REPORT ON PROCEEDINGS BEFORE

STANDING COMMITTEE ON STATE DEVELOPMENT

DEVELOPMENT OF A HYDROGEN INDUSTRY IN NEW SOUTH WALES

CORRECTED

At Macquarie Room, Parliament House, Sydney, on Monday 21 June 2021

The Committee met at 9:20.

PRESENT

The Hon. Catherine Cusack (Chair)

The Hon. Mark Banasiak
The Hon. Wes Fang
The Hon. Sam Farraway
The Hon. Ben Franklin
The Hon. John Graham
The Hon. Taylor Martin
The Hon. Mark Pearson
Mr David Shoebridge
The Hon. Mick Veitch (Deputy Chair)

CORRECTED

The CHAIR: Good morning, everyone. Welcome to the Standing Committee on State Development inquiry into the development of a hydrogen industry in New South Wales. Before I commence, I acknowledge the Gadigal people, who are the traditional custodians of this land. I pay respect to Elders past, present and emerging of the Eora nation and extend that respect to other Aboriginal people present. Today we will be hearing from a number of stakeholders, including Geoscience Australia, industry bodies, local councils and universities. While we have many witnesses with us in person, some will be appearing via videoconference and teleconference. I thank everyone for making the time to give evidence to this important inquiry.

Before we commence I would like to make some brief comments about the procedures for today's hearing. The hearing is being broadcast live via the Parliament's website. A transcript of today's hearing will be placed on the Committee's website when it becomes available. In accordance with the broadcasting guidelines, media representatives are reminded that they must take responsibility for what they publish about the Committee's proceedings. While parliamentary privilege applies to witnesses located in New South Wales giving evidence here today, it does not apply to what witnesses say outside their evidence at the hearing. I therefore urge witnesses to be careful about comments they may make to the media or others after they complete their evidence.

Committee hearings are not intended to provide a forum for people to make adverse reflections about others under the protection of parliamentary privilege. In that regard, it is important that witnesses focus on the issues raised by this inquiry's terms of reference and avoid naming individuals unnecessarily. All witnesses have a right to procedural fairness according to the procedural fairness resolution adopted by the House in 2018. If witnesses are unable to answer a question today and want more time to respond, they can take questions on notice. Written answers to questions taken on notice are to be provided within 21 days. If witnesses wish to hand up documents, they should do so through the Committee staff.

In terms of the audibility of the hearing today, I remind Committee members and witnesses to speak into the microphone. As we have a number of witnesses in person and via videoconference, it may be helpful to identify to whom questions are directed and who is speaking. For those with hearing difficulties who are present in the room today, please note that the room is fitted with induction loops compatible with hearing-aid systems that have telecoil receivers. Finally, could everyone please turn off their mobile phones or turn them to silent for the duration of the hearing.

CORRECTED

KRISTINA ANASTASI, Branch Head, Advice, Investment Attraction and Analysis, Minerals Energy and Groundwater Division, Geoscience Australia, before the Committee via teleconference, sworn and examined

ANDREW FEITZ, Director, Low Carbon Geoscience and Advice, Minerals, Energy and Groundwater Division, Geoscience Australia, before the Committee via teleconference, sworn and examined

The CHAIR: I welcome our first witnesses from Geoscience Australia. Do you have opening statements that you wish to make?

Ms ANASTASI: I would like to make a very short opening statement if I may, but I understand there may be some timing constraints.

The CHAIR: Feel free to make a short statement.

Ms ANASTASI: Thank you.

The CHAIR: Keeping it brief is great because it allows more time for questions.

Ms ANASTASI: Thank you. Geoscience Australia sits in the Commonwealth portfolio of resources and northern Australia within the Department of Industry, Science, Energy and Resources, and is Australia's national public sector geoscience organisation. We provide science-based analysis, data and advice on Australia's resources to government, industry and community to support evidence-based decision-making that ultimately contributes to a safer, more prosperous and well-informed Australia, as well as a sustainable environment. The responsible development of a diverse resources sector in Australia's low-carbon economy, including the establishment of a commercial hydrogen industry, is a 10-year target in Geoscience Australia's Strategy 2028 under the key strategic priority area of building Australia's resources wealth.

In regards to the development of a hydrogen industry, Geoscience Australia provides geospatial information and data to assist governments and industry with their planning and to identify those regions with high potential for future hydrogen production. It is this information that was used for the preparation of our submission to this inquiry. With regard to Australia's National Hydrogen Strategy, Geoscience Australia provided technical support and developed an online tool that enables stakeholders to undertake their own hydrogen prospectivity assessments called AusH2. AusH2 has been publicly available since November 2019. Further, in March this year Geoscience Australia released its Hydrogen Economic Fairways Tool [HEFT]. HEFT enables users to undertake economic assessments of hydrogen production viability, including both renewable and carbon capture and storage [CCS] hydrogen.

Finally, Geoscience Australia is also undertaking a number of activities that support the strategy under the Exploring for the Future program. They include improving the functionality comprehensiveness of the HEFT, exploring geological options for hydrogen storage—including salt resources and depleted conventional gas fields—saline aquifers and hard rock mine caverns, as well as understanding natural geological hydrogen resources potential. Thank you. Both myself and Dr Feitz are happy to answer questions that the Committee may have.

The CHAIR: Thank you very much. Can I ask, arising from that statement, whether you were commissioned to undertake the geospatial analysis in 2019? Did you do that work for somebody?

Dr FEITZ: Yes. That study was commissioned by the hydrogen strategy task force. That fed into the National Hydrogen Strategy.

The Hon. TAYLOR MARTIN: Thank you both for taking the time to appear. Dr Anastasi, at the end of your opening statement you started to touch on the Hydrogen Economic Fairways Tool. Would you be able to continue giving us a briefing on what that is about and what it can be used for?

Ms ANASTASI: Yes.

Dr FEITZ: Yes. The economic fairways tool is a geospatial tool that combines geospatial information with economics. This tool was originally developed by Geoscience Australia in collaboration with Monash University for our mineral prospectivity. We would combine the location of resources—infrastructure, water, roads and all that sort of information—with potential exploitation of new mineral deposits. It was a tool to look for the suitability for that. We thought that this was a fantastic tool that could be adapted for the hydrogen industry because many of the same issues arise. It is the colocation of various resources along with the supporting infrastructure. The tool was released in March this year, so unfortunately just two months after we put in this submission, but it has received a lot of very positive feedback from industry and other stakeholders, both domestically and internationally.

At this stage it is focused on solar and wind and a hybrid of solar and wind, but we are looking at expanding the renewable aspects of it to include hydro and pumped hydro, and also batteries and grid connection in future. But at this stage, yes, the tool is available for anyone to use.

The Hon. TAYLOR MARTIN: Would you be able to go into a bit more detail on the issue of water? Because, of course, to produce hydrogen, which is what is needed in this process, we do not find it like we do with many of our resources at the moment; we have to create it. Would you be able to give us a bit more context around the issue of water in Australia for hydrogen production?

Dr FEITZ: Absolutely. Our work is consistent with the National Hydrogen Strategy and the recommendations with that. For large-scale hydrogen production, it recommends to use seawater desalination as well as wastewater recycling as the primary sources of water. That said, for small-scale households, if they have a very small hydrogen generator, then obviously they could link that up to their domestic supply. However, the strategy is around the seawater and the water recycling. In our report that was prepared for the National Hydrogen Strategy, we did touch on groundwater resources. However, due to the competition for these and supporting such a large hydrogen industry, the strategy decided that they would go down the path of not including groundwater resources.

The Hon. TAYLOR MARTIN: Sure, that makes sense. On page 14 of your submission it lists the identified hydrogen research centres in New South Wales. Are you in a position to give us an overview of what some of those universities have been up to, given we will be hearing from the University of Wollongong and the University of Newcastle later on in the day? But from my experience with some of these universities, there is some really great work going on and it is not really at the commercialisation stage and it is not really made very public at this stage. Are you able to give us an overview as to some of the work there?

Dr FEITZ: I guess we are reporting on those institutions that we are aware of. I have had discussions with some of these institutions, particularly the University of New South Wales and also the University of Newcastle. However, I am not sure we can add too much information on that at this stage. It is only being aware of which institutions are out there. There is a lot of research that needs to be done to support driving down the costs for hydrogen in Australia, so we support university engagement, yes.

The Hon. MICK VEITCH: Can I follow on about the capacity to use wastewater? For example, Sydney has a large amount of wastewater. For us to have a viable hydrogen economy, or industry, how much wastewater could we effectively use for this activity?

Dr FEITZ: Yes, exactly. In our report we identified the very large volumes of wastewater that are currently discharged from Sydney and the Greater Sydney region. The volume of water that is discharged is certainly enough to support the national scale hydrogen industry. So there is plenty of water in New South Wales in the Sydney region to support a hydrogen industry. That said, there are definitely advantages too of turning some of that recycled water into hydrogen compared to discharging to inland rivers and stuff. For example, I was speaking to some representatives from I think it was the department of planning when we were putting together our supporting document for the National Hydrogen Strategy.

And talking about the water resources, a key issue that came up, especially for some of the inland wastewater treatment plants, was there are real issues around nutrients and the level of treatment that needs to go into preparing the water to go into those inland receiving systems. If that water could be potentially used for hydrogen, that decreases that load on those receiving bodies. I thought it quite an interesting aspect that I had not considered before, but it could support the re-use of water in those regions for hydrogen production.

The Hon. MICK VEITCH: In your submission you talk about blending with natural gas. Can you explain to the Committee how that works, particularly with existing natural gas pipelines in New South Wales?

Dr FEITZ: Sure. There are a number of trials around the country at the moment that are looking at blending hydrogen into the natural gas system to try to—I believe it is down in Albury-Wodonga, there is a project down there that is being supported. Essentially, with the current existing transmission system, it is recommended you can blend up to around 10 per cent, though there are trials being undertaken to potentially improve that to make that go higher. But you can safely blend up to 10 per cent into the natural gas system and that does not require any changes to the distribution and the domestic use of the appliances. If you want to move towards a higher potentially in the future up to 100 per cent hydrogen gas supply system, that will most likely require new infrastructure in terms of new pipes that can accommodate that.

Ms ANASTASI: And appliances.

Dr FEITZ: Oh, yes. And, of course, an upgrade to appliances to be able to accommodate the hydrogen supply. That said, back in the sixties and seventies the gas that we used was produced from coal. That contained

elevated levels of hydrogen in it back in those days. When we migrated from that coal gas, or "town gas", across to natural gas, that required a change to the appliances back then. Apparently that turnover period was about 10 years, so it is a little bit back to the future. If we go back to hydrogen, you may need to change the appliances again.

The Hon. MICK VEITCH: My last question is to do with workforce development and skills development. Are we training enough people now to move across to a hydrogen economy or do we have to seriously upgrade both our vocational and tertiary training into this market?

Dr FEITZ: We will certainly need more skills. That is not an area that is part of our submission, I am afraid, so I am not really across the level of—

Ms ANASTASI: Many in the industry you will hear saying there is the ability to upskill or transfer the current skills that they do have. They would be talking about that there are complimentary skills already available in the industry to feed the expansion, particularly within the gas industry itself in terms of transferring those skills into a hydrogen-based economy.

The Hon. MICK VEITCH: I did lie; I have one more question. It is to do with large-scale storage. Has Geoscience Australia done much work on New South Wales in regard to capacity for large-scale storage?

Dr FEITZ: As was listed in our submission, commercial hydrogen that is produced overseas and stored overseas is stored in rock salt. That is kind of like the hippie rock salt candles that you can get, that sort of pink rock salt. It is very large deposits of that type of salt. That type of salt you can produce a cavern with and store hydrogen. That is very effective and it has been used for many, many years for hydrogen storage. Unfortunately, our assessment is that there are not large salt deposits in New South Wales that could support that. So the next option would be to look at what most industries are looking at, looking at depleted gas fields. Unfortunately, again, in New South Wales we have Coonarah, a small conventional gas field near Narrabri, that might be suitable for hydrogen storage potentially. But to support Newcastle and the Wollongong area, there does not appear to be conventional hydrogen storage options. So in that case we will be required to look at alternative options.

That could be potentially aquifer traps—which are kind of like depleted gas fields but they are essentially filled with water rather than gas—identifying those types of structures in the Sydney area, or potentially looking at hard rock mining and hard rock caverns. Those caverns are in rocks like granite and basalt and gabbro and gneiss and other types of hard rocks. There have been studies overseas, particularly in Sweden actually, which does not have salt and it does not have depleted gas fields. They use the hard rock mines to store their gas and their oil and various other fluids. It is certainly an area that we identify as being an area that needs more attention and research. Potentially we need a lot more research in New South Wales to identify what might be suitable for large-scale hydrogen storage.

The CHAIR: Having been out in the outback seeing massive quantities of salt, has that been considered at all in that sort of vicinity?

Dr FEITZ: There is certainly a lot of salt out in the outback, that is for sure. Unfortunately, they are not the sort of salts that we require. We are really looking for more halide-type salts rather than other types of evaporites, like gypsum and various other salts like that. You also need it really thick. These salts are underground and they could be potentially in some cases 800 metres thick of pure salt. There are some quite amazing resources in Australia that have these sort of salts. Potentially out in the Darling Basin we have identified that there could be potentially, based on the ages of some of the formations out there and the kind associated with some of the other—there is potential possibly. I would be looking out in the Darling Basin in some of those deeper troughs and potentially there could be salt there.

It is a very underexplored area of New South Wales. I know that the New South Wales Government has been looking at assessing carbon storage options out in that part of the basin and they are finding reasonable storage permeability levels. If it is suitable for carbon storage, it might be suitable also for hydrogen storage, but there is a lot more research that would be required.

The Hon. MARK PEARSON: Thank you very much for being available to give evidence. Taking into account that I only really studied physics and chemistry up to year 12 in school and not any longer, so keeping it as lay as possible could you walk us through the amount of energy that is required to separate hydrogen from the water molecule? What are the different ways that amount of energy can be provided?

Dr FEITZ: Now you are testing my chemistry skills as well. I am going to have to take that question on notice in terms of the amount of energy, but it is a considerable amount of energy that is required to produce a kilowatt of hydrogen using electricity, so to power up an electrolyser I am afraid I do not have that number at my fingertips. I will have to take that on notice. I am sorry.

The Hon. MARK PEARSON: That is fine if you could take it on notice, because I think it is one of the questions that we have to grapple with as a committee because there are questions about the most environmentally friendly or green or not green way of getting that amount of energy to heat up the hydrogen. Are there any dangers in some ways of storing hydrogen as opposed to others in terms of the volatility of the hydrogen compound when it is stored in certain scenarios?

Dr FEITZ: The key issue of hydrogen storage is because it is a very light molecule, it does not have the same density as other gases when storing it. So, for example, with natural gas, for the same volume of hydrogen that you might be storing, you are actually storing maybe eight times less hydrogen in the same storage container. You just cannot compress the hydrogen to a level that is similar to natural gas. That is a key issue. In that respect, a lot of hydrogen storage applications require storage at quite high pressures. Naturally there are safety issues that need to be considered around the storage of hydrogen at high pressures. That said, hydrogen is widely used in industry. Around the world there are something like 70 million tons of hydrogen that is produced each year. Most of that hydrogen is produced from fossil fuels without carbon capture and storage. It is a commodity that is used widely and is managed safely. Having those safety protocols in place can ensure that we can use hydrogen safely.

Ms ANASTASI: I just wanted to add as well that we have got to remember that our natural gas is also considered volatile in that way as well. We have a good deal of expertise and knowledge already about how we handle volatile liquids or natural gases and elements that we are already undertaking in a safe manner. I think industry feels quite confident that it would be able to take that step up into managing hydrogen as well in that safe way.

The Hon. BEN FRANKLIN: Thank you to you both for being here today virtually. It is a really important area that we are looking at. Obviously the two essential components for hydrogen are water which, as you rightly point out in your submission we need to predominantly source from the coast—whether that be through recycling or desalination, but probably recycling—and, of course, electricity which, particularly under our electricity road map, would be more and more provided from a disparate group of regional solar and wind providers across New South Wales, which, of course, will be a significant distance away from the water resources. Could you discuss issues that you think need to be resolved and any solutions you might have about the tension between the physical distance that is going to be separating those two and how to reconcile them, obviously including the upgrade of electricity transmission lines but also anything else that you think needs to be taken into consideration?

Dr FEITZ: Our economic fairways model—we have been doing some modelling of this particular issue actually, and it turns out that it is most likely more cost-effective to produce hydrogen at the coast where you have plentiful water and a port is nearby, and to have the electricity basically produced at the coast and have the electricity come to you rather than produce hydrogen, say, out west and then try to pipe the hydrogen to the export port. That seems to be where our economic analysis is taking us at this stage. That said, our economic analysis is at a national scale; these are national scale datasets. We are upgrading that all the time, so put a caveat on that. I would recommend for New South Wales to consider doing a more detailed economic assessment of that balance. However, from our assessment, that seems to be the case—that it is much better if you are looking at exporting hydrogen to do it at the port.

The Hon. BEN FRANKLIN: I understand. If you did do it there, what would the physical requirements be in terms of the amount of land that would be required, frankly, and what would be any other relevant considerations in terms of both the production and the storage of hydrogen? This will probably necessarily be close to populated areas and so potentially the cost of land and storage are going to be quite significant. I was wondering if you have thought about that in terms of the modelling. Do you have any comments to make?

Dr FEITZ: It has not been considered as part of our modelling but it is worth considering that, for example, at Newcastle there is an above ground liquid natural gas [LNG] storage facility there that stores about 1.5 petajoules of natural gas. In comparison, for underground storage, you are looking out at Moomba, for example, they can store up to about 85, over 50 times that volume. The underground storage certainly is very helpful when it comes to having a smaller footprint in terms of storage. Forgive me, I have missed the second part of your question.

Ms ANASTASI: It would have been about the footprint to establish a hydrogen facility. Is that what you are asking us about the footprint for storage options nearby?

The Hon. BEN FRANKLIN: That is right. Spot on. Yes, both.

Dr FEITZ: I guess a good example of that would be to look at the plans for the Asian renewable energy hub up in the Pilbara region. They have a very large footprint in terms of their renewal energy generation capacity but the size of the operations where the electrolysers occupy is quite a small fraction of that overall footprint of

that project. Yes, I would recommend using that as a potential guide. Again, off the top of my head, I do not have those numbers but I can certainly take that on notice again too, if that would be helpful.

The Hon. BEN FRANKLIN: That is terrific, thank you, and that also segues nicely into my next question, which was about any international best practice that you think is relevant for consideration in our context when we look at the development of the hydrogen industry in New South Wales. Do you have any comments to make or any information you think we should be looking at?

Dr FEITZ: I think one of the key issues that everyone is grappling with at the moment is the issue of storage. It is an issue. I know that there was a very nice report produced by Bloomberg New Energy Finance Limited that considered the different cost options for hydrogen storage. It notes those areas that are blessed with salt, that is a real blessing for them, but there are other options. If it comes to hard rock caverns, although they are not widely used around the world at the moment, that is an area that has been identified as something worth considering. I know that the CSIRO has recently completed a very large study looking at hydrogen storage options around the country as well. I believe that report will be coming out next month, so that would also be useful. I think grappling with the hydrogen storage issue is an issue. The other one would be decreasing the cost of hydrogen production, decreasing the cost of the electrolysis, the capital cost of the electrolysers, and trying to generate lower costs for electricity if it is for a green hydrogen application. They are the key issues.

The CHAIR: Dr Feitz, I just wanted to clarify. Are there any particular countries that my colleague was asking about that have good practice in this regard that we could learn from?

Dr FEITZ: To be honest, I think Australia is really taking a lead in this area.

The CHAIR: Okay, that is good to know.

Dr FEITZ: We do use a little bit of hydrogen which is produced from our methane, of course, for fertiliser production in this country. We already do generate hydrogen. It is not blue hydrogen at this stage but there are certainly plans and ambitions to convert that across to blue hydrogen. Yes, I think Australia is really taking a lead in this area with the release of the National Hydrogen Strategy.

The Hon. MICK VEITCH: If I could just reverse the Chair's question, are there any lessons on what not to do?

Dr FEITZ: That is a tricky one. Nothing stands out, to be honest. I think just trying to get a better handle on the economics, the modelling and optimising systems with the planning is prudent. But there is nothing that really stands out that we need to consider.

Ms ANASTASI: The other way to look at it in terms of learning is we can only build on what we have learnt and where we have come to in our technology and our activities as we have established and developed our natural gas industry because there are a lot of similarities. We can take some of those learnings and, almost as we did, step changes. We move into hydrogen, take those learnings and build, like as Dr Feitz called it, a 2.0 version, which is the next better, and taking those learnings to try to avoid any issues out of that. I think we are on the right path but the biggest one will be the cost and the biggest one will be about managing the expectations of blue versus green, whether you are using the transition of natural gas in terms of supporting the hydrogen industry versus utilising 100 per cent renewables. There is a statement and a consideration that could be made in respect that utilising natural gas as that transition into blue hydrogen with CCS, you are potentially developing low emissions or no emissions through the utilisation of CCS as we strengthen our whole renewable energy sector and electricity networks for it.

The Hon. WES FANG: Recently, the State Government announced in Wagga Wagga, where we have got a special activation precinct, that we are going to have on-site generation of hydrogen. Each of the special activation precinct blocks will be supplied with hydrogen to the facilities in order to allow the industry to start to adapt to the use of hydrogen and plan for that into the future. How important is it for us to have a uniform policy around the supply of hydrogen to industrial precincts in order to promote this? Is it something that can be potentially just a one-off or is it something that we should be looking to this across the State in existing and upcoming developments?

Ms ANASTASI: I heard bits of pieces of it. What was the question about?

The CHAIR: I think I can paraphrase the question. My colleague asked a question about the industrial demand for hydrogen-produced energy and how important that is in terms of attracting investment and growing the industry?

The Hon. WES FANG: And how important it is to have a universal policy across the State when we are looking at industrial precincts? Is it something that we really want to have everybody working off?

CORRECTED

Ms ANASTASI: Sorry, I think the policy is a matter for the New South Wales Government to determine and how it wants to deal with its precincts. But I do know that there is a consideration in respect to hydrogen being utilised. We have seen it through the strategy and we are also seeing it through the Government's technology roadmap about green steel and elements of that and coming through into those types of precincts. Dr Feitz, do you want to add something?

Dr FEITZ: I would add that part of the National Hydrogen Strategy is to develop these hubs in terms of trying to get greater hydrogen use in particular in industrial hubs. I think in answer to your question, I think concentrating around those sort of hubs and supporting multiple industries around a hub is actually—

Ms ANASTASI: It is very positive.

Dr FEITZ: It is consistent with the National Hydrogen Strategy.

Ms ANASTASI: How that is done is that in New South Wales it would be a policy matter how you take forward the hydrogen strategy or the policy, but we are very much looking at it and I know industry is also looking at it in terms of how they decarbonise and options, as Dr Feitz mentioned earlier, as avenues for reducing costs and supporting greater commercialisation of hydrogen.

The CHAIR: I thank both of our witnesses for attending this hearing. Our time has, unfortunately, expired. The Committee has resolved that answers to questions taken on notice be returned within 21 days. The secretariat will contact you in relation to the questions you have taken on notice. Thank you very much again for your participation today.

Ms ANASTASI Madam Chair and members, we would also like to thank you for inviting us to present to the inquiry. We are very excited about hydrogen. We are very excited about the work that Geoscience Australia is doing as well in supporting the implementation of the national strategy and supporting establishing a national hydrogen industry in Australia.

The CHAIR: Thank you very much. That is great.

(The witnesses withdrew.)

FIONA SIMON, Chief Executive Officer, Australian Hydrogen Council, before the Committee via videoconference, affirmed and examined

ANNA FREEMAN, Policy Director Energy Generation, Clean Energy Council, before the Committee via videoconference, affirmed and examined

The CHAIR: Thank you very much for appearing. Dr Simon, would you like to make a short statement?

Dr SIMON: The Australian Hydrogen Council is the peak body for the emerging clean hydrogen industry in Australia. Our objective is to grow the industry and have clean hydrogen as the key part of the energy mix. We really do focus on policy settings. Policy is very much the lens we use. As we know and we have seen through the submissions to this inquiry, New South Wales is well positioned to play a key role in the emerging hydrogen industry. The opportunities are real. But if New South Wales is to take meaningful action developing the industry, it needs to establish clear planning and policy. We need to create a market, which means designing market mechanisms to value hydrogen against fossil fuels and providing funding support for infrastructure to reduce the investment gap. We have discussed these matters in our submission.

I just wanted to quickly expand on the scale of the task and the urgency for action. We start with how we make green hydrogen. For this we need renewable electricity to power the electrolysers. In his recent quarterly essay, Dr Alan Finkel said that if we were to export as much hydrogen by energy value as the LNG we exported in the year to June 2020 we would need about eight times the total electricity that was generated in Australia at that time. He said that if we use solar for that energy we would need about 75 times Australia's installed solar capacity that year. I should note that this kind of renewable electricity requirement to make hydrogen is on top of what we need to decarbonise domestic electricity use. So we can see this is huge and it needs to be planned for. It is definitely possible. Dr Finkel says it is quite conceivable when spread over 30 years.

So the question is how we do build for this? How do we build for the future? We really need the workforce. The renewables opportunity alone is said to bring in as many as 45,000 new jobs. Hydrogen jobs are in addition to that. The National Hydrogen Strategy said there could be as many as 17,000 new jobs, many in regional areas. This is by 2050. We know that green steel is a manufacturing opportunity that could also plausibly provide tens of thousands of jobs, with Fortescue's Dr Andrew Forrest saying at least 40,000 jobs, if we only captured 10 per cent of the world's steel market. That is the comparison for jobs to what is available in Australia's coalmining regions. But I should also say that, in making green steel, we are also then adding further to the renewable electricity requirements to make the hydrogen. So, again, further potential multiples of Australia's total electricity demand would be required.

There is this required scale and then the jobs. They go hand in hand. That is the challenges and the opportunities. Thankfully, we have years to go in the energy transition, but building new industries also takes years. So we are talking about significant projects, infrastructure to be built, the one again, multiyear projects. We are talking about long-term culture change and workforce renewal. There is policy there to support social infrastructure to provide clear pathways. In education there is a pipeline there for students to come through the system. So I would really encourage this inquiry to take the need for scale and matching action in planning the process to really best enable New South Wales, and really its coal-reliant communities in particular, to prepare and best respond to the inevitable change we are facing because hydrogen does provide a means of realising economic benefit from the energy transition, but we absolutely need governments to create the market and build the foundation.

The CHAIR: Thank you, Dr Simon. Ms Freeman, would you like to make a brief opening statement?

Ms FREEMAN: Absolutely. Thank you, Madam Chair. I am representing the Clean Energy Council, which is the peak body for the clean energy industry in Australia. We represent and work with over 900 of the leading businesses operating in renewable energy, energy storage and renewable hydrogen. As this Committee is aware, New South Wales is committed to a target of net zero emissions across its economy by 2050. Achieving that goal will require us to have access to every tool in the toolkit. That is what hydrogen does for Australia: It gives us new options for decarbonising our hard-to-abate sectors, from minerals and metals processing to industrial manufacturing and heavy transportation. It also represents a major economic opportunity for Australia.

In very well covered research, Deloitte in 2019 found that if Australia, for example, were to secure the same global market share percentage of the hydrogen market as it had for LNG, it would result in an increase in Australian GDP of up to $26 billion on a net present value basis and around 17,000 new jobs by 2050. That is probably just the start. If we get on with decarbonising steel production, as would be relevant I think also in New South Wales, the opportunities would be even greater. So there are significant economic opportunities out

of the hydrogen industry development, but to get there, as Fiona Simon has pointed out, it is going to require detailed planning and investment over the coming decade.

New South Wales, as a signatory to the National Hydrogen Strategy, has signed up to Australia becoming a top exporter of hydrogen over the coming decade. It has been a bit slower out of the gate than some of its State counterparts, such as Western Australia, South Australia and Queensland. It is yet to release its own plan. But it has made some important progress in the last few months also. I would like to give a special mention in that regard to the $750 million Net Zero Industry and Innovation Program, which was announced in March and from which $70 million has already been earmarked to support at least two hydrogen hubs, in the Hunter and Illawarra regions. This is perhaps the most significant budget allocation of any of the States to date. It has sent an important signal to industry that the State is ready to partner with the private sector on major projects.

The key determinant of Australia's success, though, in becoming a top hydrogen producer will be our ability to lower the cost of renewable hydrogen. It has been recognised in the Federal Government's Low Emissions Technology Statement that we need to get the cost of renewable hydrogen down from around $6 to $8. I have heard recent studies that might suggest that it might be as low as $5 per kilo in that absolute best-case scenario—from that price to under $2 Australian in order to be competitive with fossil-fuel-based equivalent energy sources. That is going to be a very big challenge. It will mean cutting the cost of electricity by half or more than half than where it is today, reducing the cost of electrolysers by around three-quarters and achieving very high capacity factors for renewable electricity so that the electrolysers can run at high utilisation.

The good news is that New South Wales may have some advantage over other States and Territories in Australia on the first and the third of these factors—electricity costs and high-capacity factors—which are those we can most control. First of all, the State Government's road map for electricity infrastructure investment, which aims to deliver 12 gigawatts of new renewable electricity generation capacity by 2030, is truly a landmark plan which should position the State to drive down the cost of electricity. We would say that a strong level of ambition for developing the New South Wales hydrogen industry is highly complementary with the State Government's electricity road map. They need each other. The road map provides lower cost electricity, while the hydrogen sector provides much-needed additional electricity demand, which can help to bring new renewable energy projects online.

The second piece of good news in relation to capacity factors is that the wind and solar resources of New South Wales are counter-correlated. That is that they are more likely to produce at different times. If you have a wind and solar farm producing electricity for a hydrogen electrolyser, you can power the electrolyser for longer periods. That stands New South Wales in good stead to having the lowest levelised cost of hydrogen supply in the country—

The CHAIR: Ms Freeman, my apologies. Can I ask you to conclude your opening statement so the members can ask some questions.

Ms FREEMAN: I shall. Let me conclude by saying that the renewable hydrogen sector is eagerly anticipating the State's forthcoming hydrogen strategy, which will provide a much-needed market signal to the private sector of the State Government's vision and intent. We urge the Government to prioritise demand-creation initiatives that will create reliable, bankable demand, which can assist industry to attract the investment to build projects and scale up over time. Thank you.

The CHAIR: Thank you very much. On that note, I ask my colleague, the Hon. Wes Fang, to ask you a question on that exact issue.

The Hon. WES FANG: Good morning and thank you very much for taking the time to appear before the Committee today. In Wagga recently we have got what is called a special activation precinct by the State Government that is going to generate its own hydrogen. We are going to have a hydrogen supply to each of the development blocks there. The hope is that we will start to have that hydrogen provided to industry and encourage industry to start utilising it. How important is it that we have these hubs where the hydrogen is usable? Is it something that you can silo in certain areas or should we be looking to make it a more widespread commodity that is available to industry across the State to assist in its adoption?

Ms FREEMAN: I think that question is to me. I think I would just start by saying in any usage case for the hydrogen to get it going and to that extent the hubs are really important. The hubs really should couple production and usage and without the two you cannot do a lot. I think you need to start with a base case of actually how you are going to deploy that hydrogen. There are some examples in terms of blending. The newly awarded project, the Australian Renewable Energy Agency [ARENA] project for Wodonga-Albury, would be an opportunity for gas blending in the network.

There are also some complimentary benefits out of that for the wastewater usage from the local water authority and also the process produces oxygen, which can also be used by the wastewater treatment plant. You need an anchor usage case in order to get it started, but then from there you really can—we have seen this in the HyP SA project at Tonsley park in South Australia. Once you have got an anchor usage, it can then start to be used for other purposes. Hydrogen can be produced and provided to other customers, as we have seen, where that process of gas blending is also now producing a bit of hydrogen that is being used by Whyalla. They are able to freight it up to Whyalla. They have only been able to do that because they have got the project started in the first place. Dr Simon might have something to add to that.

The CHAIR: Dr Simon, I was going to ask if you would like to comment.

Dr SIMON: I would definitely support what Ms Freeman has said. I think that core question about the value of the hub—the nut we are all trying to crack is that hydrogen has all this enormous potential. It has all this versatility and there are all these possibilities, but we are not commercial yet. How do we chip away at that? How do we chip away at the investment gap? How do we chip away at the lack of infrastructure? It is about efficiencies and how we can realise them as well as testing technologies and starting to build the skills in the workforce et cetera. The value of hubs is really important because it is really that way of trying to realise those efficiencies, trying to use existing infrastructure, trying to co-locate uses and co-locate the uses with the production. Any hub in Australia is going to look slightly different because it will come down to the best way that the economics of the engineering combine to really try to get a hub over the line.

The idea of the hubs though is not that that is all they are. They are our testing grounds. They are our starting points. The idea is that we need hydrogen to be cheaper across the country. We are trying to get an industry up across the country. The hubs are the starting point and then you really want to have the spokes between the hubs. You want to connect everything up. It is super important to do whatever we can. When you call it a hub or something completely different really as a matter of terminology, it is about just trying to realise some efficiencies in an environment where hydrogen does cost more than we need it to cost to be commercial. It is competing with an existing industry with fossil fuels that have an existing infrastructure, supply chains, logistics and subsidies from governments.

The CHAIR: Dr Simon, could you perhaps unpack for us a little bit where those costs are in the production of hydrogen and where the opportunities are to reduce those costs?

Dr SIMON: Sure. Thank you. I would just repeat some of what Ms Freeman has already said because creating the hydrogen—first of all, you can create it in different ways, as we know. The shorthand that we all tend to use is to talk about green hydrogen because that is the long-term future. That is where you will find most agreement about what we mean. But there are multiple pathways. If we start by saying it is green, we are then talking about an electrolyser. In most cases, we are talking about electrolysers that have been splitting the hydrogen and the oxygen from the water.

The key parts there that Ms Freeman already touched on is the cost of the electricity—it is the electrons. That is the energy that you are embodying in your hydrogen. It is fundamental to the process. It is the energy that we are holding onto. We need that to be cheaper. ARENA has come out with the numbers. We would need it to be at about $20 a megawatt hour instead of $40—although that varies across the jurisdictions. There is the cost of the electrolysers themselves. They are right now made in a, sort of, bespoke manner. They are not made in large machines in factories. But that is happening. That is starting to grow globally.

The cost right now of electrolysers is quite high. What we are trying to do globally is increase the size of those electrolysers and then decrease the associated cost per kilogram of hydrogen made with electrolysers. That is what ARENA has done recently with its hydrogen funding rounds. We are trying to get to 10 megawatt electrolysers. Where we actually need to be at the scale in 10 years or 20 years is one gigawatt electrolysers. We need to see that come down. People are quite confident that will happen. But a lot of it comes down to electricity price. It is the electricity price as well as this is not an economic cost as much as it is a social cost. There need to be discussions had—and this is part of the planning piece, it is part of that whole net zero piece—of the electricity transmission and generation infrastructure required to get us to scale, which is what I mentioned before. So there is a really strong need here to take the community along, to engage with communities, because we are going to need to change the landscape as well as the workforce in order to adjust to the energy transition.

The CHAIR: Ms Freeman, do you have anything to add to that?

Ms FREEMAN: I would just reference a little piece of analysis that ARENA did last year where they found that $6 per kilogram, sort of, cost stack of what makes up the cost of hydrogen. They had around the cost of electrolyser being about 36 per cent of the cost, the electricity making up 43 per cent of the cost and operational expenditure being about 20 or 21 per cent of the cost of hydrogen production. That gives you a clear sense of

electricity. That being probably one of the key things that we actually can control in Australia. The electrolyser production costs are probably going to be depending on other markets lowering their costs over time. But electricity is something that we can control to some degree. That is what we are going to have to lean into quite heavily in order to halve or more than halve. As Dr Simon said, we need to get to about $20 a megawatt hour for renewables and we are at about at the moment between $45 and $55. Let's say $45 is a current sort of power purchase agreement price—our purchase agreement price.

That is quite a big ask. We are already running on extremely tight margins in renewable electricity projects at the moment. How do we achieve that halving of the cost? It is going to require a reduction in the risk profile of renewable energy projects. A lot of that is to do with transmission networks and availability and also connections to the network. That is something where the road map in New South Wales is so important because it is a really cohesive plan in developing the backbone for the transmission. There is basically very little, if any, available capacity on the network in New South Wales at the moment. It is a pretty dire state of affairs that currently stands. That investment in renewable energy zones is desperately needed and will be a real strategic advantage for the State over time in that proponents of renewable electricity projects can be confident they can find a place to connect to and get their electrons into the system, which will enable cheaper production of hydrogen.

Mr DAVID SHOEBRIDGE: Thank you both for your evidence today and your submissions. With the five renewable energy zones that have been created, the two that have been primed to become hydrogen hubs seem to be the Illawarra-Wollongong and the Hunter-Newcastle where you have that mixture of a highly skilled workforce, potential industrial demands for hydrogen and the transmission infrastructure in place. Is that where we should be focusing attention for the really big hubs, that is, Newcastle and Wollongong?

Ms FREEMAN: You do need both. You need the usage case, as I discussed, and you need the production. Look, it is really interesting at the moment. I think, yes, naturally it should be the home where you have the skills base and you have the potential use case. The key question is whether or not the projects are actually going to be grid connected, assuming that they are grid connected, because there are some suggestions that if you are behind the meter you might be cheaper in terms of the electricity that you can provide. But let us assume that we can bring the overall cost of electricity down across the State and it will be able to produce at the port or at the industrial end where you might be utilising the hydrogen, which is probably a smarter configuration of the project because the hydrogen pipelines coming hundreds of kilometres may not be the best approach.

It may be best if you just draw the electricity from the grid, produce it on site and use it on site. It could either be for export or for green steel production facilities, et cetera. I think it makes perfect sense at the end of the day. The priority for my members in the renewable hydrogen space is demand. They need demand. I think if we can come up with a model and we can come up with some incentive base for those industrial centres to actually utilise the hydrogen then it will be a natural home for the sector.

Dr SIMON: I would support what Ms Freeman has said. Yes, those are the two locations that come up regularly and I would not disagree with that. I would also not purport to have knowledge about where the best siting would be in New South Wales. Certainly that connection to the ports and to existing expertise is vital. The Hunter has been raised certainly by the Federal Government as they talked about their hydrogen hubs and the idea of the funding that may be available. On that I just wanted to point out that the key issue there is how does New South Wales compete with the other jurisdictions for Federal funding and attention? There are a number of prospective regions across the country and we know that Western Australia and Queensland in particular are hungry and they have more things going on at the moment with those early stage hydrogen projects. I would say that the Hunter and the Illawarra absolutely have a case to be made. It is probably not so much against other parts of New South Wales but really to compete effectively with other parts of the country.

Mr DAVID SHOEBRIDGE: Given the scale of the energy required if you wanted to replace our fossil fuel exports—something like eight times the electricity that is currently being produced across the country to generate the hydrogen—should we be looking beyond just expanding the existing grid? In particular, for places like Wollongong and the Hunter, should we look at the capacity to produce large-scale offshore electricity in offshore wind farms and be directly feeding that into those hubs? Should that be something that we are planning for now?

Dr SIMON: Is that one for Ms Freeman?

Mr DAVID SHOEBRIDGE: No, it is for you Dr Simon to start with.

Dr SIMON: I hear different things from different people. There is something to be said where we do have the locations that appear to have the ideal characteristics. As I understand at this stage, and I am sure wind does not compete commercially, but like so many things in this rapidly evolving landscape it may well be that

that is a very good way of looking at the electricity required. I would suggest that Ms Freeman is probably the better person to answer this question though so I will end there.

Mr DAVID SHOEBRIDGE: We will go to you, Ms Freeman. I note that there has been detailed mapping of the offshore wind resource off the whole east coast and there is a huge offshore wind resource there. When we see what is happening in the UK that seems like an obvious matching with the hydrogen hubs.

Ms FREEMAN: Offshore wind does have quite a task ahead of it to compete with the cost of onshore wind projects. I guess that would be the first observation I would make. It potentially does make sense depending on the capacity factor and also how that capacity factor aligns with electricity demand in the network. If the offshore wind blows best at midday it may not be the most competitive project because that is when solar is strongest and solar is the cheapest supply. It just depends on when the wind is blowing and how does that align with the needs of the electricity market at the time? Does it align with the hottest periods of the year, for example? Does it align with peak times? All of those detailed studies need to be done and I think with many of these projects, there may be in the realm of about a dozen projects on the cards, although some of those are at the media release headline level at this point and maybe they have not yet done the detailed studies.

There is quite a lot of work to understand what the generation profile would be of offshore wind in order to be competitive with onshore wind. That said, taking into account what Dr Simon said before about the massive expansion that would be required in order to service renewable hydrogen or a hydrogen industry in Australia, we are going to probably need to explore every option available. I think there is some strong optimism that, for example, some offshore sites are going to be able to be very competitive. The Star of the South project in Victoria, for example, is looking very prospective. They have not yet made a financial investment decision but they are still undertaking that work. There is a strong case and I think as the cost of offshore wind comes down over time there will be a reason for us to try to export those resources also.

The Hon. MICK VEITCH: I have a question for Dr Simon. In the Hydrogen Council's submission you talk about remote area power systems, or RAPS, and how they can be utilised in remote communities. Specifically I would like to ask about replacing diesel in the mining and agricultural sectors. What are the issues you envisage around that? Specifically, as I see it, on-farm and on-mine transition from diesel across to hydrogen, how do you see governments incentivising or assisting that transition?

Dr SIMON: Thank you for the question. For us diesel is such a good place to start with turning energy around to start using hydrogen. Right now diesel, as a price for the fuel, hydrogen is largely cost-competitive already. The problem is that we do not have the infrastructure and the vehicles for the heavy haulage trucking in mining, for example. We do not have the sorts of things that are needed right now. It will come down to, in any given use in agriculture or in mining or the remote area power systems, we can replace the diesel without being concerned that the hydrogen is not commercial in terms of the cost of the hydrogen. The benefit of looking at diesel first is to say, "We are not looking at an ongoing subsidy but we are going to look at something like a one-off cost to get the infrastructure up or to replace the machinery."

I would say, like with all things in hydrogen, this is still a nascent area and there will be different manufacturers of different sorts of equipment and the like, or those who are watching the environment and, if given the right incentive, might progress their research and development or progress their production lines. So I would say it is about governments providing an incentive for the market for consumers to say, "We want this"—for farmers to want it, for the mining sector to want it—and to put that request back through to those who make the equipment that those consumers use.

It could be rebates on expenditure towards replacement machinery or it could be the research and development into particular areas of the economy that would best benefit from a conversion from diesel to hydrogen. As with all things in hydrogen, we often talk about chickens and eggs because there is a lot of interdependency—one cannot act without the other happening first, which is why with so much of this it is about governments providing that kickstart, that foundation. Diesel is an obvious one, as opposed to some of the other applications for hydrogen where we have a larger issue with the cost of hydrogen being far more than what it is competing with, which is not the case of diesel.

The Hon. MICK VEITCH: And Ms Freeman?

Ms FREEMAN: I probably know a little bit more about remote area power systems for communities. For remote communities, for example, that might be currently using diesel generators and that sort of thing. I think there is a very strong case for those communities to be transitioned to clean energy. It will be tricky for hydrogen to compete with batteries, for example, in those sorts of instances. It is competitive and a number of studies have demonstrated that hydrogen is cost competitive at the moment with diesel for those remote area car systems. However, they also need to compete with batteries and I think at the moment that is probably likely to be in some

of those cases a cheaper option for some of those communities—not to say that hydrogen cannot play a role. Probably the role it would play is utilising what would otherwise be spilled electricity.

There is an opportunity to, for example, if you have too much solar during the day or solar is producing so much that it would otherwise be spilled could you basically run an electrolyser at those times to put the hydrogen and use it later for power? The economics are, even though it is one of the most competitive options, still challenging. I think one of the best things governments could do at the moment is, like they are doing in Denham in Western Australia with the ARENA project, for example, some projects of that nature where we can test out the best configurations and how we can make hydrogen the most competitive that it can be. I think there is absolutely a case for that. As we get better at doing it and can do it more cheaply and effectively, essentially then deploying that to remaining sites. I think those demonstration projects will actually be really important.

The Hon. MARK PEARSON: It looks like the most controversial or the situation that gives us the most cause for dilemma is the energy that is required to separate the hydrogen from the water molecule. You have been talking about electrolysers being required to power that. Is it likely that we will get to a point where the power and energy of hydrogen itself will be able to provide the power and energy to separate hydrogen from water so that the power and energy of hydrogen creates hydrogen as a power resource?

Dr SIMON: Is that question for me?

The Hon. MARK PEARSON: Whoever thinks they might be able to answer it.

Ms FREEMAN: I am just trying to make sure that I have understood the question correctly. If I have, it is using hydrogen to produce power. I do not know that it would be the most cost-effective way to produce power. It is conceivable, but I do not know that it will be the most cost-effective. If you are going to produce renewable electricity to make hydrogen then to turn back into electricity, it is probably not the most efficient process. I think there is a case potentially, as we discussed before, for using what would otherwise be spilled electricity. For example, for hydrogen they are saying we probably need to overbuild the size of capacity—the size of the wind farm or solar farm—in order to make the hydrogen.

I know that in some States, for example in South Australia and Queensland, during the day we have negative electricity prices because we have so much rooftop solar that is just being spilt. Could we use that to produce hydrogen and then maybe it is used to balance the grid? Yes, potentially. I think there is some merit in it. I do not know, though, that you will build a project with the ambition of producing renewables in order to produce hydrogen in order to produce power. I think it would be more likely it was a side benefit.

The Hon. TAYLOR MARTIN: Can I just ask, and interject somewhat, and say: Is it more a question of storage and firming of energy through different times of the day and different times of the year rather than—I think to Mr Pearson's question—about the source of energy itself?

Mr DAVID SHOEBRIDGE: Storing the massive excess in the moments you have wind and solar pumping in and you may have almost zero energy costs.

The Hon. TAYLOR MARTIN: The key word being the spillage—you oversupply and then you have it to use later on. Is that fair?

Mr DAVID SHOEBRIDGE: I think that is what we are asking about.

The CHAIR: Can you direct that question to a witness?

The Hon. TAYLOR MARTIN: To Dr Simon.

The CHAIR: Is that a question?

The Hon. TAYLOR MARTIN: Yes, it is. Is it fair to say that is more a question of storage and firming rather than choosing a source itself?

Dr SIMON: Yes. I think we just need to be clear that, like electricity, hydrogen is an energy carrier, it is not a source. We can use the language of "source" in a more general sense, but that can sometimes hide the fact that we are not digging it out of the ground—it is not embodied solar that was in the ground for millennia and that is where energy comes from is. It is way of harnessing a molecular form through the electrons you have collected via solar or wind. With every conversion, as Ms Freeman said, you lose some energy value. So batteries are better—and we are not competing with batteries for hydrogen, by the way.

Hydrogen can fill a really important role across many parts of the economy but where you can use your electricity immediately and you do not need to hold onto it for long periods of time, you just create the electricity and use it, like our grid. If you want to store it for a brief period of time, the battery helps you do that. If, however, you are talking about really shifting the use of that energy through time and/or space, that is when the hydrogen

comes in. You are losing some energy value converting your electricity to hydrogen, but the benefit of having it in that molecular form is that you can now hold onto that for years; you do not lose the value as you would with the battery over a brief period of time. So it provides a seasonal storage, which is an absolute benefit for when there may be electricity droughts in the future.

The Australian Energy Market Operator, through its plannings, we are talking about Australia having the fastest energy transition. We are talking about by 2040 having 90 per cent of the electricity grid as variable renewable electricity. There will be a need to manage deep storage needs—so times for energy droughts. That is where that storage case comes into play and hydrogen could in fact be better than pumped hydro and large-scale batteries both in the sense of its flexibility because you do not have some of the same social issues as you would with pumped hydro, its locational availability—there are more options—and it is cheaper than large-scale batteries. So that is where hydrogen has that role to play. As Ms Freeman said and as you have noted, you can definitely create hydrogen from electricity in order to hold onto the hydrogen and use it to make electricity at a later point in time, but you will end up with much less of the energy value than what you originally put into the system. You would need to have a pretty strong reason for doing that, which is why it has been about that storage value but making it worthwhile.

The Hon. JOHN GRAHAM: My question is to Ms Freeman about your observation in the submission you have made about the electric buses transition which is happening in New South Wales. You have called on the Government to remain open minded about the technology mix that it adopts as it makes that transition. I am interested in what response you have had to that call or any additional background information you can give us about why it might be advantageous to include hydrogen in that transition.

Ms FREEMAN: I don't know that I have got great insights in terms of where they are at. They have not actually formally responded to that question or call. However, I do understand that they are open to—and in fact Dr Simon might have some better information than I do on this one at the moment—ensuring that there is some trial at least of hydrogen buses within that total fleet changeover. My understanding is that the relative advantage of hydrogen in buses would be that if you have got very long routes, for example, or if you have got particularly hilly terrain or bus routes, it may be better to utilise hydrogen. At the moment though they are more expensive than battery electric vehicle options, but then you have to take into account the entire system considerations of that. Because if you then have to take a bus offline or have more time to recharge it, it could be that, in fact, there are some benefits in hydrogen because potentially it can go further distances et cetera. So you need to do that whole study to understand how it fits in.

You also need to understand what is the best configuration for back-to-base routes and structures. Can you have both hydrogen and battery electric buses operating, for example, in the same areas at the networks or is that too complicated? I think they will have to think carefully about where hydrogen—that is, fuel cell electric vehicles [FCEVs]—would be most appropriate. But yes, absolutely, I think we should be trialling this because, as we have said, diesel and diesel replacement for heavy vehicles is probably the most prospective opportunity for hydrogen deployment. It could actually produce quite a lot of demand for local production, which would be really helpful in building scale for the sector. I think it is one that definitely the Government should prioritise.

Dr SIMON: I did note that the New South Wales Government released the EV strategy in the last day or so. I note that explicitly the language of electric vehicles [EVs] encompasses FCEVs, which is great. There is mention of hydrogen here and there. I guess I would always encourage people when talking about EVs, particularly when we are meant to be rolling out FCEVs in there—is that the language of charging is not right. Not that I am saying the Committee has used it, but the language of charging is one that is explicitly about electricity. We are talking about refuelling infrastructure for FCEVs. I think that the strategy was silent on that, if I read that correctly, which means that to start to solve some of those problems that Ms Freeman has mentioned, I think there needs to be more. Just even at assessment of a core network that might be an area that should be addressed for fuel cell electric vehicles.

There was something I had said to me from someone in California not that long ago. It was the assessment of a bus line in the US as to whether to go down the path of batteries or fuel cells. It really was a route-by-route assessment and they were finding that when a route extended beyond a certain length, yes, the battery electric vehicle was a bit cheaper but you actually needed one and a half battery electric vehicles to cover that route satisfactorily, which then made it a lot more expensive than the one fuel cell electric vehicle that you could use for the same route. So it is really important to do—again, I come back to the story of the planning piece and not putting all your eggs in one basket and realising that, in fact, efficient outcomes will actually require the two technologies to play side by side and we will need government support to enable that.

The Hon. MARK BANASIAK: My question is to both of you. We have had some fairly strong submissions from three council areas—Wollongong, Lake Macquarie, and the Hunter-Newcastle region—all

putting their hands up saying, "Pick me as a place to do hydrogen." Is it a case that we do not need to choose one or the other and that if we want to create the demand, we actually have to provide a good level of supply? So we do not necessarily have to pick a winner in those three and we could actually choose all three if all three business cases stack up.

Dr SIMON: I think this is where it comes down to that planning question. I am not in a position to say, "Yes, absolutely. Those three play well together and when combined will create the necessary scale", or any of the alternative ways of considering that issue. I would say that right now—because we are talking about the need to get to scale, because we are talking about the need to develop that demand and connect the different applications with the production source—I think it is better to attack the issue with gusto, so go in hard and try to make this thing happen. That may well be the three or two rather than picking one. But I would certainly suggest that it is something to really engage on closely with planning both across New South Wales but also, as I said, on that Federal level to try and take advantage of the Federal appetite as well to put money into some of these hub projects.

The Hon. BEN FRANKLIN: I want to go to the question of location that both Mr Banasiak and Mr Shoebridge have raised and go back to first premises. We had evidence from Geoscience Australia in our previous session that said that it was more economically viable to bring the necessary electricity to the significant water resources that are required. They suggested that probably recycled water would be the best way to do it, plus, of course, be close to ports in order to be able to make this work economically with the most sense. On a premise level, is that sort of logic what the two of you think is reasonable? Do you have any other comments on it, starting with Dr Simon?

Dr SIMON: I certainly would not want to out-science Geoscience Australia on this. The question of the economics is one that I imagine they have looked at but I do not know how deeply or through how many lenses or over what time frame. It is the perennial question right now we are asking: Which do you move? The electrons or the molecules? And, again, there are no easy answers, I'm sorry. It is about planning and bringing together that economic and that engineering reality for a given location for a different set of circumstances. But the fact that we are all focusing on the ports and it is really about that export story, I think might be the driver more than anything else.

Ms FREEMAN: Can I just note that there has been a really interesting piece of work done in South Australia. They actually answer something that New South Wales could look at. The South Australian Government decided, "Well, we want to work out where we should invest our dollars in terms of infrastructure investment for hubs. Where are the most prospective sites?" They engaged some consultants who finished a pre-feasibility study late last year of potential hub sites. It was a very holistic look at all of the factors of what you need to make it efficient, because what we need is a low-cost location. Every proponent will be looking at bringing all the pieces together to come up with the lowest cost of hydrogen. How do you do that? Is it best to bring the transmission lines or the pipeline, and pipe the water? Which one of those factors should be located closest to port, for example? Is it an export project or is it being used for local heavy industry? The usage case is really important to understand.

Regardless, they did this pre-feasibility study and effectively they have ended up actually coming up with what they anticipate would be the cost of green hydrogen and blue hydrogen for a range of different sites, and so have been able then to determine which are the most cost-effective or economical or highly prospective hub sites. That really enables the Government to channel its funding. It is saying, "Okay, we need to expand that pier at that location because we think that will be probably the most prospective site for hydrogen production, so let's get the infrastructure around that place right and really channel our efforts." Given that we have finite resources to invest in this—and it will be very expensive, let us be very honest. It will cost us a lot if we are serious about being a top producer for the Asia-Pacific region—or even for the world—for hydrogen. If Government is going to use its money sensibly, in a targeted fashion and as efficiently as possible, I really suggest that a piece of work like that could be really important in directing where that investment should be made.

The Hon. BEN FRANKLIN: That is really helpful, Ms Freeman. Thank you.

The CHAIR: Ms Freeman, is it possible for you to assist us to access that document if it is a public document?

Ms FREEMAN: I would be happy to share the details, absolutely.

The CHAIR: Thank you very much. You referred earlier to demonstration projects. Will you give us more information about where you would prioritise demonstration projects and what it might look like if the New South Wales Government were to invest in that?

Ms FREEMAN: When I was thinking about what are the top priorities for demand creation and market activation, number one on the list, as Dr Simon has mentioned, is diesel replacement. That is the most

cost-effective initial use. Where we can support projects to look at where they can make the switch from diesel to clean energy alternatives, which may include hydrogen—again, I think we need to always make sure that we are being open minded and utilising hydrogen for the most cost-efficient applications and not just supporting it for its sake. We do need the lowest cost transition, so we do need to keep that in mind. But diesel replacement, I think, is a real option. In WA for example, where they have a lot of regional and rural and remote communities that are on diesel generators, that is something that they could potentially prioritise—mining sites, for example.

There is a question to be asked about when should government play a role and when is it the responsibility of the private sector, which has also committed to decarbonising. But I think in demonstration projects where you are sharing the learnings there is a real case for the Government supporting some early diesel-replacement demonstration projects across remote or regional communities, farming businesses, mining sites et cetera. Finally, I just add to that—and I know we are on time so I have to be really quick—while gas blending possibly does not deliver the same bang for buck in terms of carbon abatement, it is an instantly and immediately available opportunity for us to build scale for the sector. I am aware that there is the western Sydney Jemena project. There is probably a case for that project—it is a small trial of hydrogen blending within the gas distribution network—and for similar trials being done in other communities, metro centres or regional centres across the State as well.

The Hon. TAYLOR MARTIN: Thank you both for taking the time to appear today. There was a question from the Hon. Ben Franklin where Dr Simon ended up just touching on the export opportunities. I would like to see Dr Simon picking up on that, if you would not mind. I note in your opening statement you said that the opportunities are real. Will you expand a bit more on what could be realised for Australia and for New South Wales from an export market in hydrogen?

Dr SIMON: Sure, thank you. We are seeing globally this trend toward countries wanting to decarbonise. Many of our trading partners are not as fortunate as we are in having the land, the solar and the wind resources to really create their own entirely renewable electricity market. They may not have the natural gas reserves. We have countries right now—particularly Japan and South Korea, but we hear from Singapore and we have discussions with Germany—where they are confronting a need to decarbonise and recognising that they will want to import their energy. Then you say, "How are you going to import it?" You are not really importing electrons unless people are talking about the long-range cables, so that is where hydrogen has that role to play. As I said before, there are efficiency costs if you are trying to just use your own hydrogen that you produce yourself for electricity immediately. Why would you do that? But for storage and for export, that is where it is worth it.

We have countries right now saying they will be hydrogen economies. South Korea and Japan, in particular, in our region are looking to us and looking to buy our hydrogen. As far as I am aware, they want to buy as much as we can make. The fact that Germany is talking to us about importing hydrogen—and obviously there is a distance issue there. They are just the beginnings of conversations. The export opportunity is real, because we have enough of our trading partners and others who are saying they will need to import hydrogen. They are looking to us, when they are in our region, to be the logical party to do that for them. We are, however, still competing with other countries. Those other countries, to varying degrees, are putting a bit of money into this. If I might segue very briefly, I noted that you asked Geoscience Australia about where Australia is globally. I would say that we may well be doing well from a technical perspective, and we are certainly viewed positively for the National Hydrogen Strategy and for the initiatives that have been taken.

But we are still a long way behind having a genuine road map that says we will be here by this year and these are the milestones to get there. The sorts of information that industry looks for—that markets look for—in order to be able to invest is still lacking in our country. We do not have fuel standards. We do not have a price on carbon or anything that might look like that. All of those ways of valuing the hydrogen and encouraging a shift in the economy we do not have here, while they do have them overseas. It varies from country to country. Germany, for example, with its own move to decarbonise and move to hydrogen, announced €9 billion last year to make that happen—many times more than we are putting into it here. I would say export is a huge incentive and it is really what has been driving so much of the interest in Australia, but we are competing with other countries despite having natural advantages. Others have natural advantages too, so it really is something that should also be driving that sense of urgency to make it happen.

The CHAIR: I am really sorry to interrupt this and say that time has expired, because this evidence has been amazing. On behalf of the Committee, Dr Simon and Ms Freeman, we would like to thank you very much for your participation. The Committee has resolved that answers to questions taken on notice should be returned within 21 days, and the secretariat will contact you in relation to the questions that you have taken on notice. Again, thank you so much for this excellent evidence and the time that you have spent with our Committee.

(The witnesses withdrew.)

(Short adjournment)

CORRECTED

TY CHRISTOPHER, Honorary Professorial Fellow and Director, Energy Futures Network, University of Wollongong, sworn and examined

ADAM ZARTH, Executive Director, Business Illawarra, sworn and examined

MARK GRIMSON, Economic Development Manager, Wollongong City Council, sworn and examined

The CHAIR: I welcome our next witnesses, who are appearing in person from the University of Wollongong, Business Illawarra and the Wollongong City Council. I now invite you, if you wish, to make an opening statement. Can I ask that it be kept just to a couple of minutes because we are finding that the members are very engaged and have lots of questions that they are enjoying asking. Mr Christopher, do you have a brief opening statement?

Mr CHRISTOPHER: I do, Madam Chair, but with your indulgence, we did preconceive an order for our introductions.

The CHAIR: Perfect. We will go with that.

Mr CHRISTOPHER: There is a flow-to, if that could be indulged?

The CHAIR: I thank you for that as well. We will go with the flow here. That is good. Thank you.

Mr ZARTH: Thanks, Madam Chair, honourable members. Up front, I commend this Committee for establishing this inquiry into an issue that is particularly important and that there is a lot of excitement about in the Illawarra among the business community, all arms of government working together and the broader community. I just want to quickly introduce myself as the head of the Business Illawarra part of what was formerly known as the New South Wales Business Chamber. We are a non-profit membership organisation and we are based across the Illawarra, Shoalhaven, the South Coast and the Snowies, but predominantly focused, of course, around the industrial and economic business community in Wollongong.

Our Illawarra First thought leadership group conducts its own research and has 33 business leaders who all contribute to that research to progress our economic development. We are here to fly the flag for Team Illawarra, but do not make the mistake: We are actually on a course for advancing the cause of Team New South Wales. Obviously our State is an established exporter of natural resources and well positioned to be a key player in the hydrogen markets. Port Kembla has a very important role to play in that and there is absolutely no doubt about that in our minds. But we are in competition with other States and particularly the global market and we are seeing competitors elsewhere ramping up quite rapidly in the establishment of hydrogen hubs.

In our region—and we want to tell the story of this—the private sector is leading in concert—and we commend the New South Wales Government for this—with Government to realise our potential for hydrogen production and export. Some of Government's recent policy setting at a State level, which I will quickly acknowledge here, has been really conducive to the uptake of that in the private sector. To that end, the establishment of a renewable energy zone by the New South Wales Government in December last year and establishing Port Kembla as a hydrogen hub in March 2021 this year of course are integral in attracting that investment and that interest and ensuring that all levels of government are collaborating.

The suitability of Port Kembla that I really want to highlight is its location near the ocean. A component of hydrogen is found within H2O. Port Kembla is a deepwater port with that nearby industry and research capability—I refer to our colleague Mr Christopher from the University of Wollongong—with a highly skilled workforce. We have workers already engaged in ancillary and related roles in related sectors and of course our infrastructure. I will probably close my opening statement by saying that infrastructure is something that we at Business Illawarra want to progress the discussion around.

Part of an established hydrogen industry capability—whether it be Port Kembla, in the Hunter or both—will rely on that infrastructure, whether it be road or rail. Of course, our region does need further development in respect of rail. We have put research capability behind that to prove up the case for a south-west Illawarra rail link. I will close my comments there and look forward to engagement with members of the Committee. Thanks for your time.

Mr GRIMSON: Good morning, Madam Chair and Committee members. I, too, would like to thank you for the opportunity to be here today and, on behalf of the Wollongong City Council, I welcome the opportunity to make a submission. Wollongong is a city that is committed to a clean energy future with demonstrated capability to develop a large-scale hydrogen industry as identified by both the Commonwealth as part of the National Hydrogen Strategy and, more recently, through a series of announcements by the New South Wales Government. The Wollongong City Council supports the vision and is working proactively to encourage the development of a

hydrogen hub at Port Kembla. This would not only achieve the city's adopted target of net zero emissions by 2050 but also deliver longer-term economic benefits for the Illawarra region and New South Wales as a whole.

Wollongong is a city transformed. Traditionally known as a city of world-class steelmaking and a coalmining industry, Wollongong today is an important knowledge services centre and globally connected international trade hub. In September 2019 council adopted an economic development strategy setting a target of ten and a half thousand net new jobs over the next decade. Whilst many of these will take place in the knowledge services sector we believe that Wollongong's existing skill base in advanced manufacturing will support many jobs in the emerging clean energy sector. I should just say that in addition to the recent announcements by Minister Kean for a 750 net zero industry innovations program, as part of this work, particularly the $70 million to develop hydrogen hubs, our region is working closely around the developing of those opportunities, particularly in terms of the heavy transport sector where we believe there will be real opportunities in the near term, particularly given their contribution to emissions.

A lot of this work is being led by the New South Wales Government through the Department of Regional NSW to develop Australia's first five-gigawatt large-scale hydrogen production facility at Port Kembla. There is strong industry collaboration. By way of example, last Thursday we held the seventh Port Kembla hydrogen hub meeting, which has already close to 50 participants from government, university and industry. I will leave my evidence there as well. I heard some of the earlier discussions around what are those key attributes to the large-scale production of hydrogen. We believe that Port Kembla ticks all those boxes, given our access to skills, a deepwater port particularly from an export perspective, obviously access to markets and we also are in very close proximity to the eastern gas pipeline, which is quite critical, and we have access to large-scale renewable water at Port Kembla. I will leave my remarks there. I am happy to take questions.

The CHAIR: Thank you very much.

Mr CHRISTOPHER: At the University of Wollongong, we see ourselves as being very well placed to help in the ambition of developing a successful hydrogen industry in New South Wales. We have a long history of deep engagement with local industry and the local community. Just recently our researchers delivered significant advances in the engineering and management of pipelines, including research into hydrogen transportation via pipelines. We host the Future Fuels Cooperative Research Centre, which is a long-term collaboration with natural gas and other energy suppliers in Australia, along with regulators, industry associations and government agencies. This future fuels CRC is a leader in research into alternative fuels and especially hydrogen.

A team of researchers from the University of Wollongong's Intelligent Polymer [IP] Research Institute, in collaboration with other researchers, fabricated a novel synthetic electro catalyst using a low-cost metal which allows scalable low carbon water splitting: Bottom line, a new way and a cost-effective way to produce hydrogen. This has now been successfully spun off into a new company, Hysata technology, which is co-funded by the IP group and the Clean Energy Finance Corporation. The University of Wollongong has the Simulation, Modelling, Analysis, Research and Teaching [SMART] Infrastructure Facility where we are developing hydrogen solutions particularly focused on transport, including trains, buses and underground mining equipment, with a particular focus on re-powering existing diesel fleets. The University of Wollongong is part of the NUW Alliance, which comprises four leading Australian research-intensive universities, including the University of Newcastle, the University of New South Wales [UNSW] Sydney, the University of Wollongong and Western Sydney University. The mission of the alliance is to seek out the big collaborations that are going to make a real difference and unlock new benefit for communities in the energy space.

I will conclude by saying that while my colleagues have spoken about the unique advantages of the Illawarra, the region has already attracted the attention of several significant projects that will provide early-stage opportunities for the adoption of hydrogen and the development of a regional industry supporting the whole hydrogen supply chain. After making our submission to this inquiry and by working in collaboration with the New South Wales Government and Opposition, Recharge Illawarra, i3net, representatives from Wollongong council, the business chamber, BlueScope Steel, Coregas, union groups, Squadron Energy, EnergyAustralia, Sydney Water and Jemena, the University of Wollongong has facilitated the development of a local road map for a hydrogen-centred energy future. The road map addresses the factors of hydrogen demand, hydrogen production, regulatory and legislative change, technical development and, most importantly, the employment transformation pathway through the retraining of skilled people and the establishment of new education courses for the clean energy workforce.

A further highlight of this road map is the initial focus on heavy vehicle transport, the centrepiece of which is the already committed hydrogen vehicle refuelling station at Port Kembla and the commitment to use two hydrogen vehicles for the transport of gases to and from Wollongong and Sydney by Coregas. Rather than

simply articulating a desired hydrogen end state, the road map details the milestones necessary to fundamentally transform the energy landscape, the employment environment and the region and State from our current position to a clean, hydrogen-based energy future.

The CHAIR: Did you refer to NUW Alliance?

Mr CHRISTOPHER: Correct.

The CHAIR: What is that an acronym for? What is the acronym, for the benefit of Hansard?

Mr CHRISTOPHER: Absolutely. The origin of it was Newcastle, UNSW and Wollongong. However, the membership has now expanded to the list that I had. But NUW was originally the initials of the three founding universities that came together in that alliance.

The CHAIR: Understood. Thank you very much.

Mr CHRISTOPHER: No problem.

The CHAIR: And thank you, gentlemen, for your opening statements.

The Hon. MICK VEITCH: I am fascinated and I do not think the Committee wants to get into a bidding war as to whether the Hunter or the Illawarra or even Sydney are the better locations.

The Hon. WES FANG: We can.

The Hon. MICK VEITCH: Maybe there are a couple at the table who do. But what we really want to do is get into the nitty-gritty around the development of a hydrogen economy in New South Wales and what we really need for that. I am initially keen to talk about the workforce and skill set developments required if we want to grow and support a hydrogen economy in New South Wales. I know that universities are doing a lot of work at the moment around that, particularly Wollongong. How difficult is it going to be to transition existing workers and what are the skill sets that are going to be required to do that?

Mr CHRISTOPHER: All change is a challenge, especially when we are talking about the size of the shift that we would be looking at as we move to a hydrogen economy. I have heard analogies when they talk about it being a new industrial revolution when we move to a hydrogen-based economy. I would offer a contending view to that view. I do think there are some significant early what we would call in business "adjacency plays" that can be made here. The reality is that particularly in the Illawarra—and when you leverage out of the existing heavy manufacturing and mining industries—you are dealing with an already highly skilled workforce. So it is not a significant leap for today's underground mine plant operator to become tomorrow's hydrogen electrolyser plant operator, and for today's steel rolling mill plant operator to become tomorrow's blended hydrogen production facility operator. Similarly, an underground mining electrician can quite easily transfer his or her skills over to being a plant electrician for a hydrogen electrolyser or refuelling plant.

Our thinking at this stage is while in no way being dismissive of the significance of change that is required in moving the employment environment, I think there is—and we believe there is—a significant skills base from which we can evolve in gradual steps and adapt existing courses and adapt existing training courses to build that workforce of the future as and when required.

The Hon. MICK VEITCH: You mentioned the deepwater port at Port Kembla. This is where the bidding war will happen if we are looking at export. The question is probably to Business Illawarra to start with but essentially, Mr Zarth, what infrastructure is required at Port Kembla to make it a hydrogen export capacity outlet for us?

Mr ZARTH: One of the key advantages that we see—we are lucky in this State, we have capacity at our ports that others do not from the point of view of global competitors. NSW Ports, which operates Port Kembla and Port Botany, have identified Port Kembla as its growth port. We are already seeing that take place and Port Kembla is taking its role, whether it be through the importation of construction materials—which cannot happen quick enough at the moment to service that sector—or the importation of cars, for which Port Kembla is the number one port in New South Wales. We expect there to be significant landside usage involved in the establishment of a hydrogen sector at Port Kembla.

Perhaps, if it is okay, through the Chair I will request our learned colleague to expand on what facilities might be required, because at this stage we are in a nascent stage. I would give an example recently where Coregas is already well established, I think, for 20-odd years at Port Kembla. They are putting together a $2 million hydrogen refuelling station, which Mr Grimson referred to. We had a very successful, as he mentioned, industry event to look at what the opportunity inherent in that is, and a lot of my members and others from the freight and logistics sector, a lot of trucking companies based at Port Kembla—once again, there are those linkages there—

were all together to look at how they might begin transitioning their fleet because of this investment on behalf of Coregas that was partially funded to the tune of $500,000 by the Port Kembla Community Investment Fund, which itself was part of the long-term lease of Port Kembla being ceded to the community for certain projects that it was felt would grow the economy. To your question about what would be required at the port in terms of major facilities, I am probably not the best to go there if that is appropriate.

Mr CHRISTOPHER: The answer to what would be required is highly dependent on the chosen transport mechanism for hydrogen, whether it is going to be transported in a compressed and liquefied state, or whether it is going to be transported contained in a matrix usually as ammonia in a liquid state, which has some advantages, although it does have some challenges regarding the energy mix of input and extraction from an ammonia base for hydrogen. The advantage that Port Kembla does have is it has got the real estate. It has the ability for any one of these facilities and perhaps multiple of these facilities to be installed, depending on the chosen transport mechanism for the hydrogen, whether it is liquefied as hydrogen or whether it is contained in other mechanisms.

Mr DAVID SHOEBRIDGE: Thank you, all, for your submissions and for the work I have seen you all doing in the community down there. One of the things the Clean Energy Council said and other witnesses have said is that it is critical for the State Government to start creating some serious demand, whether that is in hydrogen-fuelled bus fleet or other ways of creating demand to really get the ball rolling. What are your views on that?

Mr ZARTH: I would say that is a really good first step. It is a small step and it builds on an existing capacity at the port but with the Government's investment with that Coregas refuelling station, we can start looking at what a refuelling network might look like for hydrogen powered vehicles. There was great interest in the room at this event from the trucking companies. They want to transition to hydrogen sources of fuel.

Mr DAVID SHOEBRIDGE: Just to be clear, when I said "create demand", they need to not just give small scale grants out to produce hydrogen but actually ensure that they are a major customer, to start using the hydrogen where it is being produced. That is what I was getting at.

Mr ZARTH: I think I heard discussion earlier as I came in—again, at your discretion, I would pass to colleagues. A hydrogen-powered bus public transport fleet would obviously engender a significant source of demand in terms of vehicle requirements. Where we see the sector at the moment is that it is this headline policy, I guess, direction being set by the Government. Again, we do commend the New South Wales Government for that, whether it be through gas- and hydrogen-fired electricity generation. Of course, we have seen EnergyAustralia choose to invest at Tallawarra B with a potential for that to occur—that is, hydrogen-fired power generation. The New South Wales Government came in on that—$78 million.

Mr DAVID SHOEBRIDGE: Almost nobody is saying that the economics are there for consistent hydrogen-powered electricity; almost nobody is saying that that is the best solution. I suppose I might go to Mr Grimson and Mr Christopher about what are the demand-creating measures the State Government particularly can do to give the industry that head start?

Mr GRIMSON: For my part, I just support what Mr Zarth said there. As we said, the first heavy vehicles in Australia in the first half of next year will be operating at Port Kembla. There is capacity within Coregas' new refuelling station to see that grow. We are looking, as part of a local development plan, around potential sites for a larger refuelling station should demand be there, but there is already, as Mr Zarth alluded, a number of local trucking companies. Given the logistics that is at Port Kembla and the opportunities in that space as well, we do see opportunities potentially—the green bus around Wollongong, which is a CBD-servicing bus, it will be great to see a demonstration project there around that. Also on the back of EnergyAustralia's announcement, with the support of the State and Federal governments, by 2025 I believe that that could take up to 200,000 kilos of green hydrogen a year. Squadron Energy have also indicated interest in a new gas-fired power station that will be able to also take up to 30 per cent hydrogen from day dot, and by 2030 that potentially could be 100 per cent hydrogen; they are talking about that. So we are starting to see some projects that potentially could take larger scale hydrogen production.

Mr DAVID SHOEBRIDGE: Just to remind you, my question was about what the State Government can be doing to create demand. Mr Christopher?

Mr CHRISTOPHER: Just to step off and "yes, and" my colleague's statements—transport, transport, transport would be my answer to your question very directly. While we have talked here about heavy vehicle road transport, we are very centred and our plans here at the University of Wollongong as well—we have a very strong background in rail transport and heavy rail transport and repowering existing what are at the end of the day very valuable and very long-lived transport fleets in the rail area. The technology to repower them does exist globally.

It would be a terrific boost to Australian manufacturing if we could bring that technology over and establish industry here in Australia, here in New South Wales—dare I say here in the Illawarra—to repower existing heavy rail fleets with hydrogen-based technology. That would be a tremendous boost on the demand side of hydrogen and would really kick things along for the State of New South Wales.

The CHAIR: Can I just ask what countries is that technology currently accessible in?

Mr CHRISTOPHER: The technology that we have seen—and indeed at the meeting that was referred to last Thursday by my colleagues we saw an excellent presentation from a US-based company and they are manufacturing this equipment in the US and also in Europe. I am under evidence, so I am not 100 per cent on the exact country in Europe, but it is Western Europe and the United States.

The CHAIR: Would you mind taking that on notice, perhaps, and providing us with some further detail?

Mr CHRISTOPHER: I can provide a link and some further information. I am more than happy to.

The CHAIR: With the Committee's indulgence, I just want to ask about hydrogen in the steel industry since you are from that region. Is that an opportunity or is that further down the track?

Mr ZARTH: Madam Chair, I will lead on that if that is okay. I think BlueScope's submission to this inquiry was an excellent summary of where we are at. Again, the industrial grouping around the Illawarra is absolutely focused on the opportunity inherent in hydrogen to transition us and decarbonise our industrial base. Having BlueScope in our region over many years has given us not only a source of employment but of course a key role in the manufacturing sector, which is very critical in the current climate where we are seeing Colorbond, for example, being used in a significant scale in residential construction. In terms of BlueScope, their transition is several decades away—again, I am referring to their submission—but it is a process.

To pick up the point by Mr Shoebridge, there needs to be signals in the market and as well there needs to be co-investment and support by government. So that would be direct support in terms of transitioning their equipment. I will not seek to summarise their submission, but I do refer the Committee to it. Obviously, if that is successful, then we expect BlueScope to be with us for a very long time into the future. Of course, even recently that confidence inherent in how things are proceeding in terms of the hydrogen transition has seen them receive critical State significant infrastructure approval to realign their blast furnace because they will need to continue to use metallurgical coal in the manufacture of steel until that transition to hydrogen is undertaken, which will be very costly and of course is awaiting the technology to be ready for that to occur.

The Hon. BEN FRANKLIN: The evidence we heard this morning from Geoscience Australia was that for every tonne of hydrogen that is produced, you need at least nine tonnes of water. Where you are going to get that water from is a significant issue. One of the solutions they proposed was the idea of recycled water being that form of water being used. What do you think of that? How would that play out in the Illawarra? Is that something that council would consider helping to activate? What are your thoughts? They are to all three of you, but perhaps we could start with Mr Christopher.

Mr CHRISTOPHER: We are blessed in the Illawarra with having a very large water treatment and recycling plant adjacent to the port of Port Kembla. My colleague mentioned earlier the Port Kembla hydrogen hub initiatives, and we spoke about those earlier, which we are all a part of and have been meeting for quite some time here on. The five gigawatt scale that is being talked about in terms of hydrogen manufacture there, that is actually an input measure of the electricity demand that would be required. That is actually determined by the use of the existing recycled clean water resource out of the existing Sydney Water recycling plant that is located adjacent to the port of Port Kembla. The theory goes that current technology frontiers, if all of that water were to be electrolysed into hydrogen, then that would place an electricity demand of just under five gigawatts of electricity demand. Obviously we have a terrific opportunity to utilise that water resource. From a technology perspective, I would say there is also a lot of discussion around using seawater to produce hydrogen as well.

The Hon. BEN FRANKLIN: Desalination. Absolutely.

Mr CHRISTOPHER: But having to go through the desalination process et cetera, that does make the whole process more energy intensive and less—

The Hon. BEN FRANKLIN: And more expensive.

Mr CHRISTOPHER: Exactly, less efficient and more expensive. So I would absolutely concur with the view that having a sound clean water and, I think ideally for our society, a recycled water resource is very important at these stages of establishing a hydrogen production facility, and we are blessed to have that right next to the port of Port Kembla.

The Hon. BEN FRANKLIN: Would either Mr Grimson or Mr Zarth like to make a comment?

Mr GRIMSON: The only thing I would add is, further to what Mr Christopher has said, we are already in discussion with Sydney Water, and Sydney Water is part of our Port Kembla hydrogen hub cluster. So, yes, we are in discussions with them on the use of that resource already.

Mr DAVID SHOEBRIDGE: From memory, the numbers that we saw from, I think it was the Clean Energy Council in its submission, said that if you just used half of the wastewater produced by Sydney—

The Hon. BEN FRANKLIN: It was Geoscience.

Mr DAVID SHOEBRIDGE: It was Geoscience that said if you just used half of the wastewater produced by Sydney, you would have enough to meet hydrogen demand.

The Hon. BEN FRANKLIN: For the whole nation, I think.

Mr DAVID SHOEBRIDGE: Yes, for the whole nation. So clearly there is a significant wastewater resource which otherwise goes out to the ocean.

Mr CHRISTOPHER: Correct. A reasonable amount of the existing recycled water resource is actually used by the existing BlueScope steel plant, but there is still a great opportunity there.

The Hon. BEN FRANKLIN: But with the amount that there is left, you could power five gigs. Is that what you are saying?

Mr CHRISTOPHER: We would create a demand for five gigs of electricity and produce the equivalent tonnage of hydrogen, and the conversion depends on your assumptions on the electrolyser efficiency, of course.

The Hon. BEN FRANKLIN: I understand. But that gives us a general ballpark figure.

Mr CHRISTOPHER: It is very large, yes—export standard, roughly 1½ tonnes per day.

The Hon. JOHN GRAHAM: My question is to Mr Christopher. I was interested in the work of the NUW Alliance. It is quite a holistic program; you are working across energy types, really looking across the board. How does the hydrogen economy and the development of hydrogen sit within that broader perspective that each of the universities has got? How important is this as a part of that overall picture?

Mr CHRISTOPHER: I would say it forms a significant part of the overall picture. One of the things that particularly the NUW Alliance brings to the discussion here is not just the technical research aspects—I do not mean "just"; not only the technical research aspects but also the economics of hydrogen and also what are the social impacts. So the NUW Alliance and University of Wollongong in the role that we are playing here is about building this holistic view across all of the energy transformation environment that we are facing, considering it from the point of view of social equity, for example, as well as employment that we were talking about before, and not just, dare I say, technology for technology's sake. So whilst I would not want to give a hard figure in terms of percentage terms, in terms of the significance of hydrogen as part of the NUW Alliance, suffice to say that it is one of the top 10 issues in the discussion and in terms of priorities and research avenues to pursue.

The Hon. MARK BANASIAK: Thank you for your submission and your appearance today. It is nice to see a coordinated submission and hear evidence from all three of you.

The Hon. MICK VEITCH: And make a geographic disclosure.

The Hon. MARK BANASIAK: Yes. I live in Wollongong so I am team Wollongong.

The Hon. BEN FRANKLIN: Your question: How good is Wollongong?

The Hon. MARK BANASIAK: I just want to go to something in your submission that points towards paragraph 5 in our terms of reference, which is about infrastructure, and you also provide a link to this south-west Illawarra rail link. How crucial do you see that project in establishing, I guess, a hydrogen industry in Wollongong, and it being successful?

Mr ZARTH: I thank the honourable member for that question because whilst it is not probably top of mind in the production of hydrogen, linking infrastructure to the member's question is absolutely vital to what we understand. Now, of course, we have only just as recently as this morning had a very important increase to funding for a vital road project in the Illawarra and I guess we would point the Committee to increased efforts in planning for linking rail infrastructure to the South Coast line. As we have outlined in our report, it has significant limitations, both topographical and of course due to its age. I call it Elizabethan; I think probably not the first Elizabeth—Dickensian maybe.

Mr DAVID SHOEBRIDGE: Maybe Victorian.

Mr ZARTH: Yes, Victorian I think would be the way to go. Dickensian is what I tend to say. So I think the development of a rail link into the industrial heart of Sydney, being present in greater western Sydney but particularly around the aerotropolis, is something we are heavily urging the Government in the case for because ultimately, being near the sea, it increases our capacity to reduce hydrogen and that would be naturally transported to usages, which would be various around the aerotropolis with that industrial park going in there, and of course across the rest of western Sydney. So absolutely we believe the case for the hydrogen industry, both for Port Kembla and in New South Wales generally, strengthens the need for enhanced rail infrastructure and we would commend that report and rail in the sector quite extensively from it.

The Hon. MARK BANASIAK: Mr Christopher, you spoke in your opening statement about developing your own road map for the hydrogen industry in Wollongong. Would you be able to perhaps table that or provide the Committee with a copy so we could include that as part of our deliberations?

Mr CHRISTOPHER: Yes, of course.

The Hon. MARK PEARSON: Mr Christopher, in your evidence you flagged a concern about storing hydrogen as ammonia. What is that concern?

Mr CHRISTOPHER: If I could clarify, I was not flagging a concern. I was more wanting to highlight the infallibility of answering what is the infrastructure required in the port facility to export it. What I noted was that there were various technologies available now to store hydrogen for future transport—one of those mechanisms is to store it in the form of ammonia; another one is to be transporting it in its natural form or its compressed form as liquid hydrogen—and that each of those technologies has its advantages and disadvantages mainly at the moment from a cost perspective in terms of the technology to transform and then un-transform at the other end of the supply chain. So if I misled, then apologies. That was not my intent; it was more wanting to highlight that there are differences in technology available there now.

Mr DAVID SHOEBRIDGE: But there are also the concerns about large-scale ammonia storage near any sort of population centre, which we would want to be extra careful of. I mean we all saw what happened in Beirut. I am not suggesting that you would have the same safety protocols in Wollongong as Beirut, but large-scale ammonia storage is problematic.

Mr CHRISTOPHER: Large-scale storage of many commodities brings with it potential safety risks that need to be managed. In the port of Port Kembla we have a grain terminal and it is perhaps not widely known but grain dust is actually one of the most potentially volatile substances—I am seeing nodding heads, thank you—that is available. Indeed, the requirements around safety management in dust-laden grain environments are the equivalent of the safety requirements in an underground coalmine and subject to gases. So I suppose the answer to your question is an affirming yes.

Mr DAVID SHOEBRIDGE: But it does not have the explosive capacity of ammonia though in the risks. But it is about managing risk and doing it upfront.

Mr CHRISTOPHER: Correct.

The Hon. MARK PEARSON: And is that risk greater if you are going to export ammonia?

Mr CHRISTOPHER: The risk is usually around storage in large quantities. If we talk about the recent incident in Beirut, the risk is mainly about the protocols that entities want to put in place around large-scale storage of the ammonia due to—and I use a colloquial term—the chain reaction that can occur once some of it becomes volatile and it goes to the rest of the substance. So segregation and management of batch sizes is quite critical in your risk management of ammonia transport.

The Hon. MICK VEITCH: I have a question which follows on from that line of questioning from Mr Pearson and Mr Shoebridge. With the various techniques of storage, what are the losses from going through that process—putting it into ammonia or whatever and then taking it back out of ammonia to hydrogen? What are the losses that are sustained in that process?

Mr CHRISTOPHER: The energy loss journey for hydrogen creation storage transport via ammonia, for instance, and then out of there can be quite significant. If I may, rather than quote numbers that do have, first, some variability and, second, interdependence around them, if possible, Madam Chair, I could present a brief, say, half-page summary on exactly that—

The CHAIR: That would be terrific.

Mr CHRISTOPHER: —as information to the Committee, and that would probably be the more fulsome way I could answer that question.

Mr DAVID SHOEBRIDGE: But, of course, ammonia can be used for its own purposes.

Mr CHRISTOPHER: Correct.

Mr DAVID SHOEBRIDGE: As a fertiliser, in particular, of another feedstock; it does not have to be converted back, does it?

Mr CHRISTOPHER: That is correct, absolutely.

The CHAIR: I just wanted to ask Mr Grimson about the role of local government in terms of developing hydrogen policy. I note in your submission in terms of how the council came to be involved, you refer to the Global Covenant of Mayors for Climate & Energy and the Cities Power Partnership program. I just wondered in terms of these policy commitments that are being made, how does that translate into actions by the council and how important is it for councils to be actively engaged in this space?

Mr GRIMSON: Definitely, I would say, and certainly for council's own part and recognising the significant contribution to the city's emissions and the need for leadership. Our organisation has set a target of net zero emissions by 2030 in terms of our own operations. There are a range of opportunities and programs that we are looking at in that regard. Even on the heavy vehicle front, again it is early days but we are looking at where those opportunities may be in terms of potentially our own fleet and those types of things. As I said, as a city we have been in discussions with the likes of Premier Illawarra about a green bus trial as well. There are a range of things that we are looking to progress on that front.

The CHAIR: So really as a source of demand for the energy.

Mr GRIMSON: Yes, that is right, and demonstration projects, particularly on the heavy vehicle front.

The Hon. TAYLOR MARTIN: My question is particularly directed to Mr Christopher from the university. Is the University of Wollongong developing or involved in the development of any hydrogen-focused technology or research that you are able to give us a bit of a briefing on?

Mr CHRISTOPHER: It most certainly is. If I could refer to some paperwork that I have here. As I said in my opening address, but I am happy to expand on this in as fulsome a manner as you desire, we do host the Future Fuels Cooperative Research Centre. In particular, the hydrogen aspect of future fuels research is on hydrogen transportation and the use of pipelines for hydrogen transportation, which is a significant area of research. There are only two large-scale, high-pressure hydrogen pipeline research facilities in the Southern Hemisphere and one of them is located at the University of Wollongong. We are also heavily involved through the Intelligent Polymer Research Institute, a collaboration that I mentioned in my opening address, and have recently spun off a new company with an innovative catalyst-based technique to manufacture hydrogen from water splitting.

The SMART facility is a $61 million initiative at the University of Wollongong and it brings together rail, infrastructure systems, transport, water and energy entities, be they private companies, the private sector, government sector as well as regulators. The SMART facility is, in particular, focused on the hydrogen transport aspects that we were speaking about earlier. It has been heavily involved in the processes to establish the initial core gas program of heavy road-based transport and is heavily invested in the research area of rail transport and re-powering of rail fleets.

We are also in the early stages of looking at the re-powering of underground mining equipment and converting it from diesel-based technology into hydrogen-based technology. I will halt there. There is much more in our Sustainable Buildings Research Centre as well where we are looking at how we can use energy more efficiently. Different gas inputs into a home create different opportunities for energy usage and so forth. Rather than take any more of the Committee's time, I say that we are heavily invested in the hydrogen research space across a number of avenues.

The Hon. TAYLOR MARTIN: Are you sure? If you would like to touch on anything more, now is the time.

Mr CHRISTOPHER: One other one, if I may with your indulgence, is the Australian Institute for Innovative Materials [AIIM] which is a materials institute that we have at the University of Wollongong. They have been working and stepping off. This is a laboratory not just for energy solutions but also for medical and looking at multifunctional materials. They are involved in looking at new technology for the capture and storage of hydrogen as well, storing it in various matrix-type arrangements that would mean that the existing technologies of compressing hydrogen in liquid form or ammonia et cetera may eventually become the technologies of the past. The AIIM research centre is also focused on the increased use of hydrogen in the steel industry and working closely with BlueScope Steel, given our proximity in that area. Thank you for the opportunity.

The Hon. TAYLOR MARTIN: This question is open to all witnesses. My colleague the Deputy Chair alluded at the start of this session to the potential rivalry between the Illawarra and the Hunter region to either be the first mover or the preferred region in hydrogen technology.

The Hon. MICK VEITCH: It is time for your geographic disclosure.

Mr DAVID SHOEBRIDGE: You think it should be the Central Coast. Is that right, Taylor?

The Hon. TAYLOR MARTIN: Is it necessarily the case that there must be a rivalry or are there synergies in economies of scale to be had in having two hubs at least in New South Wales?

Mr CHRISTOPHER: If I may go first then. This was a topic that we discussed amongst ourselves prior to this. While I would not presume to speak for an entire region, I would say from a University of Wollongong perspective, our cards are on the table already in being part of the NUW Alliance. As a general observation, I would politely make the observation that much of the energy environment at the moment I think is not helped by polarised discussions, whether they be technology based or ideologically based. The role that we see the University of Wollongong and academia in general playing but also I would like to say the role that the Illawarra region could play here, is having the "and" discussions. At the end of the day, I think there are some advantages of having a multi-front approach in terms of how we would approach hydrogen within the State of New South Wales. Without drawing any political analogies, perhaps putting all of your eggs in one basket with the wisdom of hindsight does not transpire to always be the best decision.

The Hon. TAYLOR MARTIN: Well said. Agreed. Mr Zarth?

Mr ZARTH: I would highlight the importance of not one or the other but both, because of course we are competing against other States that are rapidly firming up hydrogen hubs as we speak—South Australia being just one example. I would just say that we have in Wollongong experienced strong bipartisan support. We only recently hosted a bipartisan meeting with Paul Scully, who was then shadow Minister for Resources, and Matt Kean, of course, the responsible Minister, together with Dave Bell and Liz Westcott from Energy Australia. I should say, Dave Bell is the head of our BlueScope operations at Port Kembla. It was a very fulsome discussion about the opportunity inherent locally, but of course completely acknowledging what could be attainable at the Port of Newcastle concurrently. We are here on behalf of our region. We will always support it but not at the expense of somebody else. I would say that the capacity inherent at Port Kembla is significant. I am not apprised of what the situation is but I understand my colleague will be appearing later in the afternoon. He will be able to talk to what is possible at the Port of Newcastle.

Mr DAVID SHOEBRIDGE: I just wanted to go back to when you introduced the concept of investing in hydrail. There may be some scepticism among Committee members about whether or not that is a viable initiative. Could you maybe just give your understanding of what we are seeing in places like France and certain States of Germany? As I understand it, France has put out contracts for about 30 hydrogen-powered regional rail trains. Certain States like Schleswig-Holstein in Germany have committed to being entirely electric and hydrogen by 2025. Heavy rail from hydrogen is a real technology, isn't it?

Mr CHRISTOPHER: Thank you, Mr Shoebridge. You are very well informed and your German is actually better than mine, so thank you for enunciating that. The reality is everything you have said is correct and more, again. The challenge of course when we talk about hydrogen for heavy rail transport is, as I mentioned earlier, the extended life of the rolling stock. Much of the opportunity only arises when you are at those natural changeover points in the life cycle. Within Australia and within New South Wales in particular that can be a bit of a dice roll, if you like. Where we see that there is the greatest opportunity in the short term is repowering of existing fleets—and re-lifing of existing fleets, perhaps, but certainly letting existing heavy rolling stock reach the end of its economic life by repowering it with hydrogen power plants.

I have taken the question on notice and I am more than happy to provide to the Committee the information we have on these repowering units that are of the 200-plus kilowatt range, which is what you need to power a heavy, traditionally diesel locomotive. This is where we see an opportunity—with the infrastructure of the Illawarra and the expertise within the Illawarra and within the University of Wollongong—to undertake a program to research this repowering of existing diesel fleets using, as you have correctly pointed out, technology that is not pie in the sky but is in fact firm technology available globally now.

The CHAIR: If there was a great idea from interstate that New South Wales should be stealing, what idea would you suggest we take on?

Mr DAVID SHOEBRIDGE: I think it is called "adopting".

The CHAIR: Adopt.

The Hon. MICK VEITCH: You say adopt; the Chair says steal.

Mr DAVID SHOEBRIDGE: They often have the same meaning.

Mr CHRISTOPHER: At this stage, Madam Chair, I am not seeing anyone doing anything particularly different to what is available potentially in New South Wales. I think we have significant advantages over much of what I am seeing in other States. For obvious reasons, I do not think that it would be prudent for me to name each of them. Whether we are talking Newcastle or whether we are talking Wollongong or whether we are talking other parts of New South Wales, New South Wales has the existing transport infrastructure, it has proximity to two very good deepwater ports, it has the recycled water resources and it has a robust electricity infrastructure network. Not all of the other things I am seeing in other States tick every single one of those boxes to kickstart a hydrogen program. All I would say is, here in New South Wales—I think—frankly, we need to get on with it.

The CHAIR: Is there something happening in South Australia that we should be paying attention to? It is only that South Australia was mentioned earlier.

Mr ZARTH: By me.

The CHAIR: Yes.

Mr ZARTH: Apologies. Yes, I did acknowledge just that other States are establishing hydrogen hubs. Really, that is just a method of collecting effort, whether it be from government, the private sector or other players. I believe they have ambitions, but whether their ambitions are backed up by that level of government support and private sector interest I think is another thing. It could be something we come back to the Committee on perhaps.

The CHAIR: That is okay. We might have other witnesses who are in a better position to answer those questions, but thank you.

Mr DAVID SHOEBRIDGE: Wollongong is also 50 kilometres from four or five million people in Sydney too, which is a supreme advantage.

Mr CHRISTOPHER: Correct.

The Hon. TAYLOR MARTIN: Now who is biased?

The CHAIR: Mr Shoebridge, do you have a further question?

Mr DAVID SHOEBRIDGE: No, I do not.

The Hon. BEN FRANKLIN: No, just a comment.

Mr DAVID SHOEBRIDGE: Well, Adelaide is further away.

The CHAIR: I thank all three of our witnesses for appearing here today and certainly for championing the Illawarra and ensuring that we are much better informed, and for answering all of the members' questions. It has been terrific. Your answers were very to the point and appreciated. We have resolved that answers to questions taken on notice should be returned within 21 days. The secretariat will contact you in relation to any questions that you have taken on notice. That concludes the evidence from you today.

(The witnesses withdrew.)

(Short adjournment)

ALEX ZELINSKY, Vice-Chancellor and President, University of Newcastle, before the Committee via videoconference, sworn and examined

BOB HAWES, Chief Executive Officer, Business Hunter, before the Committee via videoconference, affirmed and examined

SEAN LUCY, General Counsel, Lake Macquarie City Council, before the Committee via videoconference, affirmed and examined

DAVID HUGHES, Director Built and Natural Assets, Lake Macquarie City Council, before the Committee via videoconference, sworn and examined

ALAN BROADFOOT, Director, Newcastle Institute for Energy and Resources, University of Newcastle, sworn and examined

The CHAIR: Thank you for attending the hearing. Have you, by any chance, collaborated as to an opening statement? No. I might ask then, in turn, if any of you wish to make an opening statement. I request that it be kept brief, to a couple of minutes, because there are many questions that the Committee members are eager to ask of you. Professor Zelinsky, do you have an opening statement?

Professor ZELINSKY: Good afternoon and thank you to the Committee for the opportunity. I would like to acknowledge the Gadigal people of the Eora nation as the traditional custodians of the land and I pay my respects to Elders past and present. My apologies for not being able to be there in person today—things have changed a little bit unexpectedly. I would like to make three points to the Committee today. Firstly, a thriving local hydrogen energy industry represents a huge economic and environment opportunity for regional New South Wales. Countries around the world have signalled their commitment to net zero emissions by 2050 and green hydrogen could play an important role in reaching that net zero. Projected global demand for hydrogen is varied but largely favourable. ACIL Allen Consulting anticipates Australia's share of global trade in hydrogen could be worth up to $5.7 billion in 2040. Deloitte predicts that if Australia was to secure the same global market share for hydrogen in 2050 as it does for LNG today, the sector could produce a $26 billion increase to GDP and over 16,000 jobs.

New South Wales has assets, capability and opportunity to tap into this market. Hydrogen could also be the key to the State's net zero aspirations. But to realise this opportunity we need to act now. Secondly, the Hunter, Lake Macquarie and Central Coast region are uniquely positioned to lead the State's evolution into hydrogen. The Hunter is an energy powerhouse for New South Wales. We produce 63 per cent of the State's electricity. The energy and resources sector employs over 47,000 people. We know that the demand for coal will wane and that the future of our communities is at risk. Nowhere in the State is the opportunity and challenge of decarbonisation more acute than in the Hunter. Our region's success in moving forward to a net zero future will determine New South Wales' success.

Fortunately, the Hunter is optimistic about a hydrogen future. We see there is great collaboration across the region. Major organisations in the Hunter are working together to drive interest and activity. As the anchor institution for the region, the University of Newcastle has been heavily involved. We are among the founding organisations of the Hunter Hydrogen Taskforce and the Hunter Hydrogen Technology Cluster, or NewH2, the only hydrogen technology cluster awarded by National Energy Resources Australia funding in New South Wales.

We have the human capital needed to drive advantage and change. Our university and the CSIRO Energy Centre are delivering world-class energy research and innovation. There are other advantages. Our advanced manufacturing industries and large-scale energy users will need reliable energy in decades ahead. We have access to energy generation networks and infrastructure. We are home to a highly skilled workforce with the skills needed to work with hydrogen, and international export potential exists through the Port of Newcastle. Hydrogen is a major opportunity and one that our region is well placed to leverage.

Lastly, research and development [R&D] plays a critical role in the uptake of hydrogen technologies. We know that one of the major barriers is the current cost of production. Demonstration of emerging technologies will be an important tool. The University of Newcastle is well placed to assist. We are working with industry partners in several major initiatives. Much of this is commercial in confidence but I will provide one example now and my colleague will provide more during the course of the hearing. One example is a project with Southern Green Gas. This is an ARENA-funded demonstration plant near Roma with a team led by Professor Behdad Moghtaderi trialling the conversion of green hydrogen into renewable methane. This is then injected into existing gas infrastructure and piped to households and industrial users. Demonstration projects help to remove some technical risk. They allow researchers to explore efficiencies in operation and cost. They also help to overcome investment hurdles and attract new funding.

The Government can assist regions like the Hunter in several ways. We welcome the announcement of support for hydrogen hubs in New South Wales. We would like to see some of this investment directed towards R&D and demonstration clients. Government can also assist in access to retraining and upskilling. We have a great skill base in our workforce but we will need to pivot. There is a need to raise community understanding and trust in hydrogen. Our university stands ready to work with the Government and support our region in the key areas. Before I finish up, I would like to welcome the Committee to visit the hubs and the university to see firsthand the wonderful infrastructure we have and some of our hydrogen demonstrators. I thank the Committee for the opportunity to participate today and I welcome your questions.

The CHAIR: Professor Broadfoot, did that cover your statement?

Professor BROADFOOT: Yes, he is the boss.

The CHAIR: That is terrific. Does the Lake Macquarie City Council have an opening statement that it would like to make?

Mr HUGHES: Lake Macquarie City Council believes that local government can contribute to the transition away from carbon-based fossil fuels, potentially to hydrogen, in the operations of our cities. Therefore the benefits from potential solutions will extrapolate to other local government areas [LGAs] across New South Wales and Australia. So any solutions we have can scale. When considering the supply and demand sides of the hydrogen system or network, local government has the classic demand profile. The potential use of hydrogen in our assets can assist with the transition away from fossil fuels. What we lack in local somewhat is the supply side of hydrogen. Demonstration of alternative fuel solutions will be the key to growing acceptance and will allow use cases to be developed to demonstrate the benefits and risks to potential partners who may be exploring investment opportunities and would be willing to work with governments.

As an LGA we are seeking partners and a percentage of State and Federal governments to close the cost and risk gaps in the early stages of development of technology and application of technologies and to assist with the transition away from fossil fuels. The adoption of new solutions and technologies, potentially hydrogen, will attract economic benefits within the regional communities of Lake Macquarie and the lower Hunter, reinforcing many of the comments made by Professor Zelinsky a few minutes ago. We believe that hydrogen is best placed to transition with our communities and within the skill sets we have in our regions. We would be interested in taking questions and thank the Committee for their interest and time this morning.

The CHAIR: That was audible to us, but perhaps if you could move the computer microphone a bit closer to you, then your audio into our room might be a bit clearer. Mr Hawes, do you have an opening statement?

Mr HAWES: Can you hear me okay?

The CHAIR: Yes, perfectly.

Mr HAWES: Excellent. Good afternoon and thank you for the opportunity to appear before the Committee today. I would just like to point out that the Hunter Business Chamber as per our submission is now Business Hunter, but our charter, aims and objectives in relation to the voice of business and advocating the interests of business and the community in the Hunter region have not and will not change—so just a minor name change halfway through. I also note that, broadly speaking, Business Hunter is acutely interested in the matters that relate to the energy industry. Whilst we appreciate that the terms of reference of this inquiry are broader than just the question of energy generation, it is apparent that the issues are inextricably linked and hence a considerable amount of interest and advocacy relating to the Hunter region will stem from this.

I might say that there is particularly a lot going on in the region at the moment in this context. I also note that Clare Sykes, cluster manager for the Hunter Hydrogen Technology Cluster that Professor Zelinsky referred to—or NewH2, as it is known—is in the virtual public gallery today. NewH2 is the working group in collaboration across business, research and government agencies under the auspices of the federally funded hydrogen cluster initiative. NewH2 is connecting the Hunter with the national framework in a way that is also connecting and engaging with the New South Wales Government. We would encourage the State Government to be very cautious about creating a new network and rather work with what is already in place.

We should all work together to achieve better coordination and cohesiveness and not duplicate existing frameworks unless we can demonstrate that it would add considerable value. Business Hunter through the NewH2 is looking forward to ongoing engagement with the New South Wales Government and through this established consortium of partners providing efficiency in linking business and small- to medium-sized enterprises, research to projects, plus additional links to the national cluster networks and their extensive portfolio of projects. I also commend Professor Zelinsky's invitation to the Committee to visit Newcastle Institute for Energy and Resources

and the CSIRO. They are both world-class facilities in the Hunter, a cluster of which is unmatched anywhere else in Australia.

The Hon. MICK VEITCH: My first questions are to the good folk from Lake Macquarie City Council. In your submission you say that local government can act both as a platform to pilot technology but also as a platform to scale up technology. I am pretty keen to explore how you see local government being able to scale up technology. I gather that is around fleet in particular, but there would be other ways in which you could do that. Could you just explore that with the Committee please?

Mr HUGHES: Absolutely. I apologise. I am having a little bit of trouble hearing with our network but, if I have understood your question, it is how does local government create a demand that could then be scaled up.

The Hon. MICK VEITCH: Yes.

The CHAIR: Is it possible to move the microphone a bit closer to your mouth?

Mr HUGHES: It might be easier to move me closer to the microphone. Is that better?

The Hon. MICK VEITCH: Yes, that is better.

Mr HUGHES: If I use the example of Lake Macquarie, just in our refuse collection—so Lake Macquarie operates and owns our own fleet of garbage trucks, which collect half of our city's waste. We collect our own general waste but we contract out green waste and recyclables. In our own waste collection and in our fleet that we own, we have more than 18 refuse vehicles and those refuse vehicles consume 420,000 litres of diesel per year, emitting more than 1.125 million kilograms of carbon dioxide annually. If we could switch that fleet to hydrogen, which is practical and possible to do from what we understand of the technologies, we could reduce that carbon footprint and reduce the use of diesel. If you look at Lake Macquarie as one local government area, there are several hundred local government areas throughout Australia. You could apply the same solutions to their garbage and refuse collection. Does that answer your question?

The Hon. MICK VEITCH: It does, thank you. The second question arising from your submission, you say the New South Wales Government could develop model policy tools. What would those model policy tools look like? What are you asking there?

Mr HUGHES: The policy tools that come with vehicles is, firstly, with vehicles new technologies coming in need to be certified and need to be assessed to be safe to operate. Currently we understand that that framework does not exist within New South Wales or within Australia. Secondly, the adoption of technology generally comes with initial costs and initial risks that need to be addressed for the early adopters to take on and take the risks out of the adoption of technology. So the frameworks that we will be looking for is incentives to assist us in having a regulatory authority accept the new technology so that we could register vehicles, have them insured, put them on roads. Following that is assistance from State or Federal government to get the demonstration sites up and working to demonstrate the applicability of the technologies in the solutions and build those use cases for them, to demonstrate it to other investors, to actually join in on the solutions.

The Hon. MICK VEITCH: Thank you. The last question I have is around the hub in the Hunter area. This may be a question for Mr Hawes. Who is best suited to lead such collaboration or a coordinated approach in a region?

Mr HAWES: That is a good question. I think that depends on the task that is put before it. At the moment the cluster is basically industry-led because that was part of the requirement from the Federal Government in relation to it. We swap hats, as it were. As I said, we have got tremendous expertise up here in Alan Broadfoot's institution. From a research capability, from an industry point of view there are people already up here in the business of energy and use of hydrogen-based products. Then business groups like ours, as opposed to the generation, play a role in looking at the use and then imparting those messages to business to make sure that we are connected and collaborating, to use what the outcome of that research and that industry development does. So I think we have got a pretty effective group here. As I said, I think we are pretty good at swapping hats or swapping information. We are working very, very hard to keep improving that.

The Hon. MICK VEITCH: Thank you. Professor Broadfoot, do you want to respond to that as well?

Professor BROADFOOT: Yes. The success of the collaboration has been the fact that we have got the three major industry associations involved, which is HunterNet, Australian Industry Group and Business Hunter. It is not just individuals sitting at the table. It is the fact it is representative of most of the industries in that region. Then you reinforce that with the people in attendance from the Chief Scientist & Engineer's office and the university itself. It becomes a powerful force. The biggest thing in this market is sharing the knowledge to actually advance the market but also to adopt these new technologies. You are not going to rely on the misinformed

information. We need correctly to give it as, literally, at the coalface as we are generating this new knowledge through our international links.

The Hon. MARK PEARSON: Mr Christopher from the University of Wollongong was asked a question about working collaboratively. Have there been discussions between the Hunter, Newcastle and Lake Macquarie areas and you from Wollongong and Illawarra? Have you turned your minds to collaborating in the future on hydrogen technology?

Professor ZELINSKY: We have an alliance with the University of Wollongong, a new alliance. That is ourselves, the University of New South Wales, Western Sydney University and Wollongong. The four universities have been talking about how to cooperate in energy. Hydrogen is one of those areas. For us, that is around R&D. So there is no reason why we cannot cooperate on that scale. But when you move up to industries, a lot of industries are very much based where they are. A power station is where it is. So we have got unique opportunities and challenges in our own area. But there is no reason why we certainly could not find workplaces where we could do more work together.

I guess that the important point that is being made by my colleagues today is that we really think the biggest thing the State Government could do is to create a demand for hydrogen in the State, be it with local city councils—those could be right across the State—or with particular industry. It could be steelmaking at Port Kembla, or it could be powering a smelter at the Hunter. But what we need is a constant demand for hydrogen internally. Once you get that up and moving, then there are opportunities to go and chase after the grand prize, which is exports. But we also have to remember that other States are getting on with it. There are hubs being established. It is a real competition. If the State does not get behind this—you need to make some choices—it could actually be that the opportunity goes elsewhere, to Queensland or South Australia or Victoria.

The Hon. MARK PEARSON: Thank you very much. Correct me if I am wrong. Is it the case, Professor Zelinsky, that you and your team or department perhaps led the way in looking at what is green hydrogen?

Professor ZELINSKY: That is correct. We have been a leader in terms of looking at hydrogen now for some time because, while you have got the renewable sources of wind and solar, really, for manufacturing and large energy consumers, you have to look at a gas such as hydrogen. We have been looking at that for some time. Professor Broadfoot can actually run through some of the projects that we have been doing. He is very familiar with those. It has been going on for some years now. We have got demonstration plants or demonstrators. It is more than just a research idea; it is actually projects that are showing true capability and potential.

Professor BROADFOOT: The answer to the question is that the Newcastle Institute for Energy and Resources was set up by the New South Wales and the Federal Government to work with this issue. We have 200 active clients. The idea, being an early adopter of the technology, is that we are aligned with the market. So probably now for three or four years we have been working on a broad spread of the application of hydrogen into different applications. There are two markets to look at. The export market is going to be determined by investment and a large overseas customer to be able to buy the technology. But industry is very keen to adopt hydrogen as an alternative fuel for the issue of energy security and also for reducing of carbon emissions.

The green is an aspect of it; that is the technology we have developed. We are harvesting the water from the atmosphere. The nature of that is pure so we are trying to create hydrogen at a sustainable sell value. The second one is we are looking at solutions. People have a problem with acid drainage with mines. You can actually recover that water with ozone. As part of that we are making hydrogen as a by-product. "If you want me to sell you some hydrogen, I will make it $10 a kilo. If I am venting it in the atmosphere, what price do you want to buy it at?" is the type of model we have been looking at. We also reinforce the fact that is there is an early adoption of industry. There is very much a focus on the green hydrogen, but a lot of our technologies are still using LNG plant technology. So what we are finding is the creation of green methane or use of hydrogen in those existing technologies, so you are not looking at a large capital spend.

The Hon. MARK PEARSON: Very interesting; thank you.

Mr DAVID SHOEBRIDGE: I suppose my question is perhaps to you first, Professor Zelinsky. You talk about the State Government needing to step up, basically. We have had a series of other submissions that say, apart from setting a good regulatory framework and a few grants here and there, the State Government actually needs to start creating some demand for hydrogen and actually putting the demand in place somewhere like Newcastle or Wollongong to have that demand pull to ensure that we get the kickstart for hydrogen. Do you agree with that? If so, where should that demand be created and how should it be created?

Professor ZELINSKY: It is probably not for me to say what the demand should be. There are plenty of suggestions being made. I know there is even a consideration about turning the entire bus fleet, public buses, to run on hydrogen—that is a good example—or getting local city councils waste recycling trucks running on

hydrogen or working with an industry like smelters or steelmakers to do that. There are plenty of areas where that could be done. We are just saying that our role would be to make sure we can get the hydrogen being produced, but what you need is demand. We could work with industry, but also it requires some leadership from the State Government.

Mr DAVID SHOEBRIDGE: Professor Broadfoot, do you have any views about what the low-hanging fruit would be in terms of the State investment that would drive the demand?

Professor BROADFOOT: Looking at what cost you already pay is one way to look at it. I know the Federal Government puts funds in there for the offset of diesel. If you are in the middle of western New South Wales and you have, you know, your diesel disrupted, hydrogen could be a very viable offset accessible technology using solar and also the example of our Hydro Harvester. The other one is too is it is based on—one of the biggest low-hanging fruits is mobility transport.

Mr DAVID SHOEBRIDGE: And heavy transport, for starters.

Professor BROADFOOT: Yes, it is too. There is the impact there with the Special Activation Precinct in Parkes. What policy and strategy do we attract into those regions? There is the bus fleet and even the ferry fleet as well. Can we be early adopters in that? Is creating a market—the thing is, we have got to strengthen ourselves from the international market. The best way to do that is through a domestic market. How can we build that capacity? How we look at substitution of LNG is the early adoption of it. Even the example of using hydrogen into diesel fuel as it is without even going to straight electrolysers, the biggest thing still with the Government is what is the regulation? Who is the regulator and how do we approve new technologies to be adopted? That goes hand in hand with the insurance industry. It has to be endorsed. I think that is the early collaboration that also assists in how we create that opportunity with industry to be able to create the use of hydrogen. The biggest problem at the moment is not technical. If I make 1,000 kilograms of hydrogen, who do I sell it to?

Mr DAVID SHOEBRIDGE: One of the advantages of having the State Government move early is that they then do that pathway for regulatory approvals as well. That is one of the other advantages. If you have a State bus fleet or a State ferry fleet that moves to hydrogen, coupled with that will be all the regulatory approvals needed to ensure that others can follow in their path. Is that important too, Professor?

Professor BROADFOOT: Yes, it is. The Australian Capital Territory with its energy and water utilities were actually early adopters. If you talk to them, they went through a lot of heartaches trying to understand what those regulations were and they were the pathfinders. It becomes the answer for how do we apply it practically and safely into the market? That becomes the benchmark of application for private sectors.

Mr DAVID SHOEBRIDGE: Could I just quickly go to Lake Macquarie. You say that there are opportunities, particularly on your recycling fleet but probably also on your general garbage fleet. Do you see that as being best advanced between a sort of statewide partnership between Local Government NSW and the State Government or do you see it more as a regional Hunter arrangement? Where are you looking to advance that?

Mr HUGHES: The pathway for that collaboration could be either. Coming back to some of the comments that were made earlier, if we can establish the demand—if the demand is with our garbage truck fleet, which could then extrapolate more broadly across other local government areas, we neighbour three other local government areas that are significant local government areas and then they neighbour others—we could work together with regional and we could work with local government. It does not have to be one or the other. It could be both. In local government in the research that we have done we see that it is our garbage truck fleet that is the lowest hanging fruit that we could work on to switch. As I said earlier in the opening statement, if we could demonstrate that it works in Lake Macquarie that does extrapolate to the remaining local government areas around Australia and into commercial operators. As I was saying before, we pick up 50 per cent of our own waste. The other 50 per cent we contract out.

The next things that we see it could flow onto is our construction fleet. But, similarly, if I pick up on Professor Broadfoot's comments about switching away from diesel, line haul freight we have the M1 pass through our LGA where we have got freight moving between Melbourne and Brisbane regularly. Line haul trucks are the other area that you could see switch from diesel to hydrogen, but they are the sort of things that once people see it happening in one area you will get the knock-on effect or the cascade effect of the technologies being demonstrated, the risks and the technology investment being understood. Our lowest hanging fruit is within our refuse fleet. Back to your original question, we could work with our regional collaboration departments and we could work with Local Government NSW. We would not exclude either from that discussion.

The Hon. JOHN GRAHAM: I think you can hear from earlier questions that comments from the Illawarra witnesses about the options for multiple developments in New South Wales were very well received, essentially arguing that we should not have all the eggs in one basket. I wanted to ask about the research alliance

in the university, perhaps to Professor Zelinsky. When you are looking at New South Wales from a research point of view or from that broader perspective, how would you describe the relative strengths of the Hunter compared to the Illawarra or to other areas of the State? What are the relative strengths of these various bits of New South Wales?

Professor ZELINSKY: I guess you are asking the question from R&D capability.

The Hon. JOHN GRAHAM: I am interested both from an R&D point of view and more broadly. There is a strong case put here by all the witnesses for the importance of the Hunter. I think that is accepted. What is not as clear to us is what are the relative strengths of these various areas because there has also been the case put about the Illawarra—

Professor ZELINSKY: I will put my hand up. I was born in Wollongong. I lived in Wollongong for most of my life and then spent 20 years in Canberra before coming to the Hunter. I see a lot of parallels between the regions. The universities both have similar routes into industry and similar ages. I think the R&D capabilities are quite interesting on both sides. There is scope for universities always to link together and, in fact, that is what the alliance is about. But I have got to say that from a point of view of when you look at the sheer energy that is produced in the Hunter—starting with coal and you look at the production of use of that energy utilisation. You have got the power plants and then you have got the export of it and innovation—I think the whole value chain does sit in the Hunter.

I think that we seem to be competing against other regions in New South Wales. We are all in it together. I make one point that the ARENA grant that came to New South Wales was only for one place. They stood back and looked at it and—I do not know how other States are doing it, but I do not see many multiple sites being advocated. At the end of the day, you have to try to pick the one which is the best placed to take the advantage. That does not mean there could not be leads, a hub-and-spokes model, there are ways to collaborate. I think you have to look at where does the strength sit and where is the first mover moving and where the opportunities are strategically. I will stop there.

The Hon. JOHN GRAHAM: Your submission essentially says two-thirds of the electricity in New South Wales is produced in the Hunter. As we move to the future of energy, including hydrogen, do you expect that will continue to be the case or is it necessarily going to become more dispersed as we move into those new technologies?

Professor ZELINSKY: I think the challenge will be—and my colleague Professor Broadfoot might join in to reinforce this point—that we have to move to transition at some point, transitioning from old carbon-based fuels and that cycle to a clean energy and re-use of infrastructure. A lot of these power plants are located on very big energy connectors to the grid. So you want to be able to utilise those. There are natural gas pipelines and you want to utilise those. It is not just about producing energy; it is also being able to utilise the assets that you have in place today and help them transition over. Have a look at what else has been planned. I know that Snowy Hydro for the Federal Government is talking about a natural gas driven power plant.

That power plant, we have been told, has been futureproofed that the generation system will also run on hydrogen. That could also be switched over to hydrogen in the longer term. One of the things that we also know is that you can start to blend natural gas with hydrogen. There are many opportunities around gas and that is one of the things that we are doing with Southern Green Gas is thinking of ways how to produce these things. The important point is what is already the infrastructure that is there and how do you utilise it for the future? Knowing that we are not talking about totally greenfield sites.

The Hon. TAYLOR MARTIN: I will pick up from there. Professor, you talk about mixing with gas. Do you know of any instances where it is mixed with diesel to try and reduce the use of diesel?

Professor ZELINSKY: We have actually got some projects going with local businesses, and certainly Ampcontrol ResTech is a company that we work with. They have a partnership with the Western Australian energy producer. I will have to take the name on notice. Horizon Energy, I think it is. And they are looking at actually producing small power plants that are in remote areas of the State that are not on the grid. They have been traditionally running on diesel and they are trying to switch them over to renewables such as solar. They obviously will not have the capacity when there are issues with solar not being available 24/7. They have now been looking at trying to use ammonia and potentially hydrogen. That is long-term development that is based on industrial leadership by that company who are based in the Hunter.

Professor BROADFOOT: We have a company here in the audience, Global Hydro Power. They are looking at blending hydrogen into existing diesel using it as pure hydrogen. That way you have a problem with producing the hydrogen on an existing vehicle using the electrolysers with insurances but you can blend it though. That is the technology that has now been proven and been applied. We are looking at various applications for that.

If I go back to the other question, there are two issues. We have the grid there that we can connect a lot of this alternative energy supply but, more importantly, most of our industries have been certified with, accredited for, using hazardous area equipment. That is a legacy of our coalmining era. Hydrogen is more explosive than methane. Those skills and that accreditation under the coal sector already exist.

We may not continue to be the powerhouse of the nation, but we will certainly be the engine room because we have a lot of industry that can be early adopters and apply these technologies around Australia. We all have some agreements and partnerships with most of the universities in New South Wales but equally we are partners in new cooperative research centre [CRC] bids going to the Federal Government both with the University of Adelaide and also universities elsewhere around Australia. We have to stay relevant. We need to bring all of that information and form partnerships more at a global level because we do not think we are the only ones in the world looking at this. We need to be the early adopters. We need to be the translators so our market can make it relevant to themselves.

The CHAIR: Why do we need to be the early adopters?

Professor BROADFOOT: The early adopters—what I mean is that climate change and emission reduction, an enormous amount of money is being spent around the world on those new technologies. For us to apply here we have to make it reasonably relevant. We have applications and environments and structures which are unique. It is not so much about reinventing the wheel but how do we translate it so that our industry can take up that advantage as quickly as it becomes available.

Mr HAWES: Can I add to that? The other point about the region, there is a lot of focus on the production or the generation of new forms of energy. One of the big issues for the Hunter is the use. We have a lot of industry that for historical reasons has tapped into affordable power supplies in this region and there are a lot of businesses up here that still bend, melt and make things. For us to be able to get them in that adaptation of new technologies so that we do not see these businesses become marginal or not feasible as we go through this transition, particularly if we are not able to keep power costs or energy costs reasonable, and that has been an ongoing concern for many businesses and industries up here.

It is going to be an ongoing challenge for us to be able to pilot those sorts of technologies as they not only seek to adapt to the new forms of energy but also seek to meet their emissions targets in relation to carbon. If we set these things up in regions other than where we have an abundance of those sorts of examples of industries, as Professor Zelinsky and Professor Broadfoot have said, we risk then businesses trying to chase that technology to other geographies. Often when they have to move or relocate that cost is just too significant and they choose to close. So we have got a lot of risk up here in terms of the use of hydrogen and the use of power and the use of energy. I just wanted to make sure that is not forgotten in how we view the adaptation of these technologies as we do go forward because of the challenges that businesses also have in the carbon emissions equation also.

The CHAIR: I have a supplementary question to that. Listening to the Illawarra and the Hunter regions, both economies have a great dependence on the coal industry. I am hearing the logic is the energy expertise can translate. Surely it is also about risk management for those economies to be making that transition into hydrogen, or is it just a coincidence that you are both coal regions?

Mr HAWES: I am happy to comment initially. Historically based, yes, we have similar roots as it were. We both had a steelworks on one occasion and there are many businesses that are linked into the coal industry as a mining industry. But not forgetting that now up here particularly that industry really is responding to the pulses of overseas markets as opposed to the local needs of energy generation. A very small percentage of the coal used or mined in the Hunter region now is dedicated to energy generation, to the coal-fired power stations, and that is going to get less and less as time goes by with the scheduled closures of the respective coal-fired power stations and assets in the Hunter region. I think our needs are similar; our concerns are similar. A witness this morning, Mr Adam Zarth, is my compatriot in Illawarra, so we have talked a bit about the similarities and differences the two regions have. Obviously, they are the things the Government must look at when they are making those decisions about where to invest if they take part in developing the industry.

The CHAIR: Recently on holiday driving around the gulf area of South Australia I visited Whyalla. I was struck by how connected Whyalla, Newcastle and Wollongong are in terms of Whyalla being developed by BHP to send iron ore to Wollongong and Newcastle, who were sending the coal down to Whyalla. Why can we not think in terms of a connected strategy as opposed to—it seems to me there is a sense of fear that there is going to be winners and losers in the way the policy proceeds to evolve this new energy source. Can I address that to Professor Zelinsky?

Professor ZELINSKY: Policy winners or losers—I did not get the context. In what regard?

The CHAIR: In terms of the way energy has evolved in Australia historically, using the steel industry as an example, Whyalla, Newcastle and Wollongong were very connected. This was obviously being developed by BHP as one company, so it was managing coal and iron ore and running steelworks across those three locations and funding the investment as well, I might add. It was about a connectedness in the policy across geographic locations. I guess that was the revelation I had when I saw that. I wonder why we cannot think in those terms for hydrogen as well, rather than thinking that one region is going to be the winner in this perception of a contest. Why can we not look at multiple regions engaged in this industry in the same way that multiple regions mine coal, for example?

Professor ZELINSKY: Sure. I think that is absolutely right. There are about 13 regions around Australia that I think have been identified by the Federal Government. At the end of day, there will be a confluence of policy development choices and competitive advantage. At the end of the day, you want to make sure that the users of hydrogen are close to where it is generated, so these are the sorts of things are happening. I believe there will be multiple places in Australia where they will produce hydrogen. BHP did that on their own—they were a company that had its own cohesive policy that went over State boundaries et cetera and they were sourcing raw materials from various States to their steelworks. Their main steelworks were in Port Kembla and Newcastle and they had various presences in Whyalla and Quinara and other places. I used to work for BHP—that is where I started my career—so I am very familiar with how the company ran initially.

The CHAIR: It is quite a remarkable story.

Professor ZELINSKY: A lot of those competitive advantages disappeared over time and they disaggregated their supply chains. As Mr Hawes was saying, there was more value for them as a company to export the raw materials rather than to use them to create steel. That is another story entirely. I think what the key is here for public policy makers it that you have to make sure that the Federal Government and State Government work together with the locals regions and universities to produce a compelling strategy because if the State Government does not, other State governments will. Likewise, in the State, you have to stand back and look at where the uses and opportunities are for the use of this new energy.

The CHAIR: Can I just ask one more question to Mr Hawes? How important is it for the Hunter to have access to low-cost electricity in terms of sustaining manufacturing and employment in those sectors?

Mr HAWES: I think it is very important. As I said, for historical reasons we have industries and businesses up here that have been established as a consequence of prior government policy on the availability of a reliable source of affordable power. We have seen through our business conditions survey here in the Hunter over a long period of time from when power prices started to escalate, the significant concerns there were being shown by industry up here about that particular occurrence. We still have, even though our manufacturing industry, in a sense, has been declining nationally and regionally, a lot of businesses up here that bend, melt and make things, as we say. They need big chunky blocks of power and there is nothing on the horizon to suggest that is going to change. But many of them—InfraBuild, Molycop—are doing a lot of things in innovation to try to make sure they are up with or ahead of the game. We commend them for that but that is not going to change and that industry perspective that we have up here is something that we treasure because we want to build on what we have as well as attract new—not have one for the other.

Going back to your comments, Chair, I would be arguing that you are 100 per cent right that we should have very much a broad approach at the moment and let the market intervene when it is time to pick winners because that investment will eventually come from the private sector in some sense. The New South Wales Government should be doing all it can, as you say, to make that an equal proposition for all the regions around New South Wales. When you look at what ARENA has been investing in, it has invested $140 million across hydrogen projects since 2017. Some $32 million of that has been attracted to New South Wales but nothing since 2018. I am hopeful there is an opportunity. They chose three projects in May this year to invest in hydrogen electrolysis. None of those projects were in New South Wales. I know that they got over 30 applications so amongst that 27 hopefully there might be some that were based in New South Wales that we might be able to go back and look at and see if they are worth backing because building on those sorts of things where they get real projects on the ground is the sort of thing that gives industry and other businesses confidence.

The CHAIR: That was under the National Hydrogen Strategy, am I correct in the program?

Mr HAWES: Yes, that is through ARENA—the funding portal for a variety of different renewable energy projects across the nation. They have invested $140 million in hydrogen initiatives since 2017.

Mr DAVID SHOEBRIDGE: Professor Broadfoot, given the amount of energy that will be required to get to a hydrogen export capacity, one of the great opportunities for somewhere like Newcastle would be developing the offshore wind industry. That has a real benefit for Newcastle because it brings together a bunch of

those synergies—shipbuilding capacity, good electricity, network capacity and the skilled workforce. Offshore wind then potentially provides the kind of level of power you would need for an export hydrogen industry. Has your faculty done any investigation about offshore wind capacity?

Professor BROADFOOT: We have talked to a number of companies that were looking to invest in offshore wind generation. The conclusion was that it was logical. If you can bring that kind of energy, you are going to have to bring it onshore. If you bring it on to somewhere like the Williamtown special activation precinct, there is a big network there associated with the aluminium smelter where that can make it a viable network to make a hydrogen production at Kooragang. So it makes sense because to make hydrogen you need a fair amount of energy flow. If we can build it from green energy, that is a logical connection to get green hydrogen and it is about connectability.

Mr DAVID SHOEBRIDGE: To make offshore wind viable, you need a shipbuilding industry to actually get the rigs out offshore. It is all there in Newcastle in one view, is it not?

Professor BROADFOOT: That comes back to the fact of the gas, the ports, the skillsets and the potential for connectability to the grid. Yes, it all sits there in a row. Do not forget that when we talk to the hydrogen technology cluster, it is about translation of that knowledge we generate as the economic activity starts to take place because we have already got Orana as part of that consortium—the Central Coast. We are putting in bids for a CRC for hydrogen and a CRC has already been lodged for heavy industry. How can we convert—which is the other earlier adopter over mobility?

The CHAIR: If there are no further questions, we have reached the end of the time that has been allocated for this session. Gentlemen, thank you all for appearing as witnesses and for the great information you have given not only as champions for the Hunter, of course, but also as champions for the industry. It is greatly appreciated. Were any questions taken on notice?

Mr DAVID SHOEBRIDGE: I was going to ask a question about Mark Vaile but I am going to restrain myself, Professor Zelinsky.

The Hon. TAYLOR MARTIN: I thought you might go there.

The CHAIR: Thank you. That concludes today's hearing.

(The witnesses withdrew.)

The Committee adjourned at 13:15.