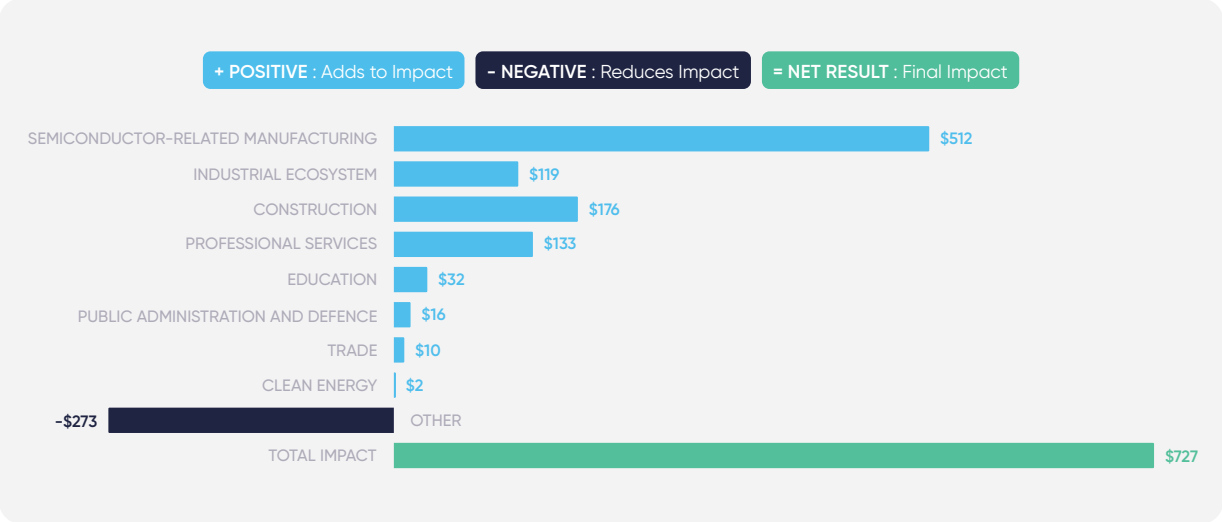
4.1. Investing in Australia's future economy

The first scenario asks what if, by 2040, **Australia's specialised semiconductor capabilities were enabling the growth and competitiveness of priority sectors, strengthening national resilience, and participating in global supply chains?**

To represent that future, DAE modelled the ecosystem growing at an average annual rate of approximately 7.5 per cent. This was consistent with the growth of comparable international semiconductor ecosystems that have expanded through design, R&D, IP, advanced materials and specialised manufacturing strengths.³⁵

In that future, the output of Australia's semiconductor ecosystem could be triple what it is today.

CHART 4.1: AVERAGE ANNUAL GAIN IN VALUE ADDED BY INDUSTRY, GROWTH SCENARIO, 2027–2040



Source: Deloitte Access Economics, 2026.

DAE's modelling shows that between now and 2040, a semiconductor ecosystem supported to scale could add \$5.3 billion in economic value in present value terms. The gains accumulate through several channels:

- » R&D investment lifts productivity within semiconductor firms.
- » Collaboration and clustering amplify those gains across the ecosystem as it grows.
- » The industries that use semiconductor innovation become more efficient as domestic supply expands.

The combined effect flows through to value added and employment across the economy. The largest benefits come when semiconductor capability is matched by the industrial base needed to commercialise innovation, scale firms and diffuse new technologies.

The gains extend well beyond the sector. The investment, commercial activity and demand for specialised services that a growing ecosystem generates benefit the industries around it (Chart 4.1). Average annual gains in value added over the modelled period reach:

- » \$512 million in semiconductor-related manufacturing;
- » \$176 million in construction;
- » \$133 million in professional services;
- » \$119 million across the broader industrial ecosystem.

Scaling the ecosystem could support an additional 10,000 workers across the economy by 2040. More than half would be employed within the high-skilled semiconductor ecosystem itself and more than a quarter in supporting professional services. Public administration and defence could gain almost 500 workers, strengthening sovereign capability. Education, government services and advanced industry all expand in response to rising demand for specialised skills.

Realising this future means overcoming challenges that stakeholders raised consistently during the engagement phase. Stakeholders are keen to see Australia specialise in areas of existing strength rather than pursue end-to-end capability. They point to a shortage of experienced mid-career professionals, a funding cliff between research and commercial scale, and gaps in the pilot-scale infrastructure that links laboratory research to volume production.

Above all, the sector are calling for national leadership: a long-term national strategy, stable policy settings and a coordinating body to bring together capability that is currently spread across jurisdictions and institutions. The seven priorities that emerged are summarised in Table 4.1 and set out below.

TABLE 4.1: CONSOLIDATED STAKEHOLDER PRIORITIES

Priority	What Stakeholders Said
1. Focus on specialisation and areas of Australian strength	Stakeholders decisively rejected the idea of Australia building broad, end-to-end value chain capability. Around 85 per cent favoured specialisation, building on existing strengths or concentrating on a small number of strategic areas, over broad expansion or maintaining current capability. Stakeholders identified the top three areas of opportunity as design-led and application-specific integration, followed by semiconductor-enabled quantum systems and advanced semiconductor devices and materials. Other areas that featured strongly in the feedback included advanced packaging, critical minerals, quantum sensing and photonics.
2. Build workforce depth and capability	The need to build semiconductor workforce capability emerged as one of the strongest and most consistent themes raised by stakeholders. Over half of participants cited workforce skills gaps as a major constraint on their organisation's ability to scale and grow. Stakeholders described the problem precisely: a domestic shortage of experienced mid-career and senior professionals, and of the commercialisation and production knowledge those roles carry, alongside graduates who are not industry-ready in practical, hands-on skills. The cause is structural, as no dedicated semiconductor pathways or programs currently exist. Internships and placements, industry-led training and international university partnerships were the most strongly favoured interventions. Attracting experienced international professionals was identified as a necessary complement, addressing immediate capability gaps that domestic pathways cannot close in the short term.
3. Strengthen commercialisation and scale-up pathways	Stakeholder feedback points to a funding cliff. Access to funding, capital and support concentrates in the early and applied research stages, then tapers sharply as projects move towards commercialisation and workforce development. The outcome data bears this out: a third of funding recipients report commercial products or services as an outcome, against two-thirds reporting new technology development. Scale-up and manufacturing funding gaps were cited by 38 per cent of all respondents. The result is an ecosystem with genuine depth in R&D but limited depth in the transition to commercial scale.
4. Target investment in enabling and strategic infrastructure	Stakeholders raised concerns about limited access to pilot-scale and low-volume production-grade infrastructure and equipment, and about the cost of accessing design tools and prototyping capability. Together these point to a gap in the translation layer between laboratory-scale research and manufacturable output.
5. Develop a national semiconductor strategy and long-term policy framework	Stakeholders consistently called for a national strategy and stable, continuous policy settings rather than one-off programs. A coordinated national semiconductor strategy and long-term policy framework was the top-ranked government action sought by stakeholders. Stakeholders noted that semiconductors currently compete with more established state and territory priorities, particularly in constrained fiscal environments.
6. Establish a national coordination mechanism	A central coordinating body or national industry hub was the top-ranked coordination mechanism. This finding was reinforced independently across every government consultation conducted, not only in the survey. Stakeholders saw such a mechanism as the means of improving visibility of jurisdictional and national capability and building a coherent ecosystem able to compete globally. Participants also noted the role of government not only as an enabler but as a customer, creating the demand and procurement conditions that support the growth of the semiconductor sector and the industries it enables.
7. Increase participation in trusted global supply chains	Stakeholders emphasised the importance of strengthening how Australian firms connect into global ecosystems. Global integration enables participation in advanced technology development, but access is shaped by scale, commercial relationships, technical readiness and position within global markets. Stakeholders identified two preferred routes: establishing strategic partnerships with leading semiconductor nations, and attracting global semiconductor companies and investment to Australia. They were also clear about the terms of that engagement. Australia should articulate a value proposition built on its strengths, rather than approach strategic relationships from a position of domestic need.

4.2. Stepping back

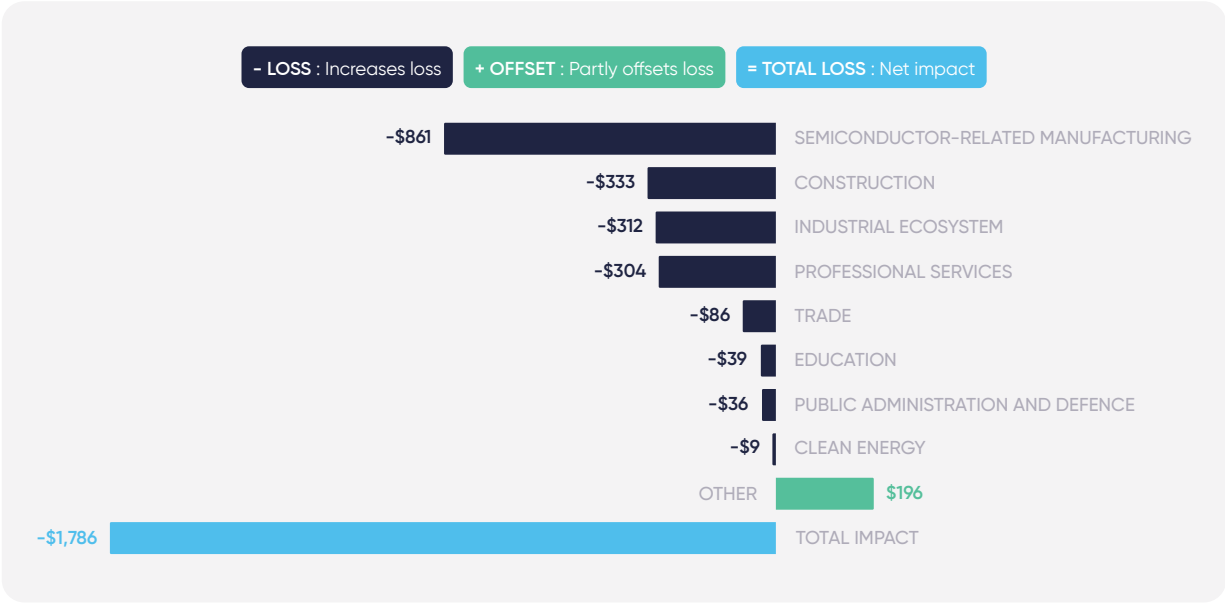
The second scenario asks what happens if that barrier stays in place. It represents a severe but plausible “no coordination” future, in which policy support, industry investment and workforce development fail to keep pace with international competitors.

In this scenario, Australia’s semiconductor ecosystem and its specialised workforce contract progressively from 2027.

From 2027 to 2040, the unwinding of Australia’s semiconductor ecosystem could reduce economic activity by \$14.7 billion in present value terms. Semiconductor-related manufacturing accounts for \$7.9 billion of that loss, construction \$3.1 billion and professional services \$2.5 billion (all in present value terms).

The scenario could cost almost 12,500 jobs, including more than 3,200 in semiconductor-related manufacturing, almost 2,700 in professional services and 2,500 in construction. Chart 4.2 shows the sectors most affected.

CHART 4.2: COMPOSITION OF VALUE ADDED AND EMPLOYMENT CHANGES, CONSTRAINT SCENARIO



Source: Deloitte Access Economics, 2026.

The composition matters as much as the size. Losses concentrate in knowledge-intensive, high-productivity industries, while modest gains appear in agriculture, mining and fossil fuels. Activity shifts away from precisely the industries Australia is trying to grow, reducing the economy’s long-term complexity and competitiveness.

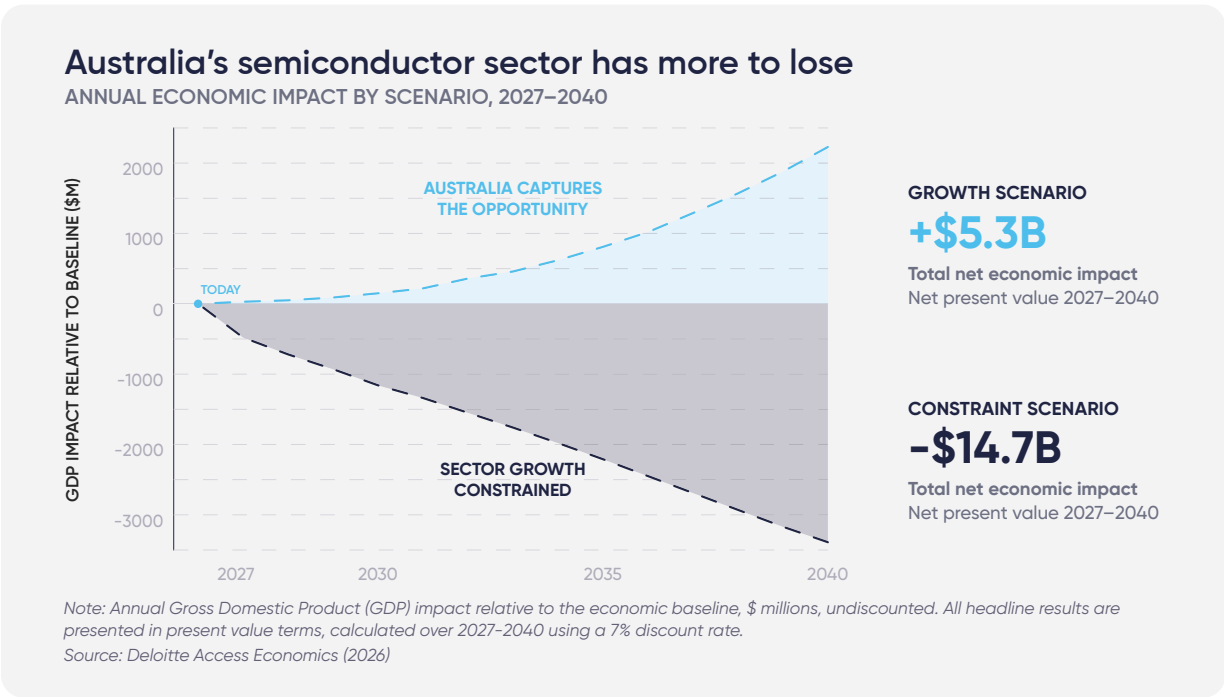
The less visible loss is the productivity spillover. Semiconductors are not a standalone industry to be won or lost in isolation. They are a foundational capability underpinning quantum, AI, advanced manufacturing, critical minerals, the energy transition, defence and digital infrastructure. Capability built in the sector shows up as productivity in the industries that use it. As the ecosystem unwinds, those gains are curtailed with it, so the economy loses not only the sector’s output but the compounding benefit of its research base. An ecosystem that drops away constrains growth in every industry that depends on that capability, and forecloses value Australia could otherwise capture from future waves of technology-driven growth. Sovereign capability in defence is not insulated from this. It rises and falls with the ecosystem.

This is a resilience question as much as a growth question. As global semiconductor supply chains grow more complex and more exposed to geopolitical disruption, the case for domestic capability has shifted from a purely commercial argument to one that also bears on security and sovereignty. The estimated loss is not only foregone growth. It deepens Australia’s exposure to supply chains it does not control, in the technologies most critical to its economic and national security.

4.3. A clear choice for action

The difference between the two paths is approximately \$20 billion in present value terms to 2040. That figure is the \$5.3 billion Australia would forgo by stepping back plus the \$14.7 billion it would lose. The employment gap is comparable: around 10,000 jobs gained on one path and almost 12,500 lost on the other.

CHART 4.3: PRESENT VALUE ECONOMIC IMPACTS BY SCENARIO



Note: The difference between the two scenarios, approximately \$20 billion, is the sum of the constraint scenario loss (\$14.7 billion) and the growth scenario gain (\$5.3 billion). It is not a single modelled result.

Source: S3B analysis based on Deloitte Access Economics, Foundations for the future: Economic baseline and growth potential of Australia's semiconductor sector, prepared for S3B, September 2026.

The case for acting is not speculative. It is supported by economic modelling and by a consensus among those working at the coalface. It is also reflected in the actions of Australia's international partners. As above mentioned, over 20 countries among Australia's major allies including the United States, Europe and Japan have responded with their own strategies and targeted, state-based investment to semiconductor capability.

The vision for Australia's semiconductor sector is ambitious; but it also achievable. Australia has ground to make up and a window in which to capture a share of the value chain and build a sector resilient enough to enable the growth and competitiveness of its critical industries and future technologies and participate in global supply chains. Through this process the sector has sent a clear signal to S3B that they are ready to do their part. What it needs is the national leadership, investment and coordination to turn that capability into scale.

Part 5

Capability Focus Area

Australia's semiconductor future depends on choosing to build capability where Australia already holds demonstrated research or commercial strength, and on significant, committed and targeted investment in the areas that offer the greatest global relevance.

Four capability areas meet that test: materials, technologies, manufacturing services, and products and applications (Figure 5.1). The capability focus areas service a number of national priority sectors³⁶ and respond to key global market categories – industrial and server and network.

The organisations, facilities and projects behind each capability focus area are profiled in Appendix B.



FIGURE 5.1: CAPABILITY FOCUS AREAS



National Priority Sectors

- Artificial intelligence
- Energy transition
- Defence
- Data centres and digital infrastructure
- Advanced manufacturing
- Health
- Quantum technologies
- Transport
- Communications
- Space

5.1. Materials

Materials span two points in the value chain: the ultra-high-purity feedstocks that enter semiconductor manufacturing, and the advanced materials that support device innovation and application development. Materials feed the other three capability areas rather than reaching end markets directly, so the markets they serve are those of the devices and systems they make possible.

SEMICONDUCTOR-GRADE INPUTS

Semiconductor-grade inputs are the raw materials and refined feedstocks, such as silicon, gallium and germanium, that must meet ultra-high purity standards before entering semiconductor manufacturing. This is the most upstream point in the value chain and the point at which Australia’s mineral endowment connects most directly to its semiconductor ambitions. It is also the clearest point of existing federal support for semiconductor inputs.

Australia already produces neutron transmutation doped (NTD) silicon and high-purity silicon metal, and refining and processing projects in gallium recovery, high-purity quartz, high-purity alumina, antimony and fluorite are moving from feasibility towards production under the Critical Minerals Strategy 2023–2030³⁷. In addition, there are at least another 12 critical minerals classified with moderate to high geological potential that have significant semiconductor applications worth exploring.³⁸ The aim is not to compete on volume but to refine and process more of these minerals onshore, through projects anchored by allied partners where trusted-supply-chain demand already exists.

The case is strategic as well as commercial: a reliable supplier of refined critical minerals becomes a partner allies depend on, and that standing strengthens Australia’s access to the parts of the value chain it will continue to source from those partners. The most direct applications are power electronics, radio-frequency and photonic devices, and chip packaging and wafer processing, with defence, energy and communications customers placing the highest value on trusted supply.

Alpha HPA

World-first alumina purification process meets booming industry demand



Image courtesy of Alpha HPA

Every AI data centre generates enormous amounts of heat. As a result, most large data centres don't operate at 100% capacity to avoid the risk of overheating.

One way to address this challenge is through improved thermal packaging, which moves heat more efficiently away from the AI chips to keep the hardware cool. High-purity alumina is rapidly becoming the preferred material for carrying heat away from chips to a data centre's cooling system.

Alpha HPA is a Queensland-based company that produces ultra-high-purity alumina through its proprietary solvent extraction purification technology, ideal for use in applications such as thermal packaging, semiconductor manufacturing, pharmaceuticals and lithium-ion batteries.

In thermal packaging, Alpha HPA's high-purity alumina is used in the heat-conductive packaging that surrounds semiconductors in AI data centres, with end users across Korea, Japan, Taiwan and the US.

For the same electricity input, a data centre could run closer to full capacity, instead of the limits many operate at today. "The higher the purity of the alumina packaging, the better for the operator of the data centre," Mr Rimas Kairaitis, Executive Director and Chief Commercial Officer at Alpha HPA said. High-purity alumina also forms components inside semiconductor fabrication equipment itself.

"As semiconductors become more advanced, the purity requirement becomes extreme," Mr Rimas Kairaitis explained.

Demand for Alpha HPA's material is rising, driven by the push towards more advanced semiconductors and, above all, AI data centres. "It's definitely the dominant area of growth, and starting to swamp everything," Mr Rimas Kairaitis said.

Alpha HPA's scale up is occurring in stages to meet the growing industry demand. Its Stage One facility in Gladstone produces around 360 tonnes of high-purity aluminium materials a year and qualifies as a trusted supplier to the semiconductor, AI data centre, pharmaceutical and lithium-ion battery industries. Stage Two is currently under construction in Gladstone and will lift output to just over 10,000 tonnes a year, with production starting late next year and full capacity by 2029. "It will potentially be the world's largest facility of its kind," Mr Rimas Kairaitis said.

Staying onshore was a deliberate choice for Alpha HPA, even though the company acknowledges it could have built the same operation overseas, at similar industrial sites in Canada or Indonesia. "We're Team Australia," Mr Kairaitis said.

"It is a story of Australian-owned and developed IP being commercialised in Australia."

That choice was reinforced by a practical advantage in Gladstone. Alpha HPA's chemical process has a strong process synergy with the neighbouring Orica facility that supplies the high-volume nitric acid and ammonia its refining depends on.

Looking further ahead, Alpha HPA expects to expand within five years, with a possible Stage Three built on or near the same site. Mr Rimas Kairaitis says a recent increase in demand from the semiconductor sector adds to its expanding sales pipeline as construction of Stage Two continues.

The company described how few specialised supply chain participants exist worldwide and how technically difficult the sector is to break into from scratch. "We have a big opportunity in Australia in the semiconductor sector," Mr Kairaitis said, adding that in high-purity alumina specifically, "we are ahead, and we need to support it."

Image courtesy of Alpha HPA Stage One Facility. Steven Wade Photography (2025): www.stevenwade.photos

ANSTO

Supporting semiconductors from high grade silicon inputs to applications in energy, transport, space and beyond



Preparing silicon ingots for irradiation in OPAL
Image courtesy of ANSTO

Semiconductor technologies require specialised infrastructure to ensure they can be manufactured, tested and used reliably.

Australian Nuclear Science and Technology Organisation (ANSTO) supports the semiconductor sector in two distinct ways: through its silicon irradiation service, which forms part of global power semiconductor manufacturing supply chains, and by providing national infrastructure that researchers and industry can access to develop, characterise and optimise materials used in semiconductor technologies.

ANSTO's Lucas Heights facility in NSW is home to OPAL, Australia's only multi-purpose nuclear reactor. OPAL is part of Australia's nationally significant scientific infrastructure, supporting health, industry, research and technology.

Using OPAL, ANSTO irradiates high-purity silicon (also known as neutron transmutation doped (NTD) silicon) by changing some of the silicon atoms to phosphorus to dope the material, giving it semiconductor properties. ANSTO has been irradiating NTD silicon since 1986, and OPAL was specifically designed to continue this important capability. "We are considered the world leader in this area by volume and quality," said Oleh Nakone, ANSTO's Group Executive, Nuclear Medicine and Commercial.

Creating NTD silicon changes the material's electrical properties in a very precise way, making it useful for a variety of technologies, such as power semiconductors. Power semiconductors enable critical components used in high-speed rail, wind turbines and 'smart' power grids that manage complex energy flow between dispersed energy sources. This includes solar and wind farms, conventional sources and even domestic photovoltaics, reliably connecting to end users. As a result, the unique properties of NTD silicon make the material important to Australia's energy transition.

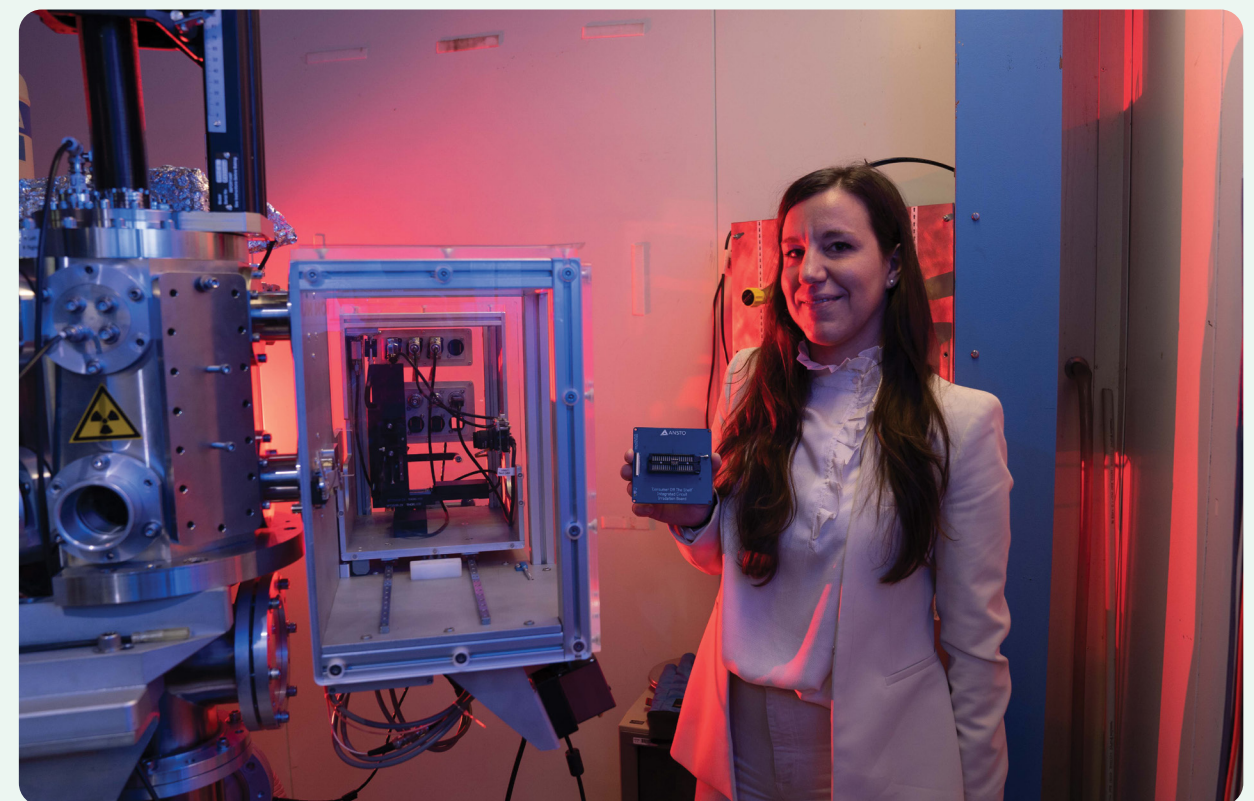
"Energy no longer just flows from the source to your house or industry. Now, there is a multi-directional flow – your house may also be generating energy. Grids now need to be able to handle complex supply and demand systems," Mr Nakone said. "Power semiconductors are key to this."

Australia has limited silicon manufacturing. Instead, overseas foundries send silicon to ANSTO for irradiation before it is returned for further processing. This places Australia directly within an international power semiconductor manufacturing supply chain and demonstrates how Australia's capability can support global technologies.

Beyond manufacturing, ANSTO provides a suite of facilities for radiation testing and development of semiconductor materials and devices. These facilities include the Centre for Accelerator Science, Gamma Technology Research Irradiator, the Australian Centre for Neutron Scattering, and the Australian Synchrotron in Victoria. These facilities provide access to advanced scientific instruments and all the types of radiation that semiconductor devices can encounter in space. This includes protons, ions, gamma radiation, X-rays and neutron beams, which support critical technology R&D across academia, industry and government.

ANSTO's facilities can evaluate the performance of semiconductor technologies under harsh radiation environments, such as those found in space, aviation or nuclear applications. This helps test whether they can withstand these environments and optimises their performance under these conditions. For example, a research group from Swinburne University used facilities at the Centre for Accelerator Science to understand the impact of radiation damage on the performance of memory and micro processing chips used in space satellites.

"We support Australian industry to grow and compete on a global scale," said Mr Nakone. "The radiation testing and hardening business is undergoing a period of growth. Australia, with its partners, entered the space race a couple of years ago. Overseas facilities can be extremely expensive, overbooked and not easily accessible," Mr Nakone explained. "Having this infrastructure domestically available is part of Australia's broader investment into sovereign capability, national resilience and building a more competitive and resilient sector."



Radiation testing chamber sample
Image courtesy of ANSTO

ADVANCED MATERIALS

Advanced materials are the new and emerging materials used in semiconductor devices, or in products made with semiconductor processing techniques such as sensors and micro-electro-mechanical systems (MEMS). The capability spans wide and ultra-wide bandgap semiconductors, advanced packaging materials, photonic and radio-frequency materials, and two-dimensional materials.

Device performance depends on material properties, device architecture and fabrication processes as well as on circuit design, which makes this capability a foundation for higher-value products. Research strength is spread nationally, including at ANU, UWA, Griffith University and several Australian Research Council Centres of Excellence, with commercial activity at BluGlass and Silanna UV in nitride-based semiconductors and at Quantum Brilliance in diamond. These materials reach markets through the devices built from them: power conversion in energy and transport; communications, sensing and defence; quantum computing and sensing; and, for two-dimensional materials, medical diagnostics and low-energy computing.

The opportunity is to build depth in the device classes, materials platforms and specialised processes where Australia can achieve global relevance, rather than replicate the full manufacturing capability of larger semiconductor economies. This requires bridging the gap between laboratory demonstration and pilot-scale, process-controlled production—a critical step in translating Australia’s research strengths into scalable commercial capability.

5.2. Technologies

There are four device-level technology families where Australia has demonstrated research or commercial strength: quantum, photonics, power and radio. They sit at different stages of maturity. Quantum remains frontier-stage, photonics is proven commercially at the component level and Radio and Power already serve established commercial markets. Australia’s device-level strength extends beyond these four, notably to medical technology and AI hardware, which are covered under products and applications.

Stakeholders consistently ranked design-led integration and semiconductor-enabled quantum systems as the two strongest growth opportunities and singled out other areas including quantum sensing and photonics.

QUANTUM

Quantum computing, sensing and communications platforms depend directly on semiconductor materials, devices and fabrication processes. Australian companies are pursuing silicon, diamond and photonic pathways, including Silicon Quantum Computing and Diraq in silicon, Quantum Brilliance in diamond, and PsiQuantum, which is building a utility-scale, fault-tolerant quantum computer in Brisbane backed by a \$940 million joint Commonwealth and Queensland investment.³⁹

Research strength and early investment do not on their own ensure that quantum hardware is built and scaled in Australia. United States programs are already funding Australian quantum companies, some of which have built significant operations offshore. The opportunity is to build the semiconductor capability needed to support Australia’s growing quantum ecosystem. Deeper domestic capability in fabrication, packaging and systems integration would provide an enabling foundation for silicon-, diamond- and photonic-based quantum technologies, helping these pathways develop and scale in Australia rather than in isolation or offshore.

Quantum markets remain frontier-stage, with nearer-term demand emerging in quantum sensing and navigation for defence, while quantum computing remains further out. However, semiconductor capabilities used in quantum—including fabrication, packaging and cryogenic electronics—are already serving photonics and defence markets.

CASE STUDY

Silicon Quantum Computing

Where semiconductors meet quantum and AI: building quantum processors one atom at a time



Visual representation of Watermelon™
Image courtesy of Silicon Quantum Computing

Silicon Quantum Computing is showing how advanced semiconductor manufacturing in Australia can turn world-leading research into globally significant quantum technologies – and make artificial intelligence faster and more efficient.

The next generation of computing will not be shaped by quantum technologies, semiconductors or AI alone. Increasingly, the opportunity lies where these technologies converge, as an Australian company has shown.

Silicon Quantum Computing (SQC), spun out of the University of New South Wales in 2017, is developing quantum systems that help conventional AI models identify complex patterns in sparse and time-series data that they otherwise struggle to see.

Their manufacturing technology, which has been built on 25 years of research, precisely positions individual phosphorus atoms into silicon– the same material at the heart of the conventional semiconductor chips found in phones and computers. Each phosphorus atom is positioned to an accuracy of 0.13 nanometres, roughly 100 times smaller than the world’s leading semiconductor foundries like TSMC.

“Owning our globally unique, full-stack manufacturing capability here in Australia means we can design, produce, and test new quantum chips each week,” said Professor Michelle Simmons, Founder and CEO of SQC.

SQC has used this technology to develop its first commercial product Watermelon™ – a quantum feature generator for machine learning, built on a silicon-based semiconductor platform but operating on quantum principles. Watermelon can help AI models train faster, with less reliance on power-hungry graphics processing units (GPUs) – the traditional semiconductor chips that power most AI. It has applications in areas such as defence, transport, telecommunications, energy, finance and high frequency trading. SQC’s second commercial product, Quantum Twins™, uses the same atomic-precision chip-manufacturing approach to simulate chemistry and materials.

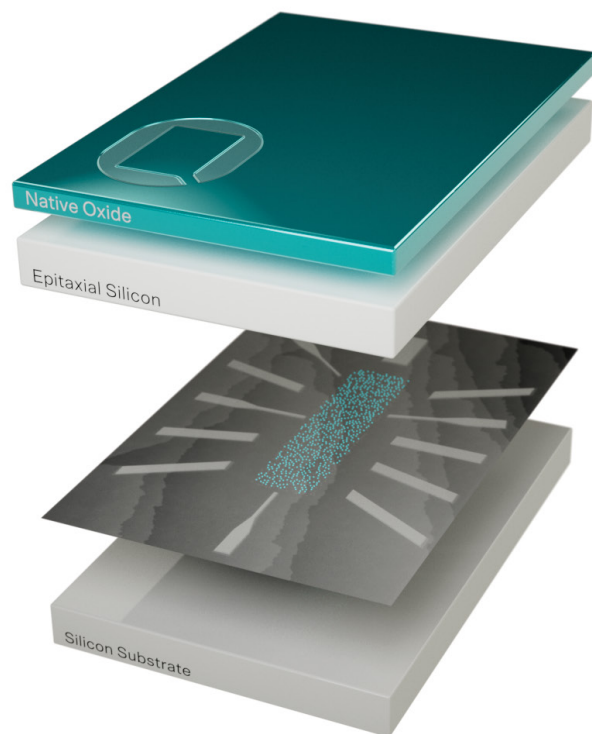
In a one-year trial with Telstra, an AI model using Watermelon predicted network metrics as accurately as Telstra’s existing deep learning model, but took days to train rather than weeks.

“Hybrid architectures combining CPUs, GPUs and QPUs provide an immediate answer to the resource and power constraints seen among classical infrastructures today,” Professor Michelle Simmons said.

Developing this type of advanced technology isn’t easy. It requires highly specialised scientists and engineers, advanced nanofabrication equipment, ultra-pure materials, cryogenic testing, sophisticated electronics, software and sustained investment over many years.

SQC is building towards its ultimate goal to deliver a full-scale quantum computer by 2033. Recently, the Australian Government backed this onshore approach with a \$60 million investment through the National Reconstruction Fund Corporation (NRFC) to expand SQC’s quantum chip manufacturing capability.⁴⁰

“For decades, Australia has established itself as an international hub for scientific excellence and innovation in quantum physics. Today, we are building on that excellence to create globally competitive products, companies and industries,” Professor Michelle Simmons said.



Watermelon – chip rendering
Image courtesy of Silicon Quantum Computing

CASE STUDY

Diraq

How semiconductor infrastructure could make quantum computers more accessible



Image courtesy of Diraq

Quantum computers work differently from the laptop or phone in your pocket. Where a regular computer uses ones and zeros to convey information, quantum computers use quantum bits, or qubits, that can exist in a combination of one and zero until they are measured.

This particular property makes them extraordinarily good and fast at solving certain problems that regular computers can’t.

However, manufacturing quantum computers comes with many challenges. Quantum computers need millions of qubits to function and are extremely fragile. Many types of qubits require conditions colder than deep space – around absolute zero – to work. In practice, this means quantum computers may struggle to fit into existing infrastructure.

Diraq is a Sydney-founded company working to close that gap.

Dr Abi Klopper, Diraq’s Technical Communications Strategist, explained that the company is “forming qubits out of modified silicon transistors,” which are the same semiconductor devices used in everyday computer chips but designed to control quantum information.

“We are using all the same techniques and materials that have been developed over the past 70 years for semiconductors, rather than developing bespoke processes. And, instead of messing with unusual materials, we can just use silicon. What that means for us is that we can get a density of qubits that no other modality can,” said Dr Abi Klopper.

Temperature and size are where designing qubits using semiconductor technology pays off again. Diraq’s qubits operate at around one kelvin – roughly a hundred times warmer than some other modalities. Combined with Diraq’s ability to fit more qubits onto a single chip, this makes the system easy to install into existing premises and far less energy-intensive to run.

Diraq has already installed a Diraq system in a data centre in Sydney as a proof of principle that it can slot nicely into existing infrastructure without much change. “There’s almost nothing that needs to be changed throughout the data centre to install a Diraq system,” Dr Abi Klopper explained. “By using the semiconductor industry, we’re minimising costs, minimising power and maximising accessibility.”

Since Diraq’s team first published the technology underpinning its silicon spin qubit design in 2014, it has progressively scaled to reach 8 qubits on a single chip this year. A 150,000-qubit chip is targeted for 2029 and more than 2 million qubits by 2031.

“Because we’re using semiconductor foundry lines, and because we’ve got this reproducible, well-worn industry path to building our chips, the next step is hundreds and then thousands,” Dr Abi Klopper said.

Reflecting on what it would take to scale further in Australia, Diraq pointed out Australian funding remains a limitation for the sector. However, Diraq sees advanced packaging as an entry point for growing Australia’s semiconductor sector. For example, Australia could build a globally competitive advanced packaging capability first, then work towards a smaller-scale foundry.

“We could start with high-quality, world-class packaging capabilities, then build towards a more affordable, less advanced tier-2 foundry. Over time, as the industry grows, it may eventually make sense to establish a tier-1 foundry in Australia,” Dr Andrew Dzurak, CEO of Diraq said.

“But whatever we build needs to be cutting-edge, so Australian and international customers will want to access it, rather than go offshore.”

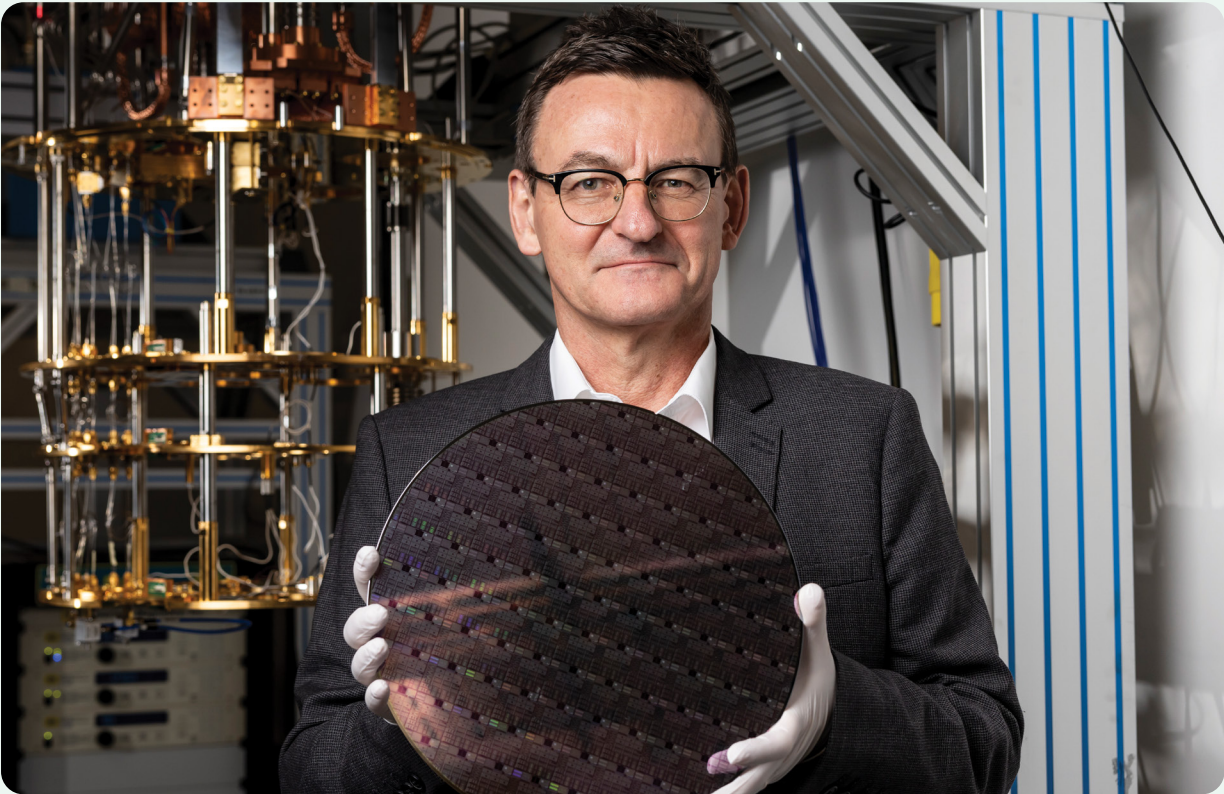


Image courtesy of Diraq. Diraq CEO & Founder holding Diraq’s wafer.

PHOTONICS

Photonics covers the design and fabrication of devices that generate, manipulate and detect light, including lasers, optical sensors, waveguides and photonic IC. Photonics serve communications, navigation, sensing and quantum technologies.

Australia’s capability spans research at Macquarie University’s Photonics Research Centre and the Australian Research Council Centre of Excellence in Optical Microcombs for Breakthrough Science, through prototyping in the ANFF network, to commercial products such as Advanced Navigation’s photonic chip for digital fibre-optic gyroscopes and BluGlass’ gallium nitride laser diodes.

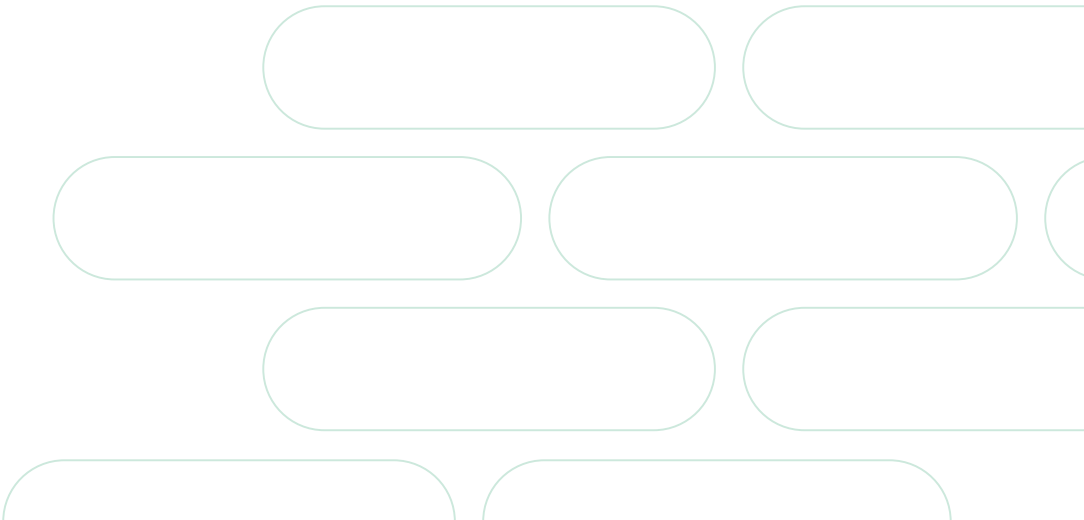
Photonics is one of the clearest cases of a capability already proven commercially at the component level but constrained by the same translation-layer gap affecting advanced materials. The opportunity is to connect this research and early commercial base to the packaging and integration capability discussed below, so photonic components can move into deployable systems rather than remaining component-level exports.

POWER

Power encompasses two related technology streams: power semiconductors and photovoltaics.

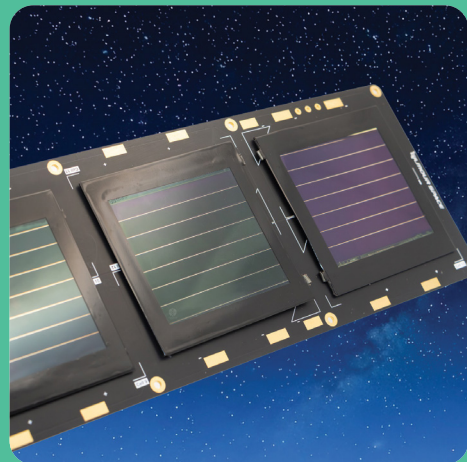
- » Power semiconductors control and convert electricity across grids, electric drivetrains and industrial systems. In the most demanding applications, wide-bandgap semiconductors are increasingly replacing conventional silicon because they can operate at higher voltages and temperatures with lower energy losses. Griffith University, ANU and UWA hold wide bandgap research capability, Queensland Semiconductor Technology (Questsemi) is developing silicon carbide devices, and ANSTO’s NTD silicon is used in high-power devices such as insulated-gate bipolar transistors.⁴¹
- » Photovoltaics convert sunlight directly into electricity using semiconductor materials. Australia has longstanding strength in this field: UNSW, Sydney pioneered and refined the high-efficiency silicon cell architectures that now underpin around 90 per cent of worldwide silicon solar module production.⁴² Despite this technology leadership, Australia did not develop the manufacturing capacity to scale this innovation domestically.

Some commercial activity exists including SunDrive – developing copper-based silicon solar cell technology, and regional company Halocell – developing next-generation perovskite solar technology. Both technology streams connect Australia’s semiconductor sector directly to the energy transition, spanning solar generation, grid and storage systems, electric transport and industrial power applications. The opportunity is to better connect research and technology development with manufacturing and supply-chain investment, so future Australian innovations can be scaled and commercialised domestically.



Halocell

Printing the next generation of solar panels in regional Australia



Halocell Space array
Image courtesy of Halocell

Printable semiconductor technology could open new opportunities for solar energy, space and advanced manufacturing.

The demand for renewable energy is surging. AI, data centres and everyday technology all need huge amounts of energy, and unstable oil prices are pushing countries to invest in alternative options. Solar energy is abundant, affordable and increasingly converted into usable power through new technologies.

Halocell, an industry-leading solar technology company based in Wagga Wagga, NSW, develops solar cells using a material called perovskite. Perovskite is a natural mineral that alone has limited uses; however, once combined with other materials, it becomes a semiconductor that is very good at turning sunlight into electricity.

The company mixes perovskite into special inks that can be printed in layers onto plastic. The layers are thinner than a human hair and can be “printed like banknotes or newspapers.” Halocell said, “It’s much quicker, requires less labour and is less energy intensive than manufacturing traditional silicon solar panels.”

While most solar panels today rely on silicon, they are heavy, rigid and extremely condition-dependent. Additionally, their performance drops significantly on cloudy days or when the sun’s angle isn’t optimal.

Perovskite as a material can be adjusted to capture particular kinds of light. “You don’t need the perfect temperature, you don’t need the perfect angle, and you could even do it under cloudy conditions,” Halocell said.

Halocell is starting with markets like space, where a lifespan of 3 to 5 years is sufficient. Gallium arsenide is the standard for satellite solar cells – efficient and radiation-resistant – but expensive, brittle, and made by few companies, putting it out of reach for most start-ups. Silicon is cheaper but degrades faster under radiation. Perovskite splits the difference, partially self-repairing its structure when disrupted, making it an attractive alternative.

Drones are another area of opportunity, especially in search and rescue, where flight time is critical. Battery swaps take 10 to 15 minutes – time rescuers can’t spare. Calculations with a Halocell partner suggest perovskite wing panels and a lighter motor could stretch flight time from 2 to 6 hours.

Halocell, in collaboration with its university research partners, recently received a \$19.2 million grant from the Australian Renewable Energy Agency to develop a see-through perovskite layer to place on top of existing silicon solar panels. The aim is to capture light that silicon misses, boosting the amount of energy collected without replacing the panel. This puts Halocell’s technology alongside the industry’s dominant product, rather than against it.

“We have proven the technology. We’ve proved the chemistry,” said Halocell.

Its next investment round will pay for space testing, flight trials with satellite partners, and a transition from manual, labour-intensive manufacturing to a more automatic process in Wagga Wagga.

“It could be upscaled relatively quickly with the right equipment,” the company said. This is the stage where investment counts most, because it turns a proven technology into a product.

Halocell said Australia is strong at research, but “there’s nothing to get companies past the prototype stage into development and manufacturing.”

By investing in advanced materials and manufacturing like Halocell, Australia can support growth in strategic sectors such as renewable energy and network infrastructure, while strengthening its position in the transition to net zero by 2050.



Image courtesy of Halocell

RADIO

Radio-frequency IC handle wireless communications, sensing, radar and IoT functions.

Australia has commercially mature, design-led capability in this area. Morse Micro develops Wi-Fi HaLow chips for long-range internet-of-things devices, Broadcom's Australian engineering group has shipped more than a billion Wi-Fi 6, 6E and 7 chips globally, and EM Solutions develops gallium nitride power amplifiers for satellite and on-the-move radio.

These capabilities serve telecommunications and wireless networking, industrial IoT and smart grids, satellite communications, and defence radar and communications. Defence adds particular strategic significance, given the importance of trusted and sovereign radio design capability.

The opportunity is to deepen and scale Australia's design strengths through better access to design tools and IP, stronger international pathways from design through fabrication and packaging, and workforce development, while strengthening connections to high-value defence and communications markets.

5.3. Manufacturing services

Manufacturing services cover the specialised infrastructure and technical services that surround fabrication: packaging devices into deployable systems, and measuring, testing and qualifying them to the standards commercial and defence customers require. They connect the technologies and devices described above to the products that reach customers.

Australia's capability is concentrated in specialised, high-value work rather than volume production, with firms including BluGlass, Silanna, Hendon Semiconductors and Syenta holding manufacturing-related capability.

CASE STUDY

Syenta

How an Australian company is solving one of AI's biggest bottlenecks

In just a few years, AI has become a technology hundreds of millions of people use every day, from running complex research simulations to planning a holiday.

Each time AI responds to a prompt, it needs to move data between components such as processor chips and memory chips. These chips contain billions of tiny electronic switches called transistors, which are made of semiconducting materials.

For 40 years, researchers have worked on making transistors smaller, allowing more of them to fit on a single chip. This allows computers to perform more calculations faster and has led to a 60,000-fold growth in computing power in the past 2 decades.

Now, the bottleneck has moved.

Instead of computing power, the limiting factor in AI systems now is how fast data can move between memory and processing chips.

Australian semiconductor technology company Syenta is working to address that challenge. Its technology demonstrates the opportunity for Australia to turn locally developed research into globally competitive semiconductor products.

The company has developed a new way to break through the 'AI memory wall' using a unique fabrication method called Localised Electrochemical Manufacturing (LEM).

"Every time you run an AI model, data has to move back and forth between compute and memory, and that highway is now completely congested," said Dr Jekaterina Viktorova, CEO and founder of Syenta.

"The industry is trying to fix this by adding more 'lanes' – called interconnects. But to do that you have to make the wiring smaller and smaller. That's where our technology comes in: we can create ultra fine interconnects at sub-micron scale, so you can build many more high-performance highways in the same space."

LEM was born out of research at the Australian National University, where Dr Jekaterina Viktorova completed her PhD. It offers significant advantages over conventional semi-additive processes: instead of requiring many separate steps, LEM can produce ultra-fine interconnects in only a single step, while using roughly 140 times less energy per layer and substantially fewer chemicals, all at an unmatched resolution and cost. Technologies such as LEM highlight the potential for Australian innovation to build strength in emerging areas of the semiconductor sector.



Images courtesy of Syenta

"The industry standard for interconnect resolution around the world is 2 microns. Syenta's technology allows us to produce one micron, and even sub-micron, architectures," said Dr Jekaterina Viktorova.

Its potential to address this major AI bottleneck has attracted interest from leading chip designers and manufacturers worldwide, as well as national and international investment. The technology could be used to manufacture chips globally, supporting emerging areas such as quantum, with Syenta retaining exclusive control of the IP for the process and design, stamp manufacturing, and chemistry.

Pat Gelsinger, former CEO of Intel and general partner at Playground Global, said, "AI's next scaling challenge isn't just compute, it's how chips connect. What's compelling about Syenta is that the company is tackling a key constraint in advanced packaging and contributing to the expansion of a more resilient global semiconductor ecosystem."

Syenta's story shows that Australia has an opportunity not to replicate what established semiconductor leaders already do, but to build competitive advantage in emerging areas where Australian innovation offers something different.

More than 90% of current advanced packaging is manufactured in Taiwan and there are manufacturing backlogs of 18–24 months. That translates into billions, if not trillions, of dollars of unmet orders worldwide. Syenta's technology directly addresses this bottleneck.

To continue growing and scaling in Australia, Syenta will need access to commercial-scale fabrication infrastructure, patient capital, and internationally competitive incentives. Supporting companies like Syenta to commercialise and grow locally could help retain more capability, IP and economic value in Australia.

"Australia will not compete by doing what everyone else is already doing in the semiconductor industry," said Dr. Jekaterina Viktorova. "We will be competitive by being early to the next disruptive innovation, and by backing the science, the people and the companies that can industrialise Australian research into globally relevant technology."

ADVANCED PACKAGING AND HETEROGENEOUS INTEGRATION

Value in semiconductors increasingly depends on how components, materials and functions are integrated into complete systems, through system-in-package, chiplet and three-dimensional integration, rather than on individual device performance alone.

Advanced packaging is the main engineering response to the 'memory wall' that limits AI performance, placing logic and memory close together with ultra-dense interconnects. Demand also comes from 5G infrastructure, high-performance computing, automotive electronics and edge devices.

Australia's emerging capability sits in dedicated facilities, including the newly established CSIRO's Queensland Advanced Photonics Packaging Centre (Q-APP) and the Advanced Manufacturing Readiness Facility (AMRF) Semiconductor Advanced Packaging Facility in development.

Australia's facilities are oriented towards industrial markets including defence, aerospace and medical technology, where low-volume, high-value and security-sensitive production is important. This creates a credible near-term opportunity in advanced packaging, the final manufacturing stage before semiconductor devices are characterised and deployed. While Australia currently has no large commercial-scale assembly, packaging and testing facility, its strengths are well suited to specialised applications rather than volume production.

Building domestic capability would help bridge the gap between prototype development and product deployment, retain more IP and system-level configuration in Australia, and provide a pathway for semiconductor devices, photonics and quantum technologies to move from component-level research into deployable systems.



Image courtesy of AMRF

METROLOGY, CHARACTERISATION AND TEST

Metrology, characterisation and test covers the measurement, inspection and qualification infrastructure that underpins failure analysis and quality assurance across the value chain, from the microscopes used to characterise materials in research to the electrical test systems that qualify devices for commercial and defence customers.

Australia's capability includes primary metrology standards at the National Measurement Institute, characterisation infrastructure across ANFF's university nodes and the Microscopy Australia network, and radiation-hardened chip test capability shared between the University of Wollongong, ANSTO and ANU.

Metrology also serves the other capability areas rather than an end market of its own, and its most demanding customers are in defence and aerospace, where radiation-hardened test and qualification are conditions of supply. That makes it a multiplier on the returns from investment elsewhere, not a standalone segment competing with it.

Stakeholder consultations identified this as a genuine gap. Metrology, testing and quality control was independently named as a technical skills shortage across the manufacturing workforce, and stakeholders singled out advanced microscopy and microanalysis as a critical enabler of materials discovery and process optimisation.

5.4. Products and applications

Products and applications capability covers the integration of semiconductor devices into finished, higher-value products. It is the segment that most directly matches Australia's design-led, largely fabless industry structure. It spans two related activities: integrated circuit design, where multiple functions come together on a single chip, and system integration, where finished chips are combined into complete products.

DEVICE DESIGN

IC design, chip architecture and application-specific engineering are Australia's most established and most immediately scalable semiconductor capability, and offer a pathway to growth that does not depend on large-scale domestic fabrication.

Products and applications and design and IP together account for about 67 per cent of Australian firms identified across the value chain. Design-oriented segments of the global industry capture a disproportionately large share of semiconductor market value relative to foundry and packaging. That is why this segment matters to a country without fabrication scale.

The commercial base includes Morse Micro and Broadcom in wireless (already mentioned in Radio above), BrainChip in neuromorphic processors, and AI hardware design teams at d-Matrix and AMD. Device design serves the widest range of markets of any capability area: wireless and communications, data centres and AI, defence, medical technology and industrial systems.

The main constraints on scaling Australia's design capability are access and cost rather than physical infrastructure. Electronic design automation tools and process design kits are expensive and can be complex for smaller firms to access.

S3B's subsidised design-tool and MPW programs are currently Australia's only government-backed mechanisms providing broader access to these capabilities. Other public investment in chip design has largely been directed to individual companies operating in critical technology areas, including AI and quantum computing.

The opportunity is to strengthen the conditions that allow design-led firms to scale: improving access to design tools and IP, and creating more coordinated pathways from design and prototyping through to fabrication and packaging, including access to international foundries. Successful international government-supported models already exist, including CMC Microsystems in Canada and Europractice in Europe, which provide coordinated support services that help bridge the gap between semiconductor design and fabrication. At the same time, AI is beginning to reshape semiconductor design, creating an opportunity for Australia to apply its AI expertise to the design process, particularly in areas where it already has strong domain capability. Building Australian capability in AI-enabled semiconductor design could increase design productivity and help retain more of the architecture, application knowledge and IP value created domestically, even where manufacturing remains offshore.

CASE STUDY

Cochlear

From Australian invention to global industry: lessons for the next semiconductor-based industry

Cochlear's growth from university research to a globally successful medical device company shows what strong R&D, a mix of semiconductor technology, and domestic manufacturing can achieve. It also highlights the policy settings, skills and supply chain capability needed to support more high-value manufacturing success stories in Australia.

About 1 in 5 Australians are living with hearing loss. In the year ahead, Cochlear expects to deliver its one millionth hearing implant. The device was invented, commercialised and is still largely manufactured in Australia. It has helped hundreds of thousands of people connect with family, work, study and the sounds around them.

Cochlear describes its product as a system rather than a single implant. Semiconductors help enable sound to be captured and processed externally, transmitted wirelessly through the skin, and converted into electrical signals that stimulate the auditory nerve so the user can perceive sound.

"Without semiconductors, we just would not be able to do that," said Greg Bodkin, Senior Vice President, Global Supply Chain at Cochlear.

The company uses a combination of off-the-shelf and custom-designed parts that give more control over the system's size, which matters for a device sitting between bone and skin. Thirty years ago, the processor clipped to a belt like a Walkman. Today, it can sit discreetly behind the ear or be concealed in hair.

Cochlear's success needed more than just a good invention. Professor Graeme Clark, who invented the device, needed to persist against initial resistance from academia and industry.

A combination of university research, private equity and government funding then helped turn the invention into a commercial product. Being first to market and investing in meaningful innovation also mattered, leading to the company now holding around 60% of the global market for such devices, earning more revenue than every competitor combined.

Cochlear now employs more than 5,500 people, makes about 50,000 implants a year, and exports more than 90% of its product overseas. Three of Cochlear’s six manufacturing sites are in Australia, with roughly 1,000 people working on factory lines in Sydney and Brisbane. “Cochlear implants began life in Australia, and continue to be designed, developed and manufactured here,” Mr Bodkin said.

As demand grows, Cochlear has expanded global capacity to strengthen supply chains and serve local markets. While other countries offer deep manufacturing ecosystems, particularly in high-volume electronics, Australia’s opportunity is in high-value, innovation-led manufacturing.

The lesson for Australia’s next semiconductor-enabled industries is clear: success will depend on strong R&D, specialised supply chains, and the judgement to know when off-the-shelf technology is enough and when custom design creates advantage.

Mr Bodkin concluded that Australia’s opportunity lies in specialised, high-value technologies built on innovation and advanced manufacturing.

“We still have a great opportunity to be manufacturers on a world stage,” said Mr Bodkin.



Cochlear Nucleus Nexa System
Image courtesy of Cochlear Limited

SYSTEM INTEGRATION

System integration is the stage at which semiconductor devices are assembled into complete products and systems with defined functionality, typically using sophisticated electronic subsystems and high-end printed circuit boards (PCBs). It is the point where chip design is translated into practical end-user applications and where much of a product’s engineering value is realised. Internationally, this is the domain in which companies such as Apple, Tesla and Amazon operate, designing application-specific chips for their products while relying on foundries, packaging providers and manufacturing partners to deliver finished products.

Australia already possesses a number of companies across different technologies which rely on advanced system integration for practical end-user application. Medical technology is a particularly strong example, with companies such as Cochlear, ResMed, Bionics and other developers of neural implants building their products on semiconductor-based systems. Similar capabilities exist across consumer and prosumer electronics, where companies such as RØDE and Blackmagic Design combine advanced hardware, software and semiconductor technology into globally competitive products. Expertise is also evident in communications, defence, energy and industrial systems.

The opportunity is to enable more Australian-designed devices to be integrated into finished, higher-value products domestically and retain more of the associated engineering, IP and value in Australia, rather than integration occurring offshore.

A critical enabling capability for system integration is the manufacture of high-end PCBs, including advanced multilayer, high-density interconnect and rigid-flex designs. These technologies provide the dense, high-speed interconnections required for semiconductor devices to operate as reliable, high-performance systems. While Australia maintains capabilities in PCB design, assembly, and testing, domestic manufacturing capacity remains limited, resulting in a strong reliance on offshore suppliers.



Blackmagic Design

How semiconductors underpin Australia's electronics industry



Blackmagic-URSA-Cine-12K-LF-100G
Image courtesy of Blackmagic Design

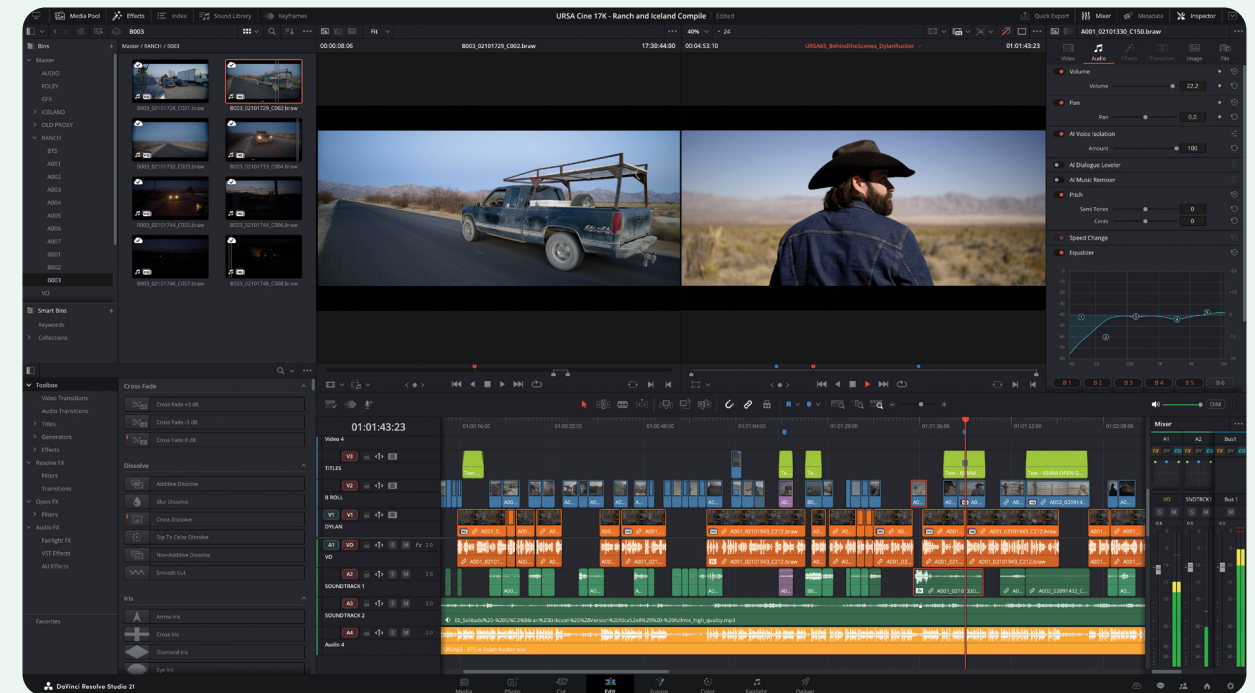
Blackmagic Design shows how systems-level engineering can turn semiconductor components into globally competitive products.

Every piece of modern consumer electronics – whether it's a camera, streaming equipment or a data storage system – relies on semiconductors. A single product can contain many different semiconductor devices, each performing a different function. Some store data, some manage power, some handle communications, while others process information.

Bringing all those components together into a finished product requires systems-level design. This process starts with what the user needs the product to do, then works backward to determine the components, connections, and software required to make it happen – all while keeping costs down and complying with technical standards that are often thousands of pages long.

Blackmagic Design, an Australian company, headquartered in Victoria, and one of the world's leading innovators and manufacturers of creative video technology, starts their process with the customer. "We think about what people want to do, and how we can make a product that lets them do that easily, without costing a fortune." Iain Waugh, Engineering Manager at Blackmagic Design said. That focus on the customer doesn't end once a product drops. Blackmagic Design is continuously innovating and updating its products to keep pace with the changing demands of its customers.

Blackmagic Design develops professional video technology, including cameras, broadcast equipment, and its DaVinci Resolve video editing software, which has been used on most feature films released over the past two decades.



DaVinci Resolve 21
Image courtesy of Blackmagic Design

However, while system-level design underpins a large share of Australia's electronics sector, not every company approaches it the same way. Some companies build around off-the-shelf designs, while others, including Blackmagic Design, do it all themselves. This approach results in developing their own IP.

The core technology underpinning Blackmagic Design's products is field-programmable gate arrays (FPGAs) – special chips that can be configured and reprogrammed to perform custom operations. They are central to how Blackmagic builds its products and are used in almost all of them. Their systems-level design has helped Blackmagic Design build a broad portfolio of professional video products that compete in global markets.

"You can do almost anything you want with an FPGA – we can create a CPU or GPU inside an FPGA if we want. We can create a video compression codec, or audio codec. If something can be done digitally, then we can usually find a way to do it in an FPGA."

Today, Blackmagic Design's products are sold through reseller networks in more than 30 countries, demonstrating the global reach that can come from strong Australian systems-level engineering.

Part 6

Priority pathways

Five priority pathways have been identified and are recommended to enable the growth and development of a more resilient and globally competitive Australian semiconductor sector. They are not mutually exclusive.

The Capability Focus Areas outlined in Section 5 define where Australia can capitalise on existing depth. The key markets are where that capability generates value: the industries that depend on semiconductors and that capture much of the return the sector produces. The five priority pathways address what stands between the two (see Figure 6.1). Each priority pathway contains a set of key actions needed to deliver the 2040 vision. They are informed by research and analysis undertaken of Australia’s long-term position within the global semiconductor landscape, and comparable, established domestic industries and extensive sector consultation. Together, they respond directly to the constraints-identified across sector and policy coordination, workforce capability , market access and investment, commercialisation, and strategic infrastructure.

THE FIVE PRIORITY PATHWAYS ARE:

1. Provide national sector and policy coordination
2. Building a skilled semiconductor workforce
3. Develop market access, investment, and partnerships
4. Create value and resilience through commercial outcomes
5. Build strategic infrastructure and global integration

FIGURE 6.1: PRIORITY PATHWAYS: CONNECTING CAPABILITY TO KEY MARKETS



6.1. Provide national sector and policy coordination

Australia’s semiconductor capability is distributed across states, universities, research agencies and firms, and there is no standing mechanism to connect it. Jurisdictions run their own programs and Commonwealth responsibility sits across several portfolios. The effect is that effort is duplicated in some places, absent in others, and not clear or visible to international partners and investors.

This is a coordination problem rather than a capability problem, and it has a structural cause. The value semiconductor capability generates accrues largely to the industries that depend on it, not to the firms that produce it. Individual firms therefore have limited incentive to invest at the scale the national interest requires, and individual jurisdictions have limited incentive to fund capability whose benefits cross their borders.

Stakeholders were unambiguous about what was required to overcome this. A coordinated national semiconductor strategy was the top-ranked government action across all stakeholder engagement channels, selected by half of survey respondents. A central coordinating body was also the top-ranked coordination mechanism to achieve this.

Stakeholders stressed the strategic case, and the weight government signals carry in directing where firms focus and invest. Governments worldwide have responded to semiconductor supply risk with national strategies and public investment on an unprecedented scale, in a geopolitical setting that is complex and changing quickly. Australia is the only AUKUS or Quad partner without a national semiconductor strategy or coordinated national semiconductor policy framework. The absence of a single authoritative strategy, with defined priorities, timelines and ministerial accountability, is the most significant structural gap in federal policy.

The case for national coordination is strengthening as global semiconductor demand shifts toward greater complexity and segmentation, creating new opportunities for specialised participants. Research capability, infrastructure, workforce development, investment, supply chains and commercial demand should be treated as interconnected parts of a single system rather than developed in isolation.

Three recommendations follow: a shared national ambition, a whole-of-government policy position to give it effect, and the national industry body that would give it standing.

ADOPT A WHOLE OF SECTOR AMBITION

Governments, industry and research institutions should adopt a single national ambition for the sector: **by 2040, Australia’s specialised semiconductor capabilities enable the growth and competitiveness of priority sectors, strengthen national resilience, and participation in global supply chains.**

Australia’s semiconductor capability is spread across jurisdictions, portfolios, universities and firms, each working to its own priorities. A shared national ambition provides a common goal to align their respective semiconductor priorities and actions. It would be the reference point for the whole-of-government strategy and the national industry body that follow. It would also give international partners and investors a clear account of where Australia intends to compete and the capabilities it intends to build.

INTRODUCE WHOLE-OF-GOVERNMENT SEMICONDUCTOR POLICY AND STRATEGY

The Australian Government should develop a whole-of-government semiconductor policy and strategy. This would align the industry, trade, research, skills and defence levers currently spread across portfolios.

Commonwealth responsibility for the settings that shape semiconductor capability is divided. Industry policy, trade promotion, research funding, skilled migration and defence procurement each affect the sector, and each is administered separately. A single stated position would establish the sector’s standing, define national priorities, and set the terms on which individual

portfolios engage. It would operate as the reference point against which departmental decisions are tested, rather than as an additional program. Stakeholders identified it as the sector’s first-order request.

ESTABLISH NATIONAL INDUSTRY BODY

A single national industry body should be established to coordinate effort across jurisdictions and build a connected national ecosystem. It would represent the sector to government, facilitate engagement with investors and international partners, and set shared priorities the ecosystem can organise around.

Its core functions cover ecosystem coordination and connectivity, industry intelligence and strategic advice, workforce and talent development, international engagement and market access, and sector representation and advocacy.

The national industry body would also provide shared leadership on the sector’s priorities, so that jurisdictions investing in semiconductor capability complement and align with a national direction rather than pursue separate ones. Importantly, this would be a convening and representation function, and would not seek to displace the programs jurisdictions already run.

Australia has used this model before. Short of a dedicated national agency, it has built industry hubs to organise priority sectors at national and state level. A national semiconductor body would apply the same approach to a sector of comparable strategic weight.

6.2. Building a Skilled Semiconductor Workforce

The sector’s binding workforce constraint sits at mid-career and senior level. Australia does not have enough experienced professionals to fill senior technical and leadership roles, or the knowledge those roles carry: how to move a device from prototype to product, run a process at yield, and win and deliver commercial contracts. Without that experience, firms struggle to commercialise. They also cannot absorb junior staff productively. That limits entry-level positions and slows the formation of the next experienced cohort.

Part of the gap is structural. The skills needed for R&D differ from those needed for volume production. With limited domestic manufacturing, Australia does not develop required talent organically. Firms fill the gap by recruiting overseas or by relocating which takes capability out of Australia rather than building it.

Overseas recruitment runs into a migration system that does not recognise the sector. Semiconductor work has no dedicated Australian and New Zealand Standard Classification of Occupations (ANZSCO) code and does not appear on the Core Skills Occupation List. Together these determine eligibility for the Skills in Demand (subclass 482) and Employer Nomination Scheme (subclass 186) visas. Applicants must instead map their work to generic codes such as Electrical Engineer or Chemical and Materials Engineer, and each case has to establish a close enough fit. Labour Agreements can accommodate occupations not yet defined in ANZSCO, but they are negotiated employer by employer.

Stakeholders identified further barriers: long processing times, unclear pathways to permanent residency, rising visa costs, and the age limit of 45 for most permanent skilled visas. The age limit bears most heavily on the senior specialists the sector needs.

Singapore

Singapore shows how coordinated education, training and industry collaboration can build the workforce needed for a growing semiconductor sector

Singapore is one example of a semiconductor industry arriving before the talent existed to support it. The country has built and fostered the development of talent to support a system that now produces one in ten of the world's chips⁴³. Australia faces a similar starting position: it lacks a talent pipeline to support the current industry and research capacity and capability needed for today. Singapore's history shows what closing that gap can look like in practice, one mechanism at a time, layered over decades.

In 1968, Singapore had no electronics industry or domestic skilled workforce to support one⁴⁴. Singapore's Economic Development Board engaged US chipmaker National Semiconductor that year, to set up a presence in Singapore with a promise of cost competitive, disciplined and readily trainable workforce⁴⁵. Other companies followed, and the industry took hold before any talent pipeline existed. Vocational institutes built with international partners followed, training Singaporeans directly for the electronics jobs multinational companies were creating.⁴⁶

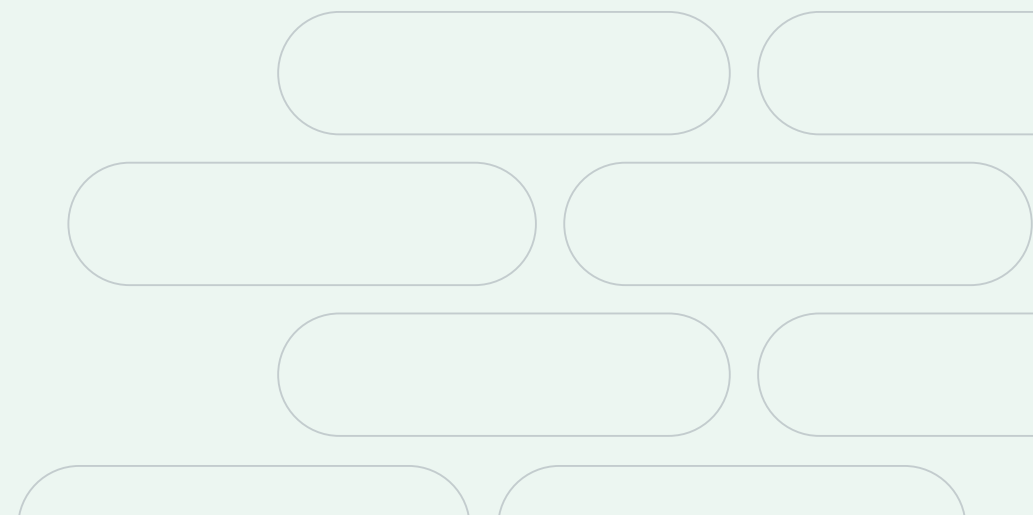
By the late nineties, the workforce skill profile had markedly improved as the industry developed its capability across the value chain. Chartered Semiconductor Manufacturing, Singapore's domestic wafer fab⁴⁷ was training local engineers and partnered with universities National University of Singapore (NUS) and Nanyang Technological University (NTU) on research.⁴⁸

However, there was still a need for more professional, technical and specialist talent that the domestic system could not produce fast enough.⁴⁹ The government began actively recruiting international talent to support its industries including semiconductors through recruitment missions abroad to attract foreign students and improved pathways for skilled migrants.⁵⁰

Through the 2000s, local universities including NUS and NTU introduced microelectronics and IC design majors run jointly with industry, producing talent purpose-built for roles in the sector.⁵¹ This ran alongside the vocational training system and the international recruitment drive already in motion.

Today, Singapore delivers a program containing several initiatives to continue building its talent pipeline. University and vocational training, spanning NUS, NTU, Singapore Institute of Technology and the polytechnics, feed a steady pipeline of engineers and technicians straight into industry. A mid-career conversion program has moved almost 3,000 professionals from sectors like precision engineering and aerospace since 2016, with up to 70 per cent salary support during training.⁵² Targeted visa settings, including acknowledgement of specific semiconductor roles on the national Shortage Occupation List, fast-track foreign talent into the gaps neither pipeline can fill fast enough.⁵³

Singapore faced a challenge Australia now confronts. It closed that gap through sustained, layered investment over decades, adding new mechanisms as the industry evolved while maintaining those already in place. Vocational training, university pathways and skilled migration were each strengthened or introduced in response to different stages of industry development and workforce demand. Australia's task is similar: to build the mechanisms that meet today's talent needs while progressively developing the deeper domestic pipeline required for the future. This will require sustained commitment over decades, with successive interventions building on—not replacing—those that came before.



The lack of a named category also compounds over time. Without one, there is no clean labour-market data on the size of the shortage, and without that data the case for a dedicated listing is harder to make. Government has broken this cycle before. After the 2023–2030 Australian Cyber Security Strategy committed to migration reform, dedicated cyber security occupation codes were created and added to the Core Skills Occupation List in 2025.

These settings matter because competition for experienced talent is global. The industry faces a projected shortfall of more than 1 million skilled workers by 2030.⁵⁴ Countries including Germany, the Netherlands and Singapore identify semiconductor roles explicitly in their skills and migration systems, and they are actively recruiting. Australia competes with lower sector visibility and less certain pathways.

Migration can meet immediate needs, but it does not replace a domestic pipeline for our workforce. Australia produces broadly trained STEM graduates, some of whom enter the sector and acquire specialist skills on the job. Workforce depth was the constraint stakeholders raised most consistently, across every jurisdiction and stakeholder type, and graduates’ practical readiness was a recurring part of it. Semiconductor content at universities is fragmented, and no university offers a comprehensive semiconductor program. No national pathway links training to industry need. Other countries like Taiwan and US run nationally coordinated semiconductor degrees that feed graduates directly into domestic facilities.

Stakeholders were also specific about what works. Internships and placements were the most favoured intervention (43 per cent), because hands-on work builds practical capability that classroom learning alone does not.

The two recommendations below address the domestic skilled workforce pipeline and the immediate shortage of experienced professionals.

ESTABLISH NATIONAL INDUSTRY READY TALENT PATHWAY FRAMEWORK

A national industry-ready talent pathway framework should be established to build practical skills for the domestic talent pipeline through structured hands-on learning, industry participation and clear career pathways.

As current industry demand does not justify dedicated semiconductor degrees or stackable micro-credentials immediately, the framework would be staged, progressing as sector demand is demonstrated.

The first stage, through 2030, would include semiconductor career awareness campaigns and funded industry-designed work-integrated learning opportunities. Training and development would be embedded in existing and new semiconductor projects, facilities and infrastructure investments including the national semiconductor innovation and translation centre and pilot scale and volume production facility (see Section 6.3 and 6.4). Industry participation would assist with co-design, and a national skills intelligence function would monitor demand and forecast future needs.

The second stage, to 2035, would focus on introducing stackable micro-credentials, dedicated courses and formal education pathways, informed by industry and delivered by universities and TAFEs. This includes targeted opportunities for mid-career professionals from adjacent industries with relevant technical skills to transfer to roles in the semiconductor industry.

By 2040, a mature sector would support dedicated degree programs and an end-to-end education pathway. A trigger and indicator framework, developed in the first stage, would determine when the sector has reached the scale to justify each step.

ESTABLISH INTERNATIONAL TALENT ATTRACTION PROGRAM

A nationally coordinated program should be established to attract, recruit and retain experienced international semiconductor professionals. It would address a shortage of mid-career and senior talent that domestic pathways cannot close in the near term.

The program would advocate for semiconductor occupations to be recognised in migration settings, improve alignment with existing occupation classifications, and support smoother processing for critical roles. It would build international recruitment and return pathways that employers can draw on, supported by partnerships and networks in priority markets. A national skills intelligence function would keep these efforts aligned with demand.

Promotional activity would present the sector and its career opportunities to experienced professionals in priority markets, delivered alongside the international engagement strategy recommended below, in section 6.3.

Filling mid-senior roles would bring onshore knowledge Australia does not currently hold and expand the capacity to train and mentor junior staff. Stakeholders nominated international attraction as a priority alongside domestic workforce development.

6.3. Develop market access, investment, and partnerships

Australia’s semiconductor ambition is not self-sufficiency; this is not feasible for any one nation. It is trusted, specialised participation in global value chains. In an industry this specialised and geographically distributed, growth depends on access: to customers, to capital, to manufacturing and packaging partners, and to the technical partnerships through which smaller firms join the product and process development of larger ones. Stakeholders emphasised strengthening how Australian firms can connect into global ecosystems.

Access of this kind is not automatic. It is shaped by scale, commercial relationships, technical readiness and position in the market. Participation in global supply chains often depends on established relationships, demonstrated credibility and visibility in international networks. Firms with existing partnerships or an overseas presence navigate these pathways more easily than newer and smaller entrants, so access to foundries, tool vendors, packaging providers and specialist services is uneven.

Australian firms are mostly small, distant from the main centres of semiconductor activity and from deep capital markets, and largely unknown to the partners they need. The dependence runs deep. Australian firms rely on overseas partners for fabrication, packaging, tools and specialised inputs, sourced from a small number of countries, and export controls and geopolitical pressure are adding structural risk to those supply chains.

Australia’s trade agreements and technology alliances provide broad mechanisms for engagement. Broad is not the same as sufficient, and membership of a framework is not the same as a place in a supply chain. Securing access requires targeted measures directed at specific vulnerabilities, with trade engagement, industry promotion and international partnerships coordinated so that firms can navigate supply chains, find market opportunities and build long-term commercial relationships.

Two recommendations follow: an international engagement strategy, and a coordinated effort to position Australia’s mineral endowment in semiconductor supply chains.

DEVELOP INTERNATIONAL ENGAGEMENT STRATEGY

An international engagement strategy should be developed to provide coordination and deliver targeted initiatives. It would present Australia’s semiconductor capability internationally and improve access to capital and to trusted, diversified supply chains.

The strategy would give Australia’s international engagement a defined commercial focus. Australian firms and researchers identified two target global market categories, Industrial and Server and Network, which are also the categories driving global demand growth. Engagement organised around those categories should be directed at buyers and partners with a demonstrated requirement, rather than general promotion of national capability.

The strategy should cover both routes stakeholders identified: facilitating strategic partnerships with leading semiconductor nations, and attraction of global semiconductor companies and investment to Australia. Its promotional activity would be delivered together with the international talent attraction program, in section 6.2.

Stakeholders were clear about how Australia should engage, arguing for a value proposition built on demonstrated strengths rather than an approach framed by domestic need. Converting trade and alliance membership into co-investment and supply chain access is the work the strategy would do.

COLLABORATE ON CRITICAL MINERAL REFINING AND PROCESSING FOR CHIPS

Australia’s semiconductor mineral endowment should be mapped against semiconductor specifications and promoted to international partners and investors, in collaboration with the CMCI CRC and relevant government agencies. This would identify where Australia can extend beyond extraction into higher-value refining and processing.

Australia’s mineral holdings are well documented in general terms but are not assessed against semiconductor specifications, which are considerably more demanding than most industrial applications. The exercise would establish which inputs can be refined domestically to the required purity, at what point in the value chain that becomes commercially viable, and where existing capabilities could feasibly be upgraded to produce semiconductor-grade materials.

The results should direct targeted support for further domestic refining and processing capability and the technology development it requires, while also providing an evidence base to promote investment opportunities internationally. This would put Australia in a better position to use its endowment strategically, as a trusted supply chain partner rather than a volume exporter of ore.

Raw materials and refining is a segment where Australia’s existing industrial strengths are transferable but domestic value capture is limited. The distance between extraction and semiconductor-grade input is measured in processing capability rather than resource availability, and no investment judgement about closing it can be made without the mapping.

6.4. Create value and resilience through commercial outcomes

Australia generates semiconductor research and IP at a standard that attracts international attention. It struggles to capture and retain the commercial value as that research is translated and scaled into market. The commercial ecosystem is largely made up of startups and small firms, many of them early-stage or pre-revenue. Funding concentrates at the research end and tapers as projects approach commercialisation. A project that reaches the point where it needs manufacturing, customers and capital finds limited support domestically, and scaling depends on offshore suppliers for fabrication, packaging, tools and specialised inputs.

Australia is well equipped for research and early-stage innovation, but less developed in the shared infrastructure needed to prototype, package and test at commercial standard,

and to support process maturation, qualification and early production. That gap is a central contributor to the missing middle between capability and commercial scale.

The recommendation below addresses the institutional gap between research and commercial deployment.

ESTABLISH NATIONAL SEMICONDUCTOR INNOVATION AND TRANSLATION CENTRE

A national semiconductor innovation and translation centre should be established as a front door to Australian semiconductor capability, partnering with industry on applied projects where there is genuine demand-side scale. Supported by sustained government commitment and governed by industry, the centre would coordinate and deliver programs that translate research and prototypes into production and commercial deployment. A firm approaching it would be connected to the domestic facility, laboratory or international partner best suited to their needs.

The centre would also be responsible for the pilot scale and low volume manufacturing capability recommended below in section 6.4. providing a pathway from R&D and prototyping towards commercial production. Placements within the facility would support workforce development through cross-training between R&D and production environments, helping researchers incorporate manufacturing considerations into technology development and production teams apply emerging technologies and methods to solve challenges. The centre would coordinate national access to the design and system-in-package tools, training and services, including multi-project wafers, necessary for translation. It would also broker access and commercial arrangements that startups and smaller firms can struggle to secure independently, including affiliate and joint-laboratory partnerships with multinational semiconductor and equipment companies. This could draw on the partnership model established by imec with companies such as ASML, TSMC and Intel, while being tailored to Australia’s capabilities and industrial needs. Without it, Australia is likely to keep losing high-value IP to overseas commercialisation, and startups and talent to ecosystems that offer a clearer path to scale.

Applied partnerships would concentrate on sectors where Australia has both genuine demand and an established industrial base, including mining and resources technology, medical technology, advanced communications (5G & 6G) and satellite systems, data centre and AI infrastructure, agriculture, electrification, and cybersecurity and trusted hardware. Together, these functions would provide a clearer pathway from Australian research and IP to domestic commercialisation and scale.

imec

Bridging the 'missing middle' in Australia's future semiconductor sector



Image courtesy of imec

A model of strong partnerships, shared infrastructure and pooled resources could take technologies from lab to market faster in Australia's semiconductor sector.

Scientists across the country are developing new semiconductor materials, innovative technologies and early prototypes that underpin the technologies of tomorrow.

However, the pathway from prototype to commercial product is far from straightforward. Australia's semiconductor sector has a 'missing middle' – a gap between when technology is first developed and when it is ready to be scaled up for commercial manufacturing.

One international model Australia can learn from is imec, a world-leading research and development centre for advanced semiconductor technologies, headquartered in Belgium.

Imec brings industry partners, academia and government organisations together around shared challenges, state-of-the-art infrastructure and precompetitive research. Imec was established to help de-risk technologies before they move towards commercial development and manufacturing.

At the heart of imec's success is its Industrial Affiliation Program (IIAP), which allows semiconductor companies to work together on technologies that are too complex, expensive, or nascent to develop efficiently on their own. This model allows the financial burden and risk to be spread across multiple partners, rather than a single company.

Through the IIAP, multiple companies across the supply chain can pool resources to collaborate on fundamental problems they need to solve, and then share the results with all partner companies in the program. This collaborative network avoids IP blocking and helps translate technology from the lab to the market much faster.

Dr Romano Hoofman, Strategic Development Director at imec said that the IIAP allows "the customers and the suppliers to work together and steer each other to accelerate breakthroughs and innovation."

Industry partners also contribute advanced equipment to imec's facilities, giving imec access to technologies that would otherwise be prohibitively expensive, while allowing equipment suppliers to work alongside their major customers in shared research programs. Next to the IIAP programs, industrial partners also work together with imec in bilateral projects on activities that cannot be shared with others.

Imec is also home to the NanoIC pilot line, one of 5 pilot lines established under the European Chips Act. Building on imec's existing pilot line capabilities, NanoIC enables companies and researchers to develop and test beyond-2nm system-on-chip technologies before they move towards large-scale production. These technologies underpin advances across AI, communications, quantum computing, energy and much more.

"With pilot lines, it's not the intention to do high-volume production, but for companies to test out ideas and then later on, if it's successful, go directly to a foundry," Dr Romano Hoofman explained.

Imec also coordinates the EU Chips Design Platform, an initiative that helps lower barriers for small companies to access European chip design capabilities, such as fabrication, packaging and testing.

Imec said the platform aims to reduce costs and save time.

"Typically, when you start as a small company, you need access to IP and electronic design automation tools, which can be quite expensive. What we try to do through the EU Chips Design Platform is to negotiate good pricing for the startups," Dr Romano Hoofman explained.

The platform also provides access to pre-installed cloud software, training, business coaching, and financial assistance, with plans to eventually create a 'one-stop-shop.'

The impact of imec's model extends well beyond its research facilities. For every euro invested, imec generates 11 euros in added value and 4 euros in fiscal return. Its ecosystem has also supported more than 300 start-ups, 120 spin-offs and over 13,400 jobs, showing the broader economic value of sustained investment in semiconductor capability.



Image courtesy of imec

6.5. Build strategic infrastructure and global integration

Australia’s semiconductor infrastructure is world-class for research, credible for prototyping but thin to non-existent beyond this stage of development. The ANFF network and university cleanrooms support demonstration and early-stage development. What follows demonstration, including qualified pilot lines, tracked production, process control and the equipment to validate a design at volume, is largely unavailable domestically, as are the skills and experienced workforce to operate it. This is the translation layer, and its absence has a specific consequence.

This is the translation layer, and its absence has a specific consequence. A firm that can demonstrate a device but cannot demonstrate that it can be manufactured carries an unresolved risk, and investors price it accordingly. Offshore manufacturers offer little relief: at pilot and low volumes, Australian firms’ orders fall below the scale commercial fabs prioritise. The rational response is to move to a jurisdiction where that risk can be retired. Capability developed in Australia is then scaled elsewhere, and the associated value accrues where the manufacturing is.

Access to enabling pilot-scale and production-grade equipment was cited as a key supply chain constraint, with research organisations affected at close to six times the rate of industry respondents. This asymmetry points to a critical gap precisely where research must transition to production.

The implications extend beyond commercialisation to a supply chain resilience issue. Australia relies on a small number of countries, Taiwan in particular, for fabrication, assembly, packaging and testing. A severe disruption would affect access not only to semiconductors but to every product that contains them. Baseline onshore capability, sized to defence and other strategic requirements, cannot be established after a disruption has begun. Three recommendations follow, each building on existing infrastructure and capability.

DEVELOP PILOT SCALE AND LOW VOLUME MANUFACTURING CAPABILITY

Australia should develop a controlled volume production capability. It would give Australian firms access to manufacturing at pilot and low volume, with coordinated national access to design and simulation tools, so that emerging Australian semiconductor technologies can be scaled onshore.

The capability would be established at a single location, with buildable and flexible tooling that can be adapted as technology requirements change. It would be aligned with the research and prototyping infrastructure already held by ANFF, CSIRO and university facilities, but its purpose is commercial production and revenue generation across a diversity of customer products. It would operate as qualified pilot lines under a quality framework, with fully tracked production, statistical process control and process design kits, so that process development is compatible with, and transferable into, high-volume fabrication elsewhere. It is not a proposal for a megafab.

The facility should be built as a modular pilot line, with interchangeable process modules that allow reconfiguration as technology needs evolve. This would let it support multiple semiconductor material platforms , device architectures and end-use sectors, and maximise utilisation while reducing the risk of technology lock-in.

Volumes would be sized to what Australian firms, defence programs and dual-use technologies such as quantum require, with pathways into international high-volume manufacturing where greater scale is needed. Government support is now embedded in semiconductor manufacturing internationally, and operations at this scale are typically incentive supported. The facility should be planned on that basis.

The facility would build manufacturing skills Australia currently lacks in depth, including process engineering, tool operation, equipment maintenance, production planning, statistical process control and manufacturing execution systems. These complement the scientific and technical expertise developed in existing research facilities. Connecting research and production environments would allow cross-training, so that researchers design with manufacturing considerations in mind and production teams draw on emerging techniques.

It would also change the investment case for Australian firms. A startup that can demonstrate its technology can be manufactured presents a lower risk to investors, and firms that need only low volumes could remain onshore for longer.

Access would be coordinated through the national innovation and translation centre recommended above in section 6.3. The goal is a connected capability that supports the different fabrication requirements of semiconductor technology as it progresses along the technology readiness spectrum and into production.

ENDURING SUPPORT FOR NATIONAL ADVANCED PACKAGING CAPABILITIES

Ongoing Government support should sustain Australia’s emerging commercial advanced packaging capability beyond its initial establishment, giving industry and researchers the equipment to develop, validate and scale advanced packaging solutions domestically.

As Australia advances its entry into this globally contested segment of the semiconductor value chain, facilities such as the \$260 million AMRF semiconductor advanced packaging facility, currently in development, cannot afford to fail – and will require sustained Government support and investment over the long-term.

Australia has an opportunity to deliver high-value, low-volume and security-sensitive packaging for defence, aerospace, medical technology and quantum, where trust and capability count for more than cost.

The facility will provide the equipment to develop and qualify packaging approaches at commercial rather than laboratory scale. Access to assembly, packaging and testing services was among the most cited supply chain difficulties in consultation, and advanced packaging emerged strongly as a capability area of opportunity in stakeholder feedback. As gains from transistor scaling become costly to obtain, performance improvements increasingly depend on advanced packaging and heterogeneous integration, where the ability to design, stack and connect multiple dies can be as important as fabrication scale itself.

SUPPORT DEVELOPMENT OF ANSTO SEMICONDUCTOR CAPABILITIES

Continued support should be provided to further develop ANSTO’s semiconductor-relevant capabilities, drawing on its breadth of nuclear materials science and manufacturing expertise. Its reactor and accelerator facilities, materials characterisation infrastructure and minerals group provide a strong foundation spanning critical minerals processing through to advanced materials development and supply early in the semiconductor device chain. This would extend the national nuclear science and research infrastructure Australia already operates into new semiconductor applications through fuller use and targeted development of existing facilities.

These capabilities are distinctive. Neutron transmutation doping produces the highly uniformly doped silicon used in high-power devices, supporting established bulk materials supply chains. ANSTO’s irradiation, ion beam and materials characterisation facilities support the analysis and modification of semiconductor materials. There are opportunities to extend this capability into adjacent applications, including supporting the development of strategically important III–V compound semiconductors for infrared and microwave generation and detection, and to connect it more directly to the firms that would use it, building a strong sovereign base for advanced technologies with allied countries.

Australia already holds a strong position in this specialised global market, serving growing demand for power electronics for the energy transition. Building on this established position and the expertise that already exists provides an opportunity to strengthen Australia's contribution to global semiconductor supply chains, supporting both the bulk supply of doped silicon and the development of advanced materials for critical semiconductor applications.

6.6 Putting the roadmap into action

The evidence presented in this Roadmap does not describe a sector waiting to be built. It describes an established sector with significant capabilities and opportunities, that can only realise its full potential through national leadership, coordination and sustained investment.

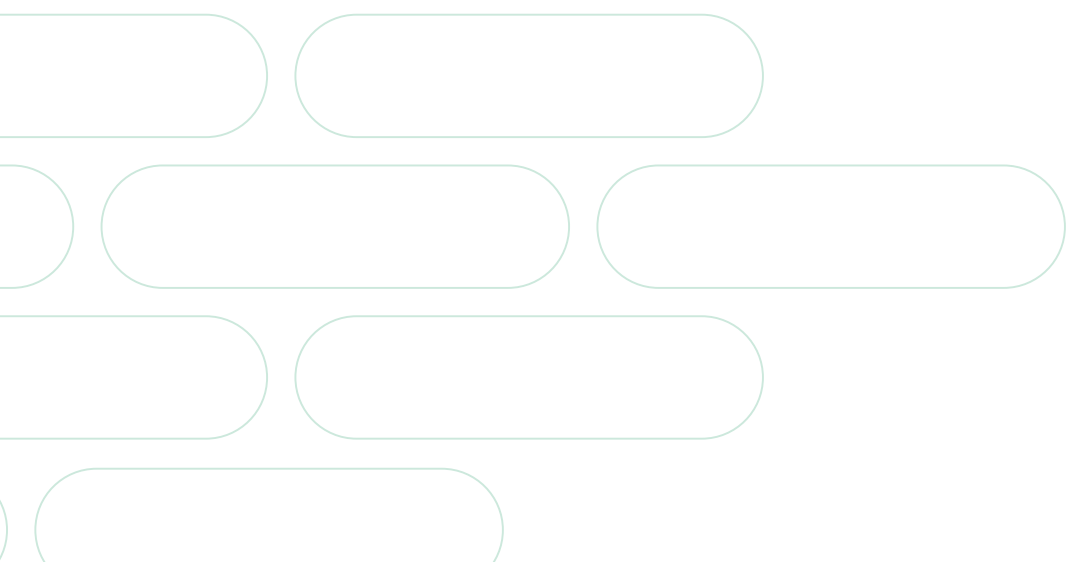
Australia's semiconductor sector is made up of entrepreneurs, researchers, educators, and industry leaders who have demonstrated resilience, ingenuity and an ability to adapt to a rapidly evolving global landscape.

In response to the sector's call for a long-term national plan, S3B has developed this Roadmap to ensure the collective voice of Australia's semiconductor ecosystem shape its future. It establishes a shared national direction for strengthening Australia's semiconductor capability, competitiveness and supply chain resilience.

This Roadmap highlights that semiconductors are not a standalone industry, but a foundational capability that underpins many of Australia's broader economic, innovation and national security priorities. Their economic and strategic importance must be reflected in Australia's policy and investment agenda.

Australia cannot afford to stand idle while its international peers make significant investments in their semiconductor capabilities. Without deliberate and coordinated action, Australia risks losing existing capabilities, weakening its industrial base and becoming increasingly dependent on external supply chains. The decisions made now will determine whether Australia converts its established strengths and emerging opportunities into sustained economic and strategic value, or repeats the pattern illustrated in this document: leaving capabilities to develop in isolation, with much of their potential value realised elsewhere.

Figure 7.1 outlines the National Semiconductor Roadmap's framework for turning this opportunity into coordinated action. It charts an ambitious but achievable long-term vision and identifies the capability focus areas where Australia can build internationally competitive strengths. It outlines the five priority pathways and their recommended actions to develop and scale the sector in a coordinated way, strengthen Australia's position in trusted global supply chains and connect its capabilities to global markets that offer significant economic and strategic value.



The recommendations are structured around two stages of implementation: immediate actions that can begin now, and targeted investments that will require planning, funding and sequencing. The five immediate actions require decisions and commitment from government and the ecosystem. For the most part, they draw on existing capabilities, institutions and resources. Together, they establish the national leadership, coordination, governance and implementation frameworks needed to support the design and delivery of the remaining recommendations.

Provided these recommendations are adopted as a package, the sector can follow the growth trajectory modelled in Section 4, in which the sector's output triples and supports an 10,000 additional jobs across the economy by 2040. Realising this opportunity would contribute to a more complex, high value Australian economy, with greater capacity to design, develop and manufacture technologies that are critical to global industries.

The release of this Roadmap marks the beginning of implementation, not the conclusion of the sector's planning efforts. S3B intends to work with leaders across Australia's semiconductor ecosystem to monitor and report on the sector's performance.

This Roadmap is a living document. It's 15-year horizon aligns with the capital intensity, technology development cycles and infrastructure investments that define the semiconductor sector and provides the certainty required for sustained industry participation. At the same time, the pace of technological advancement, changing global markets and an evolving geopolitical landscape demand flexibility. The Roadmap will therefore need to be reviewed regularly to ensure they remain relevant, responsive to industry needs and aligned with emerging opportunities. This process should enable Australia to adapt how it achieves its objectives without compromising its long-term ambition.

S3B remains committed to working with government, industry, research and education partners to advance Australia's semiconductor sector and maintain momentum behind the Roadmap. Its success will ultimately be measured not by the recommendations it contains, but by the actions taken, the capabilities developed and the economic and strategic value Australia captures.

Australia has the capabilities, the opportunity and now a shared national direction. What is needed next is the collective commitment to act.

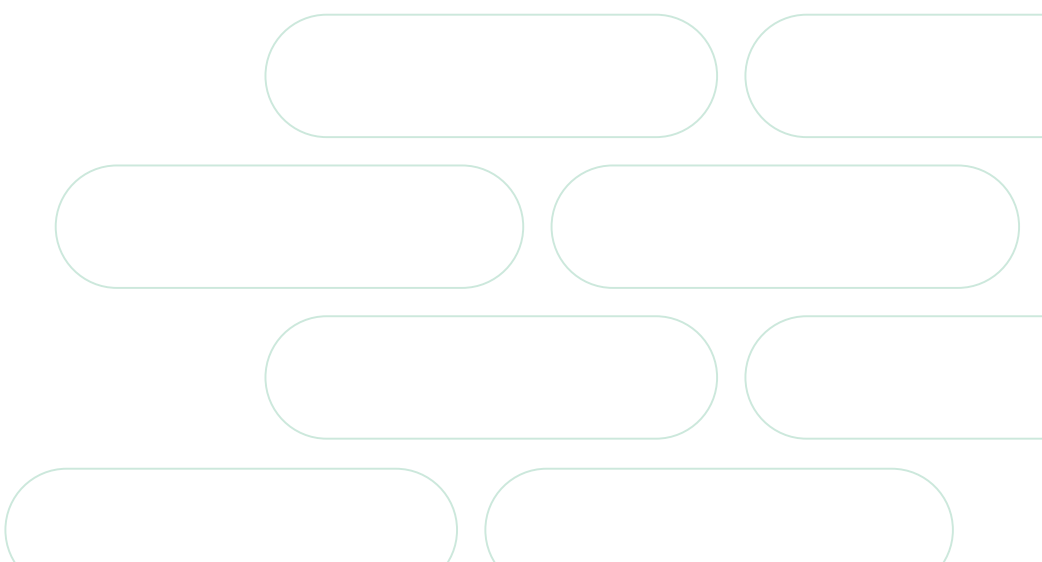
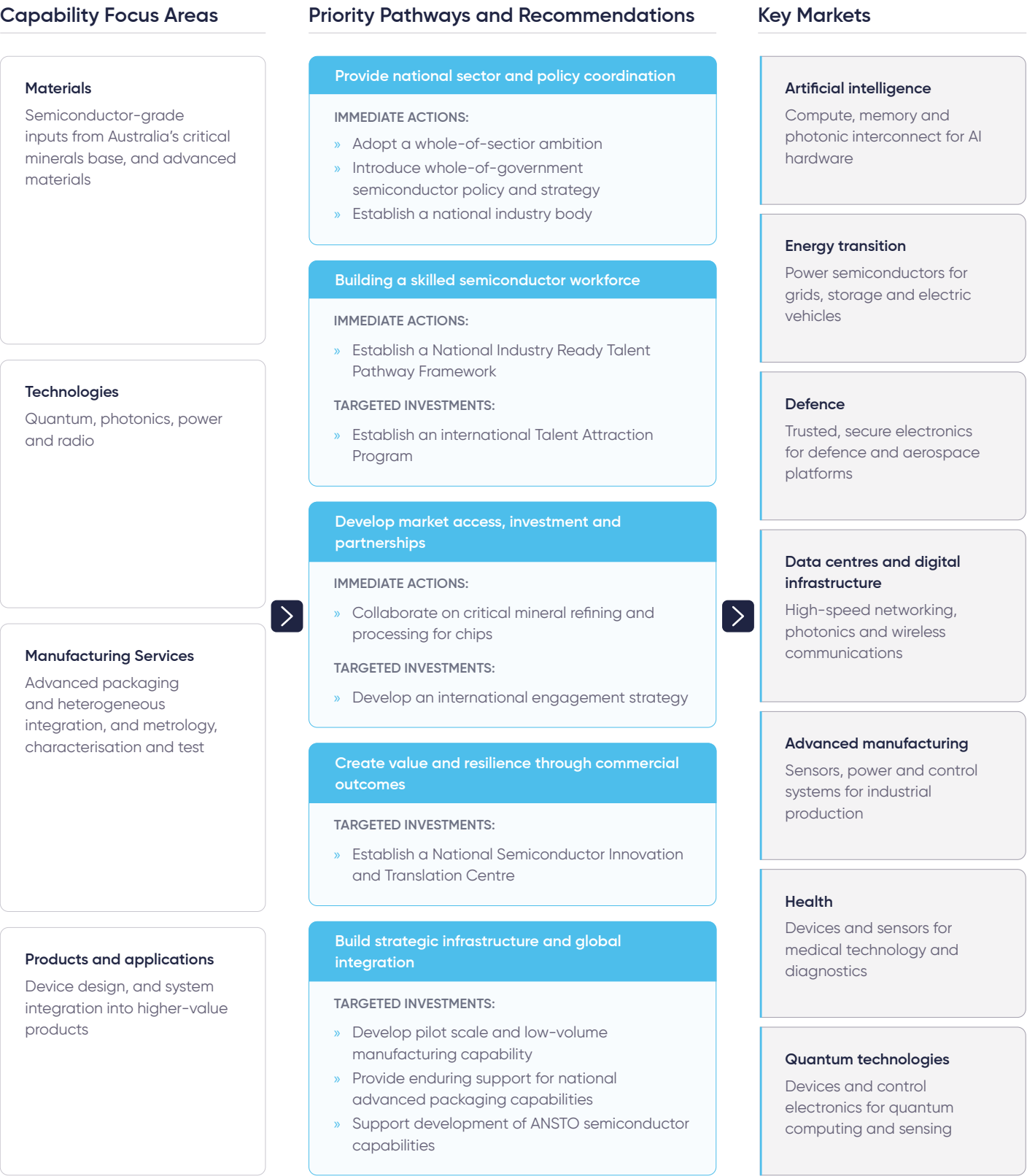


FIGURE 7.1: AUSTRALIA'S NATIONAL SEMICONDUCTOR ROADMAP

VISION 2040

Australia’s specialised semiconductor capabilities enable the growth and competitiveness of priority sectors, strengthen national resilience, and participation in global supply chains.



Appendix A

Glossary of Terms and Semiconductor Value Chain Definitions

A.1 Key Technical and Industry Terms

2.5/3D INTEGRATION

Advanced semiconductor packaging technologies that combine multiple semiconductor components into a single high-performance system. 2.5D integration places chiplets side-by-side on an interposer, while 3D integration stacks them vertically using through-silicon vias (TSVs), enabling greater performance, functionality, and energy efficiency.

ADVANCED PACKAGING

Advanced packaging includes the assembly and integration of electronic, photonic and optoelectronic devices into functional packages and subsystems. Depending on the technology, this may include electrical interconnection, flip-chip and chiplet integration, precision optical alignment, fibre coupling, micro-optics assembly, thermal and mechanical stabilisation, and optical and electrical testing.

APPLICATION-SPECIFIC INTEGRATED CIRCUIT (ASIC)

A semiconductor device designed for a specific application or function.

CHIPLETS

Small, specialised semiconductor dies that are manufactured separately and then packaged together to function as a single integrated system. Chiplets improve design flexibility, reduce development costs, and enable faster adoption of advanced process technologies.

COMPLEMENTARY METAL-OXIDE SEMICONDUCTOR (CMOS)

A widely used semiconductor technology platform for IC, including processors, memory and many digital and mixed-signal devices.

CHEMICAL-MECHANICAL POLISHING (CMP)

also called chemical mechanical planarisation - is a wafer polishing process that combines chemical etching and mechanical abrasion to create an extremely flat and smooth surface, enabling precise fabrication of subsequent semiconductor layers. It finds broad use in semiconductor manufacturing, for example. as a process step in hybrid bonding.

DESIGN

The architecture, engineering and specification of semiconductor devices or technologies, including IC, sensors, optoelectronic devices and semiconductor IP.

DESIGN ENABLEMENT

The tools, services and access pathways that support the transition from semiconductor design to fabrication, including access to design platforms, fabrication interfaces and prototyping pathways.

DOPING

The process of intentionally adding small amounts of impurity atoms to a semiconductor material to modify its electrical properties, creating either n-type (electron-rich) or p-type (hole-rich) regions essential for device operation.

EDGE DEVICES

Computing devices that process data locally at or near the source where it is generated, reducing latency, bandwidth usage, and reliance on cloud data centres. Examples include autonomous vehicles, industrial sensors, smart cameras, and IoT devices.

ELECTRONIC DESIGN AUTOMATION (EDA)

Software tools used to design, simulate, verify and layout semiconductor devices and integrated circuits.

FABLESS

A business model in which a company designs semiconductor devices but outsources manufacturing to third-party foundries.

FAN-OUT WAFER-LEVEL PACKAGING

An advanced packaging technology that redistributes chip connections beyond the size of the semiconductor die, enabling more input/output connections, higher performance, and thinner packages without the need for a substrate.

FIELD-PROGRAMMABLE GATE ARRAY (FPGA)

A semiconductor device that can be configured after manufacturing to perform specific functions.

FLIP-CHIP BONDING

A chip assembly technique where a semiconductor die is mounted face-down onto a substrate using tiny solder bumps, providing shorter electrical connections, higher performance, and improved heat dissipation compared to traditional wire bonding.

FOUNDRY

A semiconductor manufacturing facility that produces semiconductor devices on behalf of other companies.

HETEROGENEOUS INTEGRATION

The integration of different semiconductor components or materials into a single system or package.

INSULATED-GATE BIPOLAR TRANSISTORS (IGBTs)

A high-power semiconductor device that combines the fast-switching capability of a MOSFET with the high-current and high-voltage handling capability of a bipolar transistor, making it ideal for power conversion and motor control applications.

INTEGRATED CIRCUIT (IC)

A semiconductor device that integrates multiple electronic components on a single chip to perform one or more functions.

INTELLECTUAL PROPERTY (IP)

Licensable semiconductor design elements or technology blocks that can be incorporated into semiconductor device designs.

INTERNET OF THINGS (IOT)

A network of physical objects embedded with sensors, processors, software, and communication hardware that lets them collect data and exchange it with other devices or cloud systems.

KEY MARKETS

End-use industry sectors and products that rely on semiconductor devices and technologies to function; not part of the core semiconductor value chain but representing downstream application domains.

MANUFACTURING READINESS

The extent to which a semiconductor technology or process is capable of consistent, repeatable and scalable production.

MICRO-ELECTRO-MECHANICAL SYSTEMS (MEMS)

Miniaturized devices that integrate tiny mechanical components, sensors, actuators, and electronics on a semiconductor chip to detect, measure, or interact with the physical environment.

MONOLITHIC MICROWAVE INTEGRATED CIRCUITS (MMICS)

Integrated circuits that operate at microwave and millimeter-wave frequencies, with all active and passive components fabricated on a single semiconductor substrate, typically using compound semiconductors such as GaAs, GaN, or InP.

META-OPTICAL SYSTEMS

Optical systems that use engineered nanostructured surfaces, known as metasurfaces, to manipulate light in ways that traditionally require multiple lenses and optical components, enabling smaller, lighter, and more efficient devices. These systems are used in advanced imaging and augmented reality.

MULTI-PROJECT WAFER (MPW)

A semiconductor fabrication service that combines designs from multiple customers onto a single wafer, allowing companies and researchers to share manufacturing costs when prototyping or developing new chips.

NEUTRON TRANSMUTATION DOPED (NTD) SILICON

High-purity silicon produced by exposing silicon wafers to neutron radiation, which uniformly converts some silicon atoms into phosphorus atoms, creating exceptionally uniform electrical properties throughout the material.

ORIGINAL EQUIPMENT MANUFACTURER (OEM)

A company that produces end-use products incorporating semiconductor devices or subsystems.

OPTICAL MICROCOMBS

Chip-scale photonic devices that generate a spectrum of evenly spaced laser wavelengths from a single light source, enabling compact, high-speed optical communication, sensing, and signal-processing systems.

PILOT-SCALE MANUFACTURING

Low-volume, pre-commercial production used to refine processes, test manufacturability and improve reliability prior to full-scale production.

PHOTONIC INTEGRATED CIRCUITS (PIC)

Integrated circuits that use light (photons) instead of electrical signals (electrons) to transmit, process, and manipulate information on a single substrate, enabling high-speed and energy-efficient data communication.

PROCESS DEVELOPMENT

The refinement and optimisation of manufacturing processes to achieve reliable, repeatable and scalable semiconductor production.

PROCESS DESIGN KIT (PDK)

A set of rules, models and design files that enable semiconductor devices to be designed for a specific manufacturing process.

SEMICONDUCTOR

A material that can conduct electricity under controlled conditions and forms the basis of modern electronic devices.

SEMICONDUCTOR DIE

A single integrated circuit cut from a semiconductor wafer. The die contains the functional electronic circuitry and is typically enclosed within a package to form a semiconductor chip.

SEMICONDUCTOR VALUE CHAIN

The full set of activities required to design, manufacture, assemble and integrate semiconductor devices into products and systems, including upstream inputs, device production and downstream integration.

SYSTEM INTEGRATION

The process of combining semiconductor devices into complete products or systems with defined functionality.

SYSTEM-ON-CHIP (SOC)

An integrated circuit that combines multiple system components, such as processors, memory, connectivity, graphics, and input/output functions, onto a single semiconductor chip, reducing size, power consumption, and cost.

TRANSLATION LAYER

The intermediate stage between research and commercial production where semiconductor technologies are validated, refined and prepared for scalable manufacturing.

A.2 Semiconductor Value Chain Definition

RESEARCH AND DEVELOPMENT (R&D)

Organisations whose primary semiconductor-related activity is the conduct or provision of research, rather than the commercial development, manufacture or sale of semiconductor devices or systems. Includes universities, public research organisations and national research infrastructure, where activity is funded through grants or research programs rather than commercial revenue.

DESIGN

Companies whose primary activity is the design of semiconductor devices or technologies, including integrated circuits, ASICs, sensors, optoelectronic devices or licensable IP cores, as well as semiconductor-specific design tooling (e.g. EDA). Excludes PCB-level design and firms whose main activity is developing downstream products using semiconductors rather than designing the semiconductor devices themselves.

MANUFACTURING (FABRICATION)

Companies whose primary activity is the commercial production of semiconductor devices, including wafer fabrication, epitaxy, and discrete or integrated device manufacturing. Includes both integrated device manufacturers and foundries. This includes both microelectronic devices (e.g. integrated circuits) and semiconductor-based energy devices such as photovoltaic (solar) cells and modules. Excludes research-scale fabrication and prototyping facilities not operating on a commercial production basis.

ASSEMBLY, PACKAGING AND TESTING (APT)

Companies whose primary activity is the commercial assembly, packaging, integration, testing or qualification of semiconductor devices or modules, including advanced packaging and reliability testing. Covers activities from wafer probing through to final device validation.

SEMICONDUCTOR-GRADE INPUTS

Companies supplying specialised materials, substrates, gases or chemicals used directly in semiconductor manufacturing, where there is a clear and material link to semiconductor supply chains. Full inclusion generally requires production of semiconductor-grade or semiconductor-specific inputs, or a distinct commercial activity serving semiconductor manufacturing.

RAW MATERIALS

Upstream producers of minerals or metallurgical feedstocks that may be used in semiconductor supply chains (e.g. silicon, gallium and germanium).

EQUIPMENT SUPPLIERS

Companies whose primary activity is the supply, manufacture or servicing of equipment, tools or infrastructure used in semiconductor fabrication, assembly, packaging, testing or R&D. Includes process equipment, metrology, cleanroom systems and specialised manufacturing infrastructure. Excludes general-purpose equipment not specific to semiconductor production.

PRODUCTS AND APPLICATIONS

Companies whose primary activity is the design, manufacture or integration of products and systems that depend materially on semiconductor devices or semiconductor-enabled processes. Includes firms with in-house capability to specify, design or integrate semiconductor components (e.g. custom chips, FPGA-based systems or advanced sensing platforms). Excludes firms that simply incorporate off-the-shelf semiconductors without semiconductor-specific design or integration capability

Appendix B

Australia's Semiconductor Capability Areas

This appendix profiles the organisations, facilities and projects behind the four capability focus areas described in Part 5: materials, technologies, manufacturing services, and products and applications.

B.1 Materials

Materials span two points in the value chain: the ultra-high-purity feedstocks that enter semiconductor manufacturing; and the advanced materials that support device innovation and application development. Materials feed the other three priority areas rather than reaching end markets directly.

SEMICONDUCTOR-GRADE INPUTS

Semiconductor-grade inputs are the raw materials and refined feedstocks, such as silicon, gallium and germanium, that must meet ultra-high purity standards before entering semiconductor manufacturing.

Critical minerals policy is the clearest point of existing federal support for semiconductor inputs. The Critical Minerals Strategy 2023–2030 aims to capture more value onshore through a new refining and processing industry, and modelling cited in the Strategy puts the gain from downstream refining and processing at \$139.7 billion in additional GDP and 262,600 jobs between 2022 and 2040.⁵⁵ The Critical Minerals Production Tax Incentive, a 10 per cent refundable offset on eligible processing costs from 2027 to 2040, the \$5 billion Critical Minerals Facility and the \$1.2 billion Critical Minerals Strategic Reserve all support that aim. Gallium and antimony are among the first minerals the Reserve will cover. Internationally, Australia is a founding signatory to the Pax Silica Declaration, which treats critical minerals, semiconductors and AI infrastructure as a single supply chain.

Table B.1 sets out the semiconductor-relevant critical minerals projects underway or in planning, from existing production through to early-stage assessment.

Beyond the projects in Table B.1, a further 12 critical minerals with significant semiconductor applications are assessed as having moderate to high geological potential in Australia but are not yet the focus of semiconductor-oriented development.⁵⁶ They span the materials base of chip fabrication: metals used in interconnects, contacts and diffusion barriers (cobalt, molybdenum, nickel, tantalum and titanium); dopants and inputs to compound semiconductors (antimony, arsenic, indium and magnesium); lithium, used in lithium niobate for photonic devices; graphite, used in the production of silicon and silicon carbide wafers; and platinum group elements, used in contacts, thin-film metallisation and packaging.

TABLE B.1: CRITICAL MINERALS INPUTS TO SEMICONDUCTOR MANUFACTURING

MINERAL	MANUFACTURING USE	PROJECT AND DETAIL	STATUS / TARGET
SILICON	Base wafer material entering semiconductor manufacturing. Electronic-grade silicon requires extremely high purity. NTD silicon is a specialised downstream product used as an input to power semiconductor wafers	ANSTO – the world’s largest producer of neutron transmutation doped (NTD) silicon, which it has produced for around 40 years, now irradiates in its OPAL reactor and exports as an input to wafers for power semiconductors	Existing production
		Simcoa – owned by Japan’s Shin-Etsu Chemical, the country’s only silicon producer, making high-purity silicon metal at typically 99.5–99.99 per cent purity	Existing production; ~52,000 t/yr
HIGH-PURITY QUARTZ	Feedstock used to produce silicon metal and to make the crucibles in which silicon ingots are grown – the next opportunity upstream of silicon itself	ANSTO – opened a critical minerals refining facility at Lucas Heights in May 2026 that uses high-temperature chlorination to produce high-purity quartz	Facility opened May 2026
		Sugarbag Hill (High Purity Quartz Ltd) – a \$515 million ultra-high-purity quartz project	FID targeted early 2027
		Vytas Limited – developing ultra-high-purity quartz for crucibles in Perth, with an assay-services agreement in place to test quartz and synthetic silica samples ahead of any production decision	Early-stage development
GALLIUM	Refined to the purity suitable for semiconductor applications; around 90 per cent of the world’s gallium is recovered during alumina refining, which Australia’s refineries currently discard or export without recovery	Alcoa–Sojitz Gallium Recovery Project, Wagerup – the flagship project under the October 2025 US–Australia critical minerals framework, backed by the Australian and US governments and Japan Australia Gallium Associates, using liquid–liquid extraction	FID reached July 2026, groundbreaking August 2026; ~100 t/yr, ~10 per cent of global supply
HIGH-PURITY ALUMINA	Semiconductor packaging materials and chemical–mechanical planarisation (CMP)	Andromeda Metals, South Australia – running a high-purity alumina pilot plant using a proprietary low-carbon flowsheet, targeting commercial-grade (4N) samples for customer qualification	Pilot stage; samples targeted for the second half of 2026
		Alpha HPA, Gladstone – first stage operating, second stage under construction.	Letters of intent covering 12,000+ tonnes

ANTIMONY	Used in high-power specialty electronics.	Nyrstar, Port Pirie – will provide up to 5,000 t/yr (~15 per cent of global supply) by 2028 commercial-grade antimony	Shipping since February 2026
FLUORITE	Acid-grade fluorspar used in semiconductor, battery and energy markets	Tivan, Speewah (WA) – the country’s only JORC-compliant fluorite resource, developed through a joint venture with Sumitomo and the Japan Organization for Metals and Energy Security	First production targeted 2027
GERMANIUM / INDIUM	Not currently produced in Australia; semiconductor-relevant potential under assessment	Nyrstar, Hobart – government-funded feasibility work examining germanium and indium recovery at its zinc works.	Feasibility stage
		Iltani Resources – defining Australia’s largest known silver–indium deposit, Far North Queensland, backed by an \$8 million Queensland Investment Corporation investment funding an active 2026 drilling campaign	Resource definition
		ANSTO / CSIRO / Geoscience Australia – joint assessment of the gallium, germanium and indium potential of Australian zinc deposits	Assessment stage

Sources: S3B analysis.

ADVANCED MATERIALS

Advanced materials are the new and emerging materials used in semiconductor devices, or in products made with semiconductor processing techniques such as sensors and micro-electro-mechanical systems (MEMS). Device performance depends on material properties, device architecture and fabrication processes as well as on circuit design, which makes this capability a foundation for higher-value products.

Areas where Australia can add value are outlined in Table B.2.

TABLE B.2: ADVANCED MATERIALS CAPABILITY AREAS AND AUSTRALIAN STRENGTHS

MATERIAL	ABOUT
WIDE AND ULTRA-WIDE BANDGAP MATERIALS	Includes silicon carbide, gallium nitride and related nitride platforms. Research strength is spread nationally: the Australian National University (ANU) in optoelectronics and meta-optical systems, through its ARC Centre of Excellence for Transformative Meta-Optical Systems; the University of Western Australia (UWA); and Griffith University. Commercially, BluGlass has developed proprietary laser diode manufacturing and materials growth technology, and Silanna UV has built far-UVC and deep-UVC LED manufacturing based on patented nitride semiconductor epitaxy
ADVANCED PACKAGING MATERIALS	The interconnect, substrate and encapsulation materials used in system-in-package and heterogeneous integration. Australia does not yet have a dedicated packaging-materials research base distinct from the process capability described under Manufacturing Services below, where Syenta’s localised electrochemical manufacturing technology and the AMRF, NSW and Queensland packaging facilities are concentrated
PHOTONIC AND RADIO-FREQUENCY MATERIALS	The compound semiconductor materials that carry light and radio-frequency signals. UWA’s ANFF node runs a vertically integrated facility spanning materials growth, device design, fabrication, testing and packaging for optoelectronic and photonic materials, and the ARC Centre of Excellence in Optical Microcombs for Breakthrough Science (COMBS) works on the photonic integrated circuit materials that underpin microcomb technology. The gallium nitride materials growth capability described above also feeds this category
QUANTUM AND CRYOGENIC MATERIALS	Includes diamond and the materials used in cryogenic control electronics. Quantum Brilliance opened a commercial quantum diamond foundry in Australia in 2025, supported by a \$13 million National Reconstruction Fund Corporation (NRFC) investment, and University of Sydney spinout DeteQt is developing portable quantum magnetic sensors. Emergence Quantum, also spin-out from University of Sydney, develops cryogenic electronics and materials for quantum computers, including ion-trap hardware in collaboration with IonQ
TWO-DIMENSIONAL AND CARBON-BASED MATERIALS	Includes graphene and atomically thin semiconductors. Archer Materials has developed graphene field-effect transistor biosensors, now at clinical-standard prototype, alongside a carbon-based qubit program, and is collaborating with Emergence Quantum on graphene. TQ Transistors, a spin-out from the ARC Centre of Excellence in Future Low-Energy Electronics Technologies, is developing low-energy transistors based on atomically thin materials

B.2 Technologies

This priority area covers four device-level technology families where Australia holds demonstrated research or commercial strength: quantum, photonics, power and radio.

QUANTUM

Quantum computing, sensing and communications platforms depend directly on semiconductor materials, devices and fabrication processes. Examples of quantum capability are outlined in Table B.3.

TABLE B.3: QUANTUM CAPABILITY EXAMPLES

ORGANISATION	CAPABILITY
SILICON QUANTUM COMPUTING	Places individual phosphorus atoms in isotopically pure silicon with atomic precision, and fabricates its devices in Australia
DIRAQ	Uses CMOS-compatible quantum-dot structures that can be manufactured in standard silicon CMOS foundries
QUANTUM BRILLIANCE	Diamond-based quantum computing company; fabricates its devices in Australia
PSIQUANTUM	Building a utility-scale, fault-tolerant quantum computer in Brisbane using silicon photonic chips, though the chips themselves are fabricated in New York
UNIVERSITY OF SYDNEY FUTURE QUBIT FOUNDRY	A \$7.4 million facility established in 2023 to support the fabrication, packaging and characterisation of next-generation quantum devices and qubits
VICTORIA’S DIAMOND QUANTUM ECOSYSTEM	Brings together research, materials development and emerging quantum diamond foundry activity
CSIRO*	Quantum device packaging laboratory, developed under the Defence Trailblazer program, offering a suite of bonding tools to all project partners

**Also applicable with Advanced Packaging capability*

PHOTONICS

Photonics covers the design and fabrication of devices that generate, manipulate and detect light – lasers, optical sensors, waveguides and photonic integrated circuits – for communications, navigation, sensing and quantum technologies.

Examples of photonics capability are outlined in Table B.4.

TABLE B.4: PHOTONICS CAPABILITY EXAMPLES

ORGANISATION	CAPABILITY
MACQUARIE UNIVERSITY MQ PHOTONICS RESEARCH CENTRE	Research excellence in lasers and photonics, including advanced semiconductor materials applications
COMBS	Research centre focused on optical microcomb technology
UNIVERSITY OF SYDNEY NANO FOUNDRY	Provides photonic prototyping infrastructure as part of the ANFF network
UTS NANOPHOTONICS LAB	Focuses on nanoscale engineering of wide bandgap semiconductors
ADVANCED NAVIGATION	Has developed a photonic chip for digital fibre-optic gyroscopes used in inertial navigation
BLUGLASS	Manufactures gallium nitride laser diodes
SILANNA UV	Manufactures far-UVC and deep-UVC LEDs

RADIO

Radio-frequency integrated circuits handle wireless communications, sensing, radar and IoT functions across telecommunications, defence and microwave applications. Examples of Australia’s commercial maturity in this field are outlined in Table B.5

TABLE B.5: RADIO CAPABILITY EXAMPLES

ORGANISATION	CAPABILITY
MACQUARIE UNIVERSITY ANALOGUE DEVICES LABORATORY (MADLAB)	Designs high-frequency monolithic microwave integrated circuits
MACQUARIE SILICON PLATFORMS LAB	Works with hardware startups on system-on-chip and system-in-package development
MORSE MICRO	Develops world-leading Wi-Fi HaLow chip designs for long-range internet-of-things devices
BROADCOM (SYDNEY)	Sydney engineering group has shipped more than a billion Wi-Fi 6, 6E and 7 chips globally
SEMITECH SEMICONDUCTOR	Designs power-line and hybrid PLC/RF communication chips for smart grid, industrial IoT and transportation applications
EM SOLUTIONS	Develops gallium nitride power amplifiers for satellite and on-the-move radio applications
ALTUM RF	Runs its design centre and RF characterisation laboratory in Sydney, headquartered in Eindhoven

B.3 Manufacturing services

Manufacturing services cover the specialised infrastructure and technical services that surround fabrication: packaging devices into deployable systems, and measuring, testing and qualifying them to the standards commercial and defence customers require. Examples of emerging packaging capabilities are outlined in Table B.6. below.

TABLE B.6: PACKAGING CAPABILITIES

FACILITY/ORGANISATION	FOCUS
AMRF SEMICONDUCTOR ADVANCED PACKAGING FACILITY	Flip-chip, fan-out wafer-level, 2.5D/3D packaging; high-value, security-sensitive work for defence, aerospace, medtech and quantum
NSW ADVANCED PROTOTYPE PACKAGING FACILITY	Packaged semiconductor and photonic device prototypes
CSIRO QUEENSLAND ADVANCED PHOTONICS PACKAGING FACILITY*	Prototype and pilot-scale packaging of photonic integrated circuits
DISCOVERY TO DEVICE (D2D) FACILITY	Prototyping and scale-up of semiconductor-based medical technology

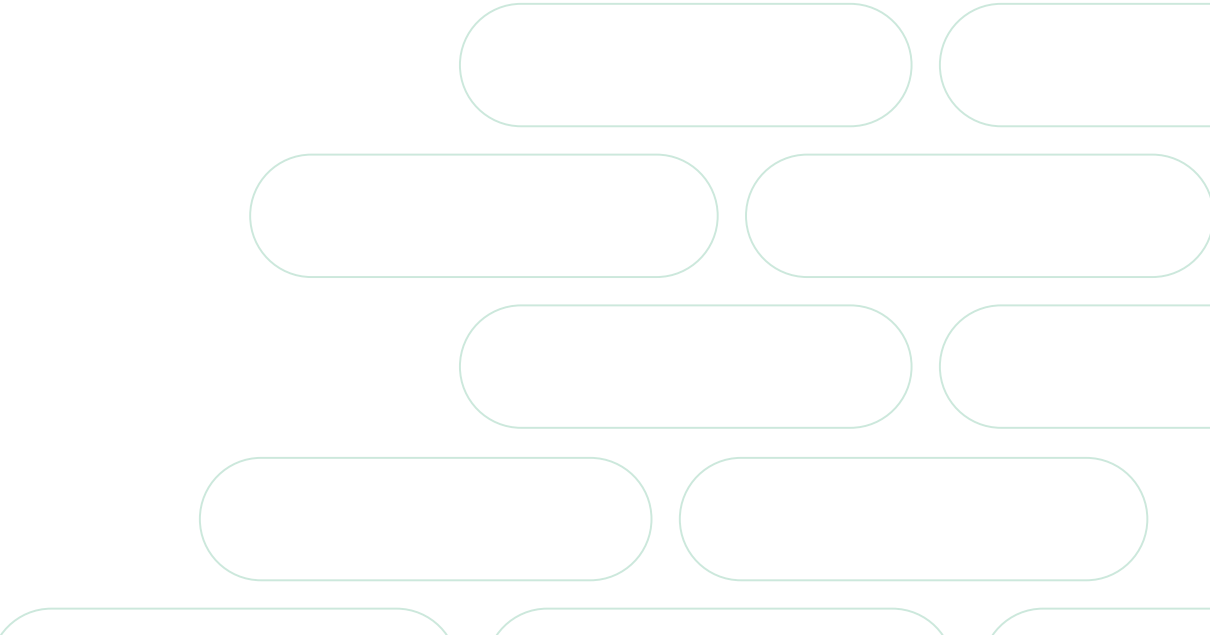
**Also applicable with Photonics capability*

METROLOGY, CHARACTERISATION AND TEST

Metrology, characterisation and test covers the measurement, inspection and qualification infrastructure that underpins failure analysis and quality assurance across the value chain. Key capabilities in this area are outlined in Table B.7 below.

TABLE B.7: METROLOGY CAPABILITY

FACILITY/ORGANISATION	FOCUS
NATIONAL MEASUREMENT INSTITUTE	Primary metrology standards for electrical, optical and dimensional parameters
ANFF	Characterisation infrastructure across university nodes nationally
CSIRO QUEENSLAND CENTRE FOR ADVANCED TECHNOLOGIES	Dedicated capability alongside its photonics packaging work
UNIVERSITY OF WOLLONGONG / ANSTO / ANU	Complete radiation-hardened chip test capability
MICROSCOPY AUSTRALIA	National microscopy and microanalysis infrastructure network



Appendix C

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