Australian Academy of Science

transcript

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D/evolving Australia

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Thank you Laurie.
Distinguished guests, friends, colleagues, ladies and gentlemen.

Better health and wealth have come from science

This privileged nation enjoys a rich science and innovation heritage, a heritage that has improved our lives and driven new industries.

Through science we can find the solutions to the most pressing problems that we face. Through science we can go to the unplumbed depths of our oceans and out through our solar system and beyond. Through science we can make discoveries that change the course of humanity.

Science and technology are not just the preserve of researchers – they are an important part of all our lives, every day.

As our Nobel laureate Peter Doherty recently wrote (and I paraphrase): '*science is everywhere… science isn't a niche topic. The kid on the computer is involving himself in science every time the laptop goes on. So is his mum, using an e-tag to travel home from work on the tollway.*[1]'

Probably every single thing you've done today has depended on science: the alarm clock or smartphone that woke you; the appliances you used to make your breakfast; the shape of your toothbrush and the constitution of your toothpaste; the conditioned air you're breathing; your ability to watch this speech in your home or office anywhere on the planet.

Science is such an integral part of our daily lives that we hardly give it a second thought – and it is in grave danger of being taken for granted.

We are rightly proud that Australians produce world-changing science. The *Excellence in Research for Australia* report[2] recently provided a view into its amazing breadth, quality and imagination.

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[1] Doherty, P 2013. Science is everywhere: spread the word, The Australian, 15 April. Accessed: http://www.theaustralian.com.au/national-affairs/opinion/science-is-everywhere-spread-the-word/story-e6frgd0x-1226620321101

[2] ARC (2012) *Excellence in Research for Australia 2012*. Available at http://www.arc.gov.au/era/era_2012/outcomes_2012.htm

Today, in Queensland, scientists are turning waste from the meat industry into electricity[3].

In New South Wales, they are using hydrogen atoms to hugely increase the efficiency of solar panels while greatly reducing their cost[4] - an advance not expected for at least another 10 years.

In Victoria, they are working on the bionic eye, to bring sight to thousands of people with severely impaired vision[5].

In Western Australia, they are developing grazing systems that will reduce methane emissions and deliver medication to farm animals[6].

In South Australia, scientists are using sensors that harness light at the nano-level to instantly analyse blood at crime scenes[7].

In Tasmania, they're working on a vaccine for the facial tumour disease that has driven Tasmanian Devils to the brink of extinction[8].

In the Northern Territory, they are using ants as indicators of ecological change, to better manage the environment and rehabilitate former mine sites[9].

And here in the ACT, they are using the common blowfly to develop a new antidote for chemical warfare agents[10].

Our scientists are indeed remarkable adventurers and pioneers!

They are also heavy-hitters by international standards.

If you measure performance by looking at the number of articles published in peer-reviewed journals – a kind of short-hand for 'how much of the world's new knowledge are we producing?' – then Australian scientists are doing very well indeed.

We Australians represent just one-third of one per cent of the world's population, but our scientists produce more than three per cent of the world's published scientific articles, conference papers and reviews[11].

In fact, last year we ranked 11th in the world[12], with more than 59,000 publications.

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[3] http://www.awmc.uq.edu.au/biosolids-demonstration-plant-opening-turning-meat-waste-into-electricity
[4] http://www.smh.com.au/technology/sci-tech/breakthrough-in-solar-efficiency-by-unsw-team-ahead-of-its-time-20130505-2j117.html
[5] http://www.bionicvision.org.au/eye
[6] http://www.ioa.uwa.edu.au/future-farm-2050/animals/future-flock#graz
[7] http://www.adelaide.edu.au/ipas/research/themes/bio/?template=1
[8] http://www.menzies.utas.edu.au/article.php?Doo=Redirect&id=1591
[9] http://www.csiro.au/Organisation-Structure/Divisions/Ecosystem-Sciences/Darwin-2012-Achievements-Report.aspx
[10] http://news.anu.edu.au/2013/06/04/blowfly-protein-key-to-terror-poison-antidote/ http://phys.org/news/2013-06-blowfly-protein-key-terror-poison.html
[11] DIISR (2011) *Australian Innovation System Report*
[12] DIISRT (2012) *National Research Investment Plan*

And research done by Australian scientists has given us significant economic, social and environmental benefits[13]. For instance, Australia's Cooperative Research Centres generate a net economic benefit of $278 million per year[14]; and in 2010, our health, medical and veterinary sector, which is now our largest complex manufacturing sector, produced $3.6 billion worth of exports.[15]

While some research programs, such as the solar cell work I mentioned, have immediate practical application, others take longer to reach the intended outcome. Cancer research is a good example. We now have 'intelligent drugs' for some cancers. These drugs specifically target the critical molecular cause, and they therefore kill the cancer cells without damaging normal cells. But it has taken over 30 years of fundamental research to get to this point.

Some basic or discovery research has no immediately apparent application. Is this wasted effort? I would strongly argue not - if it has been performed well, and has advanced knowledge. This 'blue sky' research is our future resilience capability. Our defence reserve, if you will.

Australia doesn't have a defence force because we *want* to wage war. We have a defence force *in case of* war – so that we are ready, and able to fight.

In the same way, discovery research builds resilience. It prepares us for the problems we don't yet have, or don't yet know we have. It builds our readiness for an unknown future.

When scientists in Antarctica began monitoring the stratosphere in 1955, this was blue-sky research in every sense. These scientists could not have known of the future global impact of their work. But in the late 1970s a hole began forming in the ozone layer above Antarctica – and the accumulated years of stratosphere data eventually led in 1987 to nations to signing up to the Montreal Protocol, and ceasing production and consumption of ozone-depleting compounds[16].

If it had not been for that original 'why is it so' research, we would not have known the problem even existed, let alone what was causing it or how to begin to address it.

Where does Australia's future lie?

Australia performs well in science. But we find ourselves at a crossroads. Will we be able to maintain this impressive trajectory? Will we be able to harness our scientific skills and talent to build future prosperity for Australia?

Nine months ago I experienced the joy of becoming a grandmother for the first time. Since then, I find myself reflecting more and more about what the future holds for my grand-daughter, Lyra.

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[13] Group of Eight / ATN (2012) *Excellence in Innovation*. Avialable at: http://www.go8.edu.au/__documents/go8-policy-analysis/2012/atn-go8-report-web-pdf.pdf

[14] Allen Consulting Group (2012) *Impact study of the CRC Program*. Available at: https://www.crc.gov.au/HTMLDocuments/Documents/PDF/CRC%20Program%20impact%20study_FINAL.pdf

[15] http://www.dfat.gov.au/publications/trade/trade-at-a-glance-2011.html

[16] http://www.antarctica.ac.uk//about_antarctica/geography/ozone.php

The decades in which my own children grew up were blessed with peace and prosperity. But I cannot be sure that will continue for the children growing up now, or for their children.

Because our nation is facing alarming social, economic and environmental challenges[17] :

Our marine, terrestrial and atmospheric environments are changing and degrading and we are losing biodiversity at an alarming rate;

Our food and water security is not assured, and neither is our biosecurity and cybersecurity;

Our growing girths are provoking a raft of obesity-associated chronic health problems;

Our population is increasingly afflicted by dementia as average longevity increases;

Our workforce faces growing skills shortages;

Our traditional manufacturing sectors are crumbling and we have not adequately replaced them with innovative new industries;

Our production of clean energy that is sustainable, affordable and accessible to all is lagging.

Where do we want to be in 20, 40, or 50 years?

Do we want to be struggling to maintain food security? Do we want an increasingly burdened health system trying to cope with the demands of a population stuck in a spiral of physical decline? Do we want to fall victim to the new pandemics arising from a highly connected world?

Or do we want to be a robust and resilient nation that enjoys good health, a strong economy, abundant fresh food, and has the strength to withstand the occasional shock brought on by disease or disaster?

Science provides solutions and drives economies

The challenges we face comprise a daunting list for the nation.

It is also a daunting list for science.

But science provides our best hope for preventing or overcoming these problems.

Governments around the world have recognised that science delivers solutions. They have also recognised that many of the challenges facing individual nations are in fact global. Tellingly, the G8 science ministers recently issued a statement that 'coordination of global scientific research is needed to address global challenges and maximise the social and economic benefits of research'. [18]

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[17] DIISTRE (2012) *National Research Investment Plan*

[18] G8 UK (2013) G8 Science Ministers Statement London UK, 12 June 2013. Available at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/206801/G8_Science_Meeting_Statement_12_June_2013.pdf

In the UK, an enormous 63 per cent of productivity growth over the past decade has come either directly or indirectly from innovation[19].

The US has estimated that scientific innovation has produced about 50 per cent of all their economic growth in the last 50 years[20].

To give an example: since 1990, investment in genome science has had a $965 billion impact on the US economy, leveraging a $65 return for every $1 invested.[21] And this is just the tip of the iceberg, as the field continues to transform research, pharmaceuticals, diagnostics, energy, agriculture and other applications.

Earlier this year, President Obama noted:

> *What we produce here ends up having benefits worldwide. We should be reaching for a level of private and public research and development investment that we haven't seen since the height of the Space Race [22].*

Accordingly, Obama plans to double the US science and innovation budget over the next five years[23].

In the United Kingdom, we heard last week that the government has protected research and development and increased spending on research infrastructure[24] – science is one of only three areas where spending has been protected amid the massive 11.5 billion pound cuts demanded to balance the UK budget[25].

These are important messages for Australia. What are we doing here?

The 2009 *Powering Ideas* report recognised that high quality research and development drives innovation and is essential to increase resilience, productivity and competitiveness[26]. And the *Strategic Research Priorities* released just a couple of weeks ago provides a roadmap for prioritising our research investment to meet the challenges that lie before us[27].

But are we investing enough to safeguard our future? Frankly, no. Despite the positive rhetoric, Australia is not investing nearly enough in research and development.

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[19] NESTA (2012) Plan 1: The Case for Innovation-Led Growth. Available at: http://www.nesta.org.uk/areas_of_work/economic_growth/plan_i/assets/documents/plani

[20] Department of Labor (2007) The STEM Workforce Challenge: the Role of the Public Workforce System in a National Solution for a Competitive Science, Technology, Engineering, and Mathematics (STEM) Workforce. Available at www.doleta.gov/youth_services/pdf/STEM_Report_4%2007.pdf

[21] Genomeweb June282013 Genome Project, Related Federal Investments Reap 'Massive Bang' for Buck: Report

[22] http://notes.nap.edu/2013/04/30/president-barack-obamas-speech-to-the-national-academy-of-sciences-full-transcript/#.Ucj3TTtr_eA

[23] http://www.innovationtaskforce.org/docs/FY11%20Budget%20for%20R&D-STEM.pdf

[24] http://www.bbc.co.uk/news/science-environment-23065763

[25] http://www.guardian.co.uk/science/2012/nov/08/science-spending-falls-government-pledge

[26] DIISRTE (2009) Powering Ideas: An Innovation Agenda for the 21st Century. Available at http://www.innovation.gov.au/innovation/policy/pages/PoweringIdeas.aspx

[27] http://www.innovation.gov.au/Research/Pages/StrategicResearchPriorities.aspx

Today, Australia spends a total of about 2.2 per cent of its GDP[28] on R&D - about $900 per person, per year. By comparison, both the US and Sweden spend about $1,300 per person, per year.

We are only 13th among OECD member countries, still significantly below the OECD average[29] and behind Israel, Finland, Korea, Sweden and Japan.

In the decade from 2003 to 2013, under the leadership of both Labor and Coalition governments, our total federal expenditure on science, research and innovation increased by about 58 per cent[30]. That's a great achievement. But recently we've gone backwards, with a $335 million fall in Commonwealth science investment last year and a further $291 million in cuts this year[31]. This is not only a disappointing reversal in trend - it is dangerous.

If we wish to remain innovative and competitive, we need to bring this nation up to speed. We need to *increase* our investment in R&D.

Towards increased productivity

Our resource-strong economy weathered the GFC better than most others, BUT the slowdown in Australia's productivity growth in the past decade has been greater than the average slowdown in OECD nations.[32]

The days of ready extraction of mineral resources to drive our economic growth are predicted to decline, and our traditional manufacturing industries are contracting fast. Therefore growth will need to come from other areas of the economy.

As the Productivity Commission has stated:

> "…*further productivity improvement is now in the more difficult terrain of improving human capital and innovation*.[33]"

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[28] OECD (2012) *Main Science and Technology Indicators* (eISSN: 2074-4226), available at http://stats.oecd.org/Index.aspx?DataSetCode=MSTI_PUB

[29] OECD (2012) *Main Science and Technology Indicators*. Volume 2012/1, available at http://www.oecd.org/sti/scienceandtechnologypolicy/keyFigures_20112_1_EN.pdf

[30] Figures are calculations based on the Science budget table figures: DIISTRE (2012) *The Australian Government's 2012-13 Science, Research and Innovation Budget Tables*. Available at http://www.innovation.gov.au/AboutUs/Budget/Documents/PortfolioBudgetStatementsDIICCSRTE2013-14.pdf

[31] Senate Economics Legislation Committee (2013) *Estimates*. Available at: http://parlinfo.aph.gov.au/parlInfo/search/display/display.w3p;db=COMMITTEES;id=committees%2Festimate%2Fa049f008-88db-4153-b099-842edc075d40%2F0008;query=Id%3A%22committees%2Festimate%2Fa049f008-88db-4153-b099-842edc075d40%2F0000%22

[32] D'Arcy, P. & Gustafsson, L. (2012) Australia's Productivity Performance and Real Incomes. *Bulletin (Reserve Bank of Australia)*, June quarter:23-(see pg. 29)36

In May, Dr Craig Emerson, then Minister for Tertiary Education, Skills, Science and Research, remarked when speaking to the Federal Budget that:

> *"Australia's future prosperity will depend increasingly on the high skills and innovation needed to compete against the world's brightest."*

The *White Paper* on *Australia in the Asian Century* identifies Asia as a growing global centre of innovation, with strong investments in skills, infrastructure and science.

This suggests competition from the region is likely to intensify. At the same time, it presents an enormous opportunity, including opening up new markets for innovative products and services.

Australia cannot afford to assume it has an advantage over Asian economies in higher value-added activities. The White Paper states:

> "*First, irrespective of how the Asian century evolves, Australia's prosperity will come from building on our strengths…Critical to this will be ongoing reform and investment across the five pillars of productivity – skills and education, innovation, infrastructure, tax reform and regulatory reform*[34]".

The Government understands this and in some areas is making efforts that will improve productivity. The school education reforms recommended in the Gonski Report and the rollout of the National Broadband Network are two – we hope also that the recommendations of the McKeon review of medical research are implemented.

Maximising Science Investment

For a stable, resilient and healthy Australian future, the creation and use of new knowledge is not merely one of a *range* of choices, it is *the essential foundation*.

Yet our politicians do not extend the kind of consistent and reliable strategic support to research that's required for success and cost-effectiveness.

Imagine you decide to build a house – you go to the bank and borrow enough money to buy 1000 bricks, and you lay them. And then you have to go back to the bank to ask for another loan, to buy another 1000 bricks. Having laid them, you then once more have to stop building and spend time convincing the bank to lend you enough for the next 1000 bricks and they only lend you enough for 600. When you know you are working with so much uncertainty, how far do you dare plan?

Of course you'd never try building a house this way because the house would either never get built, or turn out to be a rambling and shambolic patchwork. And so, when we build a house, we make a decision to build the whole house, we get a loan to purchase all of the materials and labour, and we build it steadily from start to finish.

It seems so obvious. And yet the brick-by-brick approach is what we do with research in this country.

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[33] Productivity Commission (2009), Australia's Productivity Performance: Submission to the House of Representatives Standing Committee on Economics, p.37

[34] Commonwealth of Australia (2012), Australia in the Asian Century: White Paper, p.134

Every year researchers and their employers have to go cap in hand to convince the government of the day to maintain funding for the Australian Research Council, the National Health and Medical Research Council, and the other agencies.

We do this with research infrastructure, too. We have this incredible $200 million machine in Melbourne – the synchrotron. It accelerates electrons almost to the speed of light, and can be used in many different forms of research, from microbiology to agriculture, from nanomaterials to forensics.

The Australian Synchrotron is one of the world's best. Scientists from many nations come to use it. The decision to build this facility was visionary, and it is in high demand.

But since it opened in 2007, there has been a constant scramble to claw enough funds for its operation. And only the original nine beam lines have been built, despite a total potential capacity of 38 beam lines.

I'd like to quote a second Australian Nobel laureate, Professor Brian Schmidt, who puts the situation thus: "it's as if Australia bought a $200 million car and drives it only around the block, because it's too expensive to put it on the road[35]."

I am very troubled by the long-term consequences of recent cuts to research funding and the looming potential that other critical programs may not be renewed or replaced.

In its recent Budget, the Government announced a $253 million investment in key research facilities – at the Australian Nuclear Science and Technology Organisation, the Australian Institute of Marine Science and CSIRO – as well as the National Collaborative Research Infrastructure Scheme (or NCRIS). This was very welcome news.

But these are short-term measures – a handful of bricks. They do not provide confidence for the future – for the research community, or for the country.

Measured against the actual need for NCRIS, for example, what has been provided over the next two years is merely a stop-gap. To get the best value through the whole lifecycle of our major research facilities, we need an investment of $200 million per year for at least 10 years[36].

…

A unique event took place a couple of weeks ago in the Australian research community. More than 10 peak bodies across the sector, including the Australian Academy of Science, joined together for the first time in an alliance[37], to call on federal politicians of all persuasions to support a strategic approach to research investment that transcends the election cycle.

We gratefully acknowledge the Opposition's commitment to at least "protect the NHMRC's funding over the forward estimates"[38]. And we call on the Government to match this leadership. But we also call on both parties to do more, not only in health and medical

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[35] http://www.theaustralian.com.au/higher-education/opinion/research-will-dry-up-without-funding-stream/story-e6frgcko-1226665836544

[36] http://www.science.org.au/reports/documents/2013Pre-BudgetSubmissionToTreasury.pdf

[37] http://science.org.au/news/media/17june13.html

[38] http://tonyabbott.com.au/LatestNews/PressReleases/tabid/86/articleType/ArticleView/articleId/9241/The-Coalitions-Commitment-to-Support-Australias-Medical-Researchers.aspx

research but across the entire research spectrum. To plan for a *staged increase in research investment*.

Inaction will have drastic consequences.

Let me give you just one example. There are only a handful of places in the world in which high-level astronomy can be done: Australia is one of them. Brian Schmidt has warned that Australia's stop-and-start approach to research funding[39] will lead to the death of optical astronomy in Australia within two years unless federal politicians drastically change the way in which research is funded.

Brian Schmidt does not issue idle threats. And he's not an easy man to ignore.

If we're not careful, we're going to lose the Schmidts and the Dohertys, and the future Nobel laureates. Bright kids won't want to stick around if there's no certainty, no continuity; if they see the nation paying mere lip service to the work they are doing and want to do.

They'll go elsewhere - to nations where, despite far more difficult economic circumstances, leaders recognise that investment in science is fundamental to their ongoing prosperity and wellbeing.

Rather than lose our best and brightest to other nations, would it not make more sense to provide challenging and stable careers for them in Australia? To encourage them, support them and nurture their talent here? To provide them with state-of-the-art facilities and technologies, so that their discoveries take place here? So that the industries arising from these discoveries are developed here?

I know there are challenges ahead for the Australian economy. I don't pretend to have all the solutions, but I do know that spending on science is investing in our future – the future wellbeing of our children and grandchildren, the future resilience and future productivity of our nation.

Now is the time for action, and not just words. Remember – the Australian economy hasn't experienced a recession for 22 years. We <u>can</u> afford to plan, *and* to invest.

Critical skills for a changing world

In setting the national objective that: "*By 2025, Australia's GDP per person will be in the world's top 10, up from 13th in 2011*.[40]" the Australia in the Asian Century White Paper names skills and education as 'our greatest responsibility'.

The Australian Government has spoken strongly about supporting Australia's education system. Last year, former Prime Minister Gillard said,

> "*Our 2025 goal is that our school system is in the top five in the world, 10 of our universities are in the world's top 100*."[41]

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[39] Schmidt, 2013, '*Schmidt warns pollies of astronomical fallout'*, The Australian 19 June 2013
[40] Commonwealth of Australia (2012), Australia in the Asian Century: White Paper, p.134
[41] Australian Government (2012) *Asian Century White Paper*

This is an aspiration the Australian Academy of Science certainly supports, and I call on the opposition to also adopt this goal.

Yet I am deeply concerned.
I am concerned about the disconnect between the government's rhetoric and its recent actions.

In response to the Gonski review, the Government announced a significant and much-needed injection of $9.8 billion into school education over the next six years, provided the state governments also come on board.

The Academy applauds the intent to spend significantly more on school education – and I urge the state and federal governments to come to an agreement. But I am truly dismayed that it is to be directly funded through a mammoth $3.8 billion in cuts and deferrals to research and higher education over the next four years! We all know that a high-quality, world-class education does not end at the age of 18!
The aspiration to have 10 universities in the world's top 100 seems – at best – unlikely in light of these cuts.

Australia's inadequate past investment in education in science, technology, engineering and mathematics – so-called STEM education – is having adverse effects. It has left us with a workforce with a sagging skill base.

Employers are reporting significant difficulty recruiting people for occupations with STEM skills. Listen to Innes Willox, the Chief Executive of the Australian Industry Group (and I quote) "*Our relative decline of STEM skills is holding back our national economy and causing real frustration for employers*"[42].

STEM skills are crucial in our changing world - 75 per cent of the fastest growing occupations require STEM skills and knowledge,[43] and employment in STEM-related occupations is projected to grow at almost twice the pace of other occupations.[44]

We must prepare our children – the workforce of tomorrow – for this eventuality.

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[42] Australian Industry Group (2013) *Lifting our Science, Technology, Engineering and Maths (STEM) Skills*. Available at:
http://www.aigroup.com.au/portal/binary/com.epicentric.contentmanagement.servlet.ContentDeliveryServlet/LIVE_CONTENT/Publications/Reports/2013/Ai_Group_Skills_Survey_2012-STEM_FINAL_PRINTED.pdf

[43] Becker, K. and Park, K. (2011) Effects of integrative approaches among STEM subjects on students' learning, *Journal of*
STEM Education 12,July – September 2011. In Australian Industry Group (2013) *Lifting our Science, Technology, Engineering and Maths (STEM) Skills*. Available at:
http://www.aigroup.com.au/portal/binary/com.epicentric.contentmanagement.servlet.ContentDeliveryServlet/LIVE_CONTENT/Publications/Reports/2013/Ai_Group_Skills_Survey_2012-STEM_FINAL_PRINTED.pdf

[44] Elizabeth Craig et al (2011) No Shortage of Talent: How the global market is producing the STEM Skills needed for growth,
September 2011, Accenture Institute for High Performance. In Australian Industry Group (2013) *Lifting our Science, Technology, Engineering and Maths (STEM) Skills*. Available at:
http://www.aigroup.com.au/portal/binary/com.epicentric.contentmanagement.servlet.ContentDeliveryServlet/LIVE_CONTENT/Publications/Reports/2013/Ai_Group_Skills_Survey_2012-STEM_FINAL_PRINTED.pdf

The Australian Council of Learned Academies (of which my Academy is a member) recently published a review of STEM education in countries around the world.[45] It concluded:

> *Most nations are closely focused on advancing STEM, and some have evolved dynamic, potent and productive strategies. In world terms Australia is positioned not far below the top group, but lacks the national urgency found in the United States, East Asia and much of Western Europe, and runs the risk of being left behind."*

With support from current and previous governments, the science Academies are working hard to turn the tide by developing inquiry-based, hands-on school education programs.

The Academy of Technological Sciences and Engineering has developed STELR, a program for year 9 and 10 students on the themes of global warming and renewable energy.[46]

And our Academy has developed *Primary Connections*[47] for primary schools and *Science by Doing* for secondary schools[48]. *Primary Connections* is now being used in more than half of all Australian primary schools, and *Science by Doing* will soon launch its free, interactive online curriculum resources. Having had a go at them recently I can report that they're lots of fun. And the trials we have done in schools demonstrate that secondary students and teachers will love them.

It's not just the skill capability of the Australian workforce that sags when we fail to invest properly in quality science and maths education. The critical thinking skills of the whole population also suffer.

Without a scientifically literate society, how do we have the kinds of debates or public discussions that are becoming increasingly crucial to the big decisions we face? How can government create a sensible long-term health, climate, energy or water policy?

With more than 2 million downloads, the popularity of our Academy's Questions and Answers series – *the Science of Climate Change*[49] and *the Science of Immunisation*[50] – attest to a public thirst for more knowledge about science issues.

Recently our sports organisations provided a telling example of the consequences of a lack of science literacy in daily life.

The Australian Crime Commission found there was "widespread use" of substance abuse in sport. This was troubling on many fronts.

Allegedly, people who were not medical practitioners were injecting players with all sorts of things. Not only were many of the substances banned from use in sport but many were not approved for human consumption in any circumstances, and came from dubious sources.

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[45] *www.**acola**secretariat.org.au/**ACOLA**/index.php/projects/...s.../project-2*
[46] http://stelr.org.au/about-stelr/
[47] http://primaryconnections.org.au/
[48] http://www.science.org.au/sciencebydoing/
[49] http://science.org.au/policy/climatechange.html
[50] http://www.science.org.au/policy/immunisation.html

Think about what this means. If we set aside the illegality and cheating issue, it means our athletes are using substances of uncertain benefit, with unknown side effects.

A scientifically literate sportsperson or club would not agree to such quackery, let alone pay for it[51].

A vision for building resilience

In summary, I have said today that Australia must invest more in research and development: to protect our economic competitiveness, our social wellbeing, and our quality of life; to build our resilience and to protect our future productivity.

I have also said that we must invest in high quality STEM education that will produce and sustain internationally competitive scientists, mathematicians, technologists and engineers; a broadly skilled workforce and a scientifically literate community.

You may ask: Why should science and education enjoy greater guarantees than other sectors at times of fiscal challenge?

I would make three points in response:

- It is simply a fact that quality science and education takes years to plan and build.
- It is the Federal Government's responsibility to plan and invest for the longer term – and that means beyond a single election cycle.
- And: The cost of NOT making strategic investment is to commit us to devolution – to commit us to going backwards.

I am not the Minister for Science.

But what would I do if I were?

I would convince the Prime Minister that the Minister for Science should always be a senior Cabinet appointment – and I am pleased to note that Minister Carr is part of the Rudd Cabinet.

I would argue passionately in Parliament and in public that strategic support for research and education is central to any rational vision for Australia's future.

I would argue that Australia must increase its R&D investment to at least to the level of our OECD and Asian competitors.

I'd ensure that Australian research and development expenditure rises over the next five years, from the current level of 2.2 per cent of GDP, to three per cent – with incentives to attract about half of the increase from industry, state governments, philanthropy and international investors.

I'd establish a new program to enable strategic global engagement: at least $25 million a year to facilitate international science collaboration between researchers, innovators and industrial

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[51] See article on *The Conversation* website: http://theconversation.com/glossary-sports-science-drugs-13408

teams. The Opposition has said that there needs to be a recommitment to appropriate international science funding. I applaud this policy and call on the Government to match it.

Ninety-seven per cent of the world's new knowledge is generated overseas - we need to assist our scientists to gain timely access to international knowledge and infrastructure.

If I were science minister, I'd work with the education minister to ensure that Australia invests in quality science and maths education at all levels – from kindergarten right through to post-grad university level, in order to improve science literacy and build our future skilled workforce.

And I'd continue to educate our adult population, through initiatives like Inspiring Australia and by strengthening science in broadcasting and the media.

I am not the Minister for Science and I cannot make those decisions.

But as President of the Australian Academy of Science I can call on our political leaders to embed science in their election promises. *To make science fundamental to the national agenda.*

To the question of how we can afford to increase investment when the Budget is in deficit, I respond: How can we afford not to?

Tougher economic times demand well-informed choices and leadership. Leadership that provides a vision and a plan for the future.

As a scientist, I begin with observation. I suggest the next Government does the same.

Look at Ken Henry's report – *Australia's Future Tax System* – it's evidence for future revenue. Look at the Gonski Review and the McKeon Review – both are evidence for future investment.

And I propose a deal: If the next Australian government embraces reform to properly fund Australian science and education, now and into the future, the Australian Academy of Science will be loud and proud in backing those reforms.

Such reforms take time and strategic investment. Our neighbours in Asia fund R&D through successive 5- and 10-year plans. We need to do the same.

We need to plan to fund the National Research Investment Plan for the next 10 years, and undertake the change necessary to pay for it.

A 10 year time scale gives certainty: enabling our scientists to achieve their full potential, and infrastructure like the synchrotron to be used to its full capacity; ensuring that the nation's knowledge and innovation bank is stocked to the brim.

I challenge the government, the alternative government and cross bench parliamentarians to develop strategic decadal plans for science and education for Australia. I challenge them to articulate their science and education policies before we are called upon to vote.

That's the Australian Academy of Science's vision for an Australia that can evolve and advance – rather than slide backwards.

A strong, productive, resilient Australia.

Thank you.