Australian Government

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The science that's shaping our future

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You've asked me to talk about the science that's shaping our future, and I couldn't ask for a topic closer to my heart.

I plan to talk to you today about three sets of emerging technologies – biotechnology, quantum technologies, and digital technologies, including artificial intelligence and robotics.

These are important opportunities for Australia – and I hope you come away as energised as I feel about the possibilities.

But my main message to you is that Australia will only realise the potential of these technologies with your help.

These emerging technologies are disruptive, they're synergistic, and the change they bring will be exponential.

We have a choice here in Australia.

We can look on in wonder.

We can sit tight and wait for the new tech to make its way to our shores, as it inevitably will, and then be a valued customer.

Or we can be in the game.

That means making the research discoveries, bringing technologies to market, and also lifting our involvement in high-tech processing and manufacturing at scale.

This requires a shift in mindset.

I know we have innovation in us.

There's a long history of inventions and breakthroughs that have an Australian connection.

I even read recently that we're now in an innovation arms race with cockatoos - as they try to flip the lids of our wheelie bins.

If we can match the cockatoos at the game of ingenuity, we're the match of anyone!

So the question is not, are we inventive?

The question is, do we have the right structures and the right cultures in place to support and grow that inventive spark, to join it up and bring it to scale.

Can we come together as a nation to make systemic change?

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Before I come to that question, let's talk first about some of that emerging science. This is science that will help solve the big global challenges, and build Australia's prosperity and sustainability.

Number 1, biotechnology.

You'll be familiar with biotech in medicine. Such as mRNA vaccines, which work by transporting a set of instructions into our cells. Or glucose monitors for diabetes. These are biosensors – devices that detect and monitor biological signals.

But we're just at the beginning.

Biotechnology describes a whole suite of different technologies based on engineering biological systems to create new products and therapies.

In medicine, biosensors will eventually be used to detect changes right down to the cellular level. This has enormous potential for monitoring your health and detecting precursors to disease.

Biosensors will be used well beyond medicine. They have applications throughout our environment – for example, in building materials to monitor deterioration.

Synthetic biology is a relatively new branch of science, but it's accelerating fast. Synthetic biology allows us to program DNA so it can do the work of repair inside the body. Or even develop artificial neural circuits so people can regain control of their limbs.

Bioengineering will give us the ability to repair organs, or grow new ones, to grow skin for burns victims.

It will give rise to new biologically based materials – leather made from orange peel or materials based on artificial spider silks stronger than Kevlar.

Bioengineering could be the basis for new biofuels and industrial chemicals, removing our reliance on fossil fuels.

So biotech has really exciting applications in many fields.

Can I set you some homework to go online and take a look at the Critical Technologies tech cards. There you'll find that biotechnology is expected to be the basis for food and medicine used in space, cell lines for personalised medicine, even biological robots.

I know sometimes this sounds like science fiction, but it is, in fact, very firmly founded right here I the real world.

Besides, we all know that science fiction has impressive predictive capability.

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The second area of emerging tech we all need to be strongly focused on is machine learning and artificial intelligence.

These technologies are how we make use out of the enormous amount of data out there.

A bit of maths:

In 2018, the world produced 33 zettabytes of data.

It's staggering. I read a comparison that suggests if you represent each bit as a $1 coin and stack them up, that amount would create a stack 84,000 light years high. That's one end of the Milky Way to the other, give or take.

An astonishing amount of data, year on year.

Machine learning is already bringing a step change in the ability to sift through data and test solutions.

We can use machine learning as a powerful predictive tool – it's slightly troubling that the Internet knows us better than we know ourselves. We know dogs can sniff out cancer. Well, Google can do it too.

Machine learning can predict trends. For example, it's being used to analyse the millions of job ads for early identification of employment trends – to help us prepare.

Machine learning can also be used to simulate real-world scenarios and model outcomes, for example to test therapies. It sped the development of a coronavirus vaccine.

Digital twins are powerful tools in city planning, allowing the creation of a digital version of a city to model the interactions between infrastructure and other systems.

You can just imagine what a step change it will be when we can build these kinds of twinned systems for the human body.

It’s not difficult to see the potential. It’s also obvious that these digital tools are not always a force for good.

We’ve all seen the negatives that connectivity has brought us.

You don’t need me to describe the harm done by algorithms that actively reinforce our perspectives rather than exposing people to diverse viewpoints.

I’ve spoken before about my discomfort at using artificial intelligence in systems that need the subtlety of human judgements – hiring decisions for example, and criminal profiling.

But the simple reality is there’s no turning back.

More than that, we don’t want to turn back.

This fourth digital revolution is here.

The trick is not to hide. But to get the safeguards right and get that balance right.

This is where we need a concerted national and international effort.

As we prepare for the ever-increasing use of machine learning, and of artificial intelligence and robotics, the answers lie in preparation and regulation, understanding the pitfalls and the potential, and shaping the technologies for good.

I know people are nervous about automation, worried it’s coming to take their jobs.

But we need to think of automation more in terms of augmentation. Not obliterating the human component, but augmenting human input.

Which is a job creator. It allows us to do more and develop capabilities faster.

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And so to quantum, the final set of emerging technologies that I want to highlight today.

I described myself as messianic about quantum at a recent event, and I really am. A quantum tragic.

There are three sets of quantum technologies that we’re especially focused on in Australia:

Quantum sensing, which will bring a step-change in mapping capability, and also allow monitoring of cellular activity at that close-up level – through picking up the tiny magnetic fields produced in cells.

Quantum computing, which holds the promise of being able to model complex systems. We'll be able to build new molecules and simulate how they behave in the body. This is because quantum computers are not only exponentially faster, the way they operate is a much closer mirror of reality than the approximations used in classical computer.

We may be able to find new catalysts to split water to create hydrogen, which will unlock one of the tricky problems that remains in our ambitions to use hydrogen for clean energy.

We'll be able to better model climate and weather systems. When a butterfly flaps its wings, a quantum computer will not be overwhelmed with complexity.

We haven't got a fully error corrected quantum computer yet. But when you look at the investment, the scale of the effort and the brilliance of the scientists, I think we'll get there in 10 years.

Already, early-stage quantum computers are being used. A Canadian team has now reported that its quantum computer completed a calculation in 36 microseconds that would take the world's most powerful supercomputer 9000 years.

The third quantum technology that's a focus here in Australia is quantum encryption. Quantum computing will unlock most of the world's systems for encrypting data, including cloud data, messaging and banking data, – and so alongside the race to develop quantum computers, there's a parallel search for new ways to encrypt data. As the World Economic Forum reported in September, the risk is that sensitive data is being harvested now by malign actors now and stored until quantum technology allows it to be decrypted.

This makes data protection in the quantum world something all of us in the policy sphere need to address now. This is urgent.

The international investment in quantum technologies is significant. Individual countries are spending tens of billions of dollars in a race to solve remaining scientific problems. Everyone wants to be first in this race because the risks and rewards are so high.

In Australia, our researchers have had their eye on the ball. This meant we invested in an organised way for more than 20 years. As a result, we have top quantum talent and start-ups working right at the edge, in quantum computing, cryptography and sensors.

I'm pleased at the level of recognition and commitment by the Minister. I'm leading the development of a quantum strategy, and chairing a National Quantum Advisory Committee made up of leading experts.

So we're in a good position. This expertise and really solid base gets us through the heats into the finals.

But we have to step up, recognise the potential and invest. We have to broaden understanding and uptake of quantum technologies.

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I want to come now to the shift in culture that I referred to at the start of my remarks – the ways of working that will maximise our chances of success with the promise that science has to offer.

First, we should not be afraid to set priorities and concentrate our efforts. This is often referred to as mission thinking.

I think we're often too quick to characterise it as "picking winners" and shy away from it.

But mission thinking is not about picking winners. It's about being specific about what we want to achieve, clear in the path forward, and patient, recognising that change is decadal.

Getting to net zero is an incredibly complex ambition, and it will only be achieved with a collective effort and significant investment.

Biotech and those quantum technologies that I spoke about need to be driven forward across our economy.

A research team, an innovative start-up, or a forward-thinking resources company can make important new discoveries, but they can't bring transformative, economy-wide change alone.

Transformative change at scale requires a collective focus.

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Second, the role of data.

Science advancement is increasingly about data – and you would have picked up that message in the technologies I've spoken about today.

It's about big data and access to data.

You may have come across the UK Biobank. It's an excellent resource, one of the largest databases in the world, containing detailed health records from half a million people – and it's available for researchers internationally.

This is incredibly valuable for medical research and it's a global effort that we need to be part of.

But we resist sharing health data. We're not keen on sharing any data with government. As government agencies, we hang on to data very tightly, and we're nervous about sharing across agencies and levels of government, let alone further afield.

I often wonder why it is that we have private firms madly gathering personal data like some insatiable machine – while large real-world datasets that would be of immense use in research are not easily available.

It is past time for a much more sophisticated approach to the question of data availability and data sharing.

These are the principles that should underpin the conversation:

- Privacy is fundamental. Ticking "I consent" on a website shouldn't change this.
- Security is fundamental. We need to recognise the value of data and its vulnerability to misuse.
- And access is fundamental. A culture of access will speed discovery and solutions to those big challenges.

How do we find this balance? One of the answers lies in building trust through a culture of transparency.

We can't expect information without providing information.

To the extent that we unnecessarily withhold information, to the extent that we massage our messaging, to the extent that we refuse to invite the community inside the room and we distrust the community to understand complexity – to that extent, we are complicit in undermining trust.

This is one of the reasons I speak often about a culture of transparency.

Because I believe if we can shift the dial on this, increase transparency and build trust, that creates momentum towards getting the right regulations and protections in place to protect privacy and security.

And ultimately, we will unlock an immense bank of data that will speed discovery in the science-led knowledge-based digital economy.

We can have our cake and eat it too.

I'm working on a separate but related initiative for research literature.

My aim is to bring research out from behind paywalls, and make it freely available for all Australians to read -- whether you work in industry or government, research institutions or schools or hospitals.

I'm in the process of developing advice on this.

Preliminary analysis indicates it would bring a big uplift in productivity.

It is a transformative change that challenges the status quo, so it's not without risk.

But it will put the world's research knowledge at our fingertips, improve visibility of the science, drive innovation, and speed the development of new technologies.

And it's part of that open culture of collaboration.

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Finally, we need a culture of curiosity. By "curiosity" I mean openness to fresh thinking. I mean preparedness to question ways of operating that we may take for granted, preparedness to challenge the prevailing mindset, preparedness to challenge our comfort and to take risks.

This is something we're comfortable with in science and research.

As I've said before, the process of discovery and experimentation is where ideas - fresh ideas, even very unlikely ideas – ignite the spark of innovation.

I talked earlier about quantum. One of the winners of the Nobel Prizes last week set up an experiment to test whether quantum entanglement was real. He thought his experiment would disprove it.

But it did the opposite. And now, 50 years later, it's quantum entanglement that will enable new forms of cryptography and communications.

Fifty years. Sometimes that's how long science takes. It's a patient game of problem solving, testing ideas and then testing new ideas, and understanding that a null result is not a failure but simply part of the process of progress.

We talk so much about risk-taking in the public sector, and yet it's enormously difficult in practice, as you will know.

The system is built around managing and avoiding risk -- and in many ways, this is important. However, it's also a handbrake on realising the promise of emerging technologies.

As I said earlier, the technologies I have spoken about today are unpredictable. They're not confined to individual sectors, but are pervasive.

It's been three years since David Thodey delivered the outcomes of his review of the Public Service.

It's striking to go back and read what that report has to say about what he called "the promise and disruption of new technologies".

The review team called for nothing less than a transformation in the public service, to develop a culture of openness, innovation, collaboration and partnership.

The APS, they said, "needs leaders who are willing to embed purpose and drive change".

The Thodey review reported in 2019.

Now I'm not trying to suggest that nothing has changed in the intervening years.

But I do want to gently suggest that not enough has changed.

We've been talking about a culture of innovation and curiosity, a preparedness to engage with risk and the embrace of true diversity for years.

But there is an enormous inertia in big systems. It's like trying to turn around an aircraft carrier in a tiny harbour.

But I know those of you in the Public Service entered the profession for a reason, and for many of you it will have been that capacity to make real change. We do have pockets of real creative ingenuity in Australia – and not only among the bird population.

It is true that large-scale change is structural.

But it is also true that it is within each of us as individual leaders, whether that be in the public or private sector, to make changes in our own organisations.

We can hear that message from the Thodey review, and more recently from the Jobs and Skills Summit, from the international community, the political leadership, and from the science itself – and we can find ways to apply those messages in our own businesses and workplaces.

This means doing the hard work on diversity – not the easy version, but the deeper version that incorporates people from different socioeconomic backgrounds, people at different ends of the age spectrum, cultural diversity and neurodiversity.

It means supporting those perspectives and rewarding fresh ideas.

We admire the unconventional and the idiosyncratic. Hollywood is built on the idea of the hero-maverick. Ukraine is inspiring the Western world with it.

We're now celebrating a Nobel laureate's willingness to swim against the tide and set up a quantum experiment that others judged as "nuts", to use his words.

We admire maverick ideas and we celebrate them. But it's time to integrate that into our actions on the ground, and engage with risk and challenge convention. That's where we find the gold.

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And so to wrap up:

In the new global landscape, there is a remarkable confluence of technologies, ambition and agreement on goals – within Australia, but also among our partner countries internationally.

We've entered a new digital revolution that will lead to capabilities that are awe-inspiring.

There's goodwill and eagerness to invest.

And there’s a deadline, which creates momentum and a sense of urgency.

We have an opportunity to lift the complexity of our economy, and enter the global supply chains for high-tech manufacturing.

An opportunity to ensure environmental, social and governance principles are built into our future economies.

An opportunity to lead transformation.

I hope you can sense the excitement in my words. Because I have absolutely crossed the Rubicon in my assessment of the potential of science and technology to bring transformative change right where we need it.

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