



Australia launches quantum industry roadmap

After several decades of research, quantum studies are translating into commercialization, which Australia wants to capture on its shores.

“Quantum computing is not some far off technology,” said Maja Cassidy, principal researcher at Microsoft in partnership with The University of Sydney. Cassidy spoke at a recent webinar hosted by Australia’s national science agency, CSIRO. “Microsoft has announced a limited preview of Azure Quantum ... that lets our customers and partners access real qubit hardware in the Cloud. So businesses will be able to apply quantum computing technologies to their specific problems.”

Last spring, CSIRO reported its roadmap for Australia’s quantum technology industry. The agency then broadcasted the webinar, in May 2020, for further discussion of the roadmap.

According to the roadmap, the quantum technology global market is projected to reach AUD\$86 billion by 2040. Over AUD\$4 billion of that revenue could be generated in Australia in areas of computing, sensor and measurement, and communications.

“Since 2019 the UK, US, EU, India, Germany, and Russia have established multibillion [AUD] dollar scale quantum technology initiatives. And there’s even reports that China has put in about [USD]\$10 billion towards quantum R&D,” said CSIRO Chief Scientist Cathy Foley, in her introduction at the webinar. “So for us to maintain leadership and capture this opportunity it’s really important that we have this national conversation ... about having a coordinated, collaborative, and cooperative approach to growing our domestic quantum economy.”

Quantum ecosystem

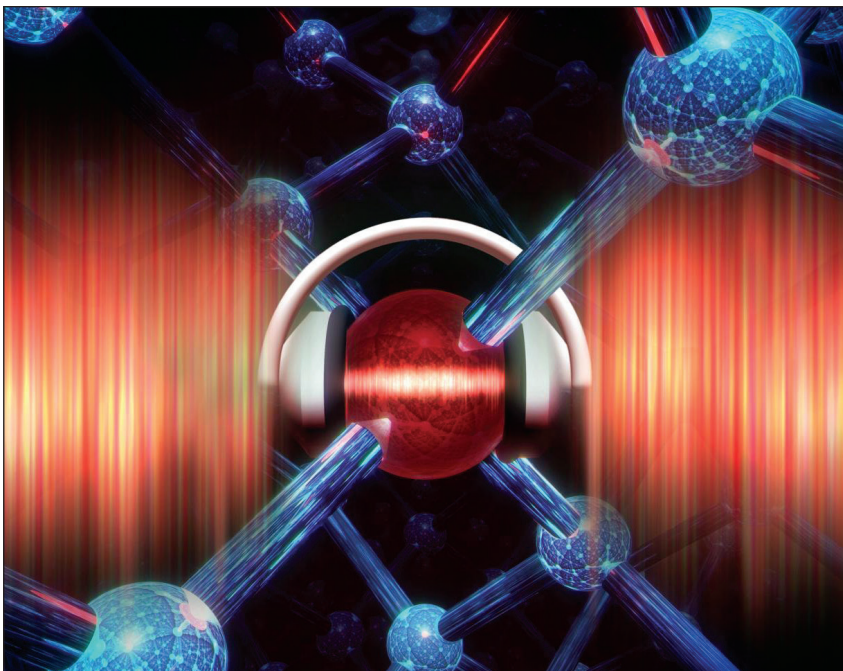
Similar to other countries that support quantum R&D as a megaproject, the CSIRO roadmap emphasizes collaboration across government, academia, and industry. During the webinar Cassidy also emphasized the need for international collaboration in order to reach commercial success.

Webinar panelist Phil Morle is a Partner at the CSIRO’s venture capital fund, Main Sequence Ventures. “[The technology companies] that are growing really well are working very closely with industry to try and find some kind of quantum advantage together to actually understand what that is whilst they’re making the technology,” Morle said.

While acknowledging that error-corrective quantum computing will not be realized yet for some years, the panel highlighted near-term economic opportunities. Among these is semiconductor consumer technology, according to Andrew White, director of the Australian Research Council’s Centre of Excellence for Engineered Quantum Systems, where close to 200 scientists across the country are working to build quantum machines. “Today in Korea, Samsung has released the Quantum Galaxy Phone.... It’s a \$500 US, so about \$800 Australian, phone that has a quantum random number generator built into it,” White said. “You know research takes about 30 years, technology takes 20 years, and then things suddenly get fast and valuable.”

Morle pointed out that the market is unfolding at the same time as the technology is being built. The first quantum company he invested in is Q-CTRL, headquartered in Sydney and founded by co-panelist Michael J. Biercuk. “All a company like Q-CTRL can do is be in that market,” Morle said, “... adjusting their business around the technology at the same time.”

To build quantum industry in Australia, the roadmap emphasizes the need to attract and keep the best talent within the country. White said, “One of the startups in Silicon Valley at the moment, in photonic quantum computing, is a company called Psi-Quantum started by a couple of Australians who did their undergraduate [PhDs and postdocs] in Australia.” The startup



Artist’s impression of an atom qubit in silicon being protected from charge noise. Credit: Tony Melov.



has raised about USD\$435 million and is valued at USD\$4.5 billion, according to White. “We’re exporting great people,” he said. “What we need to do is develop an ecosystem where we can retain them so they can flourish here.”

Morle agreed, saying that companies in Australia need to be appropriately funded in order to attract talent.

Quantum industry insights

In order to compete globally, Australia’s quantum industry needs to work fast—including international collaborations that enable this speed—and pull together resources from academia, government, and industry, according to the panelists. They advocated for government funding, an encumbered IP so that university work and industry or entrepreneurial work is separate, and international collaboration that utilizes expertise globally in addition to national expertise in order to compete globally.

Michelle Simmons, Scientia Professor and Australian Research Council (ARC) Laureate Fellow at the University of New South Wales, Sydney, director of the Centre of Excellence for Quantum Computation and Communication Technology at ARC, and the founding director of startup company Silicon Quantum Computing Pty. Ltd. (SQC), described the global competition as “the case of the tortoise and the hare. We very much see ourselves as a tortoise in this game.”

Launched in 2017, the stated goals of SQC are a 10-qubit prototype quantum integrated processor by 2023, a 100-qubit quantum processor with error correction before 2030, and a universal quantum computer by the mid-2030s. SQC specializes in precisely positioning phosphorus atom qubits hosted in silicon. Qubits in this type of semiconductor platform are sensitive to charge noise. In August, Simmons’s research

group reported a significant reduction in charge noise. According to their news release, the researchers revealed that the presence of defects either within the silicon chip or at the interface to the surface were significant contributors to the charge noise. They published this latest work in *Advanced Materials* (doi:10.1002/adma.202003361).

During the webinar, Simmons said that Google and IBM quantum systems use the superconductor platform, which will run into problems during scale-up. She believes the strength in her company is in developing atomically engineered qubits where they “can engineer each aspect of the actual device itself. This allows us to focus on generating the best quality qubits, the lowest noise qubits, and the fastest qubits.”

“The potential of quantum is going to be pervasive,” said Foley. “We’re already seeing it, and it’s accelerating.”

Judy Meiksin

South Africa’s Platinum Valley project to pull hydrogen initiatives into one ecosystem

South Africa plans to establish a Platinum Valley that will serve as an industrial cluster bringing various hydrogen applications in the country together to form an integrated hydrogen ecosystem. The initiative is part of the government’s economic recovery plans.

South Africa’s version of a “hydrogen valley” will identify concrete project opportunities for kick-starting hydrogen activities in promising hubs, with the aim of boosting economic growth and job creation, spurring the development of new industries, increasing the valorization of the country’s platinum reserves, and reducing its carbon footprint.

The industrial corridor project will start in a platinum group metals (PGMs) mining area in Limpopo, including the Limpopo Province Science and

Technology Park, and continue through the Johannesburg-to-Durban corridor.

The Platinum Valley will also allow South Africa to showcase its recent achievements in supporting the sustainable extraction, processing, and recycling of PGMs, which are essential for low-carbon technologies throughout the value chain. South Africa has 75% of the global reserves of PGMs, which form a key input into proton-exchange membrane fuel-cell technologies.

In another development, the Department of Science and Innovation has given the thumbs-up for the development of the National Hydrogen Society Roadmap for South Africa in line with the Hydrogen South Africa (HySA) Strategy.

The vision of the HySA Strategy is to use local resources to create knowl-

edge and human resource capacity, enabling the development of high-value commercial activities in hydrogen fuel-cell technologies.

The roadmap will set out the plan for creating an inclusive hydrogen society in South Africa, so that an enabling compact between industry, labor, communities, and the government can be developed. This will enable the government and industry to draw up a policy framework for exploiting the potential benefits of hydrogen by integrating it into various sectors of the economy.

An Atlas of Green Hydrogen Generation Potentials in Africa is also being developed in order to establish Africa’s potential as an exporter of green hydrogen. The atlas will not only identify clean hydrogen potentials in the continent, but will also consider related social, political, climate, infrastructure, policy, and environmental issues. □

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