WRAYS

Navigating the Future

Australia's Emergence in the Semiconductor Sector

wrays.com.au

Semiconductors underpin almost every aspect of our modern lives, playing a critical role in next-generation technologies. Australia's semiconductor sector is in a unique position, driven by its commitment to high-quality research and niche capabilities in growth areas such as telecommunications, healthcare and quantum technologies. In this article we take a closer look at the rise and fall of the photonics and semiconductors sectors in Australia, and the challenges that will need to be addressed if the country is to enhance its competitiveness in the global landscape.

The Rise of Australia's Photonics Technologies

The Australian semiconductor industry, while smaller in scale compared to global giants like the US or Taiwan, has been developing niche capabilities, particularly in areas that complement photonics technologies.

The photonics industry in Australia is closely intertwined with the country's semiconductor sector, as both fields deal with the manipulation of light and electrons for various technological applications. In Australia, the photonics industry has been growing steadily, driven by increasing demand for optical and photonic technologies in various sectors such as telecommunications, healthcare, defence, environmental monitoring and quantum technologies. The industry encompasses a range of technologies including lasers, optical fibres, sensors, and imaging systems.

Beginning with raw materials such as glass and semiconductor substrates, the photonics value chain advances via optical components and subsystems to photonics products and products enabled by photonics, including smart phones, self-driving cars, lighting systems, quantum computers, and AR/VR vision systems.

These end-use goods provide the foundation of the worldwide photonics-enabled economy, which in turn supports photonics-enabled services, usually based on the internet. The internet uses light, either through free space or optical fibre, to carry its data. For example, cloud computing, streaming video and music, and e-commerce are among the enabled services.

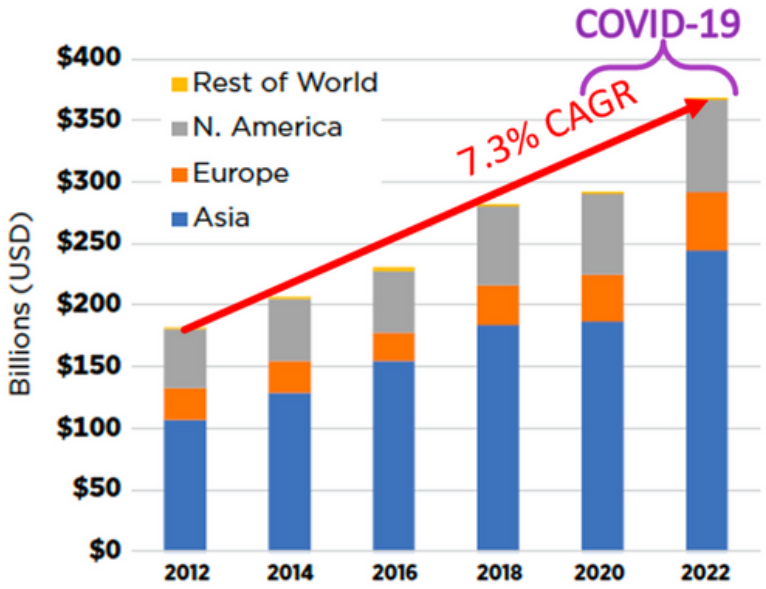
There are numerous applications for photonics, many of which are underpinned by and reliant upon semiconductor technologies, including consumer electronics (smart phones, AR/VR headsets, smart doorbells), telecommunications (fibre optics, lasers, Li-Fi), health (eye surgery, medical imaging, wearables), manufacturing (3D printing, laser cutting, robotics and vision), defence and security (night vision, satellites, autonomous systems), and sustainability (climate monitoring, solar photovoltaics, lidar for wind turbines, LED lighting, to name a few).

In 2022 SPIE reported [1] that the size of the global photonics industry across all sectors was approximately 368B and growing with a strong annual growth rate of about 7.3% compared with the global GDP growth rate over the same 10-year period of about 3% pa. Similar studies [2] on the Australian and New Zealand Photonics landscape place the size of local industry at about $6.2 B (AU ~$4.7B, NZ ~1.5B) and growing at an annualised rate over the past 10 years of about 2.8% per annum.

For comparison, following a sales record of $574.1 billion in 2022, global semiconductor sales in 2023 decreased by 8.2% to $526.9 billion. However, driven by an increased demand for chips for the automotive, artificial intelligence and industrial applications, estimates from the World Semiconductor Trade Statistics (WSTS) project worldwide semiconductor industry sales will increase to $611 billion in 2024, a 16% increase compared to 2023 [3].

The COVID years saw a temporary retraction of the global photonics industry, however the industry has made a strong recovery since and continues to grow [1, 4].

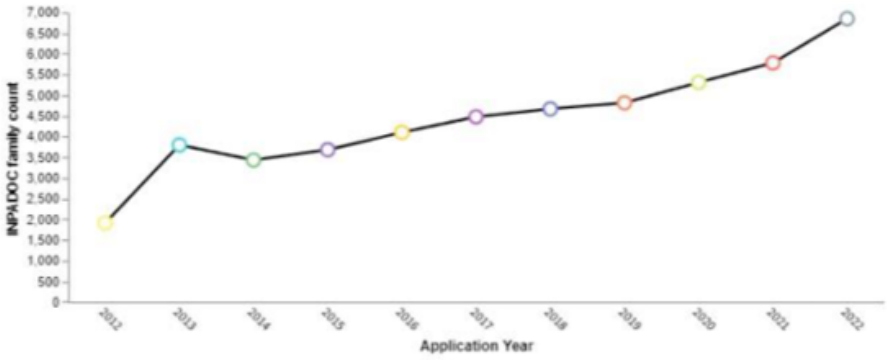
The COVID years saw a temporary retraction of the global photonics industry, however the industry has made a strong recovery since and continues to grow [1, 4].



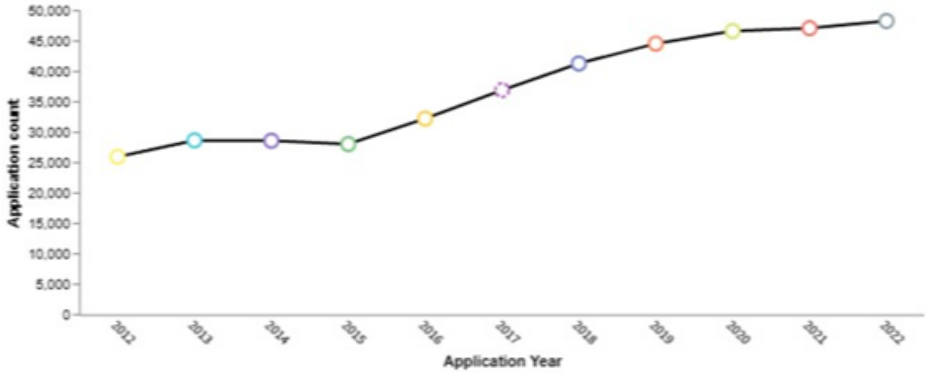
This growth is reflected in the extremely strong growth in global patent filings for the inventions in the optics and photonics industry, showing steady growth of about 13% annually over the 10 years between 2012 and 2022.

This is a similar trend seen in the broad semiconductor and quantum technology industries which has seen very rapid growth in the past 10 years globally: an average of approximately 6.5% growth per year for the semiconductor industry and more than 11% growth per year for quantum technologies across all quantum applications including quantum computing and quantum sensing etc.

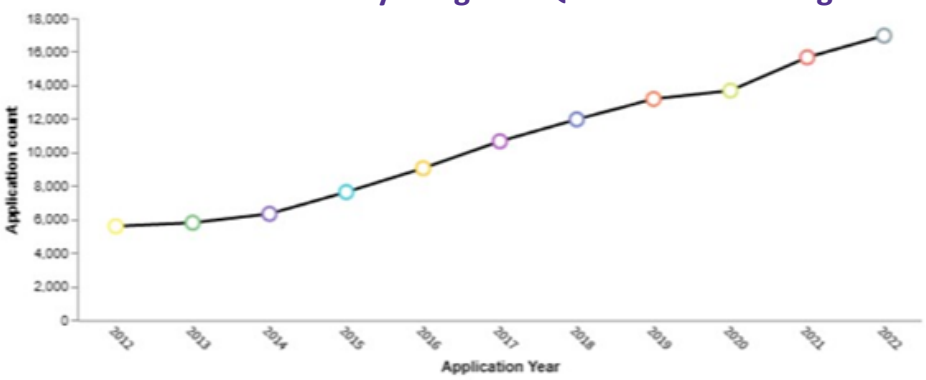
Global Patent Family filings for Optics and Photonics



Global Patent Family filings for Semiconductor Technologies



Global Patent Family filings for Quantum Technologies



Semiconductor Patent Trends in Australia

Australia's semiconductor patent filings are relatively modest compared to global leaders like the US, China, and South Korea. However, there has been a gradual increase in filings over the past decade, indicating growing activity in the sector.

Key areas of patent filings originating from Australia include:

Quantum computing: A significant portion of Australia's semiconductor-related patents are in quantum technologies, particularly silicon-based quantum computing.

Photonics and optoelectronics: Reflecting Australia's strength in this field, many patents relate to photonic integrated circuits and optical communication technologies.

Specialised sensors: Patents for advanced sensing technologies, often for environmental or medical applications.

Power electronics: Growing number of filings in wide bandgap semiconductors, e.g., SiC, GaN, and energy-efficient power devices.

Overcoming Challenges: How Australia Can Stay Competitive

To increase the global market share of semiconductor, photonics and/or quantum technologies in Australia requires improvements across the research and development sector including:

- ### Government Support and Funding

  The Australian government has recognised the strategic importance of both photonics and semiconductor industries. Figures from the OECD Directorate for Science, Technology and Innovation demonstrate a global slowdown in government R&D investment during 2023 and no real growth in business R&D. However, the first half of 2024 has shown [5] an increase in demand for photonic technologies in the defence and communications sectors.

- ### Acquisition of Skilled Workers

  The lack of skills in photonic and quantum technologies remains a key issue for both countries and both are seeking to either teach, retain or attract skilled workers from overseas. As a future career, photonics is almost entirely hidden yet, the CSIRO forecasts that quantum information science and technology could create 16,000 jobs to be filled by 2040. Australia's Chief Scientist, Dr Cathy Foley says there's currently a tension between new ideas emerging from fundamental research and a focus on areas of competitive advantage. She says Australian universities need to act with clearer intent and focus if they're to create opportunities for PhD's.

- ### Access to Infrastructure

  The Australian Strategic Policy Institute in 2022 released a Policy Brief outlining Australia's Semiconductor Moonshot.

  This briefing note outlines the case for local sovereign semiconductor Moonshot to provide Australia with sovereign semiconductor capabilities. Such desired capabilities include local semiconductor manufacturing facilities to ensure access to semiconductor components without the reliance upon external trading partners, as well as uplifting other areas of the semiconductor ecosystem including critical minerals and microchip design.

  This effort is supported by the establishment of the National Collaborative Research Infrastructure Strategy (NCRIS), an AU$4 billion government initiative designed to maximize Australia's national research infrastructure investments through the coordination of open access facilities, specific scientific fields, and co-funding throughout the nation. The NCRIS is a sponsor of the Australian National Fabrication Facility (ANFF), which makes the Heavy Ion Accelerators (HIA) network and micro and nanofabrication equipment freely accessible for high-energy ion beam research in areas of national importance, such as advanced materials science, quantum computing, and space and astronomy.

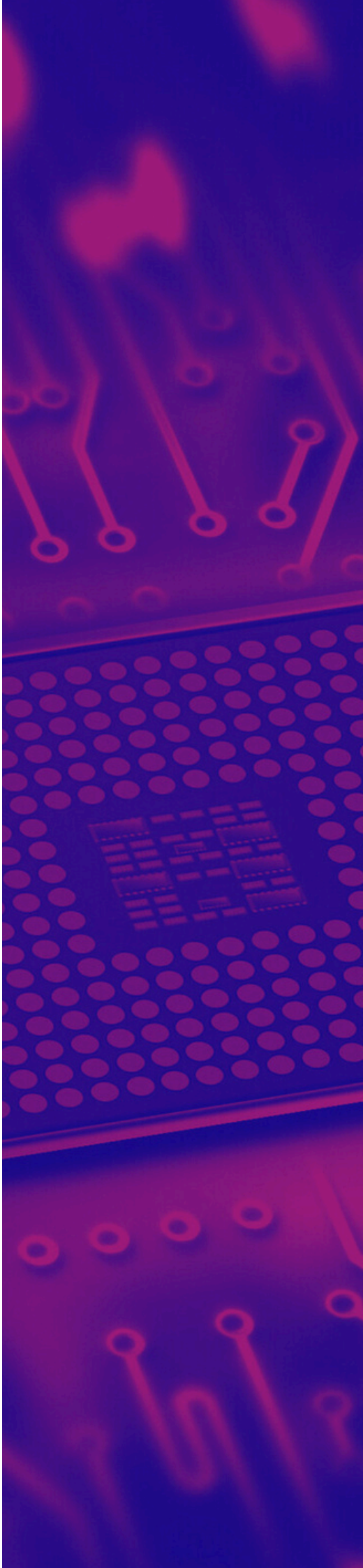
A Bright Outlook for Australia's Semiconductor Sector

Despite the challenges to developing local sovereign capabilities in semiconductors, photonics and quantum manufacturing and development, the future outlook for Australia's semiconductor industry is promising, While Australia's semiconductor patent filings may be fewer in number compared to global leaders, they often represent high-quality, innovative research, particularly with a particular emphasis on next-generation technologies in specialised fields like quantum computing and photonics that could have significant long-term impact. The patent activity in this sector reflects its focus on niche, high-value areas rather than mass-market semiconductor production.

The combination of steady market growth, technological innovation, and supportive policies positions Australia's semiconductor industry for a bright future.

Should you have any questions about protecting the intellectual property of your semiconductor innovation, please contact our author Dr Phil Burns.

Dr Phil Burns
Principal
phil.burns@wrays.com.au
T: +61 2 8415 6509



References:

[1] SPIE Global Industry Report 2024 – Optics and Photonics
https://spie.org/community-support/industry-resources/global-industry-report#_=

[2] ANZOS Photonic and Quantum Technologies In Australia And New Zealand - 2024 Industry Report
https://optics.org.au/2024-industry-report

[3] SIA 2024 State of the U.S. Semiconductor Industry
https://www.semiconductors.org/2024-state-of-the-u-s-semiconductor-industry/

[4] The Australian Photonics Industry: Current Status & Future Opportunities – Simon Poole presentation to the Sydney Photonics Industry Network (SPIN) 16 May 2024

[5] Ceres Technology Advisors
https://cerescom.net/articles/first-half-2024-mergers-acquisitions-in-photonics