

Quantum Technologies

Roadmap



Acknowledgement of Country

RMIT University acknowledges the people of the Woiwurrung and Boon wurrung language groups of the eastern Kulin Nations on whose unceded lands we conduct the business of the University. RMIT University respectfully acknowledges their Ancestors and Elders, past and present.

RMIT also acknowledges the Traditional Custodians and their Ancestors of the lands and waters across Australia where we conduct our business.

Artwork: *Luwaytini* by Mark Cleaver, a proud Palawa person and RMIT Master of Human Resource Management student.

Acknowledgement & Contributions

This document has been coordinated by the Enabling Impact Platforms. The development of the Quantum Technologies Roadmap involved academic and professional staff representing RMIT Colleges, Enterprise Portfolios, Research Centres and Groups. We gratefully acknowledge everyone who has provided their professional knowledge and valuable feedback. This Roadmap is a testament to the collaborative spirit and commitment of all involved.

Executive Summary

This document positions and examines the opportunities for RMIT in Applied Quantum Technologies in Australia. Its purpose is to review Quantum Technologies in Australia and Victoria and contextualise RMIT's Quantum Technologies research and innovation within this landscape. Quantum Technologies are undergoing rapid evolution and attracting significant investment, both internationally and nationally, across various sectors of the economy.

This report provides strategic recommendations for RMIT to establish a cohesive, externally facing approach to this dynamic field encompassing sensing, computing, communications, materials and quantum adjacent domains. By following these recommendations across horizons 1 to 3, RMIT can focus its efforts and investment and grow in its niche research, innovation, and education domains. These recommendations align with the themes of the recently released National Quantum Strategy, which include thriving research and development, access and support for essential quantum infrastructure and materials, and a skilled and growing workforce.

Our progress so far

The ultimate purpose of this document is to support the direction of Quantum Technologies research and innovation at RMIT University. Since the initial creation of this document, several significant steps have been taken to support this vision.

RMIT's role as establishment partner of the recently announced Australian Centre for Quantum Growth is evidence of the leadership of RMIT in the domain both at the Victorian state level and in the National ecosystem. Working with partners across the Growth Centre, RMIT will have a key role in capability uplift of research, industry and support community understanding of the Quantum Technology opportunities.

RMIT is in the process of creating the RMIT Applied Quantum Technology Centre to support increased collaboration, research and translation efforts. In turn, this has been supported through schemes such as RMIT's Vice-Chancellor's Research Fellowships with new appointments and Quantum Technologies being an active priority area in future recruitment rounds. There has also been a successful LIEF (Linkage Infrastructure, Equipment and Facilities) grant. This is clear evidence of on-going investment which will provide long-term support for researchers and will enable technology translation with our research partners. Indeed, there have been several new research projects initiated in the Quantum Technology domain with national and international partners over the past year. Increasingly, and in response to National Priorities, projects which require Quantum Technologies application rather than development are emerging.

RMIT continues to support the broader ecosystem including with the provision of significant thought-leadership into activities such as the Victorian Quantum Roadmap, preparation of international conferences and activities towards the recent announcement by the UN that 2025 is the International Year of Quantum Science and Technology. Combined, this significant recent progress has led to a significant increase in RMIT's external visibility of its large contribution to Quantum Technologies.

September 2024.



Foreword

Welcome to this Quantum Technologies roadmap, which highlights RMIT University's long-standing commitment to cutting-edge technologies. Throughout its history, RMIT has been at the forefront of innovation, pushing boundaries and making significant contributions to multiple impact-centred advances. Recent examples include health diagnostics with Atmo Biosciences commercialising RMIT's ground-breaking innovation in ingestible gas-sensing capsules, and in the energy sector the electricity network predictive Early Fault Detection (EFD) system designed at RMIT University and commercialised by IND Technology.

Back in 1887, Francis Ormond, RMIT's Founder, had two core ambitions. The first was the adaptation of the workforce to the new industrial economy and the second was to educate and train the local population in the technologies of the time. The digital revolution, which has industrialised innovations such as lasers (an early Quantum Technology) and transistors has transformed and shaped our world of today. The implementation of Quantum Technologies 2.0 is likely to lead the next generation of rapid change. There is a global race to not only develop and translate the latest technologies based on quantum physics, but also to enable our workforce to capture the security, economic and social potential of this new generation of technologies.

The Department of Industry, Science and Resources, led by Australia's Chief Scientist, released the National Quantum Strategy in May 2023. The strategy, based around five core themes, is designed to ensure Australia's vision for Quantum Technologies is coordinated, with long-term government investment and a critical mass of world-class, Australian-trained quantum specialists enabled to succeed. Whilst RMIT University will contribute to all five themes, the first three provide the greatest alignment with that of the university:

- creating thriving research and development, investment in and use of Quantum Technologies;
- securing access to essential quantum infrastructure and materials; and
- building a skilled and growing quantum workforce.

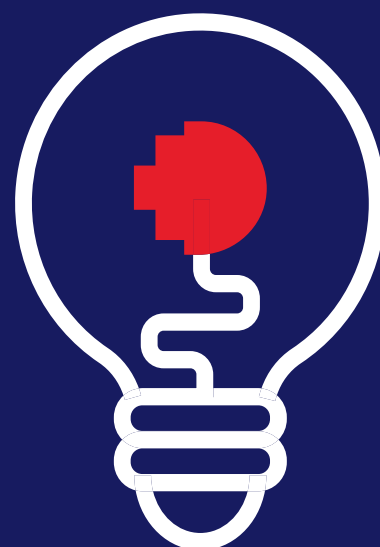
The Australian Government, some state governments, and the private sector are investing heavily in both fundamental Quantum Technologies and their translation. RMIT has been leading significant efforts in Quantum Technologies, with that momentum increasing over the last few decades. It is therefore strategic for RMIT to address the opportunities that Quantum Technologies provide and this roadmap presents a series of recommendations to progress through this initial phase. A detailed strategy is being developed to support investment considerations in the near future.

Professor Calum J. Drummond AO
Deputy Vice-Chancellor Research and Innovation
Vice President
March 2024



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Quantum Technologies at RMIT

Quantum Technologies currently are in focus throughout research and government investment. The balance of the reality versus hype of the Quantum Technologies opportunity will become more evident with time. CSIRO's 2020 roadmap and recent economic update points toward a significant opportunity for Australian industry worth \$2.2 billion and 8,700 jobs by 2030. [1,2] This could reach nearly \$6 billion and 19,400 jobs by 2045. The CSIRO analysis clearly highlights the requirement for all stakeholders to contribute to sector-wide development to focus and coordinate efforts.

Capability uplift through workforce enablement and (sovereign) capability is a stated requirement for the future success of Quantum Technologies in Australia. The need for enhanced collaboration across the sector is highlighted and, as part of the development of our internal consultation and workshop, we have identified areas of best practice which are a potential route to enhanced pathways in Victoria. Finally, the need for communication and engagement is clear to support the uptake and transition towards application of these technologies.

The National Quantum Strategy led by Australia's Chief Scientist was released in May 2023. [3] The National Quantum Strategy focuses on 5 core themes, shown in Figure 1.

Backed by specific recommendations, the National Strategy recommends key actions to ensure that the Quantum Technology opportunity is captured in Australia. Herein, RMIT's Quantum Technology positioning relative to the National Strategy will be highlighted, particularly in themes 1 to 3. The Victorian Strategy is anticipated to soon follow the release of the Federal approach and this will further refine the local opportunities.

There are strong quantum capabilities (Figure 2) across all states and territories, and New South Wales partly through the implementation of the Sydney Quantum Academy, has played a leading voice in Australia in the Quantum Technologies domain.

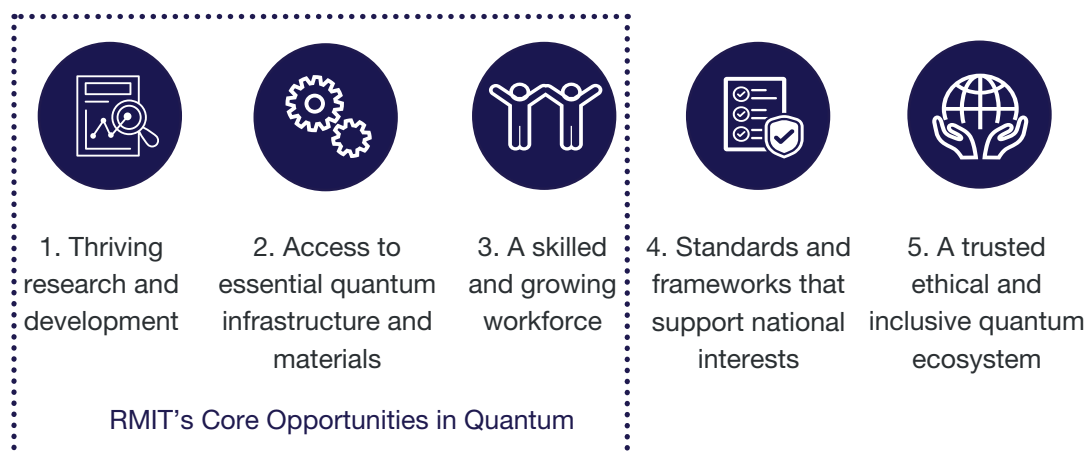


Figure 1. National Quantum Research Priorities

Quantum Technologies in Australia

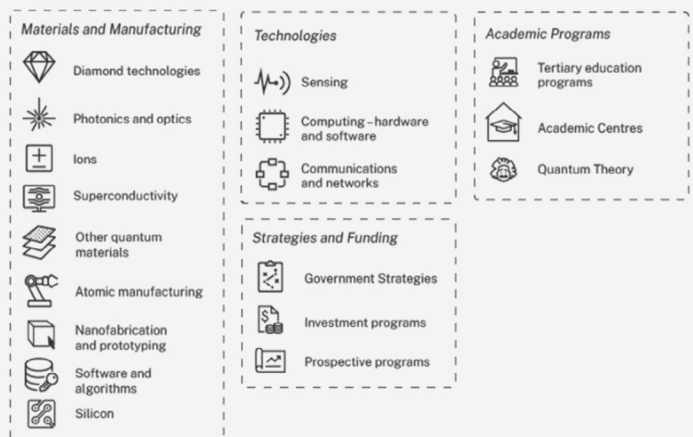


Figure 2. National Quantum Capabilities. (Adapted and reproduced from the National Quantum Strategy, Australian Government Department of Industry, Science and Resources. Creative Commons Attribution 4.0 International Licence).

RMIT's Quantum Technologies Landscape



Quantum technologies, typically categorised into sensing, computation, and communications, are evolving. Quantum computing, in its infancy, faces challenges in hardware stability and scalability before it can be applied practically. The second quantum revolution hinges on manipulating individual quantum systems like atoms, photons, and electrons, which are environmentally sensitive. This sensitivity, a hindrance in quantum computing, becomes an asset in quantum sensing, enhancing sensor performance by detecting background interference. The following sections summarise RMIT's work at the forefront of applied quantum technology.

RMIT's research capability in Applied Quantum Technologies is broad and stretches across the core domains of Quantum Sensing, Quantum Computing and Communications, and Quantum Materials and Manufacturing. RMIT has core strengths in both fundamental and importantly the application of Quantum Technologies. A summary of the breadth of RMIT's research can be found in Figure 3 and brief outline of RMIT's research activities and expertise are in RMIT's Quantum Technologies Community on page 14. Clarity in communicating RMIT's strengths across the training and research and development components of Quantum Technologies is vital to inform existing and future partners, collaborators and students. RMIT looks to apply its research platforms, such as the Nitrogen-Vacancy centre diamond materials, across multiple sectors including defence, mining and health.

	Quantum Sensing (inc.devices)	Quantum Computing and Communications	Quantum Materials and Manufacturing
Capability and Research	Hybrid Technology and Integration (Quantum/non-quantum systems) Integration of quantum technologies and systems into existing platforms	Optical Quantum Hardware and Theory Development Integrated quantum photonics; Quantum communication link	Diamond for Quantum Sensing and Quantum Computing Research Hub for Diamond Quantum Materials
	Application of Quantum Materials N-doped Diamond and Quantum optics	Quantum Materials and Manufacturing Materials e.g. Nitrogen Vacancy Centre Diamond; Photonic systems: Optical microcombs; Quantum optics; Lithium niobate for integrated quantum photonics; Silicon and superconducting materials (Theory)	
	Applications of Quantum Technologies Magnetic field sensing; laser-threshold magnetometers; diamond magnetometers; radio frequency monitoring; single photon emission for quantum communication applications; Laser-threshold magnetometry	Quantum Software and Theory Quantum information theory and quantum error correction; Quantum control and characterisation; Quantum algorithms; Quantum communication and quantum cryptography protocols; Photonic quantum computing - architecture design, development, and realisation	Quantum Materials Characterisation Full characterisation suite across length scales
	Quantum Imaging Decoherence microscopy; Quantum illumination/astronomy – theory	Hybrid Technology and Integration (Quantum/non-quantum systems) Integration of quantum technologies and systems into existing platforms; packaging; supporting infrastructure	
	Quantum Foundations Quantum Physics; Fundamental Science; Relativistic quantum information, decoherence and measurement theory		
		Quantum Communication and Quantum Cryptography Protocols; Photonic quantum computing-architecture design, development and realisation	Materials for Quantum sensors and Quantum computers silicon carbide; silicon; Quantum photonic platforms; superconductivity; Research Hub for Diamond Quantum Materials
Enablers	Research Capability: e.g. Advanced Manufacturing Precinct (Photonics, Characterisation, Industry 4.0, Cybersecurity, Cryptography, AI, Supercomputing, ARC, CoE, COMBS)		
	Training ecosystem for students, SMEs, global companies and end-users		

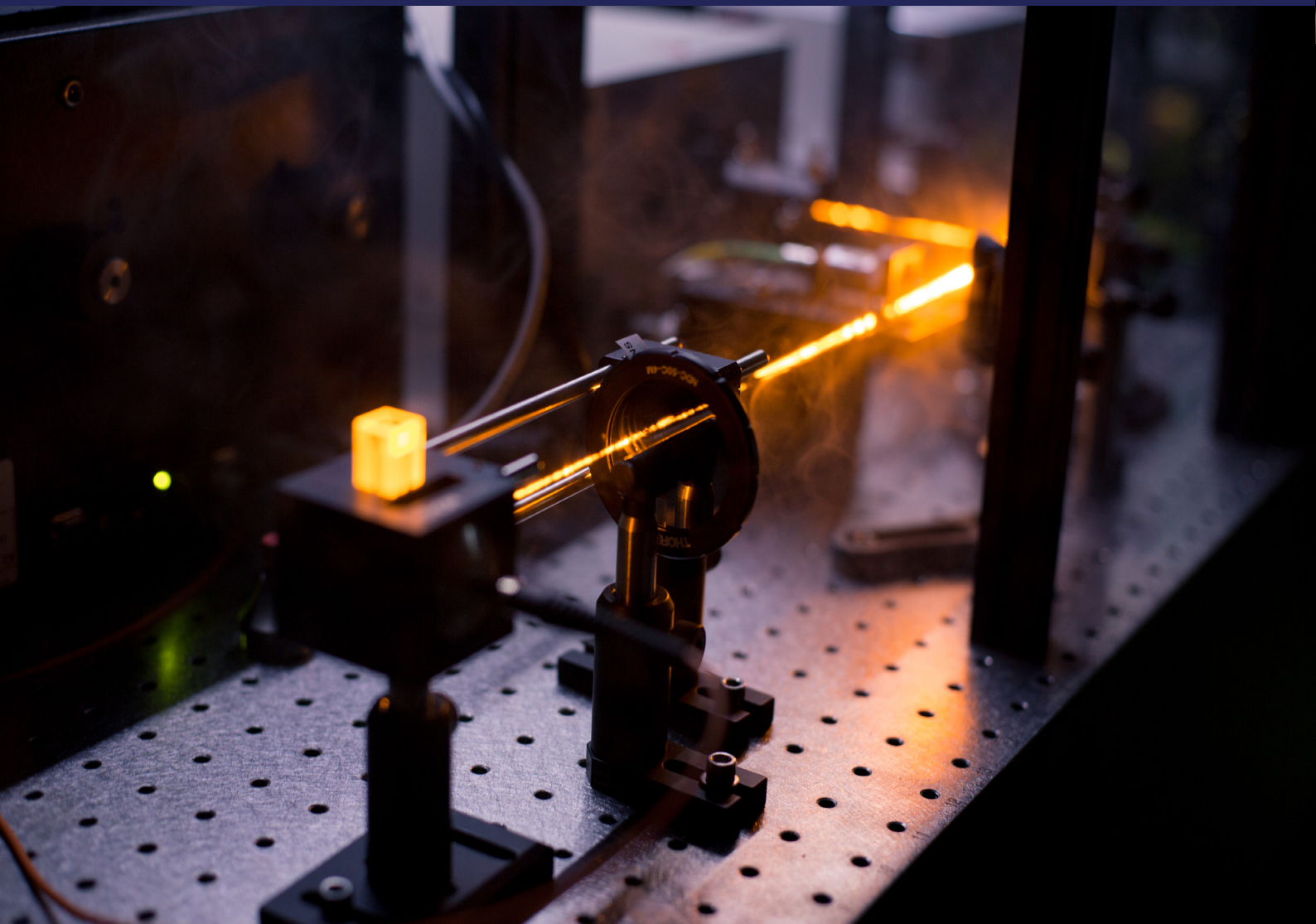
Figure 3. Summary of Quantum Technologies Capability at RMIT University

Our researchers are well connected to many leading firms, both local and global, that develop new Quantum Computing Technologies such as Xanadu, as well as sectors such as the defence or financial sectors that must ensure that they are in the driving seat to retain their commercial and strategic advantage. RMIT is seen as a source of talent by external partners already, with several researchers seen as domain leaders and sought after for consulting services. RMIT is actively involved with many leaders in the Australian Quantum Ecosystem, a recent study by the Australian National Fabrication Facility (ANFF) highlights the potential of these organisations and the need for the research and innovation ecosystem to collaborate and invest.[4]

The manufacturing and know-how of quantum materials, such as nitrogen-vacancy centre diamonds which are essential for the translation and uptake of Quantum Technologies, is a key expertise and strength of RMIT. The newly established Research Hub for Diamond Quantum Materials is led by the German-Australian quantum computing provider Quantum Brilliance, with RMIT and La Trobe universities as major research partners.

RMIT's strengths range from theoretical research to the application of these technologies with research partners across sectors including defence, mining and biotechnology. RMIT does not offer specific Quantum Technologies training at the undergraduate level. It is included as part of the Bachelor and PhD training in the School of Science. The specific nature of project students, doctoral students and post-doctoral training means that Quantum Technologies is taught across the Schools of Science and Engineering. There are no Quantum Technology offerings at the Vocational Education level.

Clearly, RMIT is a core contributor to Quantum Technology development at the state and national level. Its expertise is also sought by leading international partners and collaborators, with examples captured in Appendix C: Applied Quantum Technologies - Collaboration Highlights.





Specifically, our Quantum Technology research capability is supported and enabled by two elements:

01

Advanced materials and manufacturing facilities across RMIT's Schools and Colleges, including advanced materials characterisation. Facilities include RMIT Microscopy and Microanalysis Facility, Micro-Nano Research Facility as well as the Digital Manufacturing Facility and RMIT's deep expertise in Photonics through the recently awarded ARC Centre of Excellence in Optical Microcombs for Breakthrough Science (COMBS). These facilities support the translation to scale-up technologies.

02

A training ecosystem across higher education including undergraduate studies in the Schools of Science and Engineering as well as Masters, PhD and Post-doctoral training. Our alumni already have roles in leading companies and start-ups in the Quantum Technologies Ecosystem.

There are clear opportunities for capability development with the School of Computing in the near future.

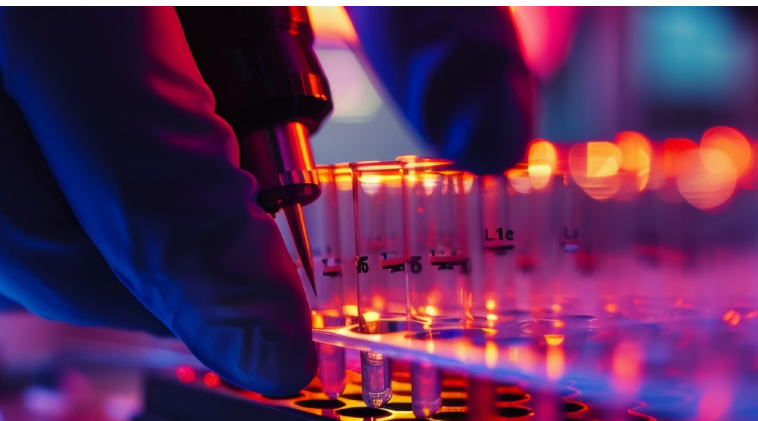
These domains are also enabled by capability in hardware, software and simulation many of which are specific to the needs of Quantum Technologies research. These strengths are well aligned to the themes of the National Quantum Strategy.

RMIT's Applied Quantum Technologies Community



ARC Centre of Excellence in Exciton Science

The ARC Centre of Excellence in Exciton Science works with partners to research and manipulate the way light energy is absorbed, transported and transformed in advanced molecular materials. They work with industry partners to find innovative solutions for renewable energy in solar energy, conversion, energy-efficient lighting and displays and security labelling and optical sensor platforms for defence.



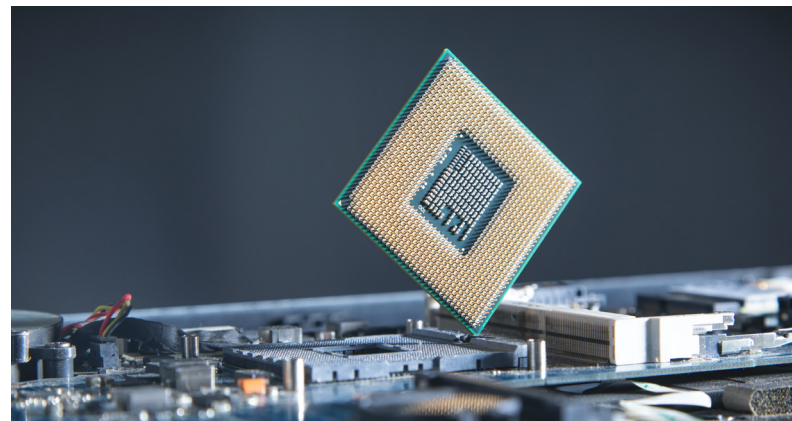
ARC Centre of Excellence for Nanoscale BioPhotonics (CNBP)

The ARC Centre of Excellence for Nanoscale BioPhotonics (CNBP) brings together physicists, chemists and biologists focused on a grand challenge – controlling nanoscale interactions between light and matter to probe the complex and dynamic nanoenvironments within living organisms.



ARC Centre of Excellence in Future Low-Energy Electronics Technologies (FLEET)

The ARC Centre of Excellence in Future Low-Energy Electronics Technologies (FLEET) addresses a grand challenge: reducing the energy used in information technology, which now accounts for 8% of the electricity use on Earth and is doubling every 10 years.



ARC Centre of Excellence for Quantum Computation and Communication Technology (CQC2T)

The ARC Centre of Excellence for Quantum Computation and Communication Technology (CQC2T) leads world-class research programs in developing a silicon-based quantum computer, and in optical quantum computing and in the fundamental physics underpinning quantum information technologies. Together with over 25 formal international partners, CQC2T represents one of the world's largest teams working to create a universal quantum computer and secure communication systems.

Trends and Drivers of Quantum Technologies

Australian Trends, Challenges and Opportunities

The current reality is that whilst there may be niche applications and deployment of new quantum technologies, the majority are several years away from deployment and use. The current level of investment and interest is driven by a range of national scale initiatives supporting sovereign capability including the National Quantum Strategy, National Reconstruction Fund, the List of Critical Technologies, the Australian Economic Accelerator, Advanced Strategic Capabilities Accelerator (emerging from the Defence Strategic Review), and the Australia – United Kingdom – United States Partnership AUKUS pillar 2. This is echoed in the private sector with significant interest from venture capitalist, including most recently [Breakthrough Victoria](#), as well as significant public interest. Research Organisations like CSIRO ([Quantum Technologies Future Science Platform](#)) and Universities, for example [ANU investing in new infrastructure](#) are investing heavily in fundamental Quantum Technology innovation. These trends can be attributed to the potential of these technologies to deliver game changing advantages, the fear of missing out from investors and key parties, and the unknown changes that these technologies might bring. This highlights the need for ongoing engagement with existing and future partners and supporting transparent communication to the public.

Quantum Technologies are one of the domains identified in the Australian Critical Technologies Action plan, which has intensified the level of scrutiny, particularly with international partnerships, over innovation in this space. Two programs are targeted (\$60 million) to grow Australia's quantum ecosystem:

- Australian Centre for Quantum Growth (\$19.8 million) - opened December 2023, with RMIT participation in leading bids.
- Critical Technologies Challenges Program (\$40.2 million). The application of Quantum Technologies to areas such as medical science, renewable and low emissions technologies, defence, resources, transport and other enabling technologies may be a key focus.

They mark the first set of actions to be delivered under the National Quantum Strategy. Current international trends are pointing to a need to support the translation of research out of the laboratory to increasing TRL levels. Whilst University based capabilities are supporting our immediate research purposes, the increased need for the application of Quantum Technologies requires a roadmap and strategy.

Further afield, and an example of resource alignment, the EU launched the Quantum Flagship in 2018 as one of the largest and most ambitious research initiatives of the European Union. With a budget of at least €1 billion and a duration of 10 years, the flagship brings together research institutions, academia, industry, enterprises, and policy makers, in a joint and collaborative initiative. Projects range across sensing, computing and communication with more than 5000 researchers involved. [5]



Training Opportunities for RMIT

Supporting new Quantum Technologies innovation will require trained workforces at all skills levels to develop, manufacture, deploy, operate and maintain new systems. Depending on the rate of progression of these technologies, this might accelerate into a race to develop the tools and structures to train an existing and new workforce in this emerging domain. It must be noted that the skill-change required here will be non-trivial and necessitate significant upskilling of workforces. Indeed, Quantum Technologies can be non-intuitive by their very nature which means that training will likely have to start early. There are also opportunities to explore RMIT-based training in Quantum Technologies and Computing which could support the creation of the next generation workforce, bringing closer the disciplines of Physics and Computing.



Talent at RMIT

People and talent have been identified as an opportunity and risk in the Quantum Domain. The ecosystem of Quantum Technologies research is currently experiencing significant mobility, with movements from universities, start-ups and government rife. At the RMIT university level, the focus must be to not only support our world-leading researchers but also to enable growth of our research portfolio, as well as ECRs and MCRs. Many universities are proactively investing in this domain to grow both their research and education offerings. Current trends in Quantum Technologies research have shown a dearth of diversity, potentially because of the required subject-matter background to gain subject matter expertise, and this is a challenge that must be addressed.



Making Quantum Possible: RMIT Applied Quantum Technologies

RMIT's current research profile has significant breadth as highlighted by the fact that our research activities span Quantum Sensing, Quantum Computing and Communications and Quantum Materials and Manufacturing. We have strong competencies in the development of Quantum Materials especially in Quantum Nitrogen-Vacancy centre diamond systems, with our expertise recognised across the globe.

The immediate interest in Quantum Technologies for near term translation is for significant deployment of quantum sensors into hybrid systems that can operate in the field today. This means that the development of RMIT-led prototypes, demonstrators and test systems enabling translation of concepts from the laboratory must be supported in order to accelerate market uptake. This will form a platform for increased complexity, optimisation and sensitivity of Quantum Sensing systems.

Security and defence are driving innovation in critical technologies. Quantum Technologies are specifically mentioned as part of the AUKUS pillar 2 agreement. The education sector is starting to address the quantum talent shortage and training the future workforce.

RMIT has the expertise to go from fundamental concepts through to industrial applications. Our unique value proposition to partners and collaborators is that working with our world-class facilities, our Quantum Technologies researchers and students work across Technology Readiness Levels (TRL, typically TRL 1- 5/6). Their work is underpinned by capabilities and know-how include advanced theoretical and computational modelling, testing and measurement, development capabilities and device fabrication facilities. An example of RMIT's integrated facilities include the Advanced Manufacturing Precinct which includes the Micro Nano Research, Digital Manufacturing and the Microscopy and Microanalysis facilities.

Quantum Adjacent: ARC Centre of Excellence in Optical Microcombs for Breakthrough Science (COMBS)

Developing controllable systems for non-classical secured communications, metrology, and quantum simulation and computation is a key opportunity in Quantum Technologies.

RMIT leads the ARC Centre of Excellence in Optical Microcombs for Breakthrough Science (COMBS) focussed on research and development of photonic chip optical frequency combs. The value of optical frequency combs for quantum are two-fold. Firstly, practically all quantum sensors rely on measurement of tiny shifts in spectral features of individual atoms or atomic scale defects. Optical frequency combs are necessary to stabilise the lasers that probe these shifts and provide a reference to quantify the measurement. These optical frequency combs are thus essential building blocks for practical quantum sensors and the ability to realise these in the form of photonic chips will vastly increase the range of use that can be considered for quantum sensors. Beyond this, each comb line can be considered an independent information channel providing a multitude of temporal and frequency modes, facilitating the creation of expansive quantum systems. By generating and managing quantum optical frequency combs, a practical and scalable framework can be established for quantum signal processing and information transmission.

For more information, visit the [COMBS](#) website.

RMIT has world leading capabilities in the design, fabrication and system implementation of classical photonic integrated circuits in silicon, silicon nitride, silicon carbide and lithium niobate and microwave systems using multi-layer ceramic technologies. We have decades of experience to integrate these two technologies together to achieve microwave photonic solutions with applications in Radar imaging and analogue signal processing with extraordinary signal to noise performance. These proven technologies can be excellent platforms to realise practical quantum systems.

Recommendations

2023-2025 Horizon 1 Short-term	2026-2029 Horizon 2 Mid-term	2030 onwards Horizon 3 Long-term
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Recommended goals

Core goals to supporting RMIT’s development, activities and innovation in the Quantum Technologies domain:

1. Engage and review the opportunity for an Applied Quantum Technologies Centre or other entity at RMIT.
2. Place RMIT Quantum Technology niche at the forefront of the current opportunity in the Quantum Technologies domain to grow RMIT’s research capability and teaching offering, including strategic partnerships.
3. Enhance RMIT’s reputation and position in the quantum innovation ecosystem.
4. Develop diverse, world-leading researchers in Applied Quantum Technologies.
5. Maintain an understanding of core Quantum Technologies and adjacent/ enabling Quantum Capabilities at RMIT.
6. Support the set-up of a Quantum Foundry for the manufacture of Nitrogen vacancy centre Diamond materials.
7. Create a Quantum Technology Strategy that enables a proactive approach to supporting and funding research by providing a detailed investment plan in people, partners, capability and infrastructure.
8. Develop a process for the governance of RMIT’s Quantum Technologies.

2023-2025 Horizon 1 Short-term	2026-2029 Horizon 2 Mid-term	2030 onwards Horizon 3 Long-term
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Recommended goals

1. Have a leading role in a thriving Melbourne and National Quantum Ecosystem for research and training with the 1st generation of students graduating.
2. Have long term strategic relationships in each Quantum Technologies domain.
3. Training and study offerings across levels.
4. Commercialisation of RMIT technology with first products deployed.

2023-2025 Horizon 1 Short-term	2026-2029 Horizon 2 Mid-term	2030 onwards Horizon 3 Long-term
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Recommended goals

1. RMIT to be one of the go-to university in Applied Quantum Technologies research in Australia.
2. RMIT as a centre of excellence in Quantum Technologies research at a global scale.
3. RMIT as a preferred university of quantum technologies investors and global talent.

An initial set of key recommendations structured as core goals have been developed. These have been structured to match time horizons, as the importance of long-term vision is key for robust investment decisions. All of these goals, whilst developed prior to the National Quantum Strategy Themes release, are strongly aligned to it.

Recommendations Summary

These recommendations provide RMIT and RMIT leadership a platform and direction for Applied Quantum Technologies. This can be achieved through strengthened research capabilities, strategic partnerships and collaboration, retention and recruitment of talent as well as maintaining a strong publication record. This approach also provides an initial framework to infrastructure and capability investment in Quantum Technologies.

This roadmap also makes the case to ensure that RMIT is a key player in the training ecosystem for Quantum Technologies through the enhancement of existing and potential development of new programs. These approaches, coupled with the implementation of a clear communication plan and public engagement, as well as ensuring the fostering of diversity and inclusion, will support RMIT's on-going success in Quantum Technologies.



Appendices

DOMAIN (APPLICATION)			
	Quantum Computing	Quantum Sensing (inc. devices) and Manufacturing	Quantum Communications
QUANTUM CAPABILITY	Quantum Cryptography ARC Centre of Excellence for Quantum Computation and Communication Technology	Quantum Cryptography ARC Centre of Excellence for Quantum Computation and Communication Technology	Quantum Cryptography ARC Centre of Excellence for Quantum Computation and Communication Technology
	Data, Processing and Communications e.g. Quantum Information Centre for Quantum Computation & Communication Technology QuRMIT	Data, Processing and Communications e.g. Quantum Information Centre for Quantum Computation & Communication Technology QuRMIT	Data, Processing and Communications e.g. Quantum Information Centre for Quantum Computation & Communication Technology QuRMIT
	Complex Devices & Systems Gibson & Greentree Research Group QPLabs	Integration e.g. into existing platforms Gibson & Greentree Research Group	Integration e.g. into existing platforms Centre for Quantum Computation & Communication Technology
	Quantum Information and Data Centre of Excellence in Exciton Science astronomy QuRMIT	Quantum Optics ARC Centre of Excellence for Nanoscale BioPhotonics ARC Centre of Excellence for Quantum Computation and Communication Technology	Quantum Devices and Fabrication ARC Centre of Excellence in Future Low-Energy Electronics Technologies (FLEET) Gibson & Greentree Research Group InPAC
	Quantum Devices and Fabrication ARC Centre of Excellence in Exciton Science Gibson & Greentree Research Group QPLabs	Quantum Devices and Fabrication ARC Centre of Excellence in Exciton Science Gibson & Greentree Research Group QPLabs Quantum Sensing group	Hybrid Technologies (Quantum/non-quantum systems) Centre in Optical Microcombs for Breakthrough Science (COMBS) Gibson & Greentree Research Group
	Quantum Materials (e.g. silicon, diamond) Gibson & Greentree Research Group	Quantum Materials (e.g. silicon, diamond) Gibson & Greentree Research Group	Quantum Foundations: Quantum Physics; Fundamental Science QuRMIT Theoretical, Computational, and Quantum Physics
	Digital Software, Algorithms, Simulation QuRMIT Theoretical, Computational, and Quantum Physics	Quantum Foundations: Quantum Physics; Fundamental Science QuRMIT Theoretical, Computational, and Quantum Physics	
	Quantum Foundations: Quantum Physics; Fundamentals QuRMIT Theoretical, Computational, and Quantum Physics		



The **Quantum Sensing Group** specialises in quantum sensing technologies based on spin defects in solids (diamond and boron nitride). These crystalline defects form quantum systems that can be used for accurate, sensitive, quantitative measurements of magnetic, electric fields, pressure and temperature, with spatial resolution exceeding classical technologies. The group develops devices that exploits quantum defects to develop, for example, quantum microscopes for the advanced characterisation of magnetic materials and electronic devices, high-accuracy temperature sensors for medical and industrial applications, high-sensitivity compact magnetometers for defence and space applications, and portable nuclear magnetic resonance.



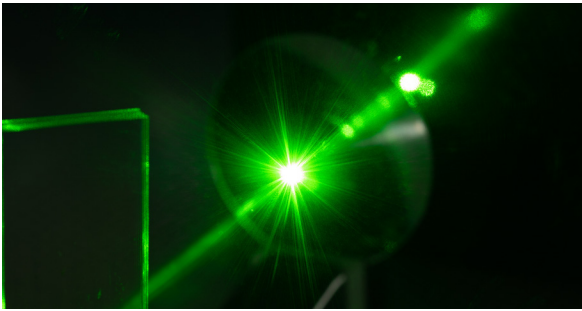
The **Theoretical Chemical and Quantum Physics Group (TCQP Group)** specialises in theoretical and computational quantum physics, and its application to materials science, condensed matter physics, and quantum technology. Research conducted within this group also contributes to two Australian Research Council Centres of Excellence, the Centre for Exciton Science and the Centre for Future Low-Energy Electronics Technologies. Part of our studies in Quantum Physics include spin ensembles, quantum-dots, photonic and phononic devices and low-temperature quantum circuits.



Diamond synthesis for quantum sensors is led by Alastair Stacey. This effort aims to improve the materials properties and device structures required for superior quantum sensor performance. Diamond-based quantum sensors have a wide range of applications including medical imaging and geospatial monitoring. RMIT diamond synthesis capabilities support collaborations with Quantum Brilliance, Princeton Plasma Physics Laboratory (PPPL) and numerous companies worldwide.



The **QuRMIT Theory Lab** specialises in continuous variable (CV) measurement-based quantum computing and related technologies, as well as fundamental quantum physics. CV cluster states are very large quantum resource states that can be generated with minimal experimental hardware, to enable large-scale quantum computing. The CV approach to quantum computing has numerous advantages to more traditional methods (based on physical qubits) including easier generation of resource states and novel methods to encode and protect quantum information for computation and communication.



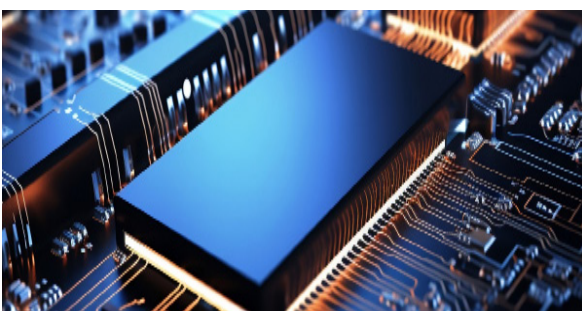
The **Quantum Photonics Laboratory (QPLabs)** is an experimental group at RMIT University's School of Engineering. Their research spans from engineering photonic quantum information and communication technologies to studying quantum effects in biological, chemical and physical systems.



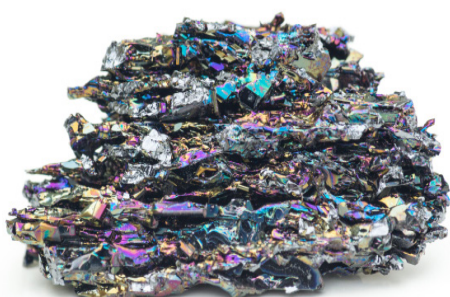
The **Gibson & Greentree Research Group** is a multidisciplinary research program, that meets the needs of partners, spanning the wide-ranging areas of theoretical and experimental quantum physics, nanomaterials, fluorescent multimodal imaging and biophotonics.



The **Integrated Photonics and Applications Centre (InPAC)** was established in 2020 to create impactful integrated photonic technologies through continuous end-user engagement to deeply understand real-world problems. The team pioneers breakthrough science in the field of integrated photonics coupled with rapid and systematic iterations to deliver a consistent stream of outcomes to end users.



Brett Johnson's research focuses on the **formation and characterisation of defects with quantum functionalities** in semiconductor materials. The aim of this research is to develop highly stable spin defects that can be integrated into electrical or optical devices for applications in quantum communication, computation and sensing. Supporting infrastructure and techniques to address the spins efficiently are also considered.



Stefania Castelletto is leading research on **silicon carbide quantum defects for single photon sources for quantum communication and quantum sensing** towards integrated spin-photon interface.

- [RMIT and La Trobe University partnering with Quantum Brilliance](#) in a joint research and development hub will harness the strength of synthetic diamonds to build a new generation of quantum computers. The newly established Research Hub for Diamond Quantum Materials is led by German-Australian quantum computing provider Quantum Brilliance, with RMIT and La Trobe universities as major research partners.
- RMIT researchers partnered with ETH Zurich and University of Queensland and [developed new nanoscale electric circuits](#) for controlling and measuring microwave signals. These are key to scaling up current quantum computer designs, by precisely controlling and measuring signals in quantum systems. The research is part of a collaboration between two Australian Research Council Centres of Excellence: the ARC Centre for Future Low-Energy Electronics Technologies (FLEET) and the ARC Centre of Excellence for Engineered Quantum Systems (EQUS).
- A \$5.2m project funded by the U.S. Department of Energy's (DOE) in collaboration with [RMIT and Princeton Plasma Physics Laboratory \(PPPL\)](#) to develop new, diamond-based quantum sensors with a wide range of applications including medical imaging and geospatial monitoring.
- [RMIT researchers were part of a DefendTex and Monash University](#) team that aimed to develop a quantum based Magnetic Induction Tomography active sensing, for sensing subterranean structures.
- [RMIT partnered with Phasor Innovation and the University of Melbourne](#) to develop next generation Quantum Diamond Magnetometers (QDM) that allow the detection of subterranean objects and movements with precision and detail.
- An [RMIT-led group has been awarded a share of \\$1.5 million](#) to develop new diamond-fibre magnetic sensors in the Global-X Challenge, run by the Office of Naval Research (ONR) Global. The team has developed a new quantum technology-based optical fibre-sensor for maritime surveillance for the US Navy, Marine Corps, the commercial applications including medical, land monitoring, maritime traffic and long-distance surveillance.
- RMIT was awarded funding from the [Rio Tinto Australia-Japan Collaboration](#) Program to work on Quantum Diamond-based Geophysical Sensor Technology.

Acronym/Term	Definition
ARC EQUUS	ARC Centre of Excellence for Engineered Quantum Systems
ARC FLEET	ARC Centre for Future Low-Energy Electronics Technologies
ARC CQC2T	ARC Centre of Excellence for Quantum Computation and Communication Technology
CIAIRI	Centre for Industrial AI Research & Innovation
CIDDA	Centre for Information Discovery and Data Analytics
CNBP	Centre of Excellence for Nanoscale BioPhotonics
COMBS	Centre in Optical Microcombs for Breakthrough Science
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DARPA	Defense Advanced Research Projects Agency
DOE	Department of Energy
InPAC	Integrated Photonics and Applications Centre
MoU	Memorandum of Understanding
QPLabs	Quantum Photonics Laboratory
QuRMIT	QuRMIT Theory Lab
TCQP	Theoretical Chemical and Quantum Physics Group
TRL	Technology Readiness Level

- [1] CSIRO Futures. (2020). [Growing Australia's quantum technology industry](#). CSIRO, Australia.

- [2] CSIRO Futures. (2022). [Growing Australia's quantum technology industry: Updated economic modelling](#). CSIRO, Australia.

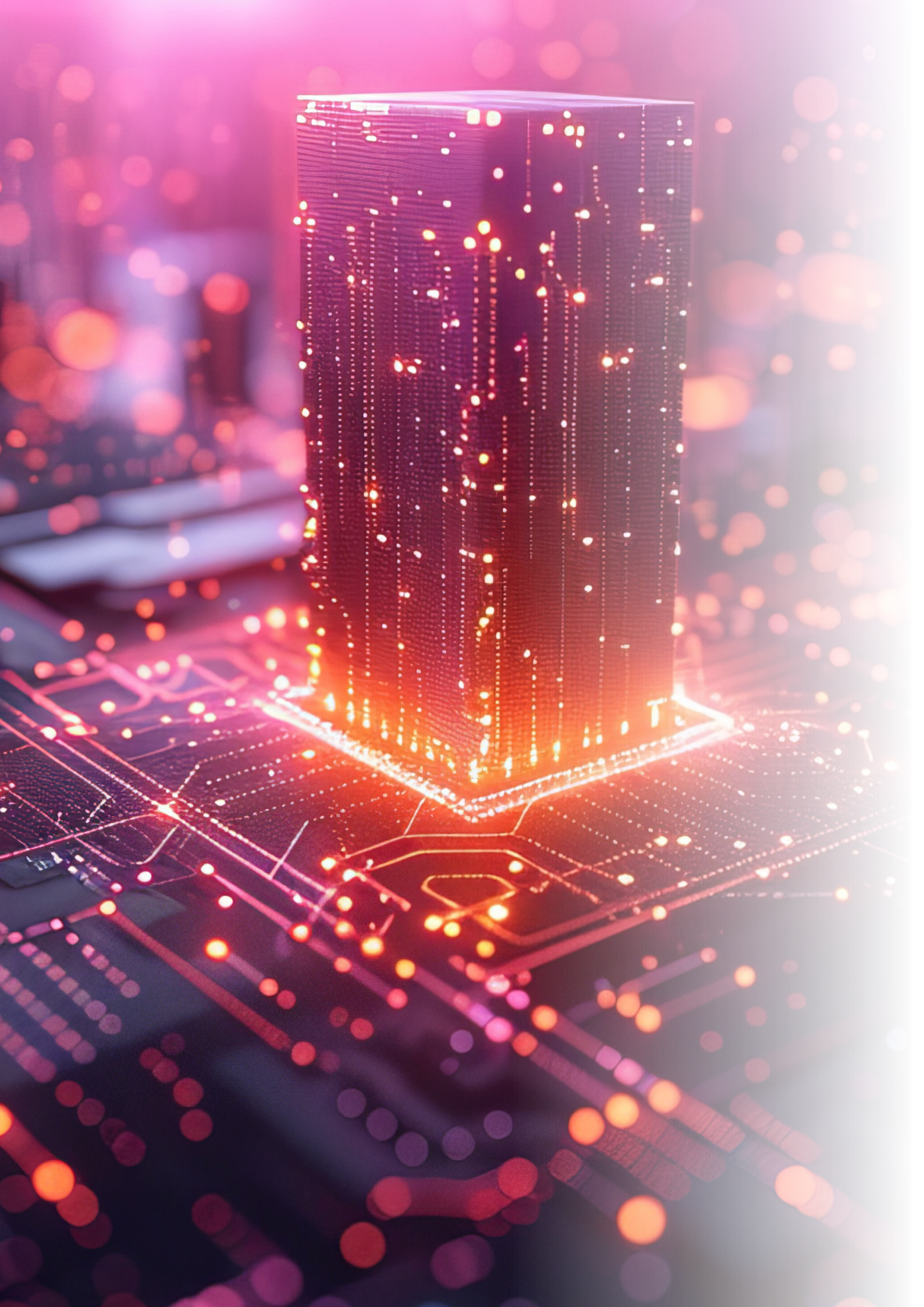
- [3] Australian Government Department of Industry, Science and Resources. (2023). [National quantum strategy](#).

- [4] Australian National Fabrication Facility. (2024). [Delivering the quantum promise](#).

- [5] European Union. (2024). [Quantum flagship](#).

Title	Organising Body	Publication Year
National Quantum Strategy, Australia	Australian Government, Department of Industry, Science and Resources	2023
Quantum	Australian Government, Department of Industry, Science and Resources	2023
Quantum Computing News and Top Stories	The Quantum Insider	2023
Quantum technologies	Australia's Nuclear Science and Technology Organisation (ANSTO)	2023
The Quantum Consortium Enabling the Quantum Ecosystem	Quantum Economic Development Consortium (QED-C)	2023
Quantum Computing is the future, and schools need to catch up	Scientific American	2023
Future Qubit Foundry to keep Australia at the forefront of quantum tech	The University of Sydney	2023
Quantum technologies	Australian Government, Department of Defence	2022
EDTAS on Quantum Computing: Technology Opportunities Quick Look Report	Australian Government Department of Defence	2022
The IBM Quantum Development Roadmap	IBM	2022
What is quantum technology?	Swinburne University of Technology	2022
What quantum technology means for Canada's future	Simon Fraser University	2022
NATO exploring Quantum Technology for future challenges	North Atlantic Treaty Organisation (NATO)	2022
KPIs for Quantum Tech in Europe: first values and 2030 targets announced - Quantum Technology	Quantum Flagship, European Union	2022
National Quantum Advisory Committee to strengthen Australia's quantum industry	Australian Government, Department of Industry, Science and Resources	2022
Quantum Technology Manufacturing Roadmap	Stanford Research Institute (SRI) International	2022
List of critical technologies in the national interest	Australian Government, Department of Industry, Science and Resources	2022

Title	Organising Body	Publication Year
The future's so bright for Quantum Technology	Forbes Technology Council	2021
Army Quantum Technology Roadmap	The Australian Army	2021
The future is Quantum Working groups - Quantum Technology	Quantum Flagship, European Union	2020
Growing Australia's Quantum Technology Industry	Commonwealth Scientific and Industrial Research Organisation (CSIRO)	2020
New Strategic Research Agenda on Quantum Technologies	European Commission	2020
Quantum Technology Roadmap	Quantum Flagship, European Union	2018
The quantum technologies roadmap: A European community view	New Journal of Physics	2018





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