

SCIENCE & TECHNOLOGY AUSTRALIA

POLICY SUBMISSION

15 NOVEMBER 2022

AUSTRALIA'S QUANTUM ADVANTAGE – QUANTUM STRATEGY FRAMEWORK CONSULTATION PAPER

Science & Technology Australia is the peak body for the nation's science and technology sectors, representing 117 organisations and more than 105,000 scientists and technologists. We connect science and technology with governments, business and the community to advance science's role in solving some of humanity's greatest challenges.

We thank the Department of Industry, Science, Energy and Resources for this opportunity to offer input on the Quantum Strategy consultation paper – [Australia's Quantum Advantage](#). The paper incorporates the stakeholder feedback from the consultation process for the Department's [National Quantum Strategy Issues Paper](#).

RECOMMENDATIONS:

Science & Technology Australia recommends:

1. the Australian Government deepens public investment in fundamental discovery science to generate the next wave of quantum breakthroughs.
 2. further targeted support to translate, apply and commercialise quantum technologies in Australia be pursued through existing DISR commercialisation programs as well as seed funding from Australia's Economic Accelerator.
 3. an urgent boost in the Australian Government's investments in the National Collaborative Research Infrastructure Scheme to secure both operational and capital funding for these crucial facilities and their greatest asset – the highly specialised staff who operate them.
 4. new and targeted investment in the infrastructure – and again, the specialist staff – needed to drive the complete package of quantum translation and commercialisation to properly support the quantum industry. Australia will need to invest in a dedicated mini-foundry capability to fully realise our quantum manufacturing ambitions.
 5. Australia should 'double down' with a strategy of renewed resolute focus to build the skills and confidence of Australian school students in the powerful fundamentals that underpin quantum – maths, physics and chemistry.
 6. Australia's major research granting agencies move to longer-term grant cycles and require the institutions that employ scientists to employ them for the length of the grant.
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7. Science & Technology Australia's Bench-to-Boardroom initiative should be supported to create a new generation of scientist-entrepreneurs at scale in Australia to help Australia 'level up' and turn more great Australian science – including quantum – into new jobs.
 8. a renewed push to drive stronger diversity and equity gains in Australia's STEM sector, including through the forthcoming review of Women in STEM and Diversity in STEM programs.
 9. a quantum communications strategy be developed to build clearer public understanding of quantum and its transformative potential applications.
 10. next steps in the quantum strategy development should include a clear articulation of the current status, short- and long-term goals quantum goals, and clearly defined roles for government, academia and industry.
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SUPPORT ALL STAGES OF THE QUANTUM PATHWAY

Australia has built quantum capability and international reputation over recent decades through a long-term, patient approach to investing in the foundational science that underpins quantum applications. As [analysis from Australia's Chief Scientist](#) attests, 'Foundations for Australia's [quantum and information science technology] success were built by university-based basic science research teams, which focused on fundamental quantum physics problems.'

As we explore commercialisation pathways to build a strong quantum industry, we must not lose sight of the continued importance of discovery science research, and its role as the foundation of all new discoveries. Strong Government support and investment in discovery science must be maintained. This applies not only to quantum research, but other aligned disciplines such as physics, mathematics, IT, machine learning, artificial intelligence, and the engineering disciplines that we will need at scale to locally manufacture quantum-based or quantum-enabled devices.

Appendix A of the framework consultation paper highlights the key themes from stakeholder input – the majority of these will be underpinned by a strong discovery science capability. The subsequent steps of translation, application and commercialisation are also clearly critical to building the strong quantum industry the sector envisions, and these will also require targeted, dedicated support.

Recommendation 1: Science & Technology Australia recommends the Australian Government deepens public investment in fundamental discovery science to generate the next wave of quantum breakthroughs.

Recommendation 2: Science & Technology Australia recommends further targeted support to translate, apply and commercialise quantum technologies in Australia be pursued through existing DISR commercialisation programs as well as seed funding from Australia's Economic Accelerator.



QUANTUM INFRASTRUCTURE

To cover the complete spectrum of quantum research, application, translation and commercialisation and build a flourishing quantum industry, Australia will need infrastructure that supports every stage of the process – from pure discovery research to industry production.

Particular attention must be paid to understanding the infrastructure that Australia will need to support both quantum research and then the translation of that research into quantum applications and industry – these infrastructure needs will be different, yet equally important. Targeted consultation with research infrastructure providers will be important to clearly identify and work towards meeting these needs. Competitor countries are already working – and investing significantly – towards major quantum infrastructure objectives. Australia must keep pace with these developments to remain competitive and avoid our promising quantum industries moving offshore.

Australia's National Collaborative Research Infrastructure Strategy is the backbone of Australia's research infrastructure – and its crucial network of facilities enable Australia to produce world-leading science. This scheme does provide funding that supports some quantum discovery research, but NCRIS funding is already stretched to the absolute limit supporting current Australian science and research facilities and projects.

Australia needs to invest in the quantum infrastructure required to support quantum translation and commercialisation. This will require a dedicated investment similar to the dedicated support given to the Square Kilometre Array – a targeted investment to support initiatives such as a mini-foundry for quantum manufacturing would be one example. To be effective, this will need to be additional funding that does not compromise other critical research infrastructure facilities and delivers robust long-term investment.

Complementary investment in the highly skilled specialist workforce Australia will need to run such infrastructure facilities, as well as support for supply chains that support such facilities, will be critical.

Recommendation 3: Science & Technology Australia recommends an urgent boost in the Australian Government's investments in the National Collaborative Research Infrastructure Scheme to secure both operational and capital funding for these crucial facilities and their greatest asset – the highly specialised staff who operate them.

Recommendation 4: Science & Technology Australia recommends new and targeted investment in the infrastructure – and again, the specialist staff – needed to drive the complete package of quantum translation and commercialisation to properly support the quantum industry. Australia will need to invest in a dedicated mini-foundry capability to fully realise our quantum manufacturing ambitions.



SUPPORTING THE TALENT PIPELINE

Science & Technology Australia fully supports building and nurturing a solid pipeline of STEM talent from the early years of schooling. STEM skills are essential to supply a well-equipped and agile future workforce.

Science & Technology Australia advocates a focus on the fundamentals that will underpin quantum literacy – mathematics, physics, chemistry – through strong STEM education throughout primary and secondary schools, with quantum literacy to be developed from those strong foundations. Opportunities for students to participate in internships or other research or industry engagement programs will also help support quantum literacy. The [internships offered by the Pawsey Supercomputing Centre](#) are a good example of how students can be exposed to potential quantum applications while developing their foundational STEM skills.

Recommendation 5: Science & Technology Australia proposes Australia ‘double down’ with a strategy of renewed resolute focus to build the skills and confidence of Australian school students in the powerful fundamentals that underpin quantum – maths, physics and chemistry.

Given the rapidly advancing progress in quantum applications, the industry will require a robust supply of STEM talent, equipped to apply their knowledge in a wide array of not yet predicted applications. A well-trained workforce that can adapt, and acquire and apply new skills, will be critical to building a strong and stable workforce that can see the potential of quantum advances through to fruition.

Recommendation 6: Science & Technology Australia proposes Australia’s major research granting agencies move to longer-term grant cycles and require the institutions that employ scientists to employ them for the length of the grant.

Targeted development is needed to build the innovative and entrepreneurial talent that will transform basic discoveries and breakthroughs into viable quantum commercial pathways. STA advocates nurturing a new generation of scientist-entrepreneurs with deep scientific knowledge and also the ability to engage with industry to translate ideas and research into applications and products that will benefit the Australian economy and society.

Science & Technology Australia’s proposed Bench-to-Boardroom program would do exactly this – a specialised combination of training and mentoring that would create cohorts of scientists ready to take their research out of the lab and realise its real-world potential.

Recommendation 7: Science & Technology Australia proposes our Bench-to-Boardroom initiative to create a new generation of scientist-entrepreneurs at scale in Australia to help Australia ‘level up’ and turn more great Australian science – including quantum – into new jobs.



SUPPORT FOR ALIGNED DISCIPLINES

To realise Australia's quantum ambitions, it will be crucial to support a strong talent pipeline aligned STEM sectors and industries that will either work in parallel with quantum technologies – high performance computing, artificial intelligence, machine learning – or have direct quantum applications – quantum computing, optics, photonics, chemistry, biotechnology (to name but a few).

As well as the skills required to build quantum devices and hardware, there must also be a focus on developing the software and algorithms that quantum systems will require. This underscores the need to develop strong capabilities across a broad range of STEM disciplines and the need to be clear that quantum technologies will in many cases work in concert with existing/traditional methods rather than completely replacing or surpassing them.

Objective 4 in the framework acknowledges this, along with the need to support greater diversity within the STEM workforce. Science & Technology Australia supports this goal, and notes a key factor in supporting a robust and diverse workforce is job stability and security. Diversity and inclusion is critical across the entire STEM sector. Initiatives to improve participation of under-represented groups are needed everywhere in our STEM system – this is not specific to quantum. Diversity initiatives that reach across the whole STEM sector are likely to drive most effective progress.

Recommendation 8: Science & Technology Australia recommends a renewed push to drive stronger diversity and equity gains in Australia's STEM sector, including through the forthcoming review of Women in STEM and Diversity in STEM programs.

CLEAR ARTICULATION OF CURRENT STATUS, FUTURE POTENTIAL AND SPECIFIC QUANTUM NEEDS

Australia's quantum framework should include a sophisticated communications strategy to develop clear and compelling content to raise quantum literacy across government and the Australian public.

Clearer communication of quantum's underlying concepts and its potential applications are essential to ensure the benefits of quantum are understood, without overselling or overpromising on quantum potential too early in the industry's development – this runs the serious risk of undermining sectoral, government and public confidence.

As a starting point, a clear articulation of the current state of quantum technologies would be useful. As one example, the quantum framework references accessing 'a noisy intermediate-scale quantum computer to support the development of use cases for quantum technologies...' without explaining exactly what a noisy intermediate-scale quantum computer is or can do. Conveying the next level of detail about where we currently are, and the short- and long-term goals we are striving to attain, would give the public – and the broad research and industry communities – helpful context.



One way to support this would be to include science communication expertise on the Quantum Advisory Committee. Science & Technology Australia is a respected provider of specialised expert professional development and science communication training. We would be ideally placed to assist the Advisory Committee to develop such materials and would be delighted to explore such an opportunity with the Department of Industry, Science and Resources.

Recommendation 9: Science & Technology Australia proposes a quantum communications strategy be developed to build clearer public understanding of quantum and its transformative potential applications.

The framework's seven objectives, with corresponding initiatives, include important considerations to support quantum research and the quantum industry. However, at this stage, the framework objectives could be applied to any STEM discipline – next steps should include identifying specific goals and roles for government, academia and industry – with reference to the specifics of the quantum ecosystem.

Recommendation 10: Science & Technology Australia proposes that next steps in the quantum strategy development includes a clear articulation of the current status, short- and long-term goals quantum goals, and clearly defined roles for government, academia and industry.

Science & Technology Australia would be delighted to assist the Australian Government with the next steps in the development of Australia's exciting quantum industry. Please do not hesitate to contact us if we can assist with any additional information.

Yours faithfully,

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