REPORT ON PROCEEDINGS BEFORE

LEGISLATIVE ASSEMBLY COMMITTEE ON INVESTMENT, INDUSTRY AND REGIONAL DEVELOPMENT

TECHNOLOGY AND THE AGRICULTURE AND MINING SECTORS

At Jubilee Room, Parliament House, Sydney, on Wednesday 27 July 2022

The Committee met at 9:30.

PRESENT

Mrs Nichole Overall (Chair)

Mr Clayton Barr
Mr David Harris
Ms Felicity Wilson

PRESENT VIA VIDEOCONFERENCE

Mr Philip Donato
Ms Robyn Preston

* Please note:
[inaudible] is used when audio words cannot be deciphered.
[audio malfunction] is used when words are lost due to a technical malfunction.
[disorder] is used when members or witnesses speak over one another.

The CHAIR: Good morning everyone and thank you very much for joining us this morning for this very important public hearing. Before we commence, I would like to acknowledge the Gadigal people, who are the traditional custodians of the land on which we meet here at Parliament House. I also pay my respects to Elders of the Eora nation past, present and emerging, and extend that respect to other Aboriginal and Torres Strait Islander people who are present or who are viewing the proceedings via the internet. Today we are conducting a public hearing for the Committee on Investment, Industry and Regional Development's inquiry into technology and the agriculture and mining sectors. I thank the witnesses who are appearing before the Committee today and appreciate very much your time and expertise and being able to join us as part of these proceedings.

Professor ALAN BROADFOOT, Executive Director, Newcastle Institute for Energy and Resources, University of Newcastle, before the Committee via videoconference, sworn and examined

Ms IRMA DUPUIS, PhD Candidate, University of Newcastle, before the Committee via videoconference, affirmed and examined

The CHAIR: Would either of you like to make a short opening statement before we begin the questions?

ALAN BROADFOOT: Yes, I would just say a short one. I just wanted to thank the Committee on behalf of the university to allow us to attend and express our informed decisions to be able to assist in this inquiry. We're very much a university focused on the region. We have significant research activity happening both in mining and resources, and the agricultural sector. To that end, we do have a National Centre of Excellence in Eco-Beneficiation of Critical Minerals. It's the only one in the country, and we're also part of the new Federal Government trailblazer program for recycling clean energy, which has an impact on both sectors, and we're also a part of the national drought resilient hubs. Most of our activities are in western New South Wales with our mining research centres.

The CHAIR: Excellent. Thank you very much, Professor, for that brief statement. We will now move to questions from the members. I will begin. I am just mindful of the fact that we have many very interesting questions, I'm sure, from our members that are going to be forthcoming but we are also mindful of our time frame. We have a number of witnesses that we are going to be proceeding with today, so we will move things along as quickly as we can to make sure that we're covering as much territory as possible and looking to a conclusion for this round of questioning at 10.15 a.m. On that basis, I'll begin. Page 3 of UON's submission noted that the university has pathways for delivering tailored short courses to respond to regional industry demand for high-quality training and skills shortages. What does the university's pathways for delivering these short courses involve and are they available to the broader community outside the university's enrolled students?

ALAN BROADFOOT: There are four levels of deliverables. One is, which one of Irma's programs is part of, we have at the upper end a Doctoral Training Centre, where we're embedding the candidate's research with the Institute's partners. In many cases—and Irma can talk to this—we involve multiple partners in multiple regions for that enabling change. The next level down is we deliver short courses online, usually aimed at two levels. One, we can work with an industry partner, for example, whether it's the NSW Farmers or the Minerals Council, to deliver structured courses to the industries. We're delivering one this week face-to-face based on mineral processing. The second element is the publicly available courses. We usually deliver those through our network system, whether it be through the Business School or through our Integrated Innovation Network and we can deliver that on a subject-by-subject basis or a two-week program.

The CHAIR: How is the demand for these short courses? Have you seen the uptake increasing in recent times?

ALAN BROADFOOT: In the mining sector, yes, because it's an industry that's going through transformation, shifting from, say, a traditional large-market scale with coal to a lot more junior miners looking at critical minerals. In that is enough need for skills on how to process these, especially with the focus on supply chain disruption to look at solutions for production, firstly, processing at the mine site. This is going to be a big shift for our economy to be able to do the pre-processing here because that gives accessibility to more products to manufacture in the energy sector here in the country. That's a new generation of technologies that will have to be applied and a significant upskilling of skills within the workplace. The second one is that we are in a very severe skills shortage. Industry, both agriculture and mining, are not looking for four-year degrees or three-year degrees; they're looking for actual knowledge in a process. There's a lot more appetite for industry to pay for their staff to attend those courses, whether that be a forum with the wine industry or whether that be an accredited short course for two weeks associated with bulk material handling. It's a varied market.

The biggest restriction is, of course, COVID and the ability to have people move. It's a chaotic market at the moment, especially in the agricultural sector post-drought and floods. There is very little time to break away to actually take on these higher courses. The short answer is that it's varying and it's based on economic need that they have to adapt to in this skills shortage versus just simply the fact of the need to be able to produce goods. For example: I was contacted by the Narrabri Industrial Network last week asking us, "How can we engage more with your programs because we need to have an understanding to be able to attract and support and increase participation in the town to maintain our economic activity."

Mr PHILIP DONATO: Firstly, Professor Broadfoot and Ms Dupuis, thank you both for coming to today's hearing. It is very important when an opportunity is given to members of various stakeholder networks and people with specific expertise to come and give evidence in relation to these matters. My questions—and

I will keep them fairly brief because I know we are on a tight schedule and there are a number of members who will ask questions—are primarily addressed to you, Professor Broadfoot. In relation to some of the things you have raised in response to questions that were asked by the Chair—and I note the extract from your submission has been included in the documents that we have before us today—these short courses that you are talking about, can you tell us what period of time are we talking about for a short course? What is the definition of a short course? Is it a couple of weeks? Is it several months? What are we looking at for a short course?

ALAN BROADFOOT: They can vary from three days—normally it is about a week—up to three months. It is usually a portion of a subject from an undergraduate program.

Mr PHILIP DONATO: What sort of time frame would you be looking at if you were approached by various industries or stakeholders in various industries across the State? You mentioned earlier about being contacted by someone from up in the Narrabri region. What sort of time frame are you looking at in terms of from the time when someone approaches you to look at putting on or running or preparing a short course to actually delivering it? What time frame would that be looking like?

ALAN BROADFOOT: It depends if they want accreditation for the course that goes towards a degree. If it is a short course that already exists, we can deliver it within a couple of weeks, but if you wanted an accredited module, that's a process that would have to go through the appropriate quality assurance checks and measures of the university. It depends. If it's an existing subject, we could have something delivered within a month or two, depending on the availability of academics to deliver those programs. If it's going to introduce a new masters course for the industry, that would take about 12 months.

Mr PHILIP DONATO: I might be doubling up on the question the Chair asked, but how have you found the community sentiment or stakeholder engagement in relation to the take-up of these short courses, and what's the feedback been like from those industries?

ALAN BROADFOOT: Probably the trend at the moment is they want a concentrated course to get it out of the way in terms of a week-long type of course. The feedback is extremely good because they are paying for the course as well, but they are asking for repeat courses to extend it to other parts of their company. But there is no real focus on having a qualification from it; it is just the need for the knowledge that they are trying to achieve. There will be an overlap with VET programs as we emerge with better, new technologies to regions. As an example, you are seeing that both with renewables and hydrogen. Our university supported that by creating a new degree in renewable energy. You've got to get the course contents in place, but obviously not delivering a three year course in the first year. We've got to concentrate on the first year, develop the coursework and get it to the market. There is an extremely high take-up of that course, but that is overlapped with what qualifications are required in the VET sector.

Ms ROBYN PRESTON: Good morning, Professor Broadfoot and Ms Dupuis as well. My question is: Is there a lack of trust amongst some of the stakeholders? The Committee was picking up on that at the [inaudible] trust from some regional agricultural businesses towards researchers and suppliers. I'm just wondering how has the university been able to deal with that, if it has recognised that, and how could government address that as well?

ALAN BROADFOOT: The short answer to that is the model that we have established at the Newcastle Institute Energy and Resources was started between the Federal and State governments as part of that solution. The difference here is that we have created a precinct that is supporting 18 research centres that just work with industry, and 80 per cent of the workforce here, academic and technical are funded by those industry projects, so there is dedicated engagement. At present we have 230 active clients ranging from SMEs to larger scale internationals, and we are supporting 240 PhDs in those particular programs. The solution of it was to dedicate resources to engagement. Our university and our engagement with industry was about 5 per cent of our research income. I belong to a research division, and what has occurred because we put in a dedicated team to run this multi-discipline, multi-partner engagement, nearly 45 per cent of our research income now comes from industry.

Last year our income from industry increased by 47 per cent. I think the University of Newcastle has deliberately not taken on Blue Sky research. It has put a very big focus on regional engagement and engagement with industry. That then flows into knowledge transfer when you are deploying the technologies and applying it in regional Australia—what coursework will follow. You can't answer the question of coursework first; this is research-driven activity with those particular partners. In the end, the short answer is that we have demonstrated, by this critical cultural change, success of an active engagement through the funding we are now receiving directly from industry.

Mr DAVID HARRIS: My question is to Irma about the blockchain technology. Can you describe really briefly for us what other applications other than the wine industry this might be utilised in? Talk a little bit around

the complexities of regulation. Should government be getting involved in regulating blockchain or staying out and letting the industry self-regulate?

IRMA DUPUIS: Thank you for the question. Most of the applications of blockchain have been in the financial sector so far. That is the most visible part of this kind of technology. Because it is a way of storing data across multiple organisations as opposed to one organisation owning the data, it is very suitable for a large supply chain like agricultural supply chains. You could have interesting applications in traceability, or trying to have better food safety. Some trials have found that it really increases the speed of recovery of goods in a food issue event—so something like an incident in the production chain—to be able to do food recall, for example. It's a very good application. There is a lot of work that remains to be done with blockchain applications because there are a lot of different stakeholders including consumers and industry, and definitely regulation is something to be looked at. Depending on the application, it will probably have to be a case by case. I would recommend consulting with all the stakeholders in the industry and the technology to come to a consensus that benefits everyone. That would be what I would say about the regulation. There are some initiatives around the world that have been trialled as well that could be helpful to look at. Thank you.

Mr DAVID HARRIS: Thank you. Yes, it's a brave new world, very interesting, the application of those technologies. Thanks, Chair.

The CHAIR: It is indeed complex stuff. Mr Barr?

Mr CLAYTON BARR: Thank you very much, Professor Broadfoot and Ms Dupuis. Thank you for joining us from the world's best university and the home of great innovations globally.

The CHAIR: No bias.

Mr CLAYTON BARR: No bias whatsoever. I have a broad macro question. How you think the work that you're doing and the advances that you see coming down the pipeline are going to disrupt regional economies and regional communities in terms of employment and social impacts?

ALAN BROADFOOT: Well, it will be significant. I give you the example with Irma: Irma was the Marketing Manager at Tamburlaine Wines up in Cessnock.

Mr CLAYTON BARR: Sorry, Mr Broadfoot, just to correct you: that would be Tamburlaine Organic Wines in Cessnock, wouldn't it?

ALAN BROADFOOT: It is an example where you see new networks of collaboration. There is a lot of collaboration. For example, First Creek has now come in as a partner, and also a packaging company as well. This is regional collaboration facilitated by a university. I see that these networks will become more the norm in the actual regions. The other disruption example is if we're trying to work on new breakthroughs in rare earth recovery, what you'd see at a typical rare earth mine now would be that 90 per cent of the workforce is actually processing the mineral and only 10 per cent mining.

The other two impacts of the last two years is that everyone, in agriculture and with mining, is moving away from the drive-in drive-out employees. It is very much focused on sovereign manufacturing and building capacity in the regions, returning workforces to the regions, and how we can help facilitate that. They are talking to us about demonstration programs. An example: we just engaged with Tamworth Local Council on how we could deliver research programs and be supporters as part of their industrial investment in a new industrial park up there. They want it there. They want to see manufacturing in the regions. They want to see an increase in the resident skilled workforce to be able to deliver. The old traditional model was you had a mine or big agriculture industry and then you would form a town around it. This is where the aspirations sit.

What we're trying to do is help facilitate that shift in the workforce back into the regions. The difference of it is that we helped to form the Orana Opportunity Network. There is an opportunity in there for supporting a common skilled workforce between the four sectors of energy, resources, food and water. That's why we now have this focus in our research institute on those four sectors, because in a region they're a common community, they're common infrastructure, they're common skills. We have got to focus on building them up to support four sectors, not one sector. We don't go to regional New South Wales and say, "We are going to build up an energy sector." We need to build up a skilled workforce for these four major drivers. In our country, energy, food and water security are of high importance, as well as resource sustainability. I'm not saying we're starved of resources but we need to do it better. That's the program that we're looking at.

Mr CLAYTON BARR: In terms of the increased workforce in processing, do I take that to mean we're working harder to squeeze out every ounce of mineral that we can for every tonne of rock that we dig up? Is that what you mean—we're working really hard? We saw some of that in Newcrest, I guess, in terms of how they're doing more work to get more out of the rocks that they dig out, in terms of gold.

ALAN BROADFOOT: It is about efficiency, but it's more about an increase in looking at the mineralogy of what's being mined, or even the nutritional value of food. They are two big research areas. They can increase the value of what they are exporting or what they are going to sell in the domestic market. Traditionally we dig up lithium and we ship it offshore as a material, and then it gets processed in China and gets sent back to us. What we want to do is show that our lithium, if processed here, is a higher quality, and we can make more income as a nation by selling that processed material and embed ourselves further in the supply chain. But by doing that, we're making a raw material available to manufacturers. At the moment, if I was to build a lithium battery, I would have to buy all my lithium from a processor from China. While I'm doing that, I might as well get the packs made up over there and then ship it out as a combined product, and all I'm doing here is putting it in a box. We have got to break that cycle. I think the miners are quite aspirational about that.

Mr CLAYTON BARR: Thank you. That's a great clarification because I'd completely misunderstood what you were talking about. Part of your submission was that there is a real challenge around us being able to meet the total tonnage of these minerals we're going to need as we move towards renewables and things like that. There is a challenge in terms of the tonnage?

ALAN BROADFOOT: There certainly is, but the advantage we have is that we've literally just kicked the surface of the resource within the country. There's a major investment in New South Wales looking at exploration. We need to know what we've got there and quantify it. Because we're looking for a new ore body, it's not like we're digging a seam of coal, which is clearly easy to identify in quantity. We're extracting minerals with a lot more burden around it. We have got to work out how to be more efficient in that and that's about maximising it. But the counter to that is the focus now on secondary mining. Secondary mining is that example where we're hitting a major crisis for the recovery of copper at the moment worldwide. Copper hasn't disappeared; it's sitting in the local garbage dump. It's sitting in all the buildings around you. It's still there. It's about how we recover that and put that economically back into our processing plants as part of the feed stock from mining as well as recovering it from industrial processors.

Mr CLAYTON BARR: For example, Japan with the medals at the recent Olympics.

ALAN BROADFOOT: Yes.

Mr CLAYTON BARR: Mr Broadfoot, you mentioned drought resilience in your opening remarks. I know that you're doing some work with understanding soils. Is that where you see future technological advances in drought resilience, through better soil management? Or are there other things coming along the line that are going to help with drought resilience by way of technological advancement?

ALAN BROADFOOT: There are three things. We have a Collaborative Research Centre for High Performance Soils at the University of Newcastle. The biggest challenge for soil is loss of carbon from the soil and how we can improve that, and the link back to the actual activity where the agriculture or mining is associated. The second part of that is then how we better manage our soils and our crop productivity by not just simply fertilising everything and watering everything. We're doing work on satellite monitoring for in-ground sensors that we're only fertilising and watering on an as-needs basis, which is linking both productivity of crop as well as productivity of the soil.

The third one is improving our modelling. If you look at the submission, the resource roadmaps that we put in there, there's a big push on priority-setting. Our yield models in the last drought were not close. If we can forecast the yield—we talk about the yield and it's the harvesting of water from the run-off of land—we can better predict that and know in advance through climate modelling what crops to plant, when to plant and have greater control. The big thing about these two industries is they can't afford disruption because they're using single product supply. If they lose the crop, they've lost that income for the year. If they lose a conveyor belt on the mine, they've lost all production of that single ore. This is where we become risk averse. They need to be better informed.

Mr CLAYTON BARR: Not to put you on the spot too much, Professor Broadfoot, in terms of anticipating water and soil quality and our ability to predict rainfall and whatever else, are you saying there's a role, potentially, for a body—whether it's a government body or a farming body—to encourage or have incentives for certain farmers to grow certain products in certain areas because they're more suited? Are we going to tell farmers what to grow and where to grow it?

ALAN BROADFOOT: What's happened is farmers are asking us what they should grow. That's a decision based on environmental matters. That's more the enquiry. We don't need to tell them. It's a case of we would need to be able to be adaptive and be able to develop a number of tools that they can use to make those decisions. An example of that is we run a Pacific initiative and they're being very proactive in us. For example, in one of the major projects we're looking at the impact of east coast lows—it's our east coast low but it's coming in from their west—and how that will impact. We had to translate it to regional applications. So it's no use saying

it's going to come with the north-west. We had to say it was going to come across the island and hit the cross hill on a certain tide, and that's going to impact the crops this way, to be able to inform the local farmers.

Mr CLAYTON BARR: I'm sure the farmers would be pretty keen on that. Carbon capture and storage—myth or reality?

ALAN BROADFOOT: We've been involved with a number of programs. The cost is usually in the transport and the storage. The big challenge for New South Wales is that we don't have those artesian basins. That's where we've been developing research in two areas. The carbon capture is one aspect of it. I think that's economically viable, even direct air capture with catalytic discoveries and optimisations. So capturing the CO_2 is certainly technologically sound. The big push now is, for example, we have Mineral Carbonation International it's a spin-off company from the University of Newcastle—where we're converting the CO_2 into a carbonate to capture it as a building material. They're now setting up at Kooragang Island with a test plant using the Modern Manufacturing Initiative.

The other one we're very much focused on is CO_2 utilisation. The solution we're looking at is if we can get direct CO_2 capture and mix that with hydrogen splitting, we could make kerosene, which is sustainable aviation fuel. It's carbon negative because we're capturing the CO_2 from the atmosphere. But the challenge for energy for this country is how do we maintain aviation fuels when you have these major disruptions offshore? So my answer to your question is simple—that CO_2 capture is simple. I'm not convinced that putting it in the ground is the solution. Before we can see if it's even possible in New South Wales, there needs to be a big increased focus on CO_2 utilisation and alternative. That's the bottom line: utilisation. I think there's a massive swing by industry to see how we can use this resource.

Mr CLAYTON BARR: Thank you, once again, for delivering from the world's best university.

The CHAIR: I will ask a couple of other questions that I think may be top of mind for us as well, particularly about your resources roadmap, which noted that the university wants to seek government co-investment to expand the R&D infrastructure to address barriers to scale for industry. What are the barriers to scale that the industry has raised and what kind of co-investment are you looking at for the government to provide?

ALAN BROADFOOT: There's a big difference between software commercialisation and hardware. Engineered products still take about ten to twenty years to get to market. So if we're looking to solutions, there's a timespan that we have to overcome. The valley of death traditionally with startups is they've got a solution but where is the market? It's that time to get it into market. With engineered product, the valley of death is, I get to a certain point in my development, my technology, and then I've got to go and commit to a seven-year lease on a building and spend a significant amount of money on capital to set my production plan in place and hope it works with my new technology.

What we've found at the university is that at our Institute we have five workshops, and what we've done with our research is we have manufacturing facilities here to build large-scale demonstration equipment. We've even got demonstration equipment sitting in regional Australia. What we were looking at is probably the simple concept of building additional workshops so that they can come to our university and prototype their equipment. An example is a company from the Central Coast. They've developed their product in a small workshop. They've gone as far as they can and they need to do a demonstration scale to get to market before they invest. They're paying us to move that equipment into our workshop with our facilities for us to, one, verify the technology and, two, better understand their chemistry. We can provide that information and then we can address the issues of application.

It's market perception; the market won't go to a small workshop on the Central Coast but it will come to a major research institute and look at the technology that they're developing with their partner. So what I'm looking at is we've grown from four academics to now we have a group—I'm not supposed to call it a "workforce"—of 420 people, academics and PhD students. We're now at a point where we can bring industry research groups into that model and have these workshops where they can actually be given the funds to establish and have joint research projects. We ask them to provide research input as much as our academics. That's what we're looking at. If you read the resources roadmaps, the way to interpret them is if you read the sector snapshot, we actually went to industry saying, "What are the challenges that you have?" They've come back and said they've listened—that's what we've quantified.

Then the next one is the guiding principles, which is what they've asked of us. The third one is the developing activities and what we're going to commit to. One of them is expanding industry co-location and access to demonstration-scale facilities. I think that's the next level: blur the line. It can't be "you're an academic; you're industry". The reality of it is I'm a professor at the University of Newcastle but I spend most of my working life working in manufacturing and mining. It's only over the last 12 years I've been at this university. We've got to

break that myth and blur the line in the collaboration because the best way to transfer knowledge is through the people. For example, we stopped processing bauxite with Rio Tinto in the Northern Territory; we just used to ship it. They've just employed two of our PhDs who've just graduated to be senior process engineers in the Northern Territory to reopen that processing plant. They're applying our technology; they're employing our staff. At the moment we're graduating 60 PhDs a year and thirty of them are going to industry; that's the paradigm shift. How do we continue to facilitate that? The best way to facilitate it is to have industry embedded into our research programs well in advance before the technology has to be delivered into the market.

The CHAIR: Thank you very much, Professor. That's extremely informative. We have five minutes left and might be able to squeeze in one more question on that, which I am particularly interested in as well. Again, coming back to your resources roadmap, that targeted STEM programs should be established in schools alongside work-integrated learning opportunities. What would these targeted STEM programs look like and is it your view that the government should be incorporating these programs into curricula?

ALAN BROADFOOT: To give you an example, we have our HunterWISE program, which is the Women in Science and Engineering program. We deliver that to nine schools at present. That's where we have our senior female academics and PhD students actually go to year 10 students and they do a program with us where we give lectures to them and try to inspire them that there are career paths in engineering and science at school. They come down and they visit the campus. They also then, facilitated through our PhD and post-doctoral staff, go into doing projects. An example of that is that in Muswellbrook they were only doing the physics and chemistry through remote learning. After we've run those programs, the last time I looked there are 29 students doing those courses. If you're not doing physics, maths and chemistry, it's very hard to do the STEM subjects. We run those programs by going to local industries and saying, "Can you donate some money to us to support these initiatives because they're going to help your industry?" This is fair to say. I think there's a case study in the HunterWISE program of how it can show it can have a significant impact, and of those 29 students doing chemistry, close to 20 were girls for the first time looking at a chemistry course.

The CHAIR: That's fantastic and very encouraging to hear. On that, I think we are more or less on time. Thank you both very much, Professor Broadfoot and Ms Dupuis, for appearing before the Committee today. You'll both be provided with a copy of the transcript of today's proceedings for any corrections. We haven't had any questions taken on notice, but for anything further arising we may send you some additional questions in writing and your replies will form part of your evidence and be made public. Would you be happy to provide a written reply to any further questions if they are forthcoming?

ALAN BROADFOOT: Yes, no problem.

IRMA DUPUIS: Yes.

The CHAIR: Thank you for your time and your expertise and the work that you're doing and for joining us today.

(The witnesses withdrew.)

Professor MICHAEL FRIEND, Pro Vice-Chancellor, Research and Innovation, Charles Sturt University, before the Committee via videoconference, affirmed and examined

Mr JONATHON MEDWAY, Senior Research Fellow, Spatial Agriculture, Gulbali Institute, Charles Sturt University, affirmed and examined

Ms SAMANTHA BERESFORD, Acting Strategic Advisor, Government Relations and Regional Engagement, Charles Sturt University, affirmed and examined

The CHAIR: It is lovely to see you again, having recently had the opportunity to go and visit Charles Sturt University in the lovely city of Wagga Wagga. We thank you very much for your hospitality and welcome down there. Would any of you like to make a short opening statement before we begin the questions?

MICHAEL FRIEND: I am happy to make a very short opening statement. Charles Sturt University welcomes the opportunity to provide evidence to this inquiry into technology in the agriculture and mining sectors. We're really grateful to the Committee for making the time to visit our Wagga campus in particular to see some of the technology in action as it applies in particular to agriculture and also participate in the industry roundtable discussion where industry shared its views around opportunities and also some of the barriers to adoption of technology. Charles Sturt is Australia's largest regional university. It has a very long and proud history and track record of meeting the education, training and innovation needs of regional students, communities and their employers. Charles Sturt's history in agriculture education, research and innovation extends back almost 130 years and it is now the largest regional university training the future workforce for agriculture, environmental sciences and veterinary sciences.

In recent years, Charles Sturt has made a number of significant investments in new facilities to boost participation and grow our research. For example, these include a new IT and cybersecurity research institute in Bathurst and also, as you will have seen in Wagga, the Gulbali Institute for agriculture, environment and water research. A couple of recent initiatives that demonstrate our commitment is the commitment to the Southern NSW Drought Resilience Adoption and Innovation Hub, and that's what brings me to Broken Hill this morning, to participate in the board meeting for that and to talk to local industry representatives around their needs around innovation, in particular, but also drought resilience. The second initiative I would like to highlight is the new Biosecurity Training Centre, which is a partnership with the Department of Agriculture, Fisheries and Forestry, which accepted its first intake of students earlier this month.

Our experience and our community connections and our globally recognised research strengths mean that Charles Sturt is particularly well placed to comment on the growing importance of technology, in particular to the agricultural sector, and the opportunities and challenges that this presents for New South Wales and regional New South Wales in particular. During the visit you did see some of that in action in terms of the excellent research and teaching facilities, particularly at Wagga. As an example, as you will have seen the university's farm and its virtual twin, the Global Digital Farm, provides a test bed for new technologies—for example, Zetifi, which is a last-mile connectivity solution for farmers developed with the support of Charles Sturt University funding from the university's technology accelerator program in Wagga. Of course, that particular technology and a whole host of other technologies were showcased at the Global Agrifood Summit that was held in Wagga in early June, which had more than 400 participants in person and a further hundred online.

Finally, Charles Sturt has invested more than $10 million to date in the AgriPark initiative, which is really a regional innovation precinct, which hosts 18 industry and government partners and more than 120 staff representing a broad range of the innovation ecosystem. The university has well-developed plans to take that AgriPark to the next step to accommodate 30 organisations and over 200 staff by 2025. A key part of that is the building of a new state-of-the-art research and development facility, which will enable all of our partners to be at the same location or the same building, to really foster that collaboration and entrepreneurial approach to innovation. It also provides better access to our laboratories and other research facilities. In closing, I would like to acknowledge that our agricultural industries are already very innovative. For example, the latest Australian Bureau of Statistics data shows that 26 per cent of agriculture, forestry and fishing firms use research and development and entrepreneurial skills in innovation, which is much higher than any other sector. In closing, I think it is worth noting that our agricultural sector is well primed for the adoption of innovation to drive profitability and sustainability.

The CHAIR: Thank you very much, Professor. Yes, it was indeed a very interesting visit for Committee members to be able to conduct and see the tremendous work that is going on at the university, both historically speaking and the vision that you have for the future as well. It was very enlightening indeed. I do note that the short statement you have provided has been provided in writing, so we will table that for availability. We have quite a tight time frame today, so I will point out that our conclusion with you three here with us today will be

11 o'clock. We do have quite a bit to get through. There are a lot of questions and there is a lot of interest from our Committee members. We will move things along quite quickly so that we can get through as much as we can.

I will begin. Your submission at page 5 refers to CSU's submission to the *National Agricultural Workforce Strategy Discussion Paper*, which highlighted the ongoing shortage of agricultural university graduates, highlighting that 4,000 students enrol in the undergraduate agricultural programs, but only 850 are graduating a year despite over 3,000 graduate jobs advertised. Can you give us an idea of what might explain the discrepancy between enrolment and graduate numbers?

MICHAEL FRIEND: I am happy to start and the others can add to that. My view is that for a number of years agriculture was unfortunately seen as a bit of a sunset industry. That is now changing, so we are seeing much greater interest in agriculture, but still there is a disconnect between the supply of students ending up as graduates and the demand. Actually a key part of the reason behind our Global Digital Farm initiative is to make agricultural students in particular more attracted to studying agriculture because the range of job opportunities in relation to agriculture is going to expand dramatically, I think. As we see more application and adoption of digital technologies within the agricultural sector, it will open up a lot more opportunities for students of differing backgrounds. We are talking about IT and other STEM-related disciplines, so students studying those disciplines can see that the agricultural sector is a really great opportunity to apply their skills.

The CHAIR: Excellent. Do you have anything further to add on that, Mr Medway or Ms Beresford?

JONATHON MEDWAY: No, I think Michael has said it.

SAMANTHA BERESFORD: The only thing I would add is the number of industry partnerships that we have developed at Charles Sturt to really help drive those student numbers and bring people into the university is a real key focus for us. For instance, we have a great partnership with Hutcheon and Pearce, which is the largest John Deere dealership in Australia. They are bringing all the new innovation and tech out of the US. We want to be able to showcase to our students that on-ground, practical application of agriculture that actually drives them and makes them understand that they know that they have a job at the end of it.

Ms ROBYN PRESTON: Welcome to our witnesses. My question is about regulatory reform. Do you think it is needed to address some of the concerns around data ownership, data transfer, right to repair, and reactivity of regulatory responses—like drones, for example? I am happy for any of the witnesses to respond to that question.

MICHAEL FRIEND: The answer is yes. I might throw to John, though, because I know he has thought about this in much greater detail—if you are happy to respond to that, John?

JONATHON MEDWAY: Yes. Certainly the NFF is leading a lot of work around the data ownership and contractual arrangements and those sorts of things, so I think that's a really positive step. The decision report from 2017 highlighted that 56 per cent—I think—of producers don't trust agtech, so it's clearly a real opportunity for policy around how do we start addressing the issues of ownership and data sharing and those sorts of things. Right to repair—again, I think some of the technologies that are coming on board might actually enable some of those issues to be dealt with. Perhaps at some point in the future it might be that a local repairer can have John Deere approval to work virtually with John Deere guidance on how to do repairs and things. There are some avenues there that we could be exploring.

Mr PHILIP DONATO: My question is directed to Professor Michael Friend. You touched on it in response to a question that the Chair asked you in relation to the workforce requirements and the graduates and the job opportunities and the discrepancies. What do you believe governments can do or industry can do to change the perception of attracting people into agricultural careers? Should the focus be on community education or encouraging students to take up agriculture? What are your thoughts on that?

MICHAEL FRIEND: Yes, that is a really good question. I think industry is pretty active in this space, but they can only do so much. John before cited an example of Hutcheon and Pearce, and Sam did as well, in terms of how they are very proactive in promoting the opportunities, but they can only do so much. Certainly there is the opportunity to get into non-agriculture disciplines and for universities to showcase the efforts.

But I think it actually starts much earlier than that. Interestingly, the STEM strategy is very strong on increasing interest and engagement in STEM for mid to junior high school students so that they think of that as a career pathway. We could actually provide some really tangible opportunities at that level about the application of the STEM technologies in high schools as it applies to agriculture, so you really sow that seed early on that agriculture is a high-tech industry that is going places and has a very strong career path. Governments, in particular, and Department of Education can really push that agenda.

Mr PHILIP DONATO: There's been some feedback from stakeholders about the proposed establishment of regional technology hubs to attract skilled workers. Do you think those regional hubs would help facilitate or attract more agricultural graduates? What are your thoughts on that?

MICHAEL FRIEND: Well, that is our view. Part of the reason behind the establishment of AgriPark is to establish that hub or innovation precinct where students not only come to learn the theory but they're also getting embedded, industry-based internships. That is actually part of the real attraction for our industry partners, to be part of AgriPark. They see that that is a really powerful way of attracting the best and the brightest into their businesses through short-term placements and the like. I'm a big advocate for regional innovation precincts, in particular in agriculture. There is some merit in having some of that capability based in the cities but, really, when you think about the likely increase in demand for the skills that are going to be required for agriculture in the future, that really needs to be developed in the region where the industry can have easy accessibility to it.

Mr PHILIP DONATO: Jonathon or Samantha, do either of you want to touch on any of those issues or add to what Michael said in relation to those questions?

JONATHON MEDWAY: I would certainly add that one of the ambitions of the Digital Farm is very much wanting to utilise virtual reality and augmented reality to take the farm into the classroom, as Michael said, particularly high school and junior. There is a real opportunity that farmers, researchers and people sitting on tractors or harvesters could be actually running webinars with classes on a regular basis to be showing how agriculture really works.

SAMANTHA BERESFORD: Mr Donato, just to Michael's point before, I think Charles Sturt are really putting up their hand and leading the way, especially around that regional innovation. The AgriPark is not something that's new to us. It's been a culmination of years and years of hard work. We really want that government support to say, "We recognise that. You have put a stake in the ground and you are trying to lead agtech innovation across the world." I think there are some great things that government are doing, like the Special Activation Precinct, for instance, that's right on our doorstep. We'll do the research and we'll host that at our campus, but all the commercialisation and big stuff can be done with the State Government in the Special Activation Precinct. We are seeing that happening already. We have a company in the Special Activiation Precinct that comes across and uses our facilities, and vice versa. It is working. But we are doing it; it's not just a thing.

Mr DAVID HARRIS: I want to touch back on the workforce and the training. You've got a teaching course on your campus as part of Charles Sturt. What crossover is there between the work that you're doing and teacher training? I'm a teacher and Clayton is a teacher. Teachers teach what they know. It seems there would be a great opportunity for them in their early training course to be across the agricultural things so that when they actually go out into the real world with kids, they would actually take that knowledge with them. Is there crossover?

JONATHON MEDWAY: Yes, I would say there is, and there are certainly plans for increasing in that regard. The undergraduate courses in Wagga are being revamped to have a much stronger digital focus. Part of that process for reaching into schools to be generating that interest in agriculture is that the teachers are the first port of call for doing that. That is certainly on the agenda that it has to be done because until you're aware and have seen how all these technologies operate, you can't possibly hope to be teaching them.

MICHAEL FRIEND: Certainly our education students that choose that sort of STEM pathway, moving towards a career as a high school science teacher or similar, have the opportunity to be exposed to it. But I agree with John—we need to do better in that. That's part of the impetus behind the Global Digital Farm, in particular, to really make that much more accessible to not only our students at the Wagga campus but our students across other campuses and, indeed, online, and perhaps students from other universities in education.

JONATHON MEDWAY: There's actually a PhD student at the moment, Scott Graham from Barker College, who's done a remarkable job with improving the credibility of agriculture at Barker College to the point where I think it's now the largest provider of HSC ag students. A huge proportion of those students actually go on to study agriculture, and that's at a school in North Sydney. There's a lot that that can be learned from the program that Scott is doing to drive that whole process.

Mr DAVID HARRIS: That's really good because the earlier you sow the seeds, so to speak, into children's minds about possible career aspiration, the better chance you've got. I taught in Hillston, south-west of Griffith, and Merriwagga and little towns like that. It was really interesting that the farm kids knew about agriculture and the town kids didn't. It seemed very stark even on that scale. If your family was involved in agriculture, you knew a lot about it. If you lived in the town in Griffith, you didn't necessarily know much at all. If you then translate that into city kids, who have no idea whatsoever, that's why what you're doing with the Digital Farm is so important, because it's not even on their radar to do that unless they join a company and do that

internship, as you say, and see other opportunities. If you asked the average city kid, "Will you ever think of agriculture as a profession?", they would look at you with a blank face because they have no concept of what that actually means.

JONATHON MEDWAY: It's almost a concept of an "agricultural Questacon" to be driving, at the youngest ages, an interest in agriculture based on the technology. There is so much interesting stuff out there that could be part of it.

The CHAIR: Mr Barr? I point out that we have about 20 minutes left.

Mr CLAYTON BARR: So how much of that would you like me to consume? Madam Chair, I'm happy to work with you. Of course I've got a million questions. I also want to put on record my thanks to you all for hosting us out there. It was absolutely brilliant—more than brilliant, it was inspiring. For any of the year 9 and 10 students who are reading this *Hansard*, I would encourage you to consider CSU for an agricultural future. Having given that plug, I want to ask about the workforce in general. At the luncheon it was a real conversation, not just the workforce in terms of sheer numbers but the skills and the qualities of the workforce.

Michael, you touched on this at the start. We just heard testimony from the University of Newcastle about their experience, maybe anecdotally, that in some of the mining industries it's less about the person with the four-year degree and more about the person with the specific skill set on a specific course or a subject or content. Is that something that you are seeing changing? Is part of the reason that 4,500 students start and only 800 graduate in any way linked to the fact that people get those first couple of subjects then find their career pathway, and just leave uni and go off on the career pathway instead?

MICHAEL FRIEND: I'm not sure that we have 4,500 students start and only 800 complete. It's really around the 4,500 job opportunities and only 800 graduates that—

Mr CLAYTON BARR: My apologies.

MICHAEL FRIEND: No, that's fine. Certainly I think what we are seeing from employers is an increased interest in specific skill sets, which it's fair to say our traditional ag science graduates don't necessarily have. It is changing. Most university programs in agriculture will have some elements of digital literacy and agri-tech, but that really does need to change, improve and increase so that we offer much more training in that particular domain. Again, one of the key jobs behind the establishment of our Digital Farm is to embed that in pretty much the majority of our existing subjects so that people can see the opportunities for digital, and agtech in particular, in a range of industries and in a range of disciplines. I think we will start to see increased demand for perhaps bespoke and other short courses in that area because I don't think we're going to meet the demand for those skills just through our current undergraduate pipeline. We'll need to offer some opportunities for reskilling for the existing workforce. Jon, you might want to comment some more on that.

JONATHON MEDWAY: Yes, and certainly that's where I've been approached by industry, saying, "How can we be putting together short courses around managing data, using GPS or a whole range of different, quite specific technical requirements?" I think that is going to be a growth industry for the next little while, being able to satisfy, in a short period of time, intensive training on targeted issues.

Mr CLAYTON BARR: Sort of linked to that, I guess, in terms of inspiring—I know we've talked about STEM. The conversation about STEM has been around for a long time. We still don't seem to be getting the outcomes we need from STEM, although I think there have been some improvements. As I understand it, if my history is correct, landing on the moon inspired 10 or 15 years of scientists—undergraduates studying science because they wanted to explore that. If I understand it correctly, all the *CSIs* inspired a whole bunch of students enrolling in police detective work. You mentioned a Questacon sort of style. Is there any scope or potential through other avenues to inspire inquiry into agriculture and exploration of agriculture?

MICHAEL FRIEND: Certainly, again, it's part of the intent of what we're trying to achieve with the Global Digital Farm and make it, as Jon mentioned, a complete immersive virtual experience so regardless of where you are you can have a look at it and get inspired by it. Jon, maybe we should make it into a Digital Farm miniseries or something like that to really get people—

The CHAIR: We do have *The Farmer Wants a Wife*, after all.

Mr CLAYTON BARR: *The Farmer Wants a Wife*, "Love Farm".

MICHAEL FRIEND: Absolutely. Let's do something a bit different. I like that. Let's think a bit out of the box. Jon?

JONATHON MEDWAY: I actually follow a couple of American farmers on YouTube that have a million-plus subscribers. So the notion that there could be a Digital Farm YouTube channel that can be a—some

of these farmers post two or three clips a week on what they're doing on the farm. It's fascinating viewing. That's the kind of thing that's out of the box that we might be able to utilise.

Mr CLAYTON BARR: Connectivity out in the middle of the farm—I know Zetifi is working on that last mile, but for some farms it's more than a mile. So what role is there for governments in increasing connectivity? I remind all listeners that primarily it's a Federal responsibility, but we're happy to kick it along.

MICHAEL FRIEND: Government support in that area is critical. Talking to farmers in the Broken Hill area, that's a massive issue. They would adopt a lot more technology solutions if they had more reliable connectivity. Jon might correct me if he disagrees with me, but I think it's often a little bit oversold as an excuse because there are some other on-farm solutions that you've alluded to. But, yes, absolutely, we need better connectivity. It is not only remote areas like Broken Hill; there are areas not too far from Wagga where you are in almost complete black spots.

JONATHON MEDWAY: I would like to add to that. I think part of the discussion around a lot of agtech focuses on cost rather than value. I think there are a number of off-the-shelf solutions available. You can sign up to Starlink in 30 seconds and you've got as much connectivity as you want. We hear so much about the cost of soil testing is too much and we need to bring the cost of a soil test down. But if a farmer is about to spend $100,000 on fertiliser, reducing a soil test from $50 to $40 really doesn't change the economics. That's where I think, to some extent, we focus on cost as being a really simple message as opposed to going through what is the value of doing more soil testing or adopting some of these technologies.

It's certainly a massive issue with agtech. That return on investment isn't something that is well and independently verified. For 25 years technology companies have been wanting to sell silver bullets and shiny things to farmers, and sometimes it does take a conversation to educate someone—"This is how you're going to need these three different pieces of technology. You're going to need some more information to bring it all together, but, ultimately, you're going to get a five-to-one return on your investment." I think we almost need to lift the level of the conversation to some point rather than just saying, "No, it's too cheap or it's too expensive."

MICHAEL FRIEND: To add that that, the integrating point is often the issue. There are so many potential individual solutions that, in isolation, don't necessarily stack up, but when you put them together they can make a really strong value proposition.

Mr CLAYTON BARR: Is this the tech trust problem?

JONATHON MEDWAY: I think so, yes. So many technology providers are focused purely on selling a silver bullet—

Mr CLAYTON BARR: "Off the shelf", as you put in your submission.

JONATHON MEDWAY: —off the shelf and that their particular technology is the solution rather than selling their technology as part of a bigger package. It's the way the marketplace works but it doesn't help because it confuses the market. I think a lot of farmers have almost reached saturation point where they just don't know how to sift through all of their options to make a reliable choice. Again, that's where things like the smart farm, Digital Farms—that's what we want to be able to do, to road-test these technologies and add some quality control or quality comment to enable farmers to make those decisions.

MICHAEL FRIEND: It's really about having those trusted intermediaries, whether that be our Global Digital Farm, other universities working in that space or government departments like DPI being that trusted intermediary. As Jon says, there are plenty of tech providers out there with solutions trying to find a problem, effectively, and trying to flog a particular product. Some of them will bring value and some clearly won't, but it's around having those trusted intermediaries to road-test it.

Mr CLAYTON BARR: To go back to some of the conversations we had when we were out on site, it was something as simple as a farmer potentially only producing half the yield at the bottom end of the paddock compared to the top end of the paddock. It's just understanding that, because if you invested the first $100 or $1,000 into that, your yields, hopefully, in the next five or 10 years might pay back 100-fold.

JONATHON MEDWAY: That's a massive frustration because a lot of that data is still sitting on the harvesters because farmers don't know what to do with it. At the moment, their only access to understanding it is going to someone who's trying to sell them fertiliser as well. So their adviser could be completely legitimate and not be trying to just sell product, but there's a perception that they might be. That's where the universities can be playing an independent host role to be looking at how universities can be processing data for producers independently so then they can sit down with their adviser and make decisions. A little along the way, the US land-grant universities perhaps work where they provide independent services to the industry.

MICHAEL FRIEND: I was going to add that a lot of tech providers are boffins. They're out trying to sell a particular technology and they're not speaking the language of producers. Again, that's a really important role for us and others as trusted intermediaries, to be able to put that information in a way that makes sense economically for farmers to consider adopting.

Mr CLAYTON BARR: We used to have public service agronomists. I think that a lot of them are no longer employed. There are a lot of private sector agronomists. Does that change the trust equation? If they're publicly funded and there is no financial windfall for them, they're just giving information and helping farmers, compared to a private sector who by their nature will be after a wage and a salary.

MICHAEL FRIEND: In terms of the private sector consultant, there are two types. There are those that are associated with the big resellers. There are trust issues there because the business model is quite often about selling a particular product, as Jon notes. But there are also independent consultants that are not tied to a particular reseller and I don't think there are the same issues with trust there. There are still some government extension and adoption staff within Local Land Services. Absolutely there is trust there through that sort of independent perspective on things, but their resources are limited as well.

Mr CLAYTON BARR: Can I just talk—sorry, Madam Chair, I appreciate the indulgence. I am very mindful of the time. If you can't see it, you can't be it. Can I tell you my experience of the agriculture industry? I drive along a road; I see a gate and a dirt road that goes off over the hill to somewhere and occasionally I see a tractor. I've got no idea what work takes place over there. I just see tractors sometimes moving around. A kid living in the town can see a teacher or a nurse or a shopkeeper or a restaurant keeper or a chef or a barista but they can't see what happens at the end of that dirt road. What do you think about that? The digital online farm is one of the approaches. How do we shift that? How do we fix it?

MICHAEL FRIEND: I am sure Jon's got some views but, as we highlighted before, making that experience virtual so that kids can access that virtual experience and say, "That's pretty cool. I didn't realise that happened behind the farm gate or over the hill or that's the technology that's in a modern combine harvester these days. Wow, I didn't realise that." You are quite right. If you are not getting onto a farm, then you've not got any hope of understanding the complexity of technology that is currently in play and that has the potential to be in play.

JONATHON MEDWAY: I would add to that. Gaming is one possible option. There are now starting to be some really quite interesting farm simulation games becoming available that actually use some really powerful science behind them about plant growth models and interactions with climate and sustainability and all those sorts of things. Again, we are just starting some conversations to say, "How might we take a game platform simulation activity and bring that into a promotional role for agriculture and at university-level teaching?"

Mr CLAYTON BARR: What sort of wages are available? I'm sorry, I don't mean to be crass, but every kid in Cessnock can tell you that if you drive a truck in a coalmine, you earn $140,000. If you're a nurse or a teacher, you earn about $100,000 and same for a police officer or whatever. If you're a barista in a coffee shop or if you work at Woolworths, you're probably on about $40,000 or $50,000. My kids in my town can tell me that. I don't think anyone could tell me what you would earn for the different roles. I know there are lots of different roles on a farm, but how much can people be earning if they're working on farms?

MICHAEL FRIEND: I guess there are two answers to that. Certainly at the entry level, it's not that great, although farmers are increasingly realising they're having to pay more to get the right skills so there is that sort of demand squeeze. But a good farm manager will earn easy $150,000 if they're managing a big enterprise. Then of course in the advisory sector, most graduates—and you will probably know this data off the top of your head, Jon—will start with a package circa $70,000 with a car and a phone straight out of university, and they're getting a lot more flexibility than they would be if they were locked into some of those other jobs you describe. That's an outdoor experience and they're learning on the job.

Mr CLAYTON BARR: And I am sure there is plenty of money in dung beetle farming.

SAMANTHA BERESFORD: Of course.

Mr CLAYTON BARR: Madam Chair, I will leave my questions at that. I thank you for your indulgence yet again. I again want to applaud everything happening at Charles Sturt University. If you're a young person out there, look into it and get down there and have a shot.

SAMANTHA BERESFORD: Madam Chair, can I just make one comment to Mr Barr's first comment about what State government can do. I know that you acknowledge that it's a Federal government issue, the connectivity issue, but I think there are things that State government can be doing. For instance, Transgrid—when they're putting in the new 500 kilovolt powerline, they run a full optic fibre cable with that.

Mr CLAYTON BARR: Yes, they do.

SAMANTHA BERESFORD: So as part of your EIS process or the VPA, make sure that they're having to give back to farmers that they are doing that to into their regions. I think there are little ways that you can do that.

Mr CLAYTON BARR: We could set up a State-owned corporation that was in telecommunications using our optic fibre cable.

SAMANTHA BERESFORD: Correct. You can use the optic fibre cable.

Mr CLAYTON BARR: There you go, and then we can sell that corporation.

The CHAIR: We have five minutes left, surprisingly. Mr Barr always asks very incisive questions. It is great to see and it was fantastic to be able to see the Digital Farm and the virtual reality interfaces that you're working with and it is really exciting. Obviously we have touched on some of the things that are actually impacting the early adoption or even the longer-term adoption of this technology, and we do want to make it as interesting as we can. We've gone over connectivity, trust, cost, communication as well and whether there's a need to simplify or reduce the complexity of that communication so that we are better demonstrating the messaging and better able to put it out there. Also when we were down there with you and we did the roundtable, there were examples of legal and regulatory constraints, and we were specifically talking about drones in that instance. What do you feel the regulatory reforms are that may be able to enhance the journey forward in all of this that we need?

JONATHON MEDWAY: I often think of the drone argument that there is a lot of noise in that space. If someone could show me a really easy thing that all farmers need to be doing with drones, that would be a terrific option. But at the moment, the actual applications are relatively niche and there are some spectacular niche markets for using drones for really low-volume fungicide application and a few things like that. But most of the drive for regulation is coming from the companies that are trying to sell drones. They can be quite hard work to actually use them, and that's where it's consultants and other service providers that seem to be managing quite well within the current framework. If you're a licensed provider and you want to provide a service with contract spraying, you fill out the forms and you can operate the same way an air pilot who wants to fly from Sydney to Melbourne has to fill out paperwork. That is just what is required. If everyone thinks it's okay for 70-kilogram and 80-kilogram units to be flying around uncontrolled over the horizon, then there are going to be legal and insurance issues related to that. I'm not sure how much is really required.

The CHAIR: Professor Friend, did you have anything that you wanted to add to that?

MICHAEL FRIEND: No, I think Jon has covered it, thank you.

The CHAIR: Excellent. In that case we are almost bang on time.

Mr DAVID HARRIS: One more question: given the importance of biosecurity—and you announced your new unit that you've set up there and the first tranche of students. We've obviously had varroa mite and we've also got foot-and-mouth. How big an industry, if I can use that term, do you think biosecurity will become in future years given some of the pressures of disease overseas and then transforming to Australia?

JONATHON MEDWAY: I think it's largely going to become almost a by-product of some of the technology that is coming together. So many of the different technology applications actually aren't of themselves a requirement of a whole system but all these things coming together with the one platform—selling compliance is really difficult, but if you have systems in place that boost productivity and efficiency, compliance and biosecurity become a by-product of how some of those things come together. The use of online GIS systems and being able to automatically share data makes a lot of that biosecurity a lot easier.

MICHAEL FRIEND: Yes, and considerable investment will flow into that and is already flowing into it through a number of initiatives, so I think it is a growing area, particularly for R&D, so that we safeguard ourselves firstly against an incursion and secondly if the worst happens and an incursion occurs, then we are able to activate and respond really, really quickly to snuff it out.

The CHAIR: Biosecurity could be our new TV show. I'm not quite sure what our acronym would be.

Mr CLAYTON BARR: As long as it's got a "beep beep beep beep" while we're waiting for the score to come up and then cut to an ad break.

The CHAIR: Excellent. Thank you all very much for appearing before the Committee today. It's lovely to see you all again, and you will each be provided with a copy of the transcript of the proceedings for corrections and any questions that obviously were not taken on notice. We are managing to get through them all. We may

send you some additional questions in writing and of course your replies will form part of the evidence and be made public. Are you all happy to provide a written reply to any further questions should they be forthcoming?

SAMANTHA BERESFORD: Yes, absolutely.

JONATHON MEDWAY: Sure.

MICHAEL FRIEND: Yes, and thank you again so much for the opportunity.

The CHAIR: Thank you for joining us and for your hospitality, as I mentioned, and safe travels today as well.

JONATHON MEDWAY: Good luck with the rest of the day.

(The witnesses withdrew.)

(Short adjournment)

Mr ANDREW ABBEY, Policy Director, NSW Minerals Council, sworn and examined

The CHAIR: I welcome our next witness from the NSW Minerals Council, Mr Andrew Abbey. Would you like to make a short opening statement before we begin the questions?

ANDREW ABBEY: I do have an opening statement. I will be fairly brief. I'd like to thank the Committee for inviting the NSW Minerals Council to assist in its consideration on this issue. I don't have much further to add to the submission lodged by the NSW Minerals Council other than to emphasise the following key points. Mining obviously occurs in the regional areas of New South Wales. The economic contribution of mining to regional areas such as the Hunter, the Illawarra, New England, the north-west, the Far West and Central West areas of New South Wales is significant. The mining industry contributes both directly through jobs and direct spending in the regions, as well as indirectly by supporting thousands of businesses and jobs throughout New South Wales.

The benefit of mining to regional New South Wales can continue and potentially grow as the world looks for new resources to support the rapid growth in emerging technologies such as electric vehicles, renewable energy infrastructure and advanced manufacturing, to name a few. As the New South Wales Government's *Critical Minerals and High-Tech Metals Strategy* points out, New South Wales is well placed to take advantage of this increasing global demand for new resources such as critical minerals, rare earths and high-tech metals, provided the investment and policy settings are right. Today there are close to 20 metals and minerals projects located around the Central West and Far West of New South Wales at various stages of planning and investigation. If all those projects were to proceed, they could deliver over $8 billion in investment and thousands of direct full-time jobs in the regions.

New South Wales has a proven record for mining resources efficiently and effectively. The mining industry in New South Wales is mature and world class, having evolved over 200-plus years, and competes strongly on the world stage—if not leads it, as is often the case. During this time, the industry has continued to grow and, importantly, it has evolved and adapted to respond to a range of challenges including health and safety requirements, better environmental performance, labour and workforce challenges, increasing productivity and global competitiveness and, importantly, increased community and investor expectations overall. Underpinning the evolution of mining in New South Wales has been its willingness and ability to embrace new technology and innovation. Over the years, there have been countless examples of the New South Wales mining industry adopting new technology—I think the New South Wales Government submission points that out quite well actually—and it continues today, such as Iluka Resources trialling new mineral sands underground mining technology at its Balranald project which, in addition to being more cost effective, would significantly reduce its environmental footprint; and South32 partnering with CSIRO to develop technology to safety abate emissions from ventilation air methane in underground coalmines.

The continued growth of the existing mining industry and the pursuit of new mining opportunities can have obvious benefits for regional communities, but—and as noted in our submission—there can be some challenges. Regulatory processes can be a barrier to efficient and timely take-up of new technology. This is not meant to be a criticism necessarily levelled at the Government, and we understand there need to be checks and balances, but the question for us is can industry and the Government together create a better environment to embrace new technology? For example, on the NSW Resources Regulator's *Innovation Policy*, which is primarily focused on health and safety and is a very proactive initiative, can this approach be applied more broadly to a broader suite of regulatory spaces? Access to labour is another challenge for the mining industry. As the uptake of technology increases in all industries, including mining, there will be increased competition for labour with the right skills and expertise. That competition will be across the various sectors including agriculture, mining and the like.

There needs to be the right education and training programs available and they need to be able to flexibly adapt and respond to new emerging requirements. The investment environment has to be right. Like all industries, mining competes for global capital. If New South Wales wants to be ahead of the pack in terms of developing its critical minerals and metals, including the confidence to spend the large capital investment typically required for new technology, we need to make sure investment is incentivised. As I said, the range of initiatives outlined in the Government's submission is a great start, but what else can we do? The right infrastructure needs to be in place. We've already mentioned education and training, but water, electricity, telecommunications and transport infrastructure also need to be readily available, particularly as areas further west are explored. This is predominantly the area where the critical minerals and high-tech metals are located.

These challenges should also be seen as opportunities, for example, workers with new transferable skill sets living in the regions, new education programs in regional areas that are more aligned with emerging

technological requirements—and those new skill sets don't necessarily have to be industry-specific; they could be transferable across a range of different industries such as data, telecommunications and the like, so they would be applicable to a range of industries—new high-tech support industries to support high-tech mining operations, new emerging industries such as downstream processing of minerals and manufacturing of renewable energy infrastructure and new infrastructure in the regions, to name a few. This is in addition to the proven direct and indirect economic benefits mining can bring to the regions and can continue to do so under the right conditions. Thanks for the opportunity. I'm happy to take questions.

The CHAIR: Thank you very much, Mr Abbey. I'll just point out that we have until 12.00 p.m. today to pose questions to Mr Abbey—yes, Mr Barr, I am looking at you. Mr Abbey, just touching on some of the things that you have mentioned in your opening statement, the mineral and resources industry is also facing critical skills shortages and access to labour. What are the current shortages in terms of trade skills and experience?

ANDREW ABBEY: The volume of staff is actually an issue. The industry itself, the NSW Minerals Council, other State jurisdictions and the Minerals Council of Australia are running active education programs to try to get people interested or a pipeline of people coming through into the mining sector. We've actually relatively recently engaged a staff member that's solely focused on careers and training. I don't have the exact locations but we were around the various regions relatively recently this year in terms of careers dinners. In terms of the actual skills, it's across the board in terms of skill sets: mining engineers, geologists et cetera. But I think the point I'd like to add to that, if it's okay, is that it's not just the skill sets today; it's being ready for the skill sets of tomorrow. How do we future-proof ourselves and have a nimble and flexible education and STEM system available that provide those opportunities? It's not just about somebody fixing a truck—whilst that's important—but what is the next thing we're going to require and how do we make sure there are people readily available in Australia, particularly if we're going to take advantage of the emerging global trends for high-tech metals and minerals and the like, which we are well placed to take advantage of, so that staffing and skill sets and the like are not a limitation?

The CHAIR: A number of questions flow on from that. Directly out of that, then, you're talking about the education programs et cetera. How is the level of interest and are these programs working? Are we actually attracting and retaining the workforce?

ANDREW ABBEY: It is challenging across the board. Having read the agriculture submissions as well, I think all industries are suffering. I suspect some of that is to do with recently coming out of the COVID space. But there's also the skill sets and the right skill sets. Yes, there are a lot of challenges and we are focused on, "Are there the right skill sets out there?" University numbers, as I understand it, are actually quite low in the mining space and in the mining engineer space. They are areas where we are trying to get in early and show people what opportunities are available and what the potential benefits of having a career in the mining industry can be. We are working closely with various universities as well to promote the attractiveness of their courses and, if you were inclined to go down that path, the benefits of going down that path.

The CHAIR: Do you feel that increased provision of STEM, VET and TAFE courses would assist in that space? Or are you also dealing with more of a need of onsite experience as well?

ANDREW ABBEY: To answer the second part first, it's a combination. There is no question about that. But increasing STEM-type education and following roles is no doubt increasing. I think that's a direct response to the changing nature of technology in the mining industry or any other sector. It is a combination of actually attracting both sets. There will increasingly be a broader range of skills required in the mining industry. Already there's quite a range of skill sets, going down to the people who fix the vehicles or change tyres and the like to engineers. But I think there's also that next layer of digital technology, automation, artificial intelligence and the like that will demand new skill sets. From that, how do we build a workforce that is capable and futureproofed? There are potentially opportunities to have those education systems actually located in the various regions. I know the New South Wales *Critical Minerals Strategy* talks about a hub in the Central West. What does that mean? How do you build on it? How do you get the right education or STEM education systems in those locations or in the Hunter Valley and the like?

The CHAIR: You mentioned automation and the impacts of that on the future workforce. Do you see that as a potential advantage? If we have these skills shortages or we have workforce labour shortages, does automation fill that space? Or does it potentially become problematic because we're no longer requiring these people to be doing those jobs?

ANDREW ABBEY: To answer the first part, it can fill that space, but in terms of second part, it's not necessarily problematic. We've had a good look at this. Firstly, with automation there still will be jobs on the ground. It doesn't mean you end up with a zero workforce and a couple of young kids in a control room somewhere playing their Xbox, driving a truck down a coalmine. There still will be people employed at a mine site. There is

no question about that. The opportunity, from our perspective, is that it actually creates new types of jobs—high-skilled jobs and alternative jobs—that could create a new, attractive environment for people who may not have previously thought that mining was an attractive role based on the skill set and technological requirements. Experience has shown that automation doesn't wipe out your workforce. It might change it, but there still will be people required to run the systems, to fix the trains, to fix the vehicles and the like. But there also will be new jobs associated with the technology associated with increasing use of automation. It is also an important health and safety aspect. In some environments, automation is a very effective way to limit risk to human life. In addition to the other benefits, it's a key driver of automation.

The CHAIR: Obviously, though, we also have to have those training pathways, the education facilities and programs that are going to upskill the workers and those who are training and intending to work in these spaces. Does that mean that we will then have potential gaps in these industries for work that's no longer being fulfilled, if automation can't fulfil it, and we are upskilling our workers who are looking at those more advanced career paths? Are we looking then at creating gaps?

ANDREW ABBEY: There's the potential. But I guess that's where it becomes the onus on the industry, as well as with government, if we're serious about embracing emerging technology. How do we make it an attractive proposition to people to want to upskill themselves or acquire the right skill sets to enter the mining space? Whilst there may be the risk, it's also a challenge and an opportunity for industries to look at how do you best attract people into that space and what can you do to attract people into that space.

The CHAIR: We certainly have to have those pathways and those educational programs in place in order to be able to upskill the workers as these other things are coming online.

ANDREW ABBEY: Absolutely. The research is very clear at both Commonwealth and State levels. There's a lot of research about emerging trends and embracing new technology. Updating skill sets of the employment base is critical. There need to be education programs and STEM programs in place to provide that opportunity to upskill the local population. The worst-case scenario is you have to import people. We have got a great labour base in our State. Why shouldn't we give them the best opportunity to take advantage of potential jobs in the future or emerging industries?

The CHAIR: Thanks very much, Mr Abbey. Sorry for stealing your thunder there, Mr Barr. I might have stolen a few extra moments from you.

Mr CLAYTON BARR: I was concerned about your time, Madam Chair, but I am happy to cede to you.

The CHAIR: Mr Donato, we might go to you for any questions that you have of Mr Abbey.

Mr PHILIP DONATO: Mr Abbey, thank you for joining us this morning. I'm the member for Orange. Obviously I have a number of mines and mine sites in and around my electorate. The Committee visited Cadia Valley out at Cadia, Northparkes, and Evolution at Lake Cowal. There are obviously other mine sites in and around, similar mine sites such as the proposed one at Kings Plains and also the one that's looking at being established just out of Trundle at Fifield there, looking at mining cobalt, which is, I understand, one of the important minerals used in the making of lithium batteries and obviously is a scarce, rare commodity. I think the Congo is the only other country in the world where they are currently extracting cobalt. There are wonderful opportunities for those communities out near Trundle and Fifield once that mine gets up and running.

I want to touch on some of the challenges. Madam Chair spoke in relation to trade skills and staff workforce. I speak to a lot of mining and mining-related industries in and around my electorate and that seems to be one of the biggest issues that I hear every single day. There is access to workforce, skilled workforce, trades, tradespeople or even apprentices. You touched on that in your opening address and in some of the answers from questions that were asked by the Chair. How are you finding the uptake, whether it be school leavers, for apprenticeships or some of these trade positions, or graduates from universities? You said that there seems to be a lack of perhaps university graduates, whether they be engineers or geologists, and sometimes a difficulty in recruiting those. Are you finding that one of your biggest issues is getting access to a skilled workforce or growing a skilled workforce, in terms of apprentices? What more can the Government do to facilitate that? That seems to be the biggest issue I hear every single day. Only yesterday I was at a metal fabrication industry in Orange that does a lot of work for the mines as well. They are having huge dramas getting access to staff. What more can governments do to assist in that space?

ANDREW ABBEY: Firstly, it is a massive issue. It's a massive issue for the mining sector not just in New South Wales but across the board in Australia. As I understand it, it is exactly as you said in terms of the metals industry or whatever. Other industries are hurting as well. From a NSW Minerals Council perspective, we have got on board with putting in place programs which are targeting school leavers and the like. As I understand

it, the numbers at university have dropped substantially over the last decade or so to seriously low levels. They're not filling that pipeline of the right people into the types of courses who would then go into the mining industry.

In terms of what we can do, I guess there's a range of things but the challenge is incentivising younger people, and saying, "Mining is an attractive proposition. What can we do that provides you with wanting to get into the mining industry?" That's a challenge between the industry itself and the New South Wales Government. It's a vexed issue. The easiest obvious answer is to say create more programs and throw money at it or whatever, which is—no question—part of the solution. But I think the responsibility and onus is also on our industry to getting on the front foot and promoting it, to say, "This is a really good, well-paid opportunity that can give you a very, very diverse range of skill sets and you'll also be contributing to future trends, and the future evolution of trends", such as renewable technology, advanced manufacturing, cobalt/lithium in iPhone batteries and the like.

You can see the advertisements on TV. A number of companies are actively doing that. I think we'll hopefully see fruit being borne soonish in terms of the push that's on at the NSW Minerals Council level, the Minerals Council of Australia level and at individual companies, as well as at other State-based representatives. But that's not a great answer to you—a crisp answer—"We've got X, Y, Z to sort it out." I think it's a range of things, including education, including dollars and including the industry itself promoting it.

Mr PHILIP DONATO: You mentioned earlier that most of the mines are in regional areas of Australia and in New South Wales. You're trying to attract people from the city or from the metropolitan areas into a career in mining when they're not seeing the benefits of it in a local community sense as opposed to someone who may live in the Hunter Valley or Orange, for example and you're finding that it's difficult getting metropolitan people to take up a career in mining as opposed to—I guess the majority of your staff, graduates, apprentices or tradespeople are regional-based people or people who live in the regions? How would you go about trying to generate and attract those people from the city, where there are obviously larger populations, to try and take up a career in mining?

ANDREW ABBEY: There are two parts to that. Yes, the short answer is it is a problem attracting people from the metropolitan areas because of the sheer variety of choices. But it is a larger population base, so it makes sense. Before I give a fuller answer to that part of the question, part of our attack also is wanting to showcase and highlight in the regional areas that people are going off and getting a great education or new or skill sets in emerging areas and the like, and then going back to their regional area and working in an industry in a high-paid job. We're keen to emphasise and highlight that where people already have their relationship structures or a family base and the like, what opportunities are available if they did want to go to university, go away from the region or wherever the university is located—hopefully in a regional area—and stay in the region.

But to your point about metropolitan areas, we're giving thought to how do you break down some of the negative perceptions, particularly in the metropolitan area, about mining? There are some obvious negative perceptions, but it's about highlighting new cobalt industries, lithium industries, mineral sands mining and the like, and what opportunities are there. But those are a lot of words. Again, it is a really challenging space. As I understand it, the agriculture sector is having very, very similar challenges about attracting people into roles in the regions, whether it be retention of people in the local area or from metropolitan Sydney.

Mr PHILIP DONATO: Finally, you spoke earlier in your opening address about some of the challenges in relation to regulations and regulatory framework in terms of establishing proposed mine sites, new mines or expansions of mines. What would you say to the Government? What would you report to government? Obviously there's always got to be a balance in these considerations.

ANDREW ABBEY: Yes.

Mr PHILIP DONATO: From the Minerals Council's perspective, what more could be done to facilitate and make it easier for your industry to be able to look at setting up new mines, generating these direct jobs and the billions of dollars they would bring to the local and State economies?

ANDREW ABBEY: There are a number of layers to a response to that. In terms of the introduction to new technology—mining companies are always on the lookout for new technology for a host of reasons. As I have said, health and safety, cost effectiveness, reduction in environmental—the Balranald Mineral Sands Project is a great example where cost efficiency is a driver, but if it's successful, in terms of them trialling the new technology, there will be significant reductions in environmental impacts. So it's a big win-win. But health and safety is obviously a big driver.

In that sense, the New South Wales Government's *Innovation Policy*, which is a very health and safety-focused policy, is a great initiative in terms of sending the signals to industry, "If you are thinking about good things that are new and different, let's give it a crack. Let's work together to get it going." That approach should, in my view, apply more broadly. Qualifying that with the checks and balances that are in place, particularly

around health and safety—and that is absolutely 100 per cent front of mind all the time for the mining industry. Provided those checks and balances are in place, whether it be health and safety, environmental performance, mining productivity, vehicle fleets—whatever it is—how do you embrace it to say, "Okay, greenhouse gas emission reductions will be an increasingly big area where new technologies are emerging"? If we're all looking at greenhouse gas emission targets reductions, how do we get on board with industry to incentivise it, promote it and bring it online quickly? That's the first part.

The other parts are things like the regulatory space in terms of approvals for projects. Once again, there are checks and balances, and of course they have to demonstrate their environmental performance bona fides. But how do we get those in and out quicker? Increasingly, these types of metals and minerals are more global looking. If countries like America and the like are looking for alternative sources of critical minerals, metal or high-tech metals and the like, how do we make New South Wales attractive in terms of sending investment signals that New South Wales is a great place to do business; they'll will deal with things quickly? There's no question that there are improvements in the New South Wales government space. The challenge is what can we do better? How do we make it more certain? As you said, we're competing with the Congo—or wherever else around the world—for dollars. How do we make New South Wales better? Things like making the regulatory framework more certain and efficient in terms of planning approvals, mining lease approvals, compliance with conditions, rehabilitation requirements—the whole bucketload of stuff, and it's a big bucket because the mining industry is heavily regulated. How do we make it more attractive?

Mr DAVID HARRIS: I am interested in the workforce issues. A few years back we set up trade training centres in schools in order to not just get TAFE-level certificates for young people but also to encourage them into areas like aged care and those sorts of areas. Is the industry looking at partnering with secondary schools to initiate similar projects in terms of attracting people? One of the comments we had from the interns at Newcrest doing robotics was that many of their colleagues didn't look at mining as an option because of its negative perceptions. Obviously, as you've mentioned, the future of mining may not necessarily be in the fossil fuel area, it might be in other areas and you can't have renewables without those metals. Yes, there's a perception issue there. I was talking to the agricultural people from Charles Sturt. The younger you get them and you set their minds, the easier it is then for them to move into careers in that space.

ANDREW ABBEY: The short answer to that is yes, absolutely, we are targeting the secondary schooling system. There's a thing called the PRIME Program, which is in a number of high schools like Singleton. I haven't got them all off the top of my head, but it is in our submission actually where they're located. But we are targeting secondary schools. Our most recent push or initiative is the careers dinners, which were all around the State. I think we actually went to Orange and definitely throughout the Hunter Valley. We were in Wollongong and the like. It is getting into the secondary schools to say, "Hey, have you thought about mining in terms of not just the money, which is very good and above average, but about the opportunities in terms of new skill sets, robotics, artificial intelligence, data, automation and the like?" It's a great opportunity to get a range of skills. That was a lot of words, again. Yes, we are targeting that area because obviously they're going to be the next generation of people coming through. I think there will also be opportunities for when we transition. Mines will go as long as they do, but ultimately some mines will close down. What do you do with that workforce that's already skilled in the like and familiar with the industry? What opportunities are available there to re-skill?

Mr DAVID HARRIS: Just on that point, when it's announced that a mine might be scaling back, is it government or industry that goes in and works with those workers to possibly redirect their skills to other projects or is it up to them to chase and say, "I might not have a job anymore. I've gotta go and chase one"?

ANDREW ABBEY: No, it's a combination of both industry and the Government. Both industry and the Government will take responsibility for looking at opportunities. In terms of transition and talking about the Hunter Valley, there still will be coalmining for a number of years to come in that space. There will be mines that reach the end of their life naturally and there will be mines that can absorb some of the workforce as well as, importantly, looking and putting in place opportunities for some of those workers to think about upskilling. If you're relatively young, unlike myself, you might get a good 20 more years if you get the right new set of skills that takes you on a different pathway in the mining career. It's a combination but it's both. It's actually everybody taking responsibility about what we do with that workforce. It's not the companies or industry or the Government walking away and far from sort of dusting their hands and saying, "It's not our responsibility." Everybody is actively looking at that space and the opportunities in that space.

Mr DAVID HARRIS: Finally, you mentioned incentivising. One of the areas we found very interesting on our trip to Newcrest was that they're looking at developing electric vehicles. One of the reasons is obviously because the diesel particulates aren't particularly good when you're underground. But it seemed that a lot of that work was being done by the mine and a local company. Is that an area where government could incentivise to sort of accelerate the use of electric vehicles?

ANDREW ABBEY: Absolutely. Whether that be at the Commonwealth level or New South Wales Government level or the university systems themselves, there is a massive opportunity in that space. At the moment, electrification of mining vehicles is not in a position where it needs to be. I think underground mining might be easier because they're smaller vehicles. But in terms of a general comment about the mining sector, we're talking about a 20-tonne battery if you want a sort of decent sized vehicle to move your material. Currently on the diesel trucks you can run them for 24 hours and fits with shifts and whatever. But it is a 20-tonne battery to run a big truck for six hours and it costs a bomb. The technology's not there yet. We actually had a presentation on this yesterday or the day before at the Health, Safety, Environment and Community Conference in terms of where the technology's at. It's improving but it is not there at a point yet where companies could just say, "Yes, we'll electrify our fleet."

It's a great opportunity and everybody should be getting on board with it as part of the broader push to bring down emissions in the transport sector and diesel use and the like. It's a great opportunity and governments should be getting on board in looking at opportunities. I think part of that will occur as a broader push to the electrification of vehicles generally, but it also presents other challenges such as infrastructure, i.e. transmission lines, which is increasingly becoming a big issue, particularly when new mines or new mining opportunities are located in areas where there is not access to the right level of electricity transmission. As we're looking towards getting rid of the use of diesel-powered generation and using renewable energy, getting it to the site is increasingly becoming a challenge. So, yes, governments with industry should be looking at opportunities to fill that space or incentivise that space.

Mr CLAYTON BARR: I should start by declaring that I was an invited guest at the Minerals Council dinner two nights ago and I do not believe that that's going to impact my ability to participate in the Committee today. I go to a bit of a segue from what Mr Harris was talking about on the electric vehicles. Most of the electric vehicles are sold east of this building in the eastern suburbs of Sydney and north, but we are ultimately going to need electric vehicle mechanics across the State. Most likely mining, because of the money that's in and around the industry, is going to be one of the early uptakers. Will mining companies take on the responsibility to set up training programs for electric vehicles for their workforce or should that be TAFE, VET, government-funded or are we going to do it in partnership? What do you think is the path forward?

ANDREW ABBEY: This is speculation, I guess.

Mr CLAYTON BARR: Yes, absolutely, it is.

ANDREW ABBEY: Once the vehicle fleet is efficient, cost effective and an electric vehicle fleet can do the role—it will come, but it's not there quite yet—and once it's in place, if the training programs aren't put in place by the Government through institutions like TAFE and wherever else, the mining industry will fill that gap just because they want to get on and do their business. But I think as part of forward thinking, it would be very, very proactive and prudent for the Government to be putting in place those education programs, not just for the mining industry but for the broader State or the good of the State because if the mandates are for increased reduction in emissions through fuel use and the like, then clearly electric vehicles is the mandated platform to do that. You're going to need people to look at how they can fix your vehicles. Of course, a mining truck might need a slightly different set of skills compared to a Tesla, but there should be training programs in place and the Government should be looking proactively at getting on the front foot in that space.

Mr CLAYTON BARR: Just clarifying earlier, and as we saw at Newcrest, the smaller vehicles at the moment are the ones making the transition on mine sites?

ANDREW ABBEY: Yes.

Mr CLAYTON BARR: The bigger vehicles are still a way away?

ANDREW ABBEY: Yes, the bigger vehicles are a way away, but they are already picking it up because it is actually going towards reducing their reporting requirements under the Commonwealth NGER scheme. It is about responsibly reducing scope 1 or scope 2 emissions.

Mr CLAYTON BARR: A final question, though I have 50 that I would like to ask. Tailings and waste that is currently stuck on site—what are we doing in terms of technology and advanced technologies to better deal with what currently is a waste product sitting there?

ANDREW ABBEY: I know there are programs looking at the beneficial reuse of tailings and ultimately being used as fill on sites. I can't give you exact examples and I don't want to mislead you or say something incorrect, and I am happy to take that on notice, but I do know there are programs, predominately university-led programs, in terms of reuse of tailings so it isn't just a waste product and it can be beneficially re-used. But I can take that on notice and speak to the various companies and get you some examples.

Mr CLAYTON BARR: Could I ask you to take that on notice please, Mr Abbey?

ANDREW ABBEY: Definitely.

Mr CLAYTON BARR: Thanks so much. Thanks for being here.

The CHAIR: Thank you very much, Mr Abbey. We are spot on time. Mr Barr, you did well. We do take your initial point as well about working together to create a better environment to be able to implement technology and build on those opportunities. It is tremendous to see. Thank you for appearing before the Committee today. You will be provided with a copy of the transcript of proceedings for any corrections and the question from Mr Barr that was taken on notice. We may send you some additional questions in writing. Of course, your replies will form part of your evidence and be made public. Are you happy to provide a written reply to any further questions that we may have?

ANDREW ABBEY: Of course.

The CHAIR: Thank you for your time.

(The witness withdrew.)

Ms LUCY McCLEAN, Director, Association of Mining and Exploration Companies, before the Committee via videoconference, sworn and examined

The CHAIR: Ms McClean, thank you very much for joining us. Before we proceed, do you have any questions about the hearing process?

LUCY McCLEAN: No, thank you. The team has been very helpful prior to this.

The CHAIR: Would you like to make a short opening statement before we begin with questions?

LUCY McCLEAN: I would indeed. First of all, thank you so much and good afternoon to you all. I really am delighted to have the opportunity to attend today. My apologies that I can't be there in person, but it is great to be able to do this virtually. Before I begin, I would like to acknowledge the traditional custodians of the lands in and around New South Wales where our members operate, work, meet and live, as well as the Noongar land where I'm coming from today, here in beautiful Perth. I offer my respect to Elders past, present and emerging, as well as any Aboriginal and Torres Strait Islander people with us today.

To introduce myself, as you have heard, my name is Lucy McClean. I'm the director for New South Wales, Victoria and Tasmania with AMEC, or the Association of Mining and Exploration Companies.To introduce our association, we are a leading national minerals industry association with now over 500 members spread across Australia. Our members are the explorers, miners, emerging operators and, of course, all the businesses and services in and around the industry that support the sector. We have a growing number of members in New South Wales. We are a national minerals industry, but we have a local focus. We proactively work with government with an outcomes focus and with other stakeholders to support a sustainable minerals industry.

As you have heard and seen in the submissions, mining is a pillar of the New South Wales economy and core to the regional industries. It has helped New South Wales to really recover from the recent tragedies of the bushfires and the pandemic. In fact, the budget that was handed down and was updated from the figures in our submission did note that the royalties have significantly increased from the minerals sector for the forecast for the 2022-23 year. Those minerals royalties are so important for government spending on schools, roads, hospitals and recovery. In fact, the increase in revenue is more than double the immediate clean-up assistance from the recent floods, or four times the additional support for COVID following the Omicron outbreak. Back to our sector. Of course, as I noted, we are a regional industry, especially our AMEC members.

You may call us the smaller end of town, or the smaller companies. Of course, our companies work in regional locations. They purchase goods and services locally and they stay at the local hotels, drink at the local establishments and routinely hire local contractors. We are a critical part of regional industries.

The other excitement that you have heard is that New South Wales is really on the precipice of a new frontier for the minerals industry, with the rise of critical minerals, as I know you have already discussed, as the electric vehicle and battery storage revolution continues and the Government provides more support for critical minerals and starts to pivot to this important sector. New South Wales is leading the way with the landmark publication late last year of the Critical Minerals and High-Tech Metals Strategy and the recent budget support to ensure that the strategy is rolled out.

It's an incredibly exciting time for the minerals industry but, like every industry, we need great people, we need great technology and, of course, we need great investment. I know you have already discussed some of the key matters regarding staffing and skills that are critical for the sector going forward. But I would like to draw your attention to the importance of investment in New South Wales. The annual *Fraser Institute Survey of Mining Companies* was released following the submissions for this inquiry. That annual investment survey notes that New South Wales again has dropped on important parameters such as investment attractiveness, the best practice minerals index and even policy perception. Unfortunately, New South Wales remains one of the lowest Australian jurisdictions for uncertainty for environmental regulations, administration, enforcement of existing regulations and regulatory duplication and inconsistencies.

Technology, which I know is the subject of this inquiry, is critical going forward. In fact, the industry has come so far from the days of the pick and shovel. We do look forward to using those important factors—the great people of our jurisdiction as well as investment—to move forward to support the industry that, of course, supports New South Wales.

The CHAIR: Ms McClean, it is great to hear that New South Wales is leading the way in so many ways and what more might be done and for you to be saying so from sunny Perth, no doubt. Thank you for joining us from that side of our great nation. I will get straight to it. AMEC's submission highlighted the access to capital—and obviously that's what you are talking about here in terms of investment as well and the importance of

investment—and it being a barrier to the adoption of technologies and innovations in mining, and calling for reductions in fees and charges. What are the fees and charges that your members are raising as the main impediments to accessing capital investment in this way?

LUCY McCLEAN: I think there are a couple of issues there. The first one is accessing capital. Of course, the industry right now is thriving, there is no doubt about it, but I think we're also aware that there's quite a few storm clouds on the horizon. Broadly, capital has been relatively easy to procure up until quite recently. But what is important for New South Wales especially is that any leader of a mining company or an exploration company will quite often have projects in multiple jurisdictions. The important factor for New South Wales is whether that company chooses to invest in New South Wales or chooses to invest elsewhere. One of the most important points is whether both the companies and New South Wales have the right parameters to attract that investment.

Regarding the fees and charges, absolutely New South Wales has its generous fair share of charges. We start with the administrative levy for the industry and the rental fees, but also issues regarding security bonds. Of course, security bonds for any project are critical for the industry, but also for government and community, to have assurance that if there's some issue that certainly the rehabilitation can be undertaken. But I understand there are issues with the bonds. In other jurisdictions, again, the bonds have a different structure. They're more of a pooled fund, as they are here in WA. That certainly helps companies. Instead of effectively having to give thousands, tens of thousands or hundreds of thousands of dollars to the Government or putting it in safekeeping, instead it's more of a pooled fund system. Certainly AMEC for many years has been calling for a review of that security bond framework.

The CHAIR: Is that the primary reform? Are you suggesting other reforms as part of that as well?

LUCY McCLEAN: That is certainly the primary reform. With the New South Wales Government, there have been some small tweaks to the rehabilitation bonds recently just for very small projects, but certainly we have called for a more holistic review of that framework.

The CHAIR: To clarify, would it effectively be shifting funds intended for rehabilitation back into operations?

LUCY McCLEAN: There are certainly a couple of options. Of course it's important to have surety, but you can also understand that especially a small company often has to pay for rehabilitation twice. They have to initially give that money to government. It sits in a pot until the project is completed. But then they've also got to have money not just for the project but to completely rehabilitate the project before they can have sign-off and get the money back from the government, in this case. Certainly there are some unintended consequences. For example, we've heard of companies where they rehabilitate some drill core drill sites that, really, they want to go back and do more work on but they need to get the money back from the rehabilitation bond before they can do more work. It's a system that we believe could have significant improvements, especially when we can look at other jurisdictions.

Ms ROBYN PRESTON: Following on from that comment in relation to the bond, how do you see it working in a better way? Can you elaborate on that?

LUCY McCLEAN: Again, let me take the example of Western Australia, where they have this pooled fund system. For smaller projects, there is simply an annual fee instead of a very significant outlay. For larger projects, it's a graduated rate. It's a system that came in here, in WA, quite a few years ago now. It has ensured that the Government has now got a very significant pool that, in fact, it's using for what we in New South Wales call legacy sites to do that rehabilitation. Certainly it is a tried and true system that can work, although in fairness WA has a larger sector and more players, but we believe it's certainly worth considering for other jurisdictions. In fact, Queensland and the Northern Territory have also introduced a variant on this kind of system that supports industry with these up-front costs.

Ms ROBYN PRESTON: Thank you. I'm glad you've raised that. It will be in the report, so I appreciate that. Getting back to the Committee's terms of reference, which refers to examining past, current and future impacts of technological innovation and adoption by the broader mining regional workforce, do you believe the larger trend for the mining workforce will be towards workers with more advanced STEM and technical skills?

LUCY McCLEAN: Absolutely. The industry itself, as I mentioned, has come a long way from the pick and shovel, and of course it's becoming more technologically advanced. But that's not to say that—the industry right now, just as with every industry around the world, needs more people. Part of that is COVID, but part of that is also some of the skill shortages. Certainly, as the old adage goes, undoubtedly in a mere couple of years there will be many jobs in this sector that haven't even been dreamed of right now. Technology and technologically advanced skills are going to have a very important role in that.

Ms ROBYN PRESTON: Based on that, you've got those in the workplace now who aren't upskilled and who are feeling that their jobs might be made redundant. What's the process for upskilling existing workers?

LUCY McCLEAN: As Australia and New South Wales pivot from coal, I believe the recent budget included the Rejuvenation for Regions project. Although I don't believe the details are confirmed, certainly I would have thought it is both the Government's and industry's job to support those workers through that transition and upskilling.

Mr PHILIP DONATO: I will keep it short because I know there are some other members who wish to ask some questions that will probably take some time. One of the terms of reference of this inquiry related to technological advancements going forward. You indicated that there are going to be jobs in the future that we don't even know about yet. It is difficult to perhaps plan for that. Previous witnesses have addressed the Committee in relation to automation, the use of robotics and other types of new technologies. As you said, it's gone a long way from the old pick and shovel days. What impacts do you think automation will have on the workforce going forward? Do you think that there will still be jobs available for some of those more traditional roles or will they be made redundant?

LUCY McCLEAN: Obviously technology is coming into every sphere of the minerals industry, right from the very beginning. Even back, dare I say, when I first started in the industry many, many years ago, a sample would be taken and sent to the lab, but these days there is even onsite testing. Technology is absolutely coming into every aspect. They assure us that we're going to need every type of skill set. There are certainly fewer people at the more mechanical level of mining, absolutely, than there were 20 years ago, I would say. So I would think that that's going forward as it becomes a more technologically advanced sector—and the systems and safety improve with it.

Mr DAVID HARRIS: This is a question that your association might have looked at or had thoughts about, or maybe I will sow the seed. One of the offshoots of developing new technology locally is that that new technology could then be marketed internationally. Is there anything happening in that space in terms of looking at that as a potential new market?

LUCY McCLEAN: Absolutely. I think we even we saw it in the New South Wales Government's *Critical Minerals and High-Tech Metals Strategy*, which notes that the days where a company effectively brings resources out of the ground and ships them offshore should be ending. There is an important focus now on the whole system, and with all the geopolitical issues that is even more important. Absolutely, there is technology that is being used locally. Just recently I've attended some industry forums with presentations on new ways of local companies looking at, for example, mapping drill core. One of our member companies, very recently listed, has a partnership with an AI company. So, absolutely, this is technological advancement, as Australians do best, starting here and absolutely certainly promoting it internationally.

Mr DAVID HARRIS: On that, when we met with Newcrest, they talked about some of the IP around their robotics. They didn't want to license things because they didn't want to restrict the market. If they actually licensed it, it would've made it more expensive for other people to access. Is that a general view or do you think there is the possibility that if we do take out IP, that would give us international advantage?

LUCY McCLEAN: I think that's a great example of industry doing the best by the rest of the industry. I think most industry players are absolutely all about supporting their peers and promoting. Whether it's drilling results or whether it's IP, absolutely I believe most companies would be willing to support the other industry by enabling that information to be freely and generally available.

Mr CLAYTON BARR: Thank you, Ms McClean, for appearing. I want to go to the Fraser Institute report—policy perception, investment attractiveness et cetera. How has that changed over the years? What do you put those changes down to, or are we just where we always have been and there's nothing new to see here?

LUCY McCLEAN: In all honesty, usually how Australia comes out of that international survey is WA is close to the top for many parameters and New South Wales is close to the bottom, frankly, for Australia and, in fact, in many other parameters internationally. I think part of the issue there is absolutely perception. But, importantly, these are questions being asked to minerals industry executives who are investing in projects. I believe that New South Wales has worked hard in recent times to promote New South Wales as a sector and, as the Deputy Premier says, the number one minerals industry jurisdiction. Certainly we understand that objective, and the Government has been working towards that goal. But, certainly as you can see from the stats, there's more work to go.

Mr CLAYTON BARR: As a committee of Parliament, we're ultimately going to make some recommendations at the end of this journey, this inquiry. One of the measures that we did really poorly on was around policy perception. In terms of suggestions or things that this Committee might consider putting forward

by way of recommendation, what types of policy settings or regulations might potentially make us more attractive? The second part of that—and I want it to be separate, if it's okay with you—is around policy and regulation settings specifically around advancing technologies and adaptability of new technologies. If we can do the first one first, on existing, and then the second one on what we see going forward.

LUCY McCLEAN: With regulation, there's an absolute plethora. As has been politely termed by members, New South Wales has a matrix of regularly framework, which only the most driven will actually want to force through. Certainly when I did a quick review—it would be couple of years ago now—there were about 600 pages of documents that a company would need to do to simply apply for an exploration licence, do one drilling program and then relinquish that licence—not to mention multiple codes, guidelines and forms. AMEC have been calling for some streamlining and some ease of access for that regulatory overburden, as we can coin it. Certainly that is one issue, but it's also the whole process and that's simply just within the industry.

There's also the issue of the project development. Again, in New South Wales—in fact, a lawyer said to me recently that for a heritage building in New South Wales, putting in a project development today, they're pretty sure that they could be turning the sod and acting on that development in a matter of months. Whereas for a minerals industry project, that is decades—literally decades. Again, that is a very significant investment for any company to want to go through in both time, cost and simply hassle. They're some issues that I believe New South Wales could work towards, streamlining and improving those systems and processes. Does that answer the first part of that question?

Mr CLAYTON BARR: Yes, thank you. I was going to ask you the second part, please.

LUCY McCLEAN: Specifically on technologies, the exciting part is that with this new pivot to critical minerals there will absolutely be new technologies. Part of the budget did note the new critical minerals fund, so we believe that some of that fund will be grants for projects. In fact, that's a great way to attract interest into the State. But new technology grants would be a great way forward because, of course, new technology costs time and it costs money. So any government-industry collaborative work on those kinds of projects would, I believe, support our way forward.

Mr CLAYTON BARR: Are there currently regulations that suppress or impede adapting new technologies that exist or have recently been developed? Are we getting in the way, in any way, shape or form, that you can identify?

LUCY McCLEAN: I can't imagine the Government getting in the way at all!

Mr CLAYTON BARR: That's what we try to do: stay out of the way. The Minerals Council have made a submission suggesting that they need more flexibility around drones, as an example. Do you have examples?

LUCY McCLEAN: Certainly, yes. In fact, Mining, Exploration and Geoscience recently put out some new guidance on drones, because it was an issue of contention and question. It is good to have the clarifications. What's important going forward is that that these kinds of new technologies will come up. So, for example, drones and using some equipment in the field. What's helpful when these technologies are developed is that industry and government can work on a way forward where there is appropriate regulation, but also, as you say, government doesn't get in the way. So certainly there are examples there.

Mr CLAYTON BARR: If you were going to stand on a soapbox and proclaim two or three of the best technological advancements in recent years, what would they be in the mining industry?

LUCY McCLEAN: In the whole industry or in the exploration sector?

Mr CLAYTON BARR: In the whole industry.

LUCY McCLEAN: The whole industry? That's a big one. That's a very good question. Let me go to the exploration sector, which is where the heart of our membership is. Certainly I would say the XRF, which is a handheld device which you can literally zap on a soil sample and get some idea of the chemical make-up of that. So I'd put that as one. I'd put the other one as all the exciting new technologies with drill core. As I've said, there's now artificial intelligence that can map drill core. So drill core comes out from the drill rig, you have may seen, and that's effectively the truth machine and it tells the geologist what's in the ground. There's now a very quick way that that can be done with artificial intelligence. The other technology? I think I'd have to hand it to the New South Wales Geo Survey in some of the amazing new seamless geology that they've developed and some of the websites and other support that they've provided to the industry. That has really supported customers investing in the State.

Mr CLAYTON BARR: I take on board that you've just mentioned that primarily the work that you do is around exploration. I guess the very other end of the entire journey is about rehabilitation and/or dealing with

some of the waste products like tailings. Are you aware of technological advancements that are helping us to either do rehabilitation better and/or deal with some of the waste products like tailings better?

LUCY McCLEAN: Absolutely. In fact, with commodity prices as they are right now, first and foremost companies are partnering with government or working to, first of all, review those tailings and work to extract more, or, different metals from them, or even the same metals that were originally produced but now we have got better technologies. Certainly technologies regarding tailings to first of all extract more minerals are critical but also, of course, then in the rehabilitation. There are many university collaborative projects which really support and improve environmental rehabilitation. I point to some of those as examples.

Mr CLAYTON BARR: Fantastic. Thanks very much, Ms McClean. Back to you, Chair.

The CHAIR: Thanks, Mr Barr. Coming back to the regulation overburden, as you termed it, if it was relaxed or streamlined as such, how do you think this would be perceived publicly? Obviously it would require pretty clear communications and messaging around all of that to make sure that we were conveying exactly why and what was happening going forward?

LUCY McCLEAN: Certainly we would call for the regulations to be streamlined—as the cliché goes, cutting red tape. But in no way do we believe that the regulation should be reduced; certainly there would be concern with community. New South Wales is a great place to live and work, as we do. For that reason, many of the minerals exploration and mining projects are very close to population centres. Of course the community and the Government need to be assured that any of our operations will not impact. We are simply calling for a review of those regulations and more certainty of both the documentation and the time frames. None of that should give cause for any issues within the community.

The CHAIR: Thank you for that clarification. Are there any other questions from any of our members present? On that note, thank you very much, Ms McClean. There are obviously some very significant recommendations advanced there for consideration. It is tremendous to be able to hear those and look into it further as part of this inquiry. Thank you for appearing before the Committee today, and for your time and expertise. Obviously, you will be provided with a copy of the transcript of proceedings for any corrections. We may send you some additional questions in writing. Your replies will form part of your evidence and be made public. Would you be happy to provide a written reply to any further questions that we may have?

LUCY McCLEAN: Yes, absolutely.

The CHAIR: Lovely. Thank you very much for your time today.

LUCY McCLEAN: Thank you so much. I wish you well with your future deliberations.

The CHAIR: Thank you.

(The witness withdrew.)

(Luncheon adjournment)

Ms ANNABEL JOHNSON, Head of Policy and Advocacy, NSW Farmers Association, sworn and examined

Ms KATHY RANKIN, Policy Director, Rural Affairs & Business Economics & Trade, NSW Farmers Association, affirmed and examined

Ms JENNY BRADLEY, Chair, Innovation and Technology Group, NSW Farmers Association, before the Committee via videoconference, sworn and examined

The CHAIR: I welcome our next witnesses, from the NSW Farmers Association. Before we proceed, do you have any questions about the hearing process?

KATHY RANKIN: No, I'm fine, thank you.

The CHAIR: Would any of you like to make a short opening statement before we begin?

KATHY RANKIN: Jenny will.

JENNY BRADLEY: Thank you for the opportunity the provide the farmers' perspective on this critical inquiry on technology and the intersection with agriculture. My name is Jenny Bradley. I'm a farmer from Armatree and a member of NSW Farmers. Technology is disrupting many sectors, and agriculture will not be exempt from this. Australian agriculture has a history of being innovative and farmers are adopters of change. It is a part of staying in business. The sector in New South Wales is already using technology such as blockchain, artificial intelligence, big data and the Internet of Things to increase agricultural productivity. Technology stands to reshape the agricultural sector. A 2021 paper by the Australian Farm Institute revealed that full adoption of technology could open a $20 billion opportunity for agriculture nationally. NSW Farmers is driving the target for the State agricultural sector to reach $30 billion in farmgate productivity by 2030. This will make us key contributors to the national target of $100 million by 2030. According to the AFI's research, this sort of growth is possible with full adoption of technology on farms. It would get the national sector, which is currently worth around $80 billion, over the line to $100 billion.

The benefits of tech adoption for productivity have already been shown. Remote drone surveillance enables farmers to monitor stock from their office. Computer programs can help store yield data. Tractors can steer themselves with GPS auto-steer. Automation could be part of the answer to the sector's ongoing worker shortage. Agtech is expected to reshape the agricultural workforce. Young farmers, who tend to be the early adopters of new tech, all attest to the importance of this adoption to the success of their businesses. While traditional opportunities will always exist in agriculture, innovation will require new skill sets all the way along the food supply chain. With all the opportunities that technology brings, there are also clear challenges and constraints. Connectivity is seen as the biggest blockade to tech adoption on farms. Regional, rural and remote areas have a history of experiencing sub-par connectivity, which is not only a safety issue but also a significant productivity constraint.

It is not just farms that suffer, either. It's also the businesses in rural communities that are being held back in a market that is increasingly defined by online performance. I have many success stories of tech adoption on my farm, but when I travel to my nearest regional centre, which is Dubbo, I have network connection for just one-third of the journey. That's a 40-kilometre stretch in a 120-kilometre trip, and that's on a major highway, which is simply not good enough. Our lived experience of challenging mobile access acts as a brake to new technology adoption through satellite or local specific networks. Another big tech concern for farmers currently is data storage. It's great having the yield information stored in a central location, but farmers need certainty around how service providers are using this information. Currently, there are no instruments to regulate the use on-farm data, which opens a plethora of ethical and moral concerns.

As is typical in the tech space, the regulatory framework is lagging behind private sector innovation. NSW Farmers now supports the use of the *Australian Farm Data Code*, an instrument developed by the National Farmers' Federation to inform the policies of service providers who manage data on behalf of farmers. It's important for farmers not only to benefit from the latest technologies but also to have certainty and clarity around how that information is stored. Technology is increasingly a critical tool and enabler for productivity improvements across the whole economy. The New South Wales agricultural sector has a clear aspiration to grow a $30 billion in-farm gate output by 2030. Technology in all its forms will be critical to aid this growth and secure our commitment to high-quality produce for consumers in Australia and across the globe.

The CHAIR: Thank you very much, Ms Bradley, for that opening statement. Following on from that almost directly, researchers have suggested to this Committee that one of the other apparent key barriers to the adoption of agtech by primary producers is often a significant issue of trust between primary producers and the

agtech developers and suppliers. Do you feel that that's the situation? If so, what more can be done to overcome this potential trust deficit and industry perception? I will open it up to all three of you to answer that one.

JENNY BRADLEY: I agree that trust forms part of that. You've got certain levels of trust, those people who understand technology. As I mentioned before, there is the *Farm Data Code*. Farmers collect a lot of data. If that data is then sold on or value-added on by those companies for their own benefit, that trust has been broken. The other level of trust is the lack of exposure to technology. So, therefore, there is a barrier of adoption due to a lack of trust. As I have stated before, connectivity is critical in technology adoption. If we haven't got that connectivity, we can't trust in the machines we use or that data collection that we do because there are always interruptions to that collection and use of that data.

The CHAIR: Would either of the other witnesses like to contribute further to that?

KATHY RANKIN: Yes, I'd be happy to make a further comment, and it really underscores what Jenny has been saying, using an example of the right to repair farm machinery. Our position is that the farming sector should have access and control over that data, given that it's about how, where and why that machine is used. But because of the restrictions that sit there around the owners and developers of that machinery, the farmers actually don't have access to that data. So where does that data go? Who uses it? That doesn't come in a contract when you purchase a large harvester.

ANNABEL JOHNSON: I will just make a comment. At the R&D stage, there's a need for agtech providers and other education and R&D service providers to have more of an understanding about the problems that are being experienced on farm so that they are developing solutions that will work for farmers. The same comes through when you go through the chain when there are technology solutions, not just agtech, that could be adopted on farm, making sure that farmers are supported. So they aren't just sold a product and asked to implement it, but there is a service making sure that the product performs and has the service that they have been guaranteed. So they're two critical points at either end of the chain that will build trust in the middle.

Mr CLAYTON BARR: Kathy, can I go back to what you were saying? Could you expand on that? It sounds like the producer of the tractor—let's say I make tractors, so Barr Company Tractors. The tractors go out and work in a field on your farm. Does I own the data and information that comes out of Barr Company Tractors?

KATHY RANKIN: Barr Company does, yes. That's one of the challenges we have. The structure of those machinery licences is that you purchase a tractor and all the data that sits in that that's collected by the computer in that tractor is actually owned by the company—say it's Barr Company Tractors, for example.

Mr CLAYTON BARR: So the GPS coordinates, the fuel usage and the yield? In terms of harvesting, some parts of the paddock might yield more tonnage and others less. That's all owned by the tractor company—in my example, Barr Company Tractors. Is that right?

KATHY RANKIN: In the main, yes.

Mr CLAYTON BARR: Holy cow!

KATHY RANKIN: That's part of the reason why the NFF Data Code was put in place. That information that is actually critical—business operation information—is taken away from you and you don't have decisions about who accesses, who uses it or where it goes.

Mr CLAYTON BARR: Do you think it's possible for a government like the New South Wales Government to legislate that that information has to be made available to the owner of the vehicle or the paddock?

KATHY RANKIN: The reason that I've raised it is that probably two or three years ago the ACCC undertook an inquiry into the right to repair machinery. That right to repair sat around the inability for a local mechanic, if you like, to be able to access the data, as you can with a commuter car now. That doesn't exist for agricultural machinery. The things that we've found from that is there are significant restrictions still going on and still in place. To answer your question, following the ACCC inquiry, the Productivity Commission undertook an inquiry. They have found that there are probably two levels of legislation that may be required in order to expand access and information around that data and that right to repair for agricultural machinery. It sits more in consumer and IT legislation, so Federal legislation rather than State legislation. There were recommendations from that Productivity Commission review that said that there did need to be consideration of amendments to federal IP law.

Mr PHILIP DONATO: Jenny may be best placed to answer this. But one of the other ladies, feel free to jump in. Fundamentally, from what I understand both from reading the submission that was made, which I've just read on the website, as well as your opening address, Jenny, fundamentally all these issues rely around, like you said, connectivity, whether that be mobile black spots or internet accessibility. As the member for Orange,

you only need to drive 10 minutes out of Orange north on the Mitchell Highway and you hit black spots routinely, which is very frustrating. That's in Orange. I'm well aware of many farmers I know, not only in the Central West but in other areas of the State, who are frequently very frustrated with the lack of mobile phone connectivity and access to the internet. It has implications, like you've said, for not only occupational health and safety but accessing the internet. Accessing emergency services as well can be problematic in that regard. Jenny, am I right in assuming that, fundamentally, a lot of this comes back to issues of inadequate connectivity, whether it be to mobile or internet services, across many parts of regional New South Wales?

JENNY BRADLEY: Sorry, Mr Donato, as far as running a business, that lack of connectivity? Is that what you're asking?

Mr PHILIP DONATO: Running a farming business or generally just accessing a mobile phone. Like you've said, when you travel from Armatree to Dubbo, three-quarters of the journey, or something like that, is not even covered with your mobile telephone. But fundamentally all these other issues rely on reliable connectivity. Would that be fair to say?

JENNY BRADLEY: Absolutely. Mr Donato, on that major highway, which is a terribly busy highway, if there was an accident if those black spots, I don't know what I'd do. Usually you just ring triple-O. That is just one small instance. Coming back to the farm business, for instance, I need connectivity to actually make sheep transfers online. I need that connectivity on my computer to be up and functioning if I were moving stock the next day, to fill out the paperwork, to make it a legal document.

Mr PHILIP DONATO: Sorry Jenny, if I can just stop you there. What's the internet like at your property where you live?

JENNY BRADLEY: Look, it's okay depending on where I am.

Mr PHILIP DONATO: Are you relaying on a satellite dish?

JENNY BRADLEY: In my house, I have a booster to bring my connectivity up to four bars.

Mr PHILIP DONATO: Yes.

JENNY BRADLEY: I had to put that in but if I drive five kilometres to one particular part of my paddock, I haven't got mobile service, no.

Mr PHILIP DONATO: I am sorry I interrupted and my apology for that. When you said inputting data application for your sheep, for example, I can see a photo behind you on your wall. I take it they are your sheep, very proudly standing behind you. No doubt you speak to many members of NSW Farmers as well as your neighbours and that general cohort, but do you find that's a common problem or theme that you're hearing?

JENNY BRADLEY: Absolutely. We have a region that's known as western districts That is a very large area, as any parliamentarian knows. That is Wilcannia, Bourke, right out there. Connectivity is one of their major limiting factors out there when it comes to stock. There's a new adoption by Integrity Systems company, which is our largest developer—our governing organisation over sheep and stock movements and accreditation around that. It's a new phone app, which is great. I have used that phone app because I have connectivity in my house. But those western district farmers out there that haven't got connectivity in their households, they won't be able to adopt that new technology.

Mr PHILIP DONATO: That would be quite a number of them, I take it?

JENNY BRADLEY: That's a common theme throughout conversations with them regarding the adoption of this new technology. Don't underestimate the new technology. It is quite clever in that it actually encompasses QR codes to transfer that information to truck drivers. But you have to be able to generate it on your mobile phone first.

Mr PHILIP DONATO: The other ladies can feel free to jump in if you wish to answer. I'm just asking generically towards Jenny, but if Annabel or Kathy want to answer, feel free to jump in or answer at the end. One of the other things you raised was the issue of trust. I know the Chair asked you a question in relation to data storage and the sharing of information and where that information is going. The Committee heard some evidence earlier from another witness about blockchains, which I know is referred to in the submission that was made by NSW Farmers as well. Are there concerns as well in relation to the security of data in blockchains?

JENNY BRADLEY: That security of data, I made reference to the *Farm Data Code*. A lot of farmers don't even realise that when they turn on their tractor, you have just hit "I agree" on the button. You have agreed to all that data being handed over to them. I think the Chair might have alluded to yield data as well. That data is collected by farmers, but we don't have ownership over it in a lot of cases. It's taken and used by larger companies

to develop machinery or in particular chemicals, and target certain areas and certain cropping areas with bigger marketing advertisements or marketing initiatives around those types of chemicals. So they do collect a lot of data that farmers are not aware that by hitting that "I agree" button to start up that tractor or harvester, that they are agreeing to actually hand over that farm data that they have collected.

Mr PHILIP DONATO: Is that information shared live is it when it is sent in for a service? That information from the tractor's computer, is that information shared back to whoever it is shared with, I guess, instantly, or is it when it goes in for a service? How does it work?

JENNY BRADLEY: I'm not quite clear on how it actually is shared, whether it's live or not. I'm not quite sure. I can't answer that. I can take it on notice.

Mr PHILIP DONATO: That's alright. I have no further questions.

Ms ROBYN PRESTON: I welcome our witnesses. I will go to the grievances that Mr Donato has raised in relation to poor mobile access and internet coverage. Good old Hawkesbury in Bilpin has doubled and it's only an hour's drive from the city. I'm just wondering, what has the NSW Farmers' Association done in relation to lobbying to telcos and also to the Federal Government to look at this issue? It's not the State Government's responsibility. What have you done and how successful have you been to date?

KATHY RANKIN: Ms Preston, I'm very happy to respond to that one because it is a really challenging situation. One of my areas of responsibility is that farmers' telecommunications issue. I would be very happy to share with the Committee a very brief overview that we prepared for the survey that informed our response to the federal telecommunications review that was released last year. One of the things that we found in that survey was that, if I could just quote it, "Over the last 12 months majority of respondents of just under 1,000 respondents experienced a slight to significant decline in mobile network coverage and 60 per cent experienced a slight to significant decline in internet connectivity."

What we have seen over a period of years, because we have been responding to these since 2018, is that there is a very specific decline in accessibility for mobile coverage in those regional areas. Some of the really significant challenges are around the fact there is increased use of mobiles as the way of engaging with the technology delivered experiences. In terms of what we've been doing, we work very closely in advocating to Telstra, to TPG and, to an extent Optus, regarding the challenges that we are facing, asking them to seek better intelligence and engagement with our individual members who are raising these concerns. On a connectivity map, everything looks rosy, everything looks fine, everything's green. But when you get down into the geographic challenges of not being able to access it, that's when the issues arise. So we are lobbying, we are advocating on a federal level, both on our own and also with the National Farmers' Federation and the Regional, Rural and Remote Communications Coalition, to get some of these changes made.

We have identified opportunities where black spot funding needs to be put into place in New South Wales. We have also contributed and identified areas where Telstra, in particular, should be putting in their bids for the Regional Connectivity Fund and, unfortunately, the focus of that funding by the telco has been on major roads connectivity rather than within the business premises or within the local farms itself. It's sad to say that we probably haven't achieved as much as we would like to have achieved, but I think that one of the benefits of what we have been doing is that we have identified that there needs to be a greater engagement by the telecommunications companies with farmers, talking about what they are buying rather than just selling them a product so that the farmers actually understand what it is that they are able to do with the product.

We have been very concerned about the potential gap when Telstra moves from 3G to 4G and then eventually 5G in the regions if our members or if the farming sector or even rural communities don't have good access to that connectivity beforehand and knowledge about what that means. We are also seeking support for the purchase—Jenny mentioned that she has a booster in her house—to support the farmers themselves to be able to increase their reception connectivity so that it is a way of bridging that divide. But it is really challenging, and we would actually like to see all of the telcos do a little bit more, including greater opportunity for access to the NBN.

We do know that the satellites and the Sky Muster Plus process is actually helping in some ways, but with telecommunications, every time you do something that makes it a little bit better, it increases the traffic. It, therefore, increases the demand and then has that knock-on effect. But we are continually working with it because it is such a critical issue, because all government departments are assuming that everybody in regional areas has the same connectivity and speed that they do in cities. With a whole lot of the business reporting and compliance that has been moved online, issues of "Do I have certainty that I will have continuity of access to that data to start and end the transaction?" as well as whether there is an opportunity to be able to use the two-factor authentication—so that interface and interaction between mobile and data availability continues to be a challenge.

Ms ROBYN PRESTON: Would anybody else from the witnesses like to comment?

JENNY BRADLEY: If this is the close, I would like to make a comment that we as farmers are early adopters of technology.

The CHAIR: Jenny, we still have some other questions to go yet. We don't need to close until 2.30. We will certainly give you that opportunity as well, but we will just finish giving the opportunity to the members to be able to ask some further questions.

Ms FELICITY WILSON: Thank you, ladies, for joining us today and for your contributions so far. I am very interested in workforce. Obviously a lot of the feedback we hear across geographies and industries is that there is a significant challenge at the moment with labour and skilled labour. You have made contributions to us in your submission about the age profile of farmers, trying to get younger people into work in farming communities. Do you have some suggestions you would like to expand upon—maybe not looking at the immediate term, where there is a challenge for everybody—about the medium- to long-term attraction of labour skills? What do you think we need within these communities in order to continue to attract young and skilled labour there and not just people working from home on big-city jobs but working locally? Can you give us a little bit more of your perspective on that?

ANNABEL JOHNSON: Absolutely. Workforce is a critical issue for the agricultural sector. It is both in the unskilled and skilled area. Much of the focus has been on unskilled, which is an area that we think technology can play an important role in. It is important that we start the planning now so that businesses are prepared for what technology might be able to offer. I'll use the example of orchards. Orchards need to—those that have been planted at the moment are making sure that there is more width in the roads so that if we do get automated technology, whether it is undertaking pruning or undertaking some of the activities or harvesting that are manually undertaken by people at the moment, you've got enough space for the vehicles or whatever the technology might be to be able to uptake. It is important to factor that in, because otherwise we will need to be retrofitting a lot of those opportunities.

That's looking at the opportunities on farm. If we take a step back, we do need a skills strategy to look at what are going to be the skills that will be required. It will be different to what has traditionally been required. Drone technology will be uptaken on farms, which is completely different to what we have been looking at. It's not just on farm. It is also going to be at our processing and value-adding places in the future where technology will play more of a role. We see it as a transition. We need to come up with a strategy to transition workforce that might have traditionally undertaken manual labour into some of these new opportunities. Do you want to provide more comment around our skills strategy?

KATHY RANKIN: Yes. We believe that there needs to be a focus, both government and private, on building entry-level skills for people to move into the workforce but then also to help people to transition as they move up into the higher levels within the workplace. Those skills really are around financial literacy, digital literacy and business management. When I say "digital literacy", I think a lot of it is really about being able to understand and interpret the data that is being provided to them. In a lot of ways, there will be a product that will be provided to organisations that they will make a decision as to whether that's going to be a useful activity for their business to take on, how does the farmer or business operator then really feel comfortable and confident about using that data for projections and understanding where to go with it, and then also looking at those skills around innovation, adaptation and adoption so that not only is it about measuring and monitoring what information is coming in but then how you plan into the future to build the productivity deliverable from there.

Ms FELICITY WILSON: In our trip to Wagga Wagga, there was a comment made that there might be that gap between seeing opportunities in the marketplace technology-wise and how to apply those realistically. People might go and purchase a drone, thinking there is a great opportunity for their business, but then maybe can't utilise it or it can't travel the distance that it needs to travel or it can't communicate back to base once it's travelling, et cetera. Who or what do you see is that point in between the people who sell technology or license technology—providers—and farmers to help translate the applicability on farm? Is that you? It's not always about skill, that application of that technology; it's about utilisation. How do you see that translation occurring?

ANNABEL JOHNSON: I think it comes critically down to making sure that we understand farmers' problems at the start and we don't sort of say, "Here's a solution that you should use." Drones are a good example in terms of farmers using them in ways that we didn't think that they would. As Jenny said, farmers are very innovative that they are going to be using that, but I think there is a critical role essentially for that "problem" definition to be better sought out, both with the R&D providers that are going to work in with agtech but other technology companies. We shouldn't limit the technology use just to agtech that will be used on farm. Technology use in biosecurity on a systematic scale will be really important to the future of the industry. I think it's that "problem" definition of making sure that everyone is on the same page and understanding and not limiting, saying,

"This is the problem, and you will use the drone in this way," because what's for certain is that our farmers will innovate in other ways that we didn't foresee.

Mr DAVID HARRIS: I spoke to Charles Sturt this morning about biosecurity, and obviously it is topical at the moment with varroa mite and also potential for foot-and-mouth. From the perspective of the NSW Farmers' Federation and the farmers, is there enough being done in terms of technology for tracking biosecurity issues—such as vehicle management, stock management and all those sorts of things—so that if we do get an outbreak, it can be closed down very quickly and dealt with?

ANNABEL JOHNSON: We'd always like to make sure that our systems are foolproof, and there are opportunities to continue to improve in that area. It's not just in terms of tracking and tracing; it's also in terms of surveillance. With climatic changes that are occurring, we're going to have pests and diseases that could come in on weather systems, on migratory birds or on other animals that don't move through our ports. There are risks that we need to get better at understanding, and have surveillance in the environment so that we can pick up these diseases or pests as quickly as possible. Once we have got a disease or pest in then, yes, tracking and tracing, so that we can understand where it is, becomes an absolutely critical element to ensure that any outbreak is quickly controlled.

In terms of our annual conference, our members have voted as of last week to move to an individual sheep identification system. That will give the sheep industry and the cattle industry individual tracing of animals that will improve. But it's a very good point: They're not the only things that need to be traced and tracked. We do need to get a better understanding about vehicles that are coming on and off our property. Our farmers do a good job in managing and understanding when they know vehicles are coming on and off, but an area of concern is when energy contractors are coming on or mining companies are coming on. Those sorts of movements where you don't need the farmer's permission to be coming onto their properties are a large concern for our farmers because there are risks that our farmers aren't able to actively manage.

The CHAIR: What about from a recreational point of view? They are now talking about rail trails. I know that for farmers in my electorate of Monaro, one of the bugbears and the concerns about that is the potential for the biosecurity risk. That's something that they feel needs to be looked at and taken more seriously in that regard as well. Would you agree with that?

KATHY RANKIN: Yes, we would, mainly because there are protections in law for farmers to actually require that people contact them before they come onto their land as long as they have got that biosecurity signage up there. The farm community knows that; the recreational users don't. From my perspective, making sure that there's a broader education campaign and awareness campaign is really important so that other people understand what is actually their responsibility as well as their right for recreation.

Mr DAVID HARRIS: Jenny, have you got a perspective on that? I know that some of our local farmers in my electorate have started to implement biosecurity measures just as a safety precaution. Is that something that you have to do and monitor? Do you have the technological support to make sure that you're pre-warned et cetera?

JENNY BRADLEY: As far as the biosecurity on farm, we encourage everyone. You have to actually have that biosecurity plan in place to be LPA accredited. But we are trying to get people within the organisation—we've had heightened awareness around making sure that those farm biosecurity plans are up to date, to be on the lookout, and to monitor who's coming into your property and who is leaving your property. We've been doing that, and I think I have seen a bit in the media, but that probably needs to be heightened. I note the point on more tourists along railway lines and things. It's great that they're getting out and about and into rural areas, but they also hold a responsibility as far as biosecurity. They are moving around the countryside and moving product around the countryside.

The CHAIR: Mr Barr, you've got four minutes.

Mr CLAYTON BARR: Is it all mine? Jenny, I note those beautiful sheep there in your background. Do you have the individual tags on them to monitor their health and wellbeing? Can you explain to the Committee how that works and what important information you get from something like the tagging?

JENNY BRADLEY: Yes, great question. I love it. Each of these particular animals in the background—we're a seed-stock producer—are individually identified, and I'm doing it at the moment, from birth for their whole of life. Every year we capture eight particular traits on those animals so that by the end of their lifetime they have got quite a large bucketful of data on that, which is carried up against that eID. We also have an automatic drafter within our system when those animals go through. If I have got 600 animals and I want to see all those ones that are carrying above-average fat on their carcasses, I will set the autodrafter and that will draft off 200 of those exceptional animals carrying a large amount of carcass fat. We can select any trait that we've collected. I can draft on birth weight. From that eID, I can draft off all those animals that have too high a birth weight and I can cull

them out, because that just creates problems when they are used across another type of sheep breed—and dystocia, so you have lamb losses. We're trying to drive a business and it all revolves around technology and eID tags in those sheep.

Mr CLAYTON BARR: So high temperatures, low temperatures, if they are needing medical or vet support, pregnancy, when they are ovulating and all that sort of information is at your fingertips due to the tags?

JENNY BRADLEY: Probably not to that detail, as far as body temperature. Remember, that data has to be collected and then we can use that to draft on. It's all that information I collect. I also use genomics, which is a genetic technology. If you are a lamb lover and you love your tender lamb—

Mr CLAYTON BARR: Yes, I am.

JENNY BRADLEY: —we collect genomics, which is all up against that eID tag. We can select off animals that carry high intramuscular fat, or IMF, and low shear force so you're not putting your boot on it when you're eating it; it melts in your mouth. We use that for genetic gain across our sheep industry. Come to me if you want tender chops and less fat!

The CHAIR: Deal.

Mr CLAYTON BARR: Alright, send me your address. It seems to me that there is more trust in the public entities around the research and the research and development and stuff like that—essentially, our universities and/or the agronomists or extension specialists. I know it's in your submission and it's in your recommendations, but I wanted to give you the chance to put it on record as well in *Hansard*. Am I interpreting your submission correctly, that there's more trust in public entities as opposed to some of the commercial entities, who have a financial outcome they might be willing to drive?

JENNY BRADLEY: Independent. Can I answer that, Annabel and Kathy, from a farmer's perspective?

KATHY RANKIN: Yes.

JENNY BRADLEY: With my cohort and my peers, we all believe that independent research gives us a better grounding and understanding, and a fair review of that information, rather than being driven by a chemical company or a product that they are trying to sell. Independent research is by far the better way that I source my information. The way that I move, I analyse all that and then make my management decisions around that independent research.

Mr CLAYTON BARR: Okay. Are some of those independent players active in reaching out to farmers as opposed to waiting for the farmer to inquire with them?

JENNY BRADLEY: I have a view that extension is probably not done to the degree that it should be. We have great independent research bodies that carry out some great research. I see a lot of it because I tend to be at the top of that food chain—I call it the food chain—but a large percentage of farmers don't see that because that extension is not out there and at ground level.

Mr CLAYTON BARR: Annabel or Kathy, I think that NSW Farmers have a body called the NSW Farmers digital technology officers. Is that right? Do you employ them to go out and assist farmers with understanding technology developments and opportunities?

ANNABEL JOHNSON: That's a project that we believe is required in this space. With our connection with farmers, we think we are independent and in a good position to be able to facilitate that. As Jenny said, if you are independent, you are not selling a product. You are actually working with the farmers and understanding what their needs are, and then what might be in the space. This a complex area, and we do think there really is a role for someone such as ourselves who is trusted by the farming sector to work on increasing adoption of agtech and other technologies.

The CHAIR: Obviously one of the things that has emerged out of this—perhaps most prominently of all—is the fact that it's connectivity that is one of the most pressing issues, and fixing this or addressing this or making some inroads on it is going to be able to see commensurate gains in other areas in this space as well. Jenny, did you want to briefly conclude now that our time is up today?

JENNY BRADLEY: I just had a statement that we do embrace change. Nearly all farmers love new technology, new toys and ways to make use of them. It drives our businesses, but if we can't reach it or use it in a trusted way that it's not going to drop out, it makes that technology really difficult. Thank you.

The CHAIR: Yes, I agree entirely. Thank you all for being here with us today and appearing before the Committee, and for the information that you have been able to provide to us. You will be provided with a copy of the transcript of proceedings to make any corrections. We haven't taken any questions on notice. We may send

you some additional questions in writing. Your replies will form part of your evidence and be made public. If needed, would you be happy to provide a written reply to any further questions if they are forthcoming?

ANNABEL JOHNSON: Yes.

KATHY RANKIN: Yes.

The CHAIR: Thank you very much and travel safely.

(The witnesses withdrew.)

Professor HUGH DURRANT-WHYTE, NSW Chief Scientist and Engineer, before the Committee via videoconference, affirmed and examined

Mr PETER DAY, Executive Director, Resources Regulator, Mining Exploration and Geoscience, before the Committee via videoconference, affirmed and examined

Ms KATE ALEXANDRA LORIMER-WARD, Deputy Director General, Agriculture, NSW Department of Primary Industries, affirmed and examined

Dr JASON CREAN, Director, Climate, NSW Department of Primary Industries, affirmed and examined

The CHAIR: Thank you all very much for joining us this afternoon. I appreciate our next witnesses from the New South Wales Government. Before we proceed, do any of you have any questions about the hearing process?

HUGH DURRANT-WHYTE: No.

The CHAIR: Would any of you like to make a short opening statement before we begin with the questions?

HUGH DURRANT-WHYTE: No, I'm fine.

The CHAIR: Mr Day?

PETER DAY: I'm fine too.

The CHAIR: In that case, we will commence. Dr Crean and Ms Lorimer-Ward, you may potentially have been in the room to hear some of the previous testimony from our witnesses. I think we can jump straight into that and say that one of the consistently raised issues on main barriers to both agtech adoption and uptake of online training courses in that digital space has been regional and rural connectivity. We know that work is occurring in these spaces, but how might these regional connectivity issues be better addressed in order to be able to deal with the issues that we have heard raised consistently throughout this inquiry?

KATE LORIMER-WARD: Thank you for the question. I would start by saying, and I will ask Dr Crean to come in with a bit more detail about one of our programs, is there's—the Government does acknowledge that there are black spots and that they do call that out. There are limits to what I can add value to that conversation today because it is not a program I look after. Within the Department of Regional NSW, we have a $400 million program, which is the Regional Digital Connectivity program. That is focused around improving regional connectivity, and it does have four strains to that program. It looks at the gig economy in those regions and it looks at connectivity to the home. One of the programs that Dr Crean will talk about is our Farms of the Future program, which is about trying to improve on-farm connectivity to support the uptake of technology. Jason?

JASON CREAN: In a general way, I guess at a New South Wales level there is that $400 million Regional Digital Connectivity program that is run by the Department of Regional NSW. That is trying to actually fix up some important gaps in connectivity in regional areas. On a more specific level, one of the programs that the Department of Primary Industries is working with the Department of Regional NSW on is the Farms of the Future program. That is a $48 million investment, basically rolling out agtech to a number of different case study regions across New South Wales. An important part of that is around the education capacity building bit, but the other part is really around incentivising device uptake and that actually also includes addressing connectivity in each of those areas. The connectivity challenges vary region by region and even sort of farm to farm. Through that program, you will end up with a more tailored solution for all those particular properties so we can not only get an adoption of some of the technology in terms of sensitive devices et cetera but also the connectivity options that are going to work for that particular property. That's the more specific sort of program of work that we have got operating within DRNSW and DPI.

The CHAIR: Professor or Mr Day, anything that you would like to add to that?

HUGH DURRANT-WHYTE: Yes. This is an area that we are quite heavily involved in from a number of different perspectives. I think the first thing to say is about overall connectivity. The communications industry is undergoing a lot of change at the moment, as I'm sure people are aware. Everything is moving to 5G, and we are certainly on the path to 6G. As a property owner myself, we are certainly aware that things like Starlink are now arguably a better performer than national broadband. Through my office, the Chief Scientist's office, we have funded a number of companies, including Zetifi and a number of others in the private sector, who are now providing systems that basically run wi-fi on mobile equipment right across the farm. I wonder whether the future here is going to be a lot more low-Earth orbit satellites rather than geostationary, which is currently where NBN is invested. I also think increasingly it is going to move away from government-provided networks to privately

provided networks in general as a connectivity issue itself. I would go further and say that, again, a future communications area in general is likely to see a much more significant private sector, non-Australian set of providers than we are currently used to.

PETER DAY: Yes, we've got nothing to add to that from the point of view of the Resources Regulator.

The CHAIR: One thing that I would point out there is that obviously we're talking about the New South Wales Government and what we're doing at a State level when we know that telecommunication is also Federal. Do any of you feel particularly strongly that more needs to be done in the Federal space as well? How well are we working across these levels of government? Obviously, it's not going to be an issue that can be resolved at a State level on its own, so is enough happening in that space and do we need to be doing more?

KATE LORIMER-WARD: I don't know that I can comment specifically about whether they're doing enough, but I do know that from an agriculture perspective—earlier this year the agriculture Minister at the time released a Digital Foundation Strategy. That Digital Foundation Strategy is an important part of starting that rapid uptake and acceleration of agtech for the primary industries sector. We hope that, through those sorts of sector-specific strategies around digital, that also links into the wider agenda around connectivity.

HUGH DURRANT-WHYTE: Again, I will say the private sector is doing a lot in this area. The Sydney Basin is home to—I can't remember what the number is but something like 80 per cent or 90 per cent of the investment that's going into digital ag at the moment, so companies like The Yield and those sorts of companies. That group of companies raised something like $150 million in venture capital last year, just to give you an idea of scale. There is an issue I heard mentioned earlier about skills. I mean, they're still largely based in the Sydney Basin rather than the regions primarily because of access to digital skills. That's certainly something that I think could probably be addressed. Many of these companies are now quite significant players overseas as well as here in New South Wales.

The CHAIR: Anything further on that, Mr Crean or Mr Day?

PETER DAY: From the point of view of the mining sector, there is a lot of research going on from a range of bodies attached to either universities or private industry—a bit like Hugh said. And no doubt while they're utilising technology, they're going to require adequate and enhanced communications systems as well. One begets the other, so they'll be very interested [inaudible] where what is developed over time through that technology pathway around communications networks.

Ms ROBYN PRESTON: My question is about looking at adequate quality education and training now to meet the more diverse skill set required in particular workers. Has the Government found any factors contributing to the low uptake of STEM education and training, particularly in regional areas?

KATE LORIMER-WARD: I'm happy to lead off. Particularly from the Department of Primary Industries' perspective, we do have a dedicated schools program, which is about particularly providing agricultural education resources that can be used within the schools to support all STEM programs. What we do is try to make sure that STEM is delivered through an agriculture lens. That does involve us organising field days or open days or excursion-type events for school students to give them exposure to ag technology. We give teachers resources and we support the National Education Foundation through PIEFA and make all of our resources freely available there. Any teachers can access those resources nationally.

The other part that we do around trying to encourage STEM in education is—the Department of Primary Industries also runs a registered training organisation called Tocal College. That agricultural college does take in students from 16 years of age. We take them into a full-time residential program. As part of that, we give them skills to be able to undertake precision agriculture to actually be able to undertake all of those sorts of agtech activities. We teach them those in a commercial setting so they learn those skills through a vocational education setting on a farm at that scale. They're some of the initiatives from Primary Industries' perspective about getting students engaged in STEM.

Ms ROBYN PRESTON: I just want to touch on the Science and Engineering Challenge event. I know that is run by the office of Chief Scientist & Engineer. What's been the interest in that program in regional and rural settings? Can you—

HUGH DURRANT-WHYTE: With the programs that have been focused on [audio malfunction].

The CHAIR: Sorry, Professor, we're just having connectivity issues, it would seem.

HUGH DURRANT-WHYTE: It's not restricted to the regions.

The CHAIR: Just a bit laggy there. We might just get you to restart, if you don't mind.

HUGH DURRANT-WHYTE: Sure. We ran a number of programs which were regionally focused, particularly, I note, the robotics in schools program, which was focused on agricultural robotics. We actually had a company design, build and deliver a number of robots for schools so that they could use them to program and operate—things like that. I will say, though, and this is probably a little slightly left field, that the skill sets in general are not—some of the companies in the agtech space or in digital mining, which is another area that I get heavily involved in. A lot of the data science, machine learning, AI types of skills—there's a very shallow pool regionally. That plays a significant part in both keeping people, I think, in the regions but also ensuring those companies themselves play a more active role in the regions, if you see what I mean. It's not obvious to me how that gap is sensibly closed.

Ms ROBYN PRESTON: Just elaborating on that and looking at the interested students in that area, do you find it more of an interest for males or females? Is there something that stands out there?

HUGH DURRANT-WHYTE: That's a good question. It does vary across fields, in my view, and I don't have the figures to hand. But in pure computer science areas, the reality is it's not been very equally balanced in a gender sense at all. Having said that, if you move to what I think of as more agtech—that is, involved in genetics, genomics and data allied to that—then it's much more close to 50/50. Also in this area, I think something that's important is a lot of combined smaller technology-based startup companies, with some notable exceptions—relatively few of them are run by females. The exception in this case—if you've not already spoken to her—is the lady who runs The Yield, which is quite a well-known, quite significant startup company. It's no longer really a startup company. It developed microclimate estimators for crops and food and things like that. They are based primarily in Sydney and in the US.

The CHAIR: Mr Donato?

Mr PHILIP DONATO: Thanks, Madam Chair. I should put on the record, firstly, that Kate Lorimer-Ward is a woman known to me. I just put that on the record to make full disclosure.

The CHAIR: No more questions now!

Ms FELICITY WILSON: Chair! Chair!

The CHAIR: Moving on—

Mr PHILIP DONATO: I'm just putting that on the *Hansard* record, that's all. Ms Lorimer-Ward, earlier you said in your address when you were asked a question in relation to the conductivity issue about the $400 million Regional Connectivity Program, which is a State-facilitated program. As I understand it, it was announced around or just before the last election in 2019. Do you know how much of that money has been spent so far?

KATE LORIMER-WARD: I don't, and I'd have to take that on notice. It's not a program I oversee.

Mr PHILIP DONATO: All right. Jason, do you know? I think you said it was dealt with through the Department of Regional NSW.

JASON CREAN: Yes.

Mr PHILIP DONATO: Do you know how much of it's been spent?

JASON CREAN: No, no—sorry, I don't. We have to take that on notice. I can only really talk about the DPI-related activities so that one's sort of not my level.

KATE LORIMER-WARD: Yep.

Mr PHILIP DONATO: That's okay. If you could take that on notice, I would appreciate that. The other issue is in relation to biosecurities. I'm not too sure who would be the most appropriate person to answer those questions but I read in the submission, specifically page 8, where you talk about advanced genetic technologies.

KATE LORIMER-WARD: Yep.

Mr PHILIP DONATO: My question is addressed to whoever it is who wants to answer it out of the four of you, or whoever is best placed to answer it. It is in relation to the threat of foot-and-mouth disease, which is obviously topical at the moment. Have there been considerations given in relation to genetic banking of whether it be cattle or sheep or other livestock? Has that been a consideration? It's not mentioned in the "Advanced genetic technologies" part of the submission, but I just wonder if it's something that's been considered as a way of preserving some of the bloodlines that many families who farm have spent many, many years—and, some of them, hundreds of thousands of dollars—to get to the bloodlines and the herds that they currently have.

KATE LORIMER-WARD: I'm happy to kick off on that. In terms specifically around genetic banking, it is something that is definitely being discussed with industry as part of a mitigation action that industry should be exploring. The technologies around genetic banking already exist and it was actually a program—we did have a program in place during the last significant drought that encouraged producers to bank genetics, particularly if they were destocking.

Mr PHILIP DONATO: Right.

KATE LORIMER-WARD: It's not a new technology and it is one that we're having active conversations with industry about.

Ms FELICITY WILSON: Thank you for joining us today. I am interested in understanding how we tackle the issue of adoption through access to capital, which is obviously something that you spoke about in your contribution so far to the Committee's work. Understanding that a lot of the different agricultural entities that we're talking about could be quite small, or the structure of those is not as sophisticated, what do we need to do to try to shift that access to capital; or is it the capital markets themselves that need to better understand the opportunities for their investment; or, is it better understanding the ROI from a producer's perspective, for instance? What do we need to do to shift that?

KATE LORIMER-WARD: I'm happy to kick off and then I might ask Jason to come in with some more detail. There are a few programs that we've run in the past that are around trying to get industry to adopt new technologies. We look at it through this lens of making sure that they understand what the technology is. So they are considering it, what role it can play and how it will actually benefit their business. Then you'd go through that stage of actually investment or commitment to that technology and then that final one is actually making sure they've got the skills to operate that and the support system around them. So we do look at it as a continuum down that process. There are a number of programs that we currently have in place already that support industry investing in their own properties in terms of ag technology. The Farm Innovation Fund has been a very successful fund, which allows people undertake a loan which is at a fixed rate over a long period of time. That's been a very successful program in supporting people taking on major investments around automation or new technologies.

For example, we know there were some cherry producers going into the summer season last year very aware of the worker shortages that they were facing as a result of the COVID restrictions and so made decisions to invest close to a million dollars in significant pack house upgrades. That meant that they could not have to employ so many people in the pack house. They were able to use programs like the Farm Innovation Fund to support that. Going back to your question about how do we get that investment market to support it, I think it is making sure that that investment market understands what value they get from having producers being able to make different decisions, better decisions, more timely decisions and, in doing that, what that return on investment is to them in terms of an investor or a lender.

JASON CREAN: I can add to that. I guess you go back to what the barriers are to the adoption through a whole range of different things. One important part of that is what the advantage of it is. What's the relative advantage of this bit of technology to a producer? We think about the profitability and we think about the riskiness of the technology. Another key thing is around how easy is it to trial this particular technology or innovation. Can you put it in place on a small scale? How complex is it for people to adopt? Do you need to do some work in actually enhancing the human capacity or producer capacity to adopt the technology?

They are some of the key things we look at and some of the programs that we have—and I give the example, I guess, of Farms of the Future again—that's actually trying to de-risk that investment in technology by incentivising uptake of the technology, reducing the marginal costs that producers need to outlay, but then allowing the trial and demonstrate it actually on their own farms, get feedback on whether it's working for them, and really trying to reduce that level of risk associated with the technology.

As well as that—I guess this is on the education and capacity-building bit—really trying to enable producers to make good decisions around the agtech and have the right conversations with suppliers about what's going to work and what's not going to work. Adoption is a complex problem. There are multifaceted reasons here as to why people don't adopt things and often it's actually for really good reasons that they don't adopt it: That the relative advantage isn't clear. So, through our sort of programs, we're really trying to address some of those key issues with, in this case, digital technologies.

Ms FELICITY WILSON: I'd also like to ask a question by which, hopefully, you can fill in the blanks in my understanding from my perspective, for instance, of climate resilience, adaptation and biodiversity. I think you're talking about a portion of the market that's choosing to try and adopt, really. They're trying to identify certain problems and make decisions. What about the portions of the industry—and I'd probably say agriculture more than mining because mining is generally a more sophisticated place, but agriculture in particular—where

they might be passively impacted in the short, medium and long term and maybe aren't realising that there are decisions they have to make; or it might even be things like they could undertake land clearing, for instance, without understanding the biodiversity implications of that or what offsets are required?

Is there enough of an understanding about existing datasets—for instance, LiDAR—to drive decision-making, or to what extent are we actually driving the knowledge and awareness for more passive actors, if you understand what I mean, so they can be part of the longer-term solutions without coming up against problems like making poor decisions for the future of their business because of long-term weather implications, for instance, or maybe make poor decisions about land clearing and biodiversity impacts, for instance? How do you tap into utilising the technologies that we already have available and datasets we have available? How do you tap into that?

KATE LORIMER-WARD: Oh. I'll have a go. I think there are two things: One is trying to understand what the decisions that actually need to be made are, and therefore are they failing to make those decisions or are they actually choosing not to make them? There's a bit there about "Are there decisions that they need to make?" and understanding what those are, and also then trying to understand what information they need to support that good decision. Part of it, I think, is the role that we try to explore, which is perhaps they don't actually need access to those LiDAR datasets; perhaps what they need is actually a device or a tool that sits in between and that supports the decision-making. So, the example I'd use is during the drought we released a supplementary feed calculator, which is an app that people could have on their phone. They didn't need to understand the 50 years of data that sat behind that around livestock nutrition and different feed rates. What they needed to do was to be able to make a decision about "What do I need to feed now, or do I feed/sell or agist?" They were the decisions they needed to make.

Our role was to create a tool that brought all that data together for them so they could make the decision they needed to make. I think the challenge we've got is to make sure that we're trying to solve the problem by being clear on what is the decision that needs to be made and what is it they need to make that decision. Perhaps they don't need all those big datasets. They need us to have the interpretive tool that sits between it that actually supports that decision-making.

Ms FELICITY WILSON: Thank you for that. I guess part of the perspective I'm coming from as well is this: To what extent are we trying to drive different decisions?

KATE LORIMER-WARD: Yes.

Ms FELICITY WILSON: It might be things like land utilisation and what types of crops are utilised, or whether or not grazing is the right choice—not to say that we should be imposing decisions about land use, but trying to drive a focus on questioning what the right land use is because sometimes it may not be right, with the world the way it is. What are we doing in that space as well?

KATE LORIMER-WARD: Actually, particularly with the climate change lens, I'll talk to that more than the biodiversity lens because that's not somewhere where I've worked a lot and I will pass that to Jason Crean. But some of the work, for example, that we've been doing is actually understanding what is the future vulnerability of some of these crops or industries under future climates. In doing that, therefore, what are the decisions that people need to make over the next period of time to make sure that they're not maladaptive? I think that's where you're heading: to make sure that people aren't making the wrong decisions. The other part that we do is an awful lot of work within DPI about understanding the fundamentals to plant behaviour, such as phenology. All of those pieces, all of that data, then gets to sit in these interpretive tools.

It's important to make sure that we separate that agtech is often the gadget, or thought of as the gadget that comes out. There are actually mountains of biophysical data that need to sit under these things to inform them. So you don't get one without the other and I think we've got to make sure we keep those linkages. But in terms of the climate change work, I mean, this is something that we see, as an agency, we will then plug in to all future decisions. Part of it is actually just getting information so people understand it.

JASON CREAN: I might pick up on just the data bit to start with.

KATE LORIMER-WARD: Yes.

JASON CREAN: It's not really the lack of data that's an issue. It's really the lack of turning up data in the information, and usable information. So, how does this information actually help you make a decision? I describe data as basically trying to get a drink of water out of a fire hydrant: There's lots of data coming in, but what we need are actually tools and decision-support systems to actually help, I guess, condense that or simplify that into some things that then a farmer can use—in this case, to change a selection of a crop or an enterprise, or

change input levels or something like that. So a really key role there in that decision-support systems space is in terms of converting a lot of that data down to information. That is the key part.

In terms of the longer term, I think you are getting to that with, I guess, the longer term climate change. We're really looking here, say, 20, 30 more years in the future and looking at actually what is coming down in terms of projections, in terms of changes in rainfall, temperature, extremes. So, in DPI we're doing a bit of work in this space. One key bit of work is really understanding the vulnerabilities of different primary industry sectors to climate change. Across in that area we're looking at broadacre cropping; we're looking at extensive livestock; we are looking at how biosecurity risks are likely to change under climate change because changes in temperature and rainfall extremes are leading to changes in pests, weeds and disease. We are also looking at horticultural crops and we've got some work in the fisheries space as well.

Basically, that work, over the next year or so, will be finalised. It's looking at 28 commodities forming biosecurity risks so I think that will help us think about the future for different activities in different regions. It will help inform that. There's a significant body of work there to be done. We don't want to dictate to people what they should or shouldn't be doing. We are just trying to provide, I guess, more simple information about what might be coming in respect of climate change.

KATE LORIMER-WARD: The Professor might have a view.

Ms FELICITY WILSON: Professor, do you have anything further to add to that?

HUGH DURRANT-WHYTE: Yes. One significant thing, I guess—I put a plea out there to encourage all data to be in the public domain. I genuinely feel, you know, private industry has an opportunity for building new industries around data analytics in general. To be honest, I don't think we ever do that well in government and, as an example, I think with the open spatial data collaboration portal put together by Customer Service, now all water data in the State at least is in the public domain. That has made a significant difference, both to users and to developers of technology. I go back to LiDAR data as an example.

I also have my hat as being the commissioner for natural resources. You know, there are five or six agencies that quite separately collect LiDAR data that overlap with each other and don't think to share it; yet, I think if that data was in the public domain—and don't forget a lot of the best data now is also actually acquired not by the public sector but by the private sector itself, so people like Nearmap, as an example, climate satellites and so on. Having that data in the public domain, I think, would be a real impetus for the uptake and use of technology and evolving public-private sector. I would strongly advocate for that. It doesn't detract from what DPI are trying to do with their knowledge of crops and crops going over into the future, but, again, the development of technology in this sector, in my view, is best undertaken by the private sector.

Ms FELICITY WILSON: Thank you.

The CHAIR: Mr Day, do you have anything further?

PETER DAY: Just in regard to Hugh's comments around public access to information and data, from a resources regulator's point of view our New South Wales Government's Mine Rehabilitation Portal allows mining companies in New South Wales to submit, analyse and report on rehab activities in terms of how they rehabilitate the landscape as they're mining. I guess our new policy around that, around some of the reform package, is to redrive progressive rehabilitation over the life of the mine rather than traditionally at the end of a mine. So, data will be made available to the public through our portal, which is called the Sharing and Enabling Environmental Data portal, which is SEED, to enable the community to view the progressive rehabilitation of mines out there over time. So that'll build the confidence in the sector that rehab is occurring as it should and as it is, and so that then will assist us with our compliance work going forward as well.

HUGH DURRANT-WHYTE: Yes, I agree with Peter. That work's great to see and it's great what Geoscience Australia does. Actually, the other one that I should have mentioned is the growing amount of work that is done on soil carbon and how much of that has been driven by private—not private datasets, but datasets that have been gathered by private companies in various ways. That will be a big driver for, I think, climate in the regions altogether. No-one really is entirely sure at this point exactly how carbon soils, carbon in sequestered soils really works but it would be the kind of work—that measurement and that research—that will really drive big changes.

Ms FELICITY WILSON: Thank you all.

Mr DAVID HARRIS: I think this question is probably best answered by Peter or Hugh. We heard from the Minerals Council this morning that there is a Critical Minerals Hub being set up in New South Wales. Do you have any updates on where that might be up to? Do you have any involvement in that?

PETER DAY: Yes, I can talk about that from the point of view of the NSW Resources Regulator, particularly the MEG component— the Mining, Exploration and Geoscience. I guess what wasn't part of our submission back at the start of this year for this inquiry. At that stage New South Wales was launching a *Critical Minerals and High-Tech Minerals Strategy*. The aim of that is to build on New South Wales' potential emission—us as a major global supplier and processor of critical minerals and high-tech metals. We know we've got a good source of materials out there in the environment and that there will be an increasing global demand for those minerals into the future to support high-tech industries such as manufacturing batteries, defence, aerospace but particularly renewables. Anything renewable will require some component that is made of those high-tech metals or critical minerals.

Under strategy, the New South Wales Government will promote exploration of those critical minerals and activate the industry through that proactive development of supply chains, processing and recycling downstream. I guess where they have backed it up with the incentive is that, in June this year, the Government announced a $130 million Critical Minerals and High-Tech Metals Activation Fund to support the actual delivery of the strategy. Primarily that money will be used over a three-year period to support project activation and commercialisation of project, normally at that early to mid stage of development, but also for research and development projects that enable the critical minerals development and investment in that area. At the moment, in terms of where MEG is up to with that, we are developing the grant program to roll out this year. That will be talking to the industry around the guidelines and the approval processes for that going forward, but that will be a major area in terms of the development of that in New South Wales.

HUGH DURRANT-WHYTE: I should declare a conflict of interest here, or a potential conflict of interest. My Chief Scientist government role is only part-time. One of the other days a week that I work, I work for Rio Tinto, which is a well-known mining company. However, having said that, Rio Tinto do not have any operations in New South Wales, so I feel able to talk to you. I work significantly in mineral processing—in lithium, new mines in Argentina are opening up; in copper, primarily in the northern US; in aluminium, Montreal and Gladstone, places like that; and in iron ore. Just picking up on what Peter said, there is considerable opportunity, I would say, in New South Wales for really relooking at critical minerals capacity. However, I will say also that, in a technical sense, not just New South Wales but Australia as a whole is a long, long way behind in its understanding of critical minerals and what it takes to process them in an economic form.

I think if we are to genuinely pursue a strategy in this area then we have to engage much more strongly with the industry on a global level than we have done to date. For example, if you pick something like lithium—and we do have stocks of lithium—the processing of lithium is proceeding literally week by week in leaps and bounds. It has gone from something from " let the water evaporate in a brine hole" into the use of carbon nanochips for filtering different types of lithium carbide, these sorts of things. The processing side of it is genuinely what will make an industry like this competitive. So it is an area I believe we should be involved in, but I will say that in the actual processing, rather than just finding the minerals, we are a long way behind.

Mr DAVID HARRIS: Mr Day, this is probably a question for you. This morning we had Lucy McClean from AMEC. She made the point to us that her sector isn't looking for a reduction in standards in terms of regulation but that there should be a reduction in the quantum of paperwork required to meet regulation. I think she quoted—I hope I have got the number right—that to do even a small project with 600 pages required a fair amount of time. Have you got any comment on how regulation is being looked at? I assume it's something that's looked at all the time. Are there any plans for streamlining some of those processes?

PETER DAY: Yes, certainly. I think some of what Lucy is referring to there is probably more so the planning process in terms of new developments going forward. Generally speaking, in terms of use of technology from a point of view of safety or environmental controls, our position is certainly that we would support that and adopt that. From a safety point of view, where I can definitely talk about from the Resources Regulator's point of view, we encourage the uptake of technology with that. We acknowledge that there are some barriers to the adoption of technology around that because, by its very nature, we need to have robust regulations that control the use of technology and standards to measure that against to ensure that in high-risk industries, such as underground coalmines, only plant and equipment that meet certain standards are used in that regard. Whilst we acknowledge that there are some barriers there by necessity, we also provide a clear pathway for consideration of alternatives out there.

The Resources Regulator operates an *Innovation Policy*, where we can consider applications from industry—and we do quite regularly—around where we can apply an exemption process where innovation is used and new technology is put forward to us for consideration to work through and around the actual legislation or technical standards that may inhibit its uptake. A lot of our time and effort is carried out working with companies to review new technology and innovation that they may have developed themselves, or they may have used a company to develop, to ensure that they aren't disadvantaged by our controls, provided they meet certain

requirements. I think that most people would certainly see the benefit of that around safety, that it has to be analysed case by case. Certainly in terms of an administrative burden, we are moving towards use of online portals and a whole range of things that, by definition, will remove duplicate handling by government employees. The industry can upload that information themselves and they can verify it themselves, and that can really reduce the time frame in terms of approvals and regulatory workflows that that would do.

Mr CLAYTON BARR: I will start with Professor Durrant-Whyte. Could you just take us back to what you described about the application of carbon nanotubes in the example you gave and other potential uses for them across the mining and agricultural sector in terms of application of technology?

HUGH DURRANT-WHYTE: Generically, they are a means to filter out different types of molecules, depending on the structure of the tube, its chargers and various other pieces. They have recently applied it—there was quite an interesting article in *Mining Weekly* not that long ago. One of the challenges of the lithium is to basically pull out the lithium without pulling out all the additional material, so rather than using membranes or brine solutions. This graphite nanochip is allowing to pull out the lithium carbide from the solution without pulling out everything else—lithium fluoride and other related minerals. It is a much more energy-efficient way of essentially extracting concentrated lithium in a processable form from standard lithium brines or lithium that is mined in other ways. That's why.

Mr CLAYTON BARR: We were at the Cadia gold mine at Cadia.

HUGH DURRANT-WHYTE: Yes, I've been there.

Mr CLAYTON BARR: They were using a float system. Am I right?

HUGH DURRANT-WHYTE: Yes, that's very typical for gold processing. In a sense, what you do is the gold is intrinsically [inaudible] through the ore. They crush the ore, which is the energy-intensive part, and then you have to float it on various solutions in order to concentrate the gold material. So you have a series of floatation tanks, depending on the concentration of the gold or copper in the ore, and that concentrates it to the point where then you can electrowin it—that is, you basically put it in kind of like a reverse battery and the anodes pull out the gold or the copper. It is a very standard technique.

There are lots of ways that are coming along at the moment for improving the way that you can win gold from ore like that. Refiltering is one way of doing it, but a better way is arguably—there are things now where you do what is called heap leaching, or where you design effectively different types of bacteria that effectively successively eat the ore with the gold on it, preferentially, and then you can concentrate the gold out. The technologies in that space are quite significant. I will say we are very good users of this technology in this country, that type of thing—and I know the Newmont mine pretty well—but we don't really develop a lot of it here. We are pretty weak on being able to do that. Arguably, the University of Newcastle is one of our strongest places for doing this type of thing. But we are still not as good as we perhaps need to be to make it economically attractive.

Mr CLAYTON BARR: Going forward, given our obvious and foreseeable demands on some of these precious minerals, isn't it true that we are going to need to squeeze out every possible gram and kilogram of these precious metals that we can for each tonne of ore that we dig up and churn out of the ground? There is not an unlimited supply of this stuff. We can't just keep digging it up. We have got to dig it up and get more out of each scoop.

HUGH DURRANT-WHYTE: It is very variable across the spectrum. If you pick something like iron ore, we have enormous quantities of it. Even at the current rate it will last hundreds of years, and even now we're mining only the best stuff. The stuff that is left over on the waste side is arguably much better quality than anything they would mine in China or India. That is true, actually, with coal as well, although I'm less familiar with the coal cycle. In areas like copper and gold, copper is important. If you look at the way the discovery curves have been going, it looks at first outing that large-scale copper deposits have been less frequently found than they have in the past. Having said that, our rate of production from initial mines that we've found has actually been improving significantly. If you look at Cadia, it has produced a lot more than its original resource would have implied and we have got better at processing it. Genuinely, the processing is pretty good. I would say that at mines like that at Parkes and so on, there are deposits that would carry on were they not at the scale of what exists in other parts of the world in those areas.

If you come to rare metals—what they call rare earths and things like that—it is a very different prospect. Your back garden has a lot of rare earths in it, right? The problem is processing them. Processing them requires a lot of tricky steps with not very nice chemicals. That is why, for example, Lynas, which is the well-known Australian company that works in rare earths, might do a lot of the mining here but it actually does the processing in Malaysia. It is not a trivial thing to do and it requires lots of different processes and so on. Arguably it is why

we have fallen behind places like China. Rare earths is a little bit of a misnomer because rare earths are not actually rare. They are just difficult to extract, if that makes sense.

Mr CLAYTON BARR: Yes. That's news to me. Peter, in terms of getting towards something like net zero, which is where we're all headed—I think the geopolitical language is there now and landed—we're going to need to essentially double our production of copper, as an example, aren't we? Is that right?

PETER DAY: In terms of those supply chains and production volumes, it's probably outside my area of expertise. I will have to take that one on notice around what we would need going forward. But certainly there is a comprehensive framework and pathway there for industry to explore and to develop new areas. We are seeing a lot of interest in mines around exploration, particularly in the western areas. Part of our pathway is that we are providing grants to explorers as well around the New Frontiers program around the far western part of the State, encouraging explorers to take advantage of some of that grant money to explore the areas for new fields.

Mr CLAYTON BARR: I pose this question to DPI. We've got conflicting viewpoints on the issue of intellectual property and commercialisation—I think a little bit. Charles Sturt University certainly are pro sharing information and I think that our Chief Scientist is pro sharing the information. But very specifically in the submission made by DPI, it was around commercialisation of the scientific research. Can we have both open, free sharing and commercialisation at the same time? How do we get around that little trick?

KATE LORIMER-WARD: You can. DPI ourselves—the New South Wales Government actually has in place an Intellectual Property Management Framework. That was put in place in 2020. That governs how all agencies should look at intellectual property. A number of principles sit under that. I will just go through them. There are five areas that they cover off. One is around management and compliance of intellectual property; there are principles around ownership and rights; there is sharing licensing assignment and commercialisation of IP; there is identification and recording of IP; and then there is branding and protection. They're the principles that we operate under. We do partner, though, with a number of organisations where we enter into shares, particularly around intellectual property because they may also be investors in the development of that information. There are points where ideally all data should be publicly available.

That can be quite different, then, to perhaps what you might commercialise, which could be that tool or that app, which is what you commercialise. But the data that underpins that could be publicly available. It can be nuanced around that. For example, if we go back to the drought app that we talked about, the supplementary feeding one, all of that data over the 50 years that was used to build that would be published data and would be accessible to people through published data. The actual building of the app is the piece that we would use to say, "That was our commercialisation activity." Now, we made a deliberate decision to not have a paywall or anything there because actually we wanted rapid uptake of that. But we may make a decision to put a paywall onto an app like that if it was going to be used in a foreign country. Maybe they do need to actually pay for some of the creation of that because we would invest for the benefit of New South Wales. There are layers that you can build to that.

Mr CLAYTON BARR: That's really helpful in terms of clarification. Thanks for that, Kate. Just while the Chair is distracted, I'm going to ask one more question.

The CHAIR: I will ask, Mr Barr, that potentially this is last because we have the opportunity to submit questions in writing as we need.

Mr CLAYTON BARR: But it's not quite the same, Chair. I understand the professor sort of touched on carbon neutrality briefly. He indicated that there's probably a lot more to learn. I'm not sure if this is a question for DPI or the experts online. Where are we at with carbon neutrality? How practical is it going to be? How much more advancement in technology do we need and is it close? Are we getting where we need to be or is it sort of still a way off?

KATE LORIMER-WARD: Oh wow!

The CHAIR: Mr Barr, seriously.

Mr CLAYTON BARR: Sorry, Madam Chair.

Mr DAVID HARRIS: That's a whole inquiry by itself.

Mr CLAYTON BARR: I might put that question on notice.

The CHAIR: Shall we put that question on notice?

KATE LORIMER-WARD: There are many aspects to that. What I would do to summarise, though, is say that the role of technology, whether it's agtech or whatever technology coming into that, is going to be at a number of levels. It's going to be at technologies that will avoid emissions being generated. It will be involved in

technologies that support sequestration or storage of emissions. Then there'll be technology that actually supports verification and measurement. They're the bits that actually then support markets operating. They're the bits of technology that actually give confidence that those outcomes are being achieved. So it's actually a big question because there are so many parts that technology could play in the carbon neutral goal.

Mr CLAYTON BARR: Does DPI already have a paper or a piece of work on this in this space?

JASON CREAN: Yes, we have. This has been a long-term area of work for DPI and a lot of organisations, but we've done some recent assessments on basically abatement opportunities across New South Wales for primary industries. It's published on our website. But, as people would know, the New South Wales Government has got a target of 50 per cent reduction in net emissions by 2030 and net zero emissions by 2050—so fairly ambitious targets. Primary or agriculture is around 14 per cent of that. As Kate mentioned, there's a range of different technologies and options we've got to get there. We're looking at livestock methane reduction opportunities, feed additives, breeding, low-methane pastures, but also in the sequestration side. So, how do you build stored carbon sequestration in vegetation. There's a range of different solutions and they work in different areas to different extents. That's been a long-term area of work for a lot of organisations, including DPI—a lot of previous research.

HUGH DURRANT-WHYTE: I'm also on the Net Zero Board. I'm the deputy chair. There are a lot of programs in this area that I won't go into now, but there's a huge amount of work going on.

The CHAIR: Thank you, Mr Barr. Thank you all. It has been a very wide-ranging discussion this afternoon and we were doing so well with the time. It has been a very informative day all round. I thank you all very much for your time and expertise, and for appearing before us today. You will each be provided with a copy of the transcript of proceedings to make any corrections. We have the question taken on notice from Mr Donato. Mr Barr, would you also like those questions posed and taken on notice?

Mr CLAYTON BARR: It sounds like there's already a bunch of work. Maybe if I could just ask one thing. Could you maybe just bump across the link or the connection to the work you've already done as opposed to—

JASON CREAN: Yes.

KATE LORIMER-WARD: Yes.

Mr CLAYTON BARR: You too, please, Professor, if that's okay, if you've done some work or if you've done the work together. I'm not sure.

HUGH DURRANT-WHYTE: Yes.

KATE LORIMER-WARD: Yes.

Mr CLAYTON BARR: That would be great. Thank you.

The CHAIR: Mr Barr may well have some additional questions that he'd like to have posed in writing. You know your replies will form part of your evidence and be made public. Would you be happy to provide a written reply to any further questions?

KATE LORIMER-WARD: We would.

The CHAIR: Thank you all very much for your time and expertise. That concludes our public hearing for today. I place on record my thanks to all the witnesses who appeared today. In addition, I thank the Committee members, Committee staff, Hansard and staff of the Department of Parliamentary Services for their assistance in the conduct of the hearing. Travel safely.

(The witnesses withdrew.)

The Committee adjourned at 15:32.