



Australian Government
Department of Industry,
Science and Resources

Australia's quantum advantage

National Quantum Strategy:
consultation paper

industry.gov.au/quantum

Supporting economic growth and job creation for all Australians

Australia's quantum advantage, National Quantum Strategy: consultation paper is an Australian Government consultation paper to inform the development of the National Quantum Strategy and position Australia as quantum leader with a thriving Australian quantum ecosystem.

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Executive summary

Quantum technologies present a unique opportunity to accelerate growth in Australia's economy and support our long-term prosperity.

Australia has an established strength in quantum technologies, with a concentration of research capability and applied technology success across many states and territories. This has earned Australia a reputation as one of the international leaders in quantum. With strong foundations, the quantum opportunity for Australia is immense. We can't let this opportunity slip and need to back ourselves and reach for our vision – to have a thriving quantum industry and be at the forefront of global technological innovation.

As part of the development of a National Quantum Strategy earlier this year, the then Department of Industry, Science, Energy and Resources sought the views of industry, academia, government and the broader community to inform its vision of growing a sustainable and thriving quantum ecosystem in Australia. Forty submissions were received in response to an [issues paper](#), and 4 roundtables were led by Australia's Chief Scientist, Dr Cathy Foley AO PSM. Several themes emerged from these consultations (see Appendix A), which underpin a set of objectives that will form the framework of a National Quantum Strategy. These objectives will ensure Australia has a world-leading quantum ecosystem that supports the breadth of our ambitions for quantum technologies – from sensor development and applying quantum capabilities to our most challenging problems, through to building one of the first fault-tolerant quantum computers. We are seeking your views on that framework through this next phase of public consultation.

The following proposed objectives aim to create the conditions to support a thriving quantum industry at the forefront of global technological innovation:

1. create a **thriving environment for the development, commercialisation and use of quantum research**, including by increasing awareness and demand
2. enable **access to world leading infrastructure** – including quantum computers – and manufacturing capabilities that will allow researchers and companies to flourish
3. **enhance Australia's global leadership in quantum research** by driving the next wave of quantum discoveries and technological breakthroughs
4. **make Australia the top destination for quantum technology talent**, and drive the growth of the skilled workforce to allow industry to scale
5. address **supply chain barriers** and enhance Australia's role in the global supply chain
6. **strengthen domestic and international partnerships**, and entrench Australia's role as an international quantum leader
7. create the right settings to **build trust, ensure inclusivity and balance national interests** with economic opportunities.

We have the shared ambition, partnerships, talent and competitive advantages to grow a thriving quantum industry and to secure our place as a global quantum leader. There are roles for governments in driving and supporting research as well as investment, commercialisation and use of quantum technologies. The Australian Government will work closely with states and territories to align and leverage our respective strengths. However, it can't be done by governments alone – it will rely on every part of the quantum ecosystem working towards the same goal, including making investments, to achieve our ambition. Delivering the strategy also needs engagement across the community, to understand and incorporate all Australians' views and identify novel opportunities.

To help shape Australia's quantum future, the government has established a National Quantum Advisory Committee, bringing together a range of experts from research, business and the spectrum of quantum technologies to chart Australia's course. The committee, under Dr Foley's leadership and supported by the Department of Industry, Science and Resources, will provide guidance and feedback to this paper to prepare a National Quantum Strategy for consideration by government.

We welcome your views on the proposed objectives and initiatives in this paper, and your contribution to Australia's quantum future.

Australia's quantum opportunity

Australia is a global leader in quantum technologies. We have the minds, ingenuity, resources and ambition to ensure we maximise the opportunities presented by this revolutionary technology. Our states and territories are building strengths and expertise in quantum fields. We are well positioned to make the next breakthroughs in quantum technologies, and turn them into the Australian businesses and industries that will shape our future. By capitalising on these opportunities, quantum technologies will deliver benefits to Australians. They will:

- accelerate economic growth
- create jobs and opportunities across industry
- strengthen our international role
- support our long-term prosperity.

World-leading quantum research and talent

Australia's position is the result [of over 20 years of investment establishing strong scientific and technical foundations](#). We have the opportunity to build on those foundations by investing further in our people, infrastructure, partnerships and capabilities. The Australian Government will continue to lead, but wants partners across the ecosystem – state and territory governments, educational institutions, industry, business and investors – to share its ambition and contribute to that next stage of growth.

Australia has a long history of world-leading research and as a [globally recognised leader in quantum research](#). Australian research and talent in quantum physics and engineering is highly regarded around the world. Our talent is behind many existing and emerging quantum applications, including quantum random number generators for security and sensors for mining and civil engineering.

Our capability is reflected across 22 quantum-related institutions that have nurtured and attracted internationally sought-after talent. [Eight Australian universities](#) perform well above the international standard in quantum physics research, and Australian research is cited [50% more than the global average](#). Quantum capabilities are rapidly emerging across Australia's states and territories.

Value to the economy

We will continue to build on our competitive advantages and be part of the growing market for quantum technologies. Our quantum companies already attract a significant amount of venture capital relative to our international competitors, capturing a [3.6% share of global venture capital for quantum from 2017 to 2021](#).

Technology and quantum jobs are important to Australia's long-term national interest and prosperity. Australia's tech sector is our third-largest industry, [employing 1 in 16 workers](#) and contributing [\\$167 billion to our economy every year, or 8.5% of GDP](#). But there is room to grow the direct tech sector, which [lags behind other Western economies](#).

Quantum is growing quickly, with the market for some technologies projected to grow at a compound annual growth rate of more than 30% over the coming years. By 2040, quantum technologies could generate over [\\$4 billion in revenue in Australia and create 16,000 jobs here](#).

Quantum technologies

Australia's National Quantum Strategy will address the full spectrum of quantum technologies, providing a pathway to growth for near-term applications such as quantum sensors and positioning Australia for success in longer term technology development, such as the development of fully fault-tolerant quantum computers. The strategy will also consider the role of software, applications and algorithms to ensure we're covering the breadth of opportunity before us.

There is immense value to be unlocked from transformative quantum applications across the economy. They can improve productivity and growth, revolutionising areas like finance, energy, defence, meteorology and healthcare.

Quantum technologies are a cross-sectoral enabler that will shape many areas of our economy. They have the potential to bring significant economic and productivity gains as well as social and environmental benefits. Quantum technologies can have revolutionary impacts on our lives, including the below.

Quantum sensing allows us to detect and map through barriers, in unique ways and at distances with extreme precision. For example, this may change our ability to map and understand the brain, the heart and other organs and transform the way we detect and diagnose disease at extremely small scales. It will also help us to:

- detect mineral deposits deeper underground without needing to dig
- find leaks or issues in underground pipes and cables
- navigate with greater accuracy. More accurate position, navigation and timing systems are important for emerging technologies such as self-driving cars and military capabilities.

Quantum computers use quantum mechanics to perform certain complex calculations in a smaller number of steps than an ordinary computer. Quantum computers work by first creating a superposition of lots of different possible solutions to a problem – encoded in qubits – and then manipulating that superposition so that wrong solutions cancel out and right ones are strengthened. By harnessing these capabilities, we have opportunities to:

- optimise logistics to deliver our parcels faster and more accurately
- improve the efficiency of our public transport networks
- model probabilities of extreme weather events, and complex health challenges like pandemics
- model optimal responses to emergencies like fires and floods
- simulate complex molecules which have applications in advanced materials (such as the best structure and material composition for aeroplanes) and clean technologies like batteries
- model chemical and drug reactions, which can drastically speed up medical research for new medicines and vaccines.

Quantum communications may enable faster and more secure communications networks. Applications for quantum communications include transferring information between quantum computers and sharing cryptographic keys between distant people in a way that means it is impossible for anyone else to copy.

While some quantum technologies like computing are emerging, other quantum technologies are already in everyday use. Quantum technologies are being rapidly developed and new applications are emerging. Australia has already led breakthroughs in areas such as an [integrated circuit manufactured at the atomic scale](#), quantum photonics and superconducting devices.

Taking action

Australia's quantum and advanced technology community has been clear that they share our ambitions, urgency and commitment to build a strong and thriving quantum ecosystem in Australia.

The Australian Government will lead the way in seizing the opportunity that quantum technologies present the economy. To capture this opportunity, we will need to take visionary and bold action to back ourselves on the global stage. The National Quantum Strategy will set the vision for Australia, identify measures to ensure we maintain momentum, and lay out how Australia will have one of the world's leading quantum industries by 2030.

We need to work across the entirety of the Australia's quantum ecosystem – all states and territories, the education sector, the technology and manufacturing industry, and businesses and investors – to ensure this is a truly national effort.

A proposed framework for the National Quantum Strategy

The proposed framework for Australia's National Quantum Strategy is made up of 7 objectives with supporting policy initiatives. These objectives have been identified as the key steps to deliver on Australia's quantum opportunity.

These objectives align with the themes identified through roundtables led by Australia's Chief Scientist, Dr Cathy Foley AO PSM, and responses to the April issues paper. These themes and a summary of stakeholder feedback are at Appendix A.

Objective 1

Create a thriving environment for development, commercialisation and use of quantum technologies

To support a world leading quantum industry, we need to build stronger pathways for the commercialisation and use of our world-leading quantum research. Australia's rates of patenting inventions and building businesses off the back of our excellent research outcomes lags behind the global standard. Addressing this requires improving awareness of opportunities, protection of intellectual property including trademarking and patents, growing the skills and capabilities in research and business communities, and strengthening linkages between academia and industry. Commercialisation pathways should include opportunities for rural and regional Australia and traditionally underrepresented groups.

For Australia to truly capture our quantum opportunity, we also need to unlock sources of patient capital – particularly for those technologies that have longer development cycles. It will be important to work with businesses across the economy to highlight how quantum technologies will transform many aspects of our lives, ensure that as many people as possible can benefit and to support horizon scanning so businesses can explore both the opportunities and potential risks related to quantum capabilities.

Initiatives under this objective could include:

- 1.1** establishing a model for supporting industry growth and use of quantum, including:
 - enabling commercialisation of quantum research, showcasing benefits to emerging and established industries, and fostering stronger linkages between academia, industry and government
 - lifting business investment in research and development
 - leveraging and expanding existing research commercialisation programs and initiatives, to grow business acumen in emerging quantum start-ups and identify new incentives to support commercialisation of quantum research.
- 1.2** investing in projects to create a pipeline of investment-ready activities for the Critical Technology Fund, part of the National Reconstruction Fund
- 1.3** increasing coordination, investment and awareness in Australia's quantum ecosystem, including:
 - developing and promoting use cases for existing and emergent quantum capabilities (for example, sensing, security, communications, simulation and optimization)
 - working with the investment community, nationally and internationally, to explore mechanisms to leverage patient longer term capital
 - considering where federal, state and territory governments can be an early adopter of quantum technologies
 - sharing of knowledge and resources between quantum researchers and practitioners across industry, government and academia
 - working with businesses across the economy to highlight the role quantum technologies can play for them and support horizon scanning to understand emerging threats and opportunities.
- 1.4** leading national quantum challenges to solve complex problems facing Australia, for example improved weather prediction, climate modelling and navigation. Challenges would bring together academia, quantum businesses and other sectors to jointly work on applying quantum technologies to solve a business problem and attract investment.

Objective 2

Enable access to world-leading quantum infrastructure

To build a thriving quantum ecosystem, we need to provide researchers and companies with greater access to advanced facilities. This will create the right enabling environment to support growth across quantum technologies from sensors through to computers.

Enabling greater access to facilities and infrastructure – for example, a noisy intermediate-scale quantum (NISQ) computer to support the development of use cases for quantum technologies, or flexible fabrication plants to support future manufacturing – will support research, propel breakthroughs in quantum technologies and develop new use cases. Access will support growth across quantum technologies including sensing, communications and security applications. Through enabling access, we will maximise Australia’s opportunity to build one of the world’s first fault-tolerant quantum computer. As part of this, and learning from the classical computer industry, we also need to consider the role of software, applications and algorithms, to ensure we’re considering the full spectrum of opportunities.

There are opportunities to better connect academia and industry, leverage existing quantum infrastructure, and improve equipment use. Building or gaining access to these facilities and other resources can be challenging – they are cost prohibitive to acquire, and gaining access can be slow and restrictive. There is a role for government in driving national collaboration and coordination, and investing in key infrastructure with partners to support the national ecosystem and ensure equitable access. This may include investing in national quantum computing capabilities and infrastructure, including advanced laboratories and pilot fabrication and manufacturing equipment.

Initiatives under this objective could include:

- 2.1** conducting a national audit to understand existing infrastructure enabling quantum research and industry. This includes working with federal, state and territory governments, industry and academia to identify future infrastructure requirements
- 2.2** developing an investment action plan that identifies private sector and government-led opportunities for investment in quantum facilities and infrastructure that will increase access for Australian business and researchers
- 2.3** exploring the feasibility of Australia obtaining early access to current-state quantum computing capabilities to facilitate and drive growth in Australia’s quantum capability. This may involve building a capability in Australia, or ensuring preferential and affordable access to cloud computing capabilities for Australian businesses and researchers
- 2.4** facilitating quantum researchers and early-stage businesses’ access to the specific quantum infrastructure they need to experiment, spin out, grow and expand
- 2.5** identifying and growing the sovereign capabilities and workforce required to maintain facilities and infrastructure, and build and support quantum equipment and components.

Objective 3

Enhance Australia's global leadership in quantum research

Our researchers are the cornerstone of Australia's quantum future. Australia's quantum research excellence in both universities and industry is praised domestically and internationally. We are known to lead on quantum research because of a strong head start, and decades of government funding in fundamental and applied quantum science. Our quantum community have reiterated the importance of maintaining this leadership position in research and improving the translation and commercialisation outcomes. We are focused on capitalising on decades of research to embed our position leading the global development of quantum technologies.

Initiatives under this objective could include:

- 3.1** coordinating the delivery of a comprehensive research funding program – in partnership with government and industry bodies – that addresses long and short-term requirements through the prioritisation of key research areas (supporting the spectrum from fundamental research to industrial development).
- 3.2** identifying and growing capability and infrastructure to support advanced research
- 3.3** working with states and territories to entrench a network of academic excellence across Australia by investing in and growing existing networks and creating new linkages between academic bodies and industry
- 3.4** leveraging and growing international partnerships to create more opportunities for collaboration (for example, Fulbright-style scholarships for Australian quantum researchers)
- 3.5** supporting a diverse and inclusive research community, so that all Australians have an opportunity to be involved in Australia's quantum future.

Objective 4

Drive skilled workforce growth to scale industry and make Australia the top destination for quantum technology talent

The talent pipeline is critically important to Australia's quantum future. Australian research institutes and quantum companies have to compete internationally for access to the best and brightest minds. Growing, retaining and regaining Australia's excellent quantum talent is one of the keys to keeping the sector onshore, but the supply of quantum-ready graduates is not keeping pace with demand. Attracting global talent to Australia, including Australians working overseas, will be critical.

To ensure we can take advantage of the quantum opportunity and the increased technology jobs that will continue to become available, Australia needs to grow a diverse and skilled workforce across a range of adjacent and supporting industries. As a part of government's commitment to achieve 1.2 million technology jobs by 2030, we also need to ensure that growth in that wider technology workforce supports the quantum industry's requirements. We also need to ensure we support greater inclusion and diversity, lifting the participation of women, Aboriginal and Torres Strait Islander people and other underrepresented groups.

It will also be important to engage with rural and regional Australia and connect with families, teachers and children so the whole of Australia understands the opportunity in front of us. We need to ensure all children can see future career opportunities linked to STEM and quantum technologies.

Initiatives under this objective could include:

- 4.1** strengthen pathways into quantum careers by working with federal, state and territory education bodies to grow STEM and quantum science awareness in school curriculums, and promote uptake of these skills and career pathways through the education sector, including schools, TAFEs and universities.
- 4.2** promoting quantum leaders as role models, with a focus on lifting participation of underrepresented groups
- 4.3** developing skills taxonomies for quantum professionals, and adjacent occupations that support the quantum industry
- 4.4** conducting modelling to identify future quantum workforce requirements, and the necessary supporting educational infrastructure.
- 4.5** delivering programs to improve quantum literacy across educational institutions and businesses
- 4.6** exploring ways to increase participation of underrepresented groups in the quantum industry, including rural and regional Australians. actively promoting Australia as a destination for quantum talent, opportunity and investment, including through targeted incentives
- 4.7** targeting key international talent – in particular overseas Australians – that align with national research and growth priorities

Objective 5

Strengthen Australia's access and role in quantum supply chains

In addition to world-class research and a strong workforce, a strong domestic quantum ecosystem needs strong adjacent and supporting industries, services and manufacturing, as well as a robust, resilient supply chain. Resilient domestic and international supply chains will ensure the quantum sector can scale up and grow. There are also opportunities to grow Australia's manufacturing and exporting opportunities by playing a greater role internationally and embedding Australian technology in international supply chains. For example, we could consider how Australia's growing semi-conductor needs can be leveraged to support our future quantum industry. By working in partnership with states and territories, and committing to home-grown innovation and production we can build flourishing technology industries here in Australia.

Initiatives under this objective could include:

- 5.1** identifying and addressing manufacturing, material, component, purchasing and supply barriers across the quantum ecosystem that restrict the commercialisation of quantum technology
- 5.2** working with states and territories to identify secure sources of supply and manufacturing – in Australia and with key partners – to support commercialisation and growth. This may include attracting global suppliers onshore
- 5.3** investigating options to reduce the quantum industry's high import dependency, including through stockpiling and growing domestic manufacturing capability, raw material production and access to economies of scale
- 5.4** integrating quantum and advanced technology requirements into planning for the National Reconstruction Fund
- 5.5** identifying opportunities for Australian industry and technologies to be embedded in global supply chains
- 5.6** working with states and territories to investigate options to build a resilient supply chain with the industrial capacity and skilled workforce to support the delivery of scalable, commercially available quantum products globally
- 5.7** analysing adjacent emerging technology and manufacturing industries to identify areas of necessary investment and growth in support of the quantum industry.

Objective 6

Entrench Australia's international partnerships and leadership

Critical technologies like quantum will be vital in the future geopolitical landscape. We can work with our trusted partners to create a new generation of quantum innovation and robust supply chains. Australia can partner with neighbours in our region to use quantum technologies to address global challenges and to secure our supply chains. International collaboration will keep Australia at the forefront of quantum technologies and build trust in Australian products.

Initiatives under this objective could include:

- 6.1** strengthening collaboration and opportunity for industry with our established partners through existing arrangements including AUKUS, the Quad, and other regional and bilateral agreements
- 6.2** leading programs to promote Australia's quantum ecosystem and attract international investment and onshore operations, in partnership with Austrade
- 6.3** identifying opportunities to grow Australia's regional leadership through collaborative programs of research, and providing access to infrastructure
- 6.4** leveraging strategic partners to drive commercialisation of Australia's quantum research, coalesce action around areas where Australia can have a comparative advantage and support international supply chains
- 6.5** participating in international quantum standards-setting bodies, in partnership with industry and likeminded international partners
- 6.6** mapping our quantum industry supply chains with international partners to understand opportunities for collaboration.

Objective 7

Build trust, ensure inclusivity and balance national interests

Australia should be a leader in responsible quantum development. We need to carefully consider the social, ethical and security challenges that quantum technologies will present. Quantum technologies will be transformative and present tremendous opportunities for all aspects of Australian life. But it will be important to ensure that quantum technologies are developed responsibly, ethically and with the broader national interest in mind.

Stakeholders have asked government to ensure regulatory measures and frameworks are fit for purpose, and do not unnecessarily inhibit opportunities for researchers and companies seeking to grow their presence internationally. These issues are shared with other emerging technologies such as artificial intelligence and blockchain. In looking at the regulatory environment, it will be important that a holistic approach is taken to ensure the appropriate balance is achieved and regulations do not have unintended impacts.

Achieving the national interest in quantum technologies will also require active balance between:

- commercial opportunities
- the transformative impact quantum technologies will enable
- national security imperatives (including appropriate controls of technology to protect our IP and national interests).

It will be important for researchers and industry to be aware of the opportunities and risks so they can make informed decisions. This needs to include close engagement with rural and regional Australia, as well as connecting with families, teachers and children so the whole of Australia understands the quantum opportunity.

Initiatives under this objective could include:

- 7.1** building a program of community engagement to make quantum accessible to as many Australians as possible, raise public awareness of quantum technologies and opportunities, drive responsible quantum development, and build social licence with the broader community
- 7.2** working across government to balance regulatory and compliance settings with the need to unlock industry growth and commercialisation opportunities
- 7.3** considering principles, regulatory frameworks and standards to guide and support the responsible use and development of quantum capability, alongside other emerging technology regulatory issues
- 7.4** supporting defence and national security requirements for quantum research and capability growth, including appropriate controls of technology to protect our IP and national interests
- 7.5** supporting a quantum secure economy and addressing national security challenges posed by quantum technologies, including secure quantum communications
- 7.6** considering options to cross-utilise quantum infrastructure and capabilities.

Appendix A: Key stakeholder insights

Over 2022, stakeholders have shared their insights with Australia's Chief Scientist, Dr Cathy Foley AO PSM, and the Department of Industry, Science and Resources on how we can seize the quantum opportunity and grow a thriving quantum industry. Dr Foley held 4 roundtables with leaders from industry and academia, and we received 40 responses to an [issues paper](#) released in April. The following presents a summary of feedback from those consultations and responses. The key themes identified were:

- maintaining global research leadership
- building stronger talent pipelines
- supporting the development and commercialisation of research
- enabling access to quantum infrastructure and facilities
- supporting local advanced manufacturing
- strengthening international partnerships
- government playing a strong role.

Australia's global research leadership

Australia is one of the early pioneers of quantum research and is a global leader in quantum research excellence. This home-grown talent has given us a foundation to build future industry success.

Quantum research was one of the most common response topics. Approximately 82% of submissions shared insights on various aspects of quantum research including commercialisation and possible pathways to maintaining Australia's research leadership. The feedback identified opportunities for strengthening our research leadership, including:

- maintaining Australia's competitive advantage by supporting cutting edge research that will push the boundaries of quantum knowledge across disciplines
- improving collaboration through joint research programs with key institutional players from research, government and industry. Nearly 80% of submissions commented on the need for greater collaboration between academia and industry
- supporting universities to collaborate across disciplines, including national research and education partnerships
- connecting Australian researchers and entrepreneurs with our existing world-class facilities.

Talent pipeline to support the quantum industry

Stakeholders indicated that there is a global shortage of people who have the skills to work in the quantum industry. Quantum talent needs are diverse and includes skills from across fields such as engineering, product design, manufacturing, packaging and marketing.

As Australian talent is internationally attractive, many locally trained quantum experts have moved overseas to work. Nearly 75% of submissions commented on the need to grow a future talent pipeline to support the quantum industry. Stakeholders linked quantum skills shortages to the decline in students studying STEM subjects through high school and into tertiary education. Suggestions to create a sustainable quantum talent pipeline to support future growth include:

- introducing STEM and quantum literacy to students from an early age
- building better diversity and representation in the STEM talent pipeline
- setting up a network of trained and experienced professionals to supply the industry
- improving public awareness of quantum's many uses to encourage uptake and increase interest in quantum careers.

Suggested actions to help keep talent onshore and attract overseas talent include:

- improving visas for quantum talent, including a special quantum visa program
- supporting local quantum start-ups to stay in Australia
- improving diversity in the quantum sector
- increasing quantum literacy in other sectors.

Supporting the development and commercialisation of quantum research

Stakeholders indicated that although Australia's quantum research is strong, our ability to bridge the gap between R&D and commercialisation is a crucial area for improvement. Commercialisation of quantum research relies strong collaboration between academia and industry, business support and funding. Stakeholders identified the following actions to increase quantum commercialisation:

- training scientists to have a better understanding of industry and commercial requirements
- increasing the awareness of quantum technologies across all industries
- government acting as an early adopter of and investor in quantum technologies
- government funding and policies that encourage research translation from laboratory to commercial product
- utilising regulatory settings to support industry growth, including greater support for start-ups, less red tape and targeted tax incentives to support commercialisation.

Some stakeholders raised concerns that the current regulatory settings impede the commercialisation of quantum technology. Stakeholders suggest that export controls, defence compliance standards and the Foreign Investment Review Board should have a greater focus on balancing the benefits of a prosperous quantum industry over its potential risks. Government could also take steps to cultivate trusted international partnerships to support industry's participation in the global ecosystem and supply chains.

Access to quantum infrastructure and facilities

Stakeholders from across industry and academia told us about the importance of accessing appropriate facilities to develop quantum technologies and new use cases. A range of infrastructure and facilities are needed, such as foundries, cryogenic facilities and advanced laboratories. Stakeholders suggest that to maximise the benefits of the facilities, they should be multi-use across research, prototyping and manufacturing. The facilities should provide equitable access for researchers and industry.

Local advanced manufacturing

Stakeholders indicated that global technology supply chain constraints are impacting on the quantum industry in Australia and will continue to do so into the future. Lack of local manufacturing capability in Australia has resulted in industry being reliant on international suppliers and manufacturers. Industry feedback recommended that the government focuses on developing an onshore advanced manufacturing sector.

Over 75% of submissions noted the need for strong adjacent industries and skills to build a local quantum ecosystem. This would enable the local supply and servicing of components and equipment. It could also open up the opportunities for Australia to play a part in the global quantum supply chain. Feedback indicated that Australia has existing capability in the following fields that could be expanded:

- photonics

- atomic-scale manufacturing
- lasers
- Meta-optics.

International quantum partnerships and leadership

Stakeholders indicated that international collaboration and partnerships will play a critical role in developing Australia's quantum industry. Over 70% of submissions referenced the need to strengthen international partnerships, including the importance of R&D partnerships to unlock our full quantum potential. Major recommendations include:

- strengthening our collaboration with likeminded international partners, especially with the Five Eyes intelligence alliance and under AUKUS
- increasing collaboration with international companies
- partnering with global suppliers to secure supply chains from international issues
- facilitating private investment in quantum opportunities by trusted overseas partners.

Role of government

Throughout the consultations stakeholders requested that government play a strong role in driving the development of quantum in Australia. Stakeholders see the key functions of government as:

- coordinating and unifying the quantum community to rally around our shared ambitions
- sending a clear signal on Australia's quantum excellence and ambitions to be a global heavyweight
- acting as an early adopter of and investor in quantum technologies
- fostering linkages between quantum and other emerging technologies
- raising awareness, building social license and sparking interest for future quantum students and researchers
- leading global quantum standards setting
- implementing appropriate security safeguards.

