

NATIONAL PRESS CLUB ADDRESS

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--- PLEASE CHECK AGAIN DELIVERY ---

Good day, friends and colleagues here at the National Press Club, Good Day Assistant Minister for Science, Innovation and Jobs, Senator the Honourable, Zed Seselja. Good day Chief Scientist Alan Finkel, National Health and Medical Research Council CEO Anne Kelso, and Australian Research Council CEO Sue Thomas.

And Good Day to those of you here in the room - and those watching around Australia – including Aboriginal and Torres Strait Islanders whose enduring custodianship of this land I respectfully acknowledge.

I am here representing 70,000 Australian scientists and technologists who understand deeply the future that is barreling towards us. We know the heat is rising, and like many of you, we regularly wake in fright.

That does not, however, mean we despair. My message today is one of hope.

We work in the solutions sector. In science, technology, engineering, maths and medicine we are ambassadors for, and creators, of the future. Every day I have the privilege of working on solutions to grand challenges and every day I have the privilege of facilitating the work of others who do the same.

So, while, as scientists and technologists, we may see all too clearly the many challenges ahead -- in climate, health, cybersecurity, energy, and transport - that clarity and insight, allows us to reflect and to work strategically towards solutions.

To be hopeful is not naïve.

The pursuit of solutions has brought hope many times before – from vaccinations against deadly diseases, even cancer, to more productive

crops; from safer and more durable clothing to sustainable building materials.

It's allowed us to build the tools that illuminate the world: the cameras to see the hidden recesses of the human body, the satellites that communicate and measure changing landscapes, and the telescopes that explore the furthest reaches of the known universe.

We've also built the tools to connect the world. The internet and digital communication technologies have thrown open access to education, so that many more of the next generation can learn how to question and how to quest... how to right the mistakes of our past. It's allowed people on one side of the world to share cutting-edge research and innovation to address profound challenges on the other.

This technology is also being used today by valentines all over the world as they navigate their way to that romantic restaurant or special picnic spot.

Many of the foundations for these exciting technologies were developed in Australia.

We also know this message of hope is one that ordinary Australians share. We've surveyed the Australian community and found a whopping 94% of people believe that Australian science and technology is important to their health and wellbeing.

90% agree that the very latest science and technology should inform policy and action on global challenges, and 78% think we should be investing more in research.

Which, in my view makes perfect sense; knowledge, ideas and innovation are the ultimate renewable resources that generate positive returns, over and over again.

So, solutions – and hope – are the foundation of my talk today.

Now, let me take you on a journey with a clear direction in mind; the creation of a proud Australian identity in science, technology and innovation. An identity that has evolved with and been forged by our isolation and independence. An identity that includes and acknowledges the world's oldest living culture.

That is, a STEMM-infused Australian cultural identity that combines our wit with our grit.

Who we are is important.

Australia's isolation has forced us to innovate and to work together. But, our isolation has also left us vulnerable in a rapidly changing world, a backwater, at constant risk of being seen and used as merely a landing pad or a pantry.

Now, as the pace of that global change quickens and the 4th industrial revolution unfolds -- as the centres of political and economic power become more distributed and less transparent – we need to embrace a STEMM cultural identity to build our economic, environmental and social strengths, and to enhance our global connections.

Fortunately, we are standing on solid rock. Our foundations are strong because innovation and scientific endeavour have always propelled Australia forward – and helped us reach outward.

Think of how the world would grind to a halt (or at least get terribly lost) without Google Maps – the platform for which was created in Australia. Think of the Australian researchers using seismic stations to identify looming tsunami threats and warn nations at risk. Think of the world's first cancer vaccine.

Think of the research that has taken a protein in Australian milk and turned it into a chewing gum that strengthens teeth –saving an estimated \$12 billion in dental costs worldwide.

You only need to take a glance around to see where Australian science has provided solutions to many of life's problems.

And, consider the wealth of human capital, our people, within our science and technology sectors today; the Australian researchers, innovators, entrepreneurs, communicators and policy-makers. All of us, women and men, work every day in government, higher education, and industry with a deep commitment to making the world a better place.

Whether we have grown up in the bush or in the city, or we have become Australian citizens after growing up overseas – and regardless of our gender or beliefs – each one of us accepts the role of knowledge creator, of diplomat, ambassador, and economic driver. Of solution-seeker.

If Australia is to ride the accelerating pace of change and remain a strong, independent and connected country; we need to sit in the driver's

seat. And that is a STEMM seat. From the government, industry, and the community we seek support – we cannot do it without you.

We need long-term planning and investment: a whole-of-government plan to invest in STEMM education, fundamental research, translation and innovation, and world-class research infrastructure. And for that, we need our policy-makers and our decision-takers to understand what it really takes to succeed in research.

It's tempting to think of that 'Eureka' moment as serendipity, but the reality is, building new knowledge takes steady, dedicated work, over many, many years. It's the hard-won revelations of fundamental research that underpin and fuel the transformational change, the automation, and the innovation that make this world a better place. Basic and applied research are what create the highly novel and new-to-market innovations.

Just two weeks ago the chair of Innovation and Science Australia, Bill Ferris stood in this very place and remarked that an 'overnight success' in innovation is usually 10 years in the making. I disagree. That success may be built on a foundation of 20, or 50, or more, years of basic and applied research. That overnight success is, in fact, many decades in the making.

We seek the support of government, industry and community because it is your support that will elevate Australian scientific and technological research and development and help overcome the many barriers to its work today - short-term resourcing, challenges for STEMM education, declining science investment and job insecurity. Of these, short-termism is the overwhelming obstacle.

Although Australians love science, especially on Valentines day, Australia has no clear whole-of-government plan for future solution-making. We have a big-picture Science Statement, which is admirable, and roadmaps and reviews that have provided insights and ways forward. But we don't have a coordinated, cross-portfolio investment plan - a plan to invest in the ultimate renewable resource.

The 2030 Plan did provide a set of priority areas for improvement. And importantly, it made some sound recommendations to stimulate private sector investment in research and development – including the much anticipated and much-needed reform of the research and development

tax incentive. But - we don't have a plan for building our basic research capabilities.

Without a whole-of government approach to research and development, one portfolio can inadvertently skewer the long-term training and resource needs of the entire science and technology ecosystem.

Without a coordinated investment plan, we lack the confidence and the means to secure a stable and successful future for Australia through science and technology.

Without it, we have no understanding of how our sector can grow in the future, and without that certainty, we risk getting stuck in a quagmire – gazing at the stars – true – but earth-bound by feet of clay. Stuck, we become cautious, and caution is the enemy of innovation.

Look at our national critical research infrastructure, for example. The big machines, ships, computers and telescopes that make research possible – they're not fully utilised, and they're trapped in an annual cycle of justifying and re-justifying their existence. To ensure timely access to this big kit for our best researchers; to empower infrastructure managers to employ the best technicians, and keep them; and to ensure our critical research infrastructure stays up to date, we need a plan that spans at least 10 years, and guarantees funding for at least four.

Australia has occasionally made steps in the right direction – like the now completely derailed Education Investment Fund, and the still growing Medical Research Future Fund. But, we haven't comprehensively bitten the bullet. Today's big picture is one of falling and short-term investment in research that's linked too heavily to a myriad of competing causes.

Longer-term investment and certainty for infrastructure – and for research itself – would benefit us all. And we know this would be supported by the Australian community. The Galaxy poll commissioned by STA showed that 78% of Australians think investing a meagre 1.88% of GDP on research and development is just not enough.

I agree.

Imagine, instead, an Australia with the guts and the vision to create an inter-generational public growth fund to kick-start an enormous expansion in the most renewable resource of all: knowledge. By the time my nine- and 12-year-olds and their peers are running the country, that

investment would be paying for itself two, three, four times over, or more. That investment would have become a trust fund upon which the next generation, and the one after that, could draw. A bedrock. A solid foundation for a thriving, independent, future Australia.

As a nation we frequently talk about finite resources. Economists do, politicians do, and scientists do too.

But the creation of new knowledge and its application – otherwise known as science and technology – is an infinite resource.

When you think of it this way, how could we as a nation not invest deeply in fundamental research, and for the long term... as well as investing strategically in translating that research.

I'd love to claim credit for the idea of visionary, nation-building support for long-term investment in R&D, but other countries have been there before us. Israel saw the sense in this approach several decades ago. The results of that sustained investment in research are developments and innovations like the flash drive, cardiac stents and instant messaging. Today, Israel's high-tech industries represent half of its total industry exports. Its economy grew by 31% in the 10 years to 2015.

South Korea's government is also reaping the benefits today of recognising public investment in research and development as the key to climbing out of an economic crisis: Korea has vaulted from developing nation to G20 economy, and spawned massive multinationals like Samsung, LG and Hyundai.

China's government, too, has been pouring support into both research and development, and into STEM education, for two decades – the country now accounts for one-fifth of the world's R&D expenditure.

China's goal is to be the global science and technology leader by 2050. It's already shifted from capitalising on other nations' research, to being a nation that drives the global innovation agenda.

For example, China's biomedical research has climbed rapidly to number four in the world. China's digital payments market leaves the rest in the dust. It's leading the lithium battery race. In the last five years China's created 50 million new jobs through innovation and entrepreneurship. Its economy grew 64% in the 10 years to 2015.

In Australia, as citizens, we increasingly rely on, understand, and celebrate the benefits of extraordinary advances in science and

technology. This was only recently affirmed when we anointed the excellent Michelle Simmons – a quantum physicist – our 2018 Australian of the year. We celebrated biophysicist Graham Farquhar as senior Australian of the Year, and inspired maths teacher Eddie Woo as the Local Hero.

Yet Michelle and Graham work in a sector that continues to be beset by unnecessary and damaging uncertainty and Eddie and his fellow teachers struggle to attract engaged students in the senior years of secondary school.

Not only do we dampen our solution-makers' capacity to fulfil their potential – we also risk losing the solution-makers of tomorrow: our students.

Changes in higher education portfolio made late last year – appear to have been introduced without consideration for the long-term needs of the Australian STEMM sector, and may inadvertently frustrate our ability to train the next generation.

The staff-to-student ratios, the specialist facilities and equipment needed for STEMM education are expensive. It costs universities a lot more to grow their science student numbers than to grow enrolments in other disciplines. By moving away from demand-driven funding, the Government is, in fact, dis-incentivising universities to support places for future scientists. And, if student numbers are to now remain static, the perverse incentive is to reduce STEMM student numbers and proportionally increase cheaper, non-STEMM enrolments. This is what I mean by being skewered inadvertently – because there is no whole-of-government commitment to investing in science and technology.

How do we build a future knowledge economy if we're not training the workforce to drive it?

Look at our education pipeline. Australian school students' achievements in STEM subjects have changed little since 1995.

At the university level, if we remove health-related fields, enrolments in science and technology degrees have fallen sharply. Relative to other subjects, 2015 marked the lowest proportion of science and technology students in a decade.

We need to show Australian students how science and technology open the door to a thrilling career and an inspiring future. We need to get them to choose science, choose maths, choose STEMM.

We also need to recognise that science and technology education is a global endeavour – our neighbours are not standing still. They're not going backwards.

The recent US National Science Foundation's annual opus on the global state of science and engineering revealed that India and China now award more than half of the world's undergraduate degrees in science and engineering. The number of bachelor degrees in science and engineering awarded in China alone has grown from 281,000 in the year 2000 to more than 1.7 million per year today.

In Australia, as the demand-driven system ends and the costs of higher education increase, we need to make STEMM degrees, and the deep commitment they take, worthwhile. We shouldn't be punishing STEMM graduates with large HECS debts, and we should be incentivising the higher education sector to provide more training in STEM. We know that the country is heading for a STEMM skills shortage in the coming decades.

Just as under-investing in STEMM education is counter-intuitive, so too is under-investing in R&D. In Australia, however, we are spending a smaller percentage of our GDP on research and development every year; today we are further below the OECD average than at any other time over the past fifteen years.

Our current budget commitments for research may look like increases – in terms of raw numbers -- but they are, in fact, below the inflation rate. Australian Government support for research and development is declining in real terms. In a fiercely competitive world, Australia risks being sidelined.

The most recent international comparisons – for the financial year 2015/16 – paint a sad picture. Australia invested just 1.8% of its national income in research and development, compared to 2.25% just seven years ago.

Yet, the numbers are in – and the astounding return on public investments in science are well documented.

European governments get a return of two and a half times the amount they put in to science and innovation. For every pound the UK spends, it reaps 20 to 50 pence. Every year. In perpetuity.

In Australia, public investments through the National Health and Medical Research Council achieve returns of \$3.20 for every dollar.

If I were able to achieve those kinds of returns as a private investor – between 250% and 320%, AND guarantee that I'd be improving my children's future – I wouldn't hesitate.

And, the payoff is not just dollars. It's in jobs, a healthier population and cheaper healthcare, it's in a thriving environment, cleaner, more reliable energy and transportation, and so much more.

Around one dollar in every seven of Australian economic activity is estimated to rely directly on advanced sciences -- as are the jobs of just over 1.2 million Australians, and more than one-quarter of Australia's exports of goods and services by value.

Consider, then, the magnitude of drop in Australian spending to just 1.8% of GDP. In today's economy this translates to almost \$7 billion less for research and development every year. Imagine what we could do in cancer research, or in cyber security, for \$7 billion?

My fields of research are marine ecology and ecotoxicology, which means I work to understand the impacts we humans have on our coasts and oceans – and to find solutions for reducing those impacts.

For \$7 billion every year, Australia's ecologists and ecotoxicologists could make revolutionary strides to clean up micro-plastics and toxins in seas around the world, identify refuge reefs and create much-needed biobanks.

Our chemists, material scientists and engineers could invent even more resilient and efficient solar panels, our mathematicians could create the world's most stable and efficient energy grid algorithms. Our batteries could be super-charged. We could be on track to prevent catastrophic climate change. And that's just the start!

Despite the incredible possibilities, Australia's investment in science and technology has actually dwindled as our economy has grown, leaving us under-prepared for the future.

I am dismayed to see increasing disorganisation, growing apathy, and science and technology research and development sinking in the list of national priorities. As public investment in science shrinks, I am disheartened to see that we, as Australians, are at risk of losing our edge, and, as global citizens of humanity, of losing our options for a brighter, better future.

This, at such a critical juncture in the history of humanity. As our planet grows ever less hospitable and our ecological niche shrinks before our eyes. As cybersecurity and data privacy threats emerge, and the possible solutions using AI beg for discovery.

As consumers of the services provided by health systems, governments encourage each of us to take out adequate insurance.

Other nations are investing ... they're taking out intellectual insurance, if you will. We are not. Today, Australia is, in fact, choosing to reduce its insurance.

Against this backdrop it is unsurprising that many more scientists feel unstable in their profession than most other working Australians, due to short-term contracts, annual grant funding cycles, gender inequality and the lack of flexible working conditions.

Please indulge me as I share a story about a researcher named Louise.

Louise is a marine scientist who studies the populations of species that are fished commercially, and measures the impact of changing ocean currents on their breeding and life cycle.

There are two possible realities for Louise.... And we have the power to choose either one.

In the first reality, Louise is able to design experiments and take them to the water. She has unobstructed access to a national research vessel, that is operational all year round. She knows her work will be supported, and that she can work full-time on her research. She can pour time into turning her research into useful statistics and advice for the fishing industry, working on how to maximise sustainable yields in a changing environment.

In the second reality, the same research vessel is only operational for half the year. Louise must go through an arduous application process to use it, which is a major distraction from her work – as is her limited

funding, which ends in June. She must seek other sources of support to continue her work, but success rates for all the major fellowships are less than 20%. She spends almost a third of her time on administration, squeezing the time she has to preserve our marine ecosystems – and the industry that depends on them.

I probably don't need to point out that the second scenario is the reality for so many people in science, technology, engineering and mathematics today. People trying to do important work to change lives and the environment for the better.

At Science and Technology Australia, we worked with Professional Scientists Australia to survey scientists and technologists, and found that more than one-third want to leave their job in the next year – many of them because of job insecurity and uncertainty. These women and men love science. They love technology. And not just on Valentine's Day. I know. I am one of them.

We are the people who have been passionate since childhood in the quest to know why, and to know how. I could have chosen a career that was guaranteed to pay three or more times the average wage of a scientist. I could have chosen not to spend eight years of deep study as a poor student. But I chose STEMM because like most scientists – I was motivated by the questions and the desire to help the world.

Scientists and technologists are the modern day explorers, working at the very edges of the unknown. We yearn to be solution makers. We are committed – but we tire of not knowing if we will have the support we need to see our life's work make a difference.

I said it earlier, and I'll say it again, because it's crucially important that you hear this message: short-termism is the greatest threat to Australia's aspirations and identity as a STEMM nation.

Regrettably, our current political system seems to reflect more short-termism than I can ever recall. We're now dealing with our fifth minister for science in four years, as well as a period with no science minister at all.

We've had interested and enthusiastic individuals: Arthur Sinodinos and Greg Hunt were excellent Ministers for Science. Michaelia Cash made strong and positive statements in the Great Hall last night - which I respectfully acknowledge.

Australia needs a powerful and secure Minister for Science to rise above the short-termism and instability.

Making a long-term commitment, and investing properly in science and technology, is a guaranteed way to supercharge the Australian economy and make us a critical contributor to the global economy and society.

Stability, world-class research infrastructure, and a system that enhances and encourages effective collaboration would be better for all Australians. Supporting the right environment for discovery to flourish will improve every Australian's life.

Investing long-term in research is the only sensible thing to do.

Throughout history, nations have risen not by doing things the way they've always been done, but by looking for new ideas and inventing better technologies.

Investing economically and culturally in a strong Australian STEMM sector is also an investment in our independence as a nation.

We must be proud and strong in forging our own path forward.

Increasingly, China is setting the global agenda. It is pouring money into research on advanced materials, organic chemistry, quantum computing, renewable energy and nanotechnology – areas where their researchers have great strengths. It shows us what's possible with strong investments in science and technology. The Chinese Government has set a target to become the world's leader in artificial intelligence by 2030 with China hoping its investment in this critical area of future competitiveness will add \$7 trillion to its GDP. Korea is focusing on life sciences and IT, Singapore on advanced manufacturing and biomedical science, and Japan is focusing on clean energy and healthy aging. Each of these nations is developing critical strengths in the solutions sector.

Australia will never lead the world with absolute numbers. For example - China has over 2,000 universities and colleges – Australia has 42. But we can lead the world in other ways – if we focus on quality, identify our strengths and invest in them.

Today we are studying and prototyping the technologies of tomorrow.

We'll create cropping techniques that are pesticide free, and breed low-emission livestock.

We'll breathe new life into our dying marine and terrestrial ecosystems.

We'll know more about the universe than ever before.

We'll accelerate our computing power to giddy heights.

We'll help our people to be stronger and live longer.

Across the disciplines, our solution-makers are all imagining better worlds.

And this brings me back to hope – and to my firm belief in Australia's core identity as innovators, and our potential as solution-makers for the future.

Australians want to explore, to discover, to understand and to improve. We like challenges. We want to think for ourselves, to write our own stories, and to take on humankind's biggest problems.

We want what science provides.

Science & Technology Australia will continue to support our potential to thrive.

We will continue to connect scientists and decision makers, like we are doing today, with 240 scientists and technologists in Canberra for Science meets Parliament – sharing with political leaders the amazing work that they do.

We will work with government to emphasise the exciting possibilities ahead and to map out a bold, whole-of-government, long-term plan for investing in our bright future.

From our community, from our government, and from industry, we need support. Long term investment to build an Australian science and technology culture that everybody feels a part of.

A community of Australians who are striving and thriving together. Using science and technology – the method, the rigor, the drive, the imagination – to make our world a better place for all who live within it. Our ambition should be open to all.

Australia is ready for a science and technology culture. Let's make that culture a reality.

One final time, I will make this commitment on behalf of the tens of thousands of scientists and technologists that we at Science & Technology Australia represent.

If you wake in the dark in fright – as we do – remember that we accept the role of connector, ambassador, knowledge creator and economic driver.

We embrace the role of solution maker. We will switch on the light.

We will find the solutions; all we need is your support.

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