



Australian Government

Chief Scientist

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How science and technology will create the future jobs in regional Australia

I'm very pleased to be speaking at an event focused on regional Australia – because the success of so many of the things I am involved with – from critical technologies to biotech; from critical minerals processing to clean energy; from STEM education to Defence tech – will depend on getting the settings right in the regions.

I know that's a big statement. But I don't think it's an over-statement.

Australia's ambition is to lift the complexity of manufacturing and enter the global supply chain for low-emissions manufacturing, including hydrogen, batteries and solar cells.

Australia has ambition to lift the skills of the domestic workforce, and the maths and science smarts of our young people.

We have ambition for medical manufacturing and biotechnology, new forms of agriculture and food production, and carbon sequestration.

We aim to play a larger role in the space industry and lift our defence capability.

Regional Australia is where so much of this action will happen. Of course that's nothing new. Regional Australia has always underpinned the Australian economy. But these emerging industries are a different kettle of fish and they require a different strategy.

Today, I want to talk about those requirements – the settings that I believe are essential for success.

I attended the Jobs and Skills Summit a couple of weeks ago, as no doubt a number of you were there as well. What I saw was a lot of common ground. It's not as though we're sitting on the back porch looking at the empty backyard – and trying to decide whether to plant an orchard or a native garden.

The vision is shared. Each of the delegates spoke from the perspective of their own sector. But just about everyone seemed to agree on the fundamentals.

They are: Improving STEM education; building a high-tech workforce in the domestic population; reshaping the skilled migration flow to recognise the realities of the global tech sector, and support the growth of the domestic workforce; putting a greater emphasis on the VET sector, focused on technology skills; reducing the barriers for women to enter full-time work, and then to stay and progress in their careers; and crucially, lifting the complexity of Australia's economy and driving new manufacturing opportunities.

That's a great place to be. Broad agreement across our economy on the goals.

While I was there, I heard Scott Farquhar, of Atlassian, say he is going to hire 1032 Australian tech specialists over the next 12 months. And those people, if he can find them here in Australia, can live anywhere. They don't need to be in a big city.

I heard Anthony Pratt say that wheat sells for a \$100 a tonne. If you turn it into flour it sells for \$500 a tonne, and if you turn that flour into bread it sells for \$5000 a tonne.

His message about value-adding equally applies to lithium, which is in huge demand for batteries; or gallium, germanium and indium for manufacturing semi-conductors.

I heard Jens Goennemann talk about the real nature of manufacturing. As he said, it's a complete misconception to think it's all about men in hardhats. Complex manufacturing – which is where Australia wants and needs to be – has jobs for anyone from any background and with any skillset.

I think the whole of Australia heard Danielle Wood say if women's workforce participation was iron ore, the country would be tripping over itself in the race to invest.

She also referred to the huge opportunity represented by the switch to clean energy. But, as Danielle said, the challenge is to make sure that the clean energy switch is aligned with the development of jobs in regional communities that have relied on coal.

Now we're at the nub of it. How to line up the moving parts – to match up the available workforce with the new jobs.

The first thing to realise is that the tide cannot be stopped. The new technologies are here, and they are running to their own timetable. It would be a mistake to think we can dillydally, and respond to the new landscape at our own quiet pace.

Internationally, there is unprecedented investment in clean energy technologies, in digital and quantum technologies, in robotics and automation and other emerging sectors. If we don't respond – quickly – others will.

And we'll get left behind. However, what we can control is our response. With sufficient attention and ambition, we can get the science right, get the workforce right, and make sure our regional communities reap the benefits.

How? Here's some of my thoughts.

The first thing is to get our heads around the scale. The scale of the transformation is mind-blowing and difficult for any of us to comprehend: the scale of the materials needed for a global low-emissions agenda; the investment; and the size of the tech-skilled workforce.

Just take one example, semi-conductors, where Australia wants to be part of the supply chain. The US has announced plans to spend US\$54 billion over five years bringing semiconductor manufacturing back onshore in the US. That's the scale of the global environment we're in. Semi-conductors may be tiny. But they're getting outsized attention.

The scale of the tech workforce is equally confronting. It's estimated we will fall short in numbers of people for tech jobs by nearly 200,000 people in 2030.¹ That's an awful lot of extra people to recruit in these new sectors.

The scale of the resources for net-zero are another example. Demand for batteries is increasing massively. By 2030, and that's not that far away, we'll need six times the amount of lithium that is currently produced to meet the demand.

Most of our energy needs will be met by wind and solar, which will require a staggering scale-up in capacity. Robin Batterham, a former Chief Scientist of Australia, gave a real sense of this recently when he pointed out that delivering our energy needs through solar cells, just to give an idea, would mean covering the equivalent area of five Tasmanias with solar arrays.

My call is to understand the scale and be realistic about what it involves. Meeting the challenge of scale will require collaboration across the economy. Government, research and industry coming together with regional communities to solve problems.

Regional hubs help this way of working. I know these are on the agenda, and they're a really good idea. Specialised hubs focused on particular technologies help build critical mass and expertise, they can allow research to operate alongside application and commercialisation, to help cross that divide and scale up quickly.

Our regional universities have an important role to play; each with its own areas of world-class research. Well supported, regional universities can build expertise and also be honeypots, helping create critical mass and economic activity. They help solve workforce challenges in regional communities. Seven out of 10 graduates from regional universities actually stay in the community. They lift local wages. In Armidale, where the campus plays a major role, the regional university is credited with lifting local wages by about 12 per cent.

Another way to meet the challenge of scale is to make the most of automation and robotics.

Scott Farquhar told us at the Jobs Summit that manufacturing in Australia's high-wage environment won't be competitive without automation. And if that's the case, it's a fact we have to deal with – not something to run away from. This in turn will require dealing with digital connectivity in regional areas. Atlassian doesn't mind where you work, but as a starting point, you're going to need a reliable Internet connection.

Once we get our heads around the scale, it becomes all the more clear that there will be knock-on consequences – to jobs, as I mentioned, but also for land use, and waste. The new industries have consequences for the shape of regional communities, and for Indigenous communities.

Renewable energy is a distributed form of energy, which will see new infrastructure across rural land – solar panels, wind farms, and transmission lines. The environmental implications and the questions of community acceptance are clear to all of us. This distributed infrastructure, as I said, has recycling implications, as batteries, solar panels and wind turbines age.

I don't raise these issues to be a party pooper. I raise them because I firmly believe that we will have the best chance at success if we dream big and then plan bigger.

It's always tempting to put the file labelled 'Difficult Problems' in the bottom drawer of the filing cabinet, or downplay the level of difficulty to avoid scaring people off. But in my experience, solutions are more likely to happen with broad input – and when you take what I refer to as a systems approach, or a design approach. Not robbing Peter to pay Paul. Not jumping from one problem to the next, but laying out the pieces of the puzzle on the table, and then putting them together.

One of those pieces, as I said earlier, is aligning skills gaps with capabilities. I've been doing some work on this in relation to quantum. Quantum technologies are estimated to create 16,000 jobs by 2040 – and the skills are similar to those needed in other emerging sectors such as space, cyber, biotechnology, clean energy and semiconductors.

This is an opportunity we simply cannot afford to let slip. If we're not careful, or quick or clever enough, it will pass us by. Initially, we need to build expertise in the university level skills – physics, computer science, software, electrical and electronic engineering. And then as the technologies mature, the needs shift to the VET sector. Data science, mathematics,

precision manufacturing and nanofabrication come into the mix – plus broader skills, such as systems analysis, and commercialisation expertise.

How do we achieve this scale-up in skills in record time? The answer is we take that systems approach: Attract international talent into our research sector, create a globally collaborative university system so that we remain deeply connected at that level. At the same time, build domestic capability. That means increasing STEM involvement and ambition right from the early school years, and using the full human potential of the talented people we have here in Australia through microcredentialling and on-the-job training.

It's not one size fits all. It's a suite of responses that operate concurrently. All of the pieces of the puzzle coming together to contribute to the whole.

My visit to the Northern Territory really brought home a lot of the challenges. But I also came away excited by the scale of ambition and the systems approach they're taking in their planning. The Northern Territory's ambition is to lift gross state product from \$26 billion to \$40 billion by 2030. And they're getting there through an intense focus on advanced manufacturing including mineral processing and clean energy. I was excited to see the scale of the partnerships being developed between industry and government, alongside the university collaborations.

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So I have talked about scale, and about the need for a systems approach. But I'm here to talk about science. So let me get to that now.

Big innovations come from pushing the boundaries on good experiments. For example, wi-fi came from radio astronomy. The Internet came from the Large Hadron Collider – 27 kilometres of underground tunnels on the French-Swiss border where scientists are smashing atoms together at high speed to discover the fundamental particles of the universe.

These are big science experiments that push the boundaries of knowledge. We've got some of them here in Australia.

You might have heard about the goldmine in Victoria that doubles as a dark-matter lab. This is an international collaboration, where scientists are trying to detect dark matter, shielded from interference by hundreds of metres of rock, 1 kilometre underground.

In WA, in one of the quietest places on earth, Australia is building a huge radio telescope array – more than one hundred thousand radio antennas – which will help us discover more about the beginnings of the universe, the nature of gravity, and possibly even life beyond Earth.

We have a Centre of Excellence that is investigating Australia's unique plants and animals for molecules that might lead to new medical treatments, pesticides or sources of dietary protein.

Scientists have a special relationship with regional Australia – it's where we do our research, find our raw materials and the inspiration and innovations of the natural world that can help us with new solutions. Regional Australia has a lot to offer science. And science has a lot to offer in return.

None of us wants Australia to become the world's quarry for the critical minerals that are in such high global demand – for the tech industries and clean energy. Instead, the opportunity is to cement Australia in the high-tech supply chain, through processing the critical minerals into alloys, metals and components.

Science is your friend here.

I'm unsure how many Australians realise that the technology used in almost all of the world's solar arrays was invented here in Australia in the 1980s – at the University of NSW. But we didn't commercialise it. Isn't that a familiar story? We didn't approach this discovery and its potential with sufficient urgency. We didn't have the manufacturing sophistication and the right materials to take advantage of the discovery. Now China is the world's largest manufacturer of solar cells, using that Australian technology. I want to see a new culture of innovation to avoid a repeat of that experience. There is so much excitement in the uniqueness of what Australia has to offer in these global endeavours.

Science is also your friend in agriculture. Automation, remote sensing and analytics, and robotics are technologies that have huge application to the farming sector. They will improve land management, productivity, animal husbandry and plant health.

Quantum technology will enable the next generation of navigation systems that don't rely on GPS or satellites. It's a way off, but when we have inertial navigation systems, that's going to be a boon for remote areas and for agriculture.

I love quantum science and I am messianic about its promise. I want everyone to understand the potential.

Quantum sensors are being deployed already and will bring a step-change in mapping capability, underwater and underground, with applications for critical minerals mining.

When quantum computing becomes a reality, perhaps as soon as 10 years from now, that's when things get really exciting. In quantum computing, calculations are exponentially faster and more complex, and also a much closer mirror of reality than the approximations that we currently use in classical computing.

This will open the door, for example, to new catalysts for splitting water to create hydrogen, which will unlock one of the tricky problems that remains in our ambitions to use hydrogen for clean energy.

We all need to be aware of the disruptive potential of quantum and other emerging technologies. As with wi-fi, or the Internet, and so many other applications that have arisen in unexpected ways, quantum technologies will open doors to places that we are yet to imagine.

Most of my career was spent in a lab in Lindfield on the north shore of Sydney. But my research included work on detection technologies that were used in mining, among other sectors. I led a team that developed and trialled different quantum sensor systems in regional areas from Coober Pedy, to Murray Bridge, Triton, Cannington, and Gulgong near Mudgee. These systems were able to see through the ancient Australian conducting overburden and down to 1 km depth to discover and delineate mineral deposits that were hard to detect.

I'll never forget being at Mudgee in the pouring rain, the whole team wearing plastic garbage bags. They didn't mind, they were just happy to be in a region that they knew for its excellent wine. So a soggy day followed by a soggy night.

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So let me come to a conclusion by putting this question to you: For those of you who live in the city, what would persuade you to move? Or if you already live in a regional area, what would persuade you to stay?

The answers are probably not that difficult. If I asked you to write them down, you would probably start with the natural environment, the bush, the beach, the night sky, the animals, a sense of community, those things that give our lives meaning.

The regions already have that part of the equation sewn up. The next thing you would write down would probably be a good job, with an exclamation mark. Opportunities for career progression, plus reliable healthcare, good education, affordable housing and safety -- the things that make it possible to live our lives in the most secure and purposeful way.

This is a consequential idea. Your organisation has recognised it in your report today. You make a clear statement that "regionalisation is more than an agenda on decentralisation; it's an ambition to grow. It ensures that regional businesses and communities more than just survive, they thrive."

I am Australia's Chief Scientist. My role is to provide science-based advice to Government, and promote the place of science in bettering our nation and solving its challenges. It's a role I believe in wholeheartedly. I don't need convincing about the pure and phenomenal potential of science.

But you will hear me say often, science cannot do it alone. Science builds knowledge and ignites discovery. Bringing that to a real-world application involves a swathe of other expertise -- from design, to business expertise, to investment, social licence, ethical and legal expertise and regulation.

You will also hear me say that it is not science for science's sake. What we're seeking is science in the service of humanity.

With critical minerals, we're not embarking on a new era of dig and ship, or fly in fly out.

At the Jobs Summit, I heard Matthew Pryor say that agricultural innovation is the greatest underleveraged opportunity available to us. But he pointed out that there's a difference between the availability of jobs and the appeal of jobs. The task is to create jobs in the regions that people want, jobs that feel more like jobs for the future.

As I was preparing to address you today, I spoke with Chris Armstrong, the deputy Chief Scientist and Engineer of NSW. Chris is about to make his own shift to regional Australia, taking up a senior position with the University of New England. I was interested to hear that he's not planning to commute or work remotely, but is putting roots down in Armidale and will become a part of the local community.

Before I started at the CSIRO, there was a debate about whether the National Measurement Laboratory where I worked would be located at Lindfield in the north suburbs of Sydney, where it ended up, or at Albury. I have wondered since then where I would have been today

if my lab had been built in Albury. My hope is that I would be right where I am, as Chief Scientist. And that is certainly the ambition we should have for the regional agenda we develop today. The solutions we want for regional communities are those that are sustainable: Education opportunities that meet the jobs of the future; job opportunities that attract people to relocate – equal to those in urban centres; high-tech manufacturing that opens new doors for Australia.

And a richness to our science and innovation system, that draws on all that uniqueness in our own backyard, to put us at the forefront of discovery.

This speech was delivered on 13 September 2022 at the Regional Australia Institute's 2022 National Summit: Rebalancing the Nation.