



Australian Government

Chief Scientist

DR CATHY FOLEY AO PSM

**INTERNATIONAL CONFERENCE
ON QUANTUM ENERGY**

***Opportunities in quantum technologies:
now, near term and in the future***

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I would like to begin by acknowledging the Wurundjeri Woi-wurrung People of the Kulin Nation, the Traditional Owners of the land on which we are meeting today. I pay my respects to their Elders past and present. I extend that respect to all Aboriginal and Torres Strait Islander people with us today.

Congratulations to Dr James Quach and CSIRO for putting on this conference.

I'm excited to be here and to be closing off the year in the same way I began it – talking about quantum!

This puts me right in my comfort zone.

It's amazing when I look back on just the past 12 months to think how far we have come: how fast awareness is building and how fast capabilities are developing. Not to mention investment, which is quite staggering around the world.

This tells me that the seeds of quantum are falling on well-prepared ground.

For those of us who want to spread the message about quantum – and I count myself at the top of that list – we're in a sweet spot.

The audience is receptive and ready to hear our message.

I was interested to hear Gerard Milburn comment in his welcome video for this conference about how well the general public understands quantum.

He's been working away quietly in quantum computing for 30 years and I can relate to his sense of surprise. Happy surprise!

I've been working away in a related field for nearly 40 years as well – on superconducting devices. And I, too, sometimes pinch myself to think that here I am as Australia's Chief Scientist at the beginning of the quantum era – where quantum technologies will become part of the toolkit for so much of science and research, and are set to be felt across our society.

[When I spoke at the Quantum World Congress](#) at the end of last year, it was fantastic to see that Australia's expertise is well recognised on the international stage.

And then – [when I spoke again at the same conference in Washington DC](#) in October this year, those of us from Australia were welcomed back like old friends. We really felt the love.

The international community know we get quantum, they know we're good at quantum – and that's a good thing for investment and activity here in Australia.

Between those two world conference events, I've found myself talking about quantum at too many events to count this year.

As I say, it's been my year of living quantum, sometimes here, sometimes, there, sometimes it feels like everywhere at once!

I'm looking forward to hearing from Sir Peter Knight and to catching up with him again here. Our paths crossed just a couple weeks ago at Quantum West in Perth, and we have another get-together scheduled for February when he's here in Australia again. I'm starting to think we might be able to persuade Peter to join the great quantum influx heading towards Australia, and maybe move here full-time!

But I know he is also in demand in the UK, where he has really driven the attention on quantum as the chair of the UK government's quantum initiative. He is a great mathematical physicist, and we are lucky to have him here, even if only as a visitor. I love the uncompromising, clear-as-day ambition in the UK missions. It's fantastic to see.

[One of my first talks this year was at the Quantum Australia conference](#) in Sydney. Quantum Australia is coming around in February for its third year and I commend Peter Turner for his leadership of the Sydney Quantum Academy and creating a globally recognised program. It is great to see that he will be speaking later in this conference.

I spoke then about the opportunity, the need to raise awareness and activity, the need for specific industries to start thinking seriously about how quantum would change the things they do, and even the questions they could ask.

Since then, the government has shown its commitment by releasing a National Quantum Strategy, whose development I led with the help of many of you in this room.

Another quantum ARC Centre of Excellence has been funded, Google has collaborations in NSW including the development of algorithms in preparation for quantum computing; and Quantum Brilliance and Inflection have both made significant investments here in Victoria.

And now here we are, at a conference designed to really dig down to the opportunities in a specific sector – quantum energy.

It's exciting to have shifted from talking big picture – about awareness raising and opportunity – to now talking specifics. Especially in relation to a challenge as big and as urgent as the switch to clean energy.

I attended an event held by AusBiotech at Parliament House a couple weeks ago, where I spoke to industry leaders in medtech and pharmaceuticals about quantum in their industry.

There are significant opportunities in diagnostics, including our understanding of the brain, and in drug development and personalised medicine.

But what I found surprising, and it left me feeling really positive, was the questions these industry leaders asked. They're thinking practicalities – for example, the need to ensure the regulatory framework is prepared so that drugs that are developed and tested entirely in the virtual realm can be approved for use. This is the kind of preparation and foresight we need, and at the same time it brings home the reality that quantum is on the march.

One of the important things for those of us working to advance quantum technologies is to ensure we are clear about the opportunities now, in the near term, and much further down the line.

We need to produce something enduring, and maintain the trust, so that investment and momentum continues.

We don't want a situation in which the reality can't match the hype, and investors or decision-makers lose interest.

This means differentiating clearly between what's available now, what's on a pathway to realisation while being realistic about the timeframe for that pathway and what belongs in Marvel movies – the fanciful ideas that we don't want to sell, at least anytime in the next few decades.

The scale of the transition to zero emissions is mind blowing. Alan Finkel put it well in his new book, *Powering Up*, when he pointed out fossil fuels make up 83% of the world's energy consumption. We have shaved off 4% from that over the past 30 years. In the next 30, we need to shave off 83%.

Another former Chief Scientist Robin Batterham has also offered a memorable comparison. He says that if we tried to deliver the required electrification using only PV, it would mean covering the area of Tasmania 5 times over with solar cells.

The task is huge.

And the scale and speed of this transition is such that current technologies won't get us where we need to be.

We need to double down on research to unlock future technologies that can help us get to net zero.

And as I say, we need to be clear and realistic about when different capabilities are likely to come on line.

One of the most promising short-term opportunities is in transmission lines to support widespread electrification.

We need about 10,000 km of new high-voltage transmission lines. But a portion – about 8% - of that capacity is wasted through loss. If we can use superconducting cables, the efficiency and performance gain would be significant.

As we move to a digital world that uses the energy hungry internet and generative AI – making an image with generative AI uses as much energy as charging your phone – we also need to create new low-energy electronics. The ARC Centre of Excellence in Future Low-Energy Electronics Technologies is working on that.

In the second category, of things in the pipeline, we can consider new solar and battery technologies, along with quantum engines.

I remember how exciting it was when solar cell efficiencies jumped from 3% to 5% in the '80s. Now we're close to 40%.

Many of the programs in Australia working on new-generation solar cells based on organics and perovskites could see improvements of that scale again.

Quantum batteries could solve storage and performance challenges by using photonics to speed up battery charging, which would mean, for example, having EV cars that can charge in short timeframes.

Quantum sensors can monitor the internal state of liquid hydrogen allowing chain-of-custody from manufacture to distribution, creating a very compelling business case for hydrogen as an effective energy export.

I know these are all technologies that you will be hearing more about over the coming days, and I'm looking forward myself to understanding more about the readiness levels and anticipated timeframes for these technologies.

I describe my third category as ideas that perhaps belong best in Marvel movies. And some of these really are far-flung. I know we've achieved quantum teleportation at atomic scale, but I'm not convinced that we should be hanging our hats on 'beam me up Scotty' anytime this century or the next.

Having said that, I'm becoming an old scientist and old scientists are universally terrible at predicting the future.

I do expect to see some of the things in this category in my lifetime.

For example, as I've said before, I expect a full stack quantum computer to be realised in the next decade. I might be wrong on that, but I don't think I'm out by more than a few years. I enjoyed Gerard Milburn's description of quantum computing as the extreme sports of quantum.

Quantum computing will be a game changer across so many sectors, including energy.

I'm also pretty inspired by the idea that we may be able to overcome existing physical limits in battery technologies, for example, using quantum science.

I was also fascinated to read Florian Metzler's recent paper where he referred to the possibility that quantum effects may be driving photosynthesis.

The idea that nature may have evolved ways to maintain temporary superposition states in photosynthesis is fascinating, and a reminder of how much we have to learn about the way the world works at very small scales.

This is why that slow work of fundamental research must continue, even as we start to apply quantum to existing technologies for real-world solutions.

Before I finish, I want to tell you briefly about a project I have underway. I refer to it (unofficially) as 'quantum speed dating', and it's designed to ensure that Australian businesses understand and are factoring in quantum technologies – into their future investments, their R&D spend, their risk mitigation, and the consideration of what might be possible in their business plans.

I held a speed dating event at the Australian Institute of Sport in August, which, as I said at the Quantum World Congress, is already making a little magic and sparking interest about where quantum advances may be used in the sports sector. It's great to see the Queensland Government commit to exploring where quantum may be applied to the 2032 Olympics.

I know your conference will do something similar for quantum in clean energy.

I plan to hold workshops through next year to build awareness and demand in sectors across the economy. So we're working hand in hand towards the same goal, as we continue to light the spark in a community receptive to what we have to say.

When I worked with quantum effects in the early years of my career at the CSIRO, I couldn't have imagined some of the applications being discussed today. Even when I began my term as Australia's Chief Scientist three years ago, quantum was a kind of blip, an area of important and promising science, but without the recognition it has today. Now I can envisage the time where it is just another tool in our kids' backpacks.

Every generation has that moment where they think, 'wasn't I lucky to be born now, to see this' – as they witness an amazing advance in human capability.

But nevertheless, I count us as especially lucky to be here in the quantum era.

These technologies will advance our understanding of how the world works at the largest, as well as the smallest scales, and maybe even crack some of those intractable research questions, whether its photosynthesis or brain cognition.

In doing so, they will give us the tools to change many aspects of our lives and our environment for the better.

Thank you.