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STANDING COMMITTEE ON STATE DEVELOPMENT

Uranium Mining and Nuclear Facilities (Prohibitions) Repeal Bill 2019

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Uranium Mining and Nuclear Facilities (Prohibitions) Repeal Bill 2019

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Terms of reference

1. That:
 - (a) the Uranium Mining and Nuclear Facilities (Prohibitions) Repeal Bill 2019 be referred to the Standing Committee on State Development for inquiry and report, and
 - (b) on tabling of the report by the Standing Committee on State Development, a motion may be moved without notice that the bill be restored to the Notice Paper at the stage it had reached prior to referral.
2. That as part of the inquiry the New South Wales Parliamentary Library prepare an Issues Paper on the bill.¹

The terms of reference were referred to the committee by the Legislative Council on 6 June 2019.²

¹ The terms of reference were amended by the House on 13 November 2019, *LC Minutes* No 31, item 6, p 656

² *Minutes*, NSW Legislative Council, 6 June 2019, pp 59-60.

Committee details

Committee members

The Hon Taylor Martin MLC	Liberal Party	<i>Chair</i>
The Hon Mick Veitch MLC	Australian Labor Party	<i>Deputy Chair</i>
The Hon Mark Bansiak MLC	Shooters Fishers and Farmers Party	
The Hon Wes Fang MLC	The Nationals	
The Hon Scott Farlow MLC	Liberal Party	
The Hon John Graham MLC	Australian Labor Party	
The Hon Natasha Maclaren-Jones MLC	Liberal Party	
The Hon Mark Latham MLC*	Pauline Hanson's One Nation	

- * The Hon Mark Latham MLC substituted for the Hon Mark Pearson MLC as a member of the committee for the duration of the inquiry

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Chair's foreword

This inquiry was established to inquire into the Uranium Mining and Nuclear Facilities (Prohibitions) Repeal Bill 2019, which was referred to the Standing Committee on State Development for inquiry and report on 6 June 2019. The bill seeks to remove all State-based legal impediments to uranium mining and the construction and operation of nuclear facilities in New South Wales.

The *Uranium Mining and Nuclear Facilities (Prohibitions) Act 1986* may be considered an artefact of its time, a post-Chernobyl era characterised by concern about the environmental and health impacts of nuclear, as well as fears of nuclear war and the proliferation of nuclear weapons. Since 1986, much has changed. Nuclear technology has improved and there are further promising innovations such as Small Modular Reactors being developed. This report highlights the opportunities that exist for New South Wales if we were to play a greater role in the nuclear fuel cycle.

If the bill is enacted in law, the prohibition on uranium mining in New South Wales would be lifted, making it legal to mine for uranium within State boundaries for the first time since 1987. However, the prohibition on nuclear facilities would still remain in place as a result of prohibitions enacted in Commonwealth legislation.

The inquiry provided a timely platform for debate on whether nuclear energy should be considered on its merits as one possible energy source in the State's future energy mix. It presented an opportunity to gather the facts about nuclear energy based on the best available science and technology and to evaluate the prospects of nuclear energy as a low emissions source of electricity.

This was not the first fact-finding mission on nuclear energy undertaken by an Australian parliament. Over the past fifteen years, Australian parliaments and governments have considered a greater role in the nuclear fuel cycle at various times. While neither the focus, findings, nor recommendations of this inquiry are entirely new, no Government has embraced the opportunities of an expanded nuclear industry.

One of the themes of this inquiry was the decarbonisation of New South Wales's electricity generation. Despite the share of wind and solar in the New South Wales electricity generation mix tripling in the past five years, just over seven per cent of the State's electricity currently comes from these sources. It is a finding of this inquiry that wind and solar firming with gas, batteries and pumped hydro would not be an adequate solution to meet the State's future needs for affordable and reliable electricity following the decommissioning of our ageing coal fired generation assets. There is an imperative for legislators and governments to be genuinely technology-neutral and not lock out appropriate, low-emissions alternatives to replace these ageing assets.

This inquiry was not about promoting an overnight change in the legal settings for nuclear energy in New South Wales. Rather, removing the barriers that exist will increase the ability for private investment in this space and there remains significant work to be done before it becomes a possibility. The report highlights that the Government will need to consider the viability of nuclear energy from an economic perspective, workforce capacity and regulatory frameworks prior to any proposal being implemented.

Serious and informed policy dialogues about nuclear energy involve incredibly complex issues and considerations – and therefore take time. They also will require a willingness to listen to contemporary evidence that challenges entrenched views. There are signs that we are ready to have this conversation with several examples of polls that showed a level of support for nuclear power. The recent public vote in Kimba, South Australia supporting the establishment of a National Radioactive Waste Management Facility shows that communities that are empowered with information can recognise the opportunities that come from a greater involvement in the nuclear fuel cycle.

As the inquiry unfolded, it became clear to the committee that the safety of nuclear technology has advanced in leaps and bounds since the 1980s and is worthy of consideration in the State's future energy mix. In particular, the passive safety features of Generation III+ and Generation IV reactors are a significant enhancement on nuclear technologies in use when the state prohibition commenced. These designs may be suitable in New South Wales where energy policy seeks to decarbonise electricity generation while simultaneously delivering secure, reliable and affordable energy to power a competitive industrial and manufacturing economy.

In view of the findings of this inquiry, the committee could find no compelling justifications from an environmental or human safety point of view which would warrant the blanket exclusion of nuclear energy, especially in its emerging small scale applications, from serious policy consideration in New South Wales. The outdated arguments for prohibiting nuclear on the basis of safety are increasingly difficult to defend. Evidence presented shows that nuclear power around the world since the 1950s has resulted in enough emissions abatement to have saved over 1.8 million lives that would have been lost to respiratory conditions and disease if those power stations were fossil fuel burning facilities instead. The on-going technological advancements in the recycling, reprocessing and disposing of nuclear waste mean that historical environmental arguments against nuclear are overstated.

On behalf of the committee, I wish to thank those that have contributed to our work by making submissions to the inquiry and participating in public hearings. I acknowledge the Australian Nuclear Science and Technology Organisation, Heathgate Resources and the South Australian Government for supporting our site visits. I also thank the secretariat for their assistance, including Anthony Hanna, Rebecca Main, Shu-fang Wei and Angeline Chung as well as Hansard reporters. Finally, I recognise Tom Gotsis, Chris Angus, Daniel Montoya, Lenny Roth, Rowena Johns and Matthew Dobson from the Parliamentary Research Service for their preparation of the issues paper 'Uranium Mining and Nuclear Energy in New South Wales'.



The Hon Taylor Martin MLC

Committee Chair

Findings and recommendations

- Finding 1** **23**
That the existing prohibition on uranium mining is a barrier to knowing the extent of uranium resources in New South Wales.
- Recommendation 1** **23**
That the NSW Government encourages and supports uranium exploration in order to further understand all economically viable uranium resources in New South Wales, including their extent and location.
- Recommendation 2** **37**
That the NSW Government works with the relevant Commonwealth agencies and industry bodies to assess whether existing frameworks for worker safety, radiation regulation and environmental regulation are appropriate and adequate for the commencement of uranium mining in New South Wales, identifying any gaps that would need to be addressed.
- Finding 2** **51**
That securing affordable, sustainable and reliable baseload power now and into the future is essential to powering the State's manufacturing and other energy-intensive industries thereby ensuring that the State maintains a competitive advantage as it works towards reducing emissions. Given the urgent importance of emissions reduction, the NSW Government should be actively considering all options to take steps to mitigate this risk.
- Finding 3** **55**
That wind and solar firmed with gas, batteries and pumped hydro would not be an adequate solution to meet the State's future needs for affordable and reliable electricity following the decommissioning of our ageing coal fired generation assets.
- Finding 4** **59**
Overall, the committee considers nuclear power to be a compelling technology that may be useful in energy policy which seeks to address the three dimensions of the energy trilemma. We acknowledge that nuclear power provides for:
- net-zero emissions (*environmental sustainability*);
 - a secure and reliable energy supply (*energy security*); and
 - an ability to support a competitive industrial and manufacturing economy (*affordability and equity*).
- Finding 5** **67**
The committee finds that Generation III/III+ and Generation IV are a significant advancement on older generation reactor designs that were in operation when the *Uranium Mining and Nuclear Facilities (Prohibitions) Act 1986* was enacted.

Finding 6

74

On the balance of expert evidence gathered for this inquiry, the committee finds that emerging nuclear technologies, particularly Generation III/III+ and Generation IV:

- benefit from significant advancements in reactor safety and design since the enactment of the *Uranium Mining and Nuclear Facilities (Prohibition) Act 1986*;
- are significantly lower risk than earlier nuclear technologies; and
- are considerably safer than other forms of electricity generation in the level of risk they pose to human health and the environment as a result of reducing airborne emissions.

Recommendation 3

74

That:

- the Department of Planning, Industry and Environment liaise with the Australian Nuclear Science and Technology Organisation to monitor the regulatory approval and commercialisation of Small Modular Reactors in the United States and elsewhere (as appropriate) and report findings to the NSW Government as they become available; and
- the NSW Chief Scientist and Engineer report to the NSW Government on broader developments in nuclear energy on a regular basis.

Recommendation 4

83

That the NSW Government commissions independent and detailed analysis and modelling to properly evaluate the viability of nuclear energy from an economic perspective, taking into account:

- all relevant inputs and variables as well as the specificities of the New South Wales electricity system;
- the costs for any new connection, transmission or other system/network infrastructure that would be required over and above the State's existing network infrastructure; and
- the projected impact on New South Wales climate emissions and any opportunities or costs that entails or avoids.

Finding 7

98

That, in order to set up a nuclear energy industry in New South Wales, a world class regulatory regime would need to be established, supported by the requisite workforce capability and skills and a 'harmonised' regulatory framework to provide certainty for private investment.

Finding 8

99

That Australia's engineers, nuclear physicists and other scientists are highly esteemed as serious players on the international nuclear science and technology scene. The presence of many of these individuals working in New South Wales forms an important part of our research and engineering community, and provides the competitive advantage to New South Wales of closely following international developments in energy technology. In particular the nuclear research cluster at the Australian Nuclear Science and Technology Organisation is valuable.

Recommendation 5**99**

That the NSW Government commissions:

- a comprehensive workforce gap analysis to identify the workforce capabilities, skills and expertise that would be needed to support a future nuclear power industry in New South Wales; and
- a workforce capacity inventory which identifies the existing clusters of research and workforce capabilities which already exist in New South Wales which are part of the international nuclear industry.

Recommendation 6**100**

That the NSW Government supports the repeal of the *Uranium Mining and Nuclear Facilities (Prohibitions) Act 1986* in its entirety.

Recommendation 7**100**

That the NSW Government pursues the repeal of the Commonwealth prohibitions on nuclear facilities by making representations to the Commonwealth Minister with portfolio responsibility for the relevant legislation.

Recommendation 8**101**

That the Legislative Council proceed with debate on the bill, having regard to the findings and recommendations contained in this report.

Recommendation 9**122**

That the Department of Planning, Industry and Environment liaise with the Australian Nuclear Science and Technology Organisation to use existing public outreach and education programs to implement broader community education initiatives about nuclear energy, highlighting:

- safety and technological advances in this industry since the 1980s;
- how nations such as Canada and France have used nuclear power as part of their decarbonisation strategies;
- the success of the Lucas Heights nuclear reactor in the southern suburbs of Sydney; and
- any other relevant issues.

Conduct of inquiry

The terms of reference for the inquiry were referred to the committee by the Legislative Council on 6 June 2019.

The committee received 72 submissions and 5 supplementary submissions.

The committee held three public hearings at Parliament House in Sydney.

The committee also conducted two site visits to the Australian Nuclear Science and Technology Organisation (ANSTO), Lucas Heights, on 24 July 2019, and the Beverley Uranium Mine and Adelaide (South Australia) on 14 and 15 August 2019.

Inquiry related documents are available on the committee's website, including submissions, hearing transcripts, tabled documents and answers to questions on notice.

As provided for in the terms of reference, an issues paper was released by the Parliamentary Research Service to support and inform consideration of the key issues for the inquiry in September 2019.

Procedural issues

In accordance with the original terms of reference, the committee was to commission the newDemocracy Foundation to facilitate community input into the bill. In working with the committee, newDemocracy proposed a deliberative poll process, involving recruiting random samples of the community, setting their remit through a clearly defined question, providing them with detailed, in-depth information about an issue, using various processes and techniques to develop their thinking, and giving participants abundant time to allow immersion in the topic.

Following consideration, it was mutually agreed between newDemocracy and the committee that the deliberative poll should not proceed due to the polarising nature of the topic of nuclear power and the time commitment involved.

Amended terms of reference were agreed to by the Legislative Council on 13 November 2019 to remove reference to the newDemocracy process.

Chapter 1 Background

This chapter presents the facts about the current legal settings for uranium mining and nuclear facilities in New South Wales, setting the scene for the examination of key issues within subsequent chapters. It provides an overview of the current state of play in New South Wales as well as other Australian jurisdictions with respect to uranium mining and nuclear facilities, detailing the legal impediments, restrictions and prohibitions established in legislation at State and Commonwealth levels. The chapter starts with an overview of the Uranium Mining and Nuclear Facilities (Prohibitions) Repeal Bill 2019 that the committee is tasked with examining.

The bill in context

The Uranium Mining and Nuclear Facilities (Prohibitions) Repeal Bill 2019

1.1 The Uranium Mining and Nuclear Facilities (Prohibitions) Repeal Bill 2019 (the bill) was introduced in the Legislative Council on 6 June 2019 by the Hon Mark Latham MLC.

1.2 The bill seeks to remove all State-based impediments to uranium mining and the construction and operation of nuclear facilities in New South Wales, by:

- repealing the *Uranium Mining and Nuclear Facilities (Prohibitions) Act 1986* in its entirety;
- amending the *Mining Act 1992* by omitting Section 10A which precludes mining authorisations being granted in respect of uranium; and
- amending the *Land and Environment Court Act 1979* to omit references to the *Uranium Mining and Nuclear Facilities (Prohibitions) Act 1986*.³

1.3 In his second reading speech on the bill, Mr Latham put forward the case for lifting the ban on uranium mining and nuclear facilities, highlighting the economic benefits to the State from uranium mining as well as the need for a new source of dispatchable baseload power to 'avert the looming power crisis in this State'.⁴

1.4 Mr Latham's argument for lifting the ban on uranium mining is couched largely in economic terms, highlighting the opportunity costs to New South Wales of a ban on an entire sector of minerals extraction. Mr Latham observed that:

Industry experts have said to me they expect there is uranium in the ground in the western districts of New South Wales. Why not mine it here when across the border South Australia has been creating jobs and investment for many decades? A new uranium mine was approved in Western Australia earlier this year. Why is New South Wales missing out on the jobs, investment and prosperity from uranium mining?

[...]

As one mining investor connected to Hartz Rare Earths said, "Who in their right mind would put their hard-earned cash into exploring for uranium in New South Wales when

³ Uranium Mining and Nuclear Facilities (Prohibition) Repeal Bill 2019, Explanatory Note, p 1.

⁴ The Hon Mark Latham MLC, Second reading speech: Uranium Mining and Nuclear Facilities (Prohibition) Repeal Bill 2019, 6 June 2019.

even if you are successful in finding an economic resource you will not be allowed to develop it and have the chance to be rewarded for all the risk you took?"⁵

- 1.5** If the bill is enacted in law, the prohibition on uranium mining in New South Wales would be lifted, removing all legal barriers to uranium prospecting and extraction – allowing mining for uranium to commence subject to commercial viability, market dynamics and appetite.
- 1.6** However, the prohibition on nuclear facilities would still remain in place as a result of the blanket prohibitions on nuclear installations/facilities enacted in Commonwealth legislation. This Commonwealth legislation would continue to prevail over any inconsistent State-based statutes.⁶
- 1.7** The bill was referred by the Legislative Council to the Standing Committee on State Development for inquiry and report on 6 June 2019.

Rationale and impetus for the bill

- 1.8** A confluence of several pressing public policy concerns has created fertile ground for proposals involving nuclear energy – proposals which continue to gather momentum within various legislatures across Australia. Such policy concerns include rising electricity prices, reduction in emissions and end of life for coal fired power assets.
- 1.9** First, electricity prices in Australia have risen steeply in recent years, putting pressure on household budgets, manufacturing industries and other sectors of the economy. As one witness observed, Australia went from an electricity price outlook of a 4-per-cent increase per year in 2006 to an outlook for 4 per cent per month in 2019.⁷ Other inquiry participants starkly emphasised that electricity costs to residential and industrial consumers in Australia have risen from one of the world's lowest to among the world's highest.⁸ According to the Australian Workers' Union⁹ and the Minerals Council of Australia,¹⁰ between 2009 and 2019, the average household and industrial electricity costs have risen by more than 90 per cent.
- 1.10** Evidence is divided on what has contributed to the sharp increase in electricity prices. The current market rules and purportedly suboptimal operation of the National Electricity Market is offered as a contributing factor,¹¹ as is the privatisation of generation and transmission assets¹² and export of Australia's raw materials for energy production with inadequate planning to meet

⁵ The Hon Mark Latham MLC, Second reading speech: Uranium Mining and Nuclear Facilities (Prohibition) Repeal Bill 2019, 6 June 2019.

⁶ NSW Parliamentary Research Service, *Uranium Mining and Nuclear Energy in New South Wales*, Issues paper, 2019, pp 102-103.

⁷ Evidence, Dr Ziggy Switkowski AO, Private citizen, 11 November 2019, p 49.

⁸ See for example: Submission 1, Mr Barrie Hill, p 7; Evidence, Mr Satyajeet Marar, Director of Policy, Australian Taxpayers' Alliance, 11 November 2019, p 58.

⁹ Submission 70, The Australian Workers' Union, p 9.

¹⁰ Submission 67, Minerals Council of Australia, p 7.

¹¹ Submission 70, The Australian Workers' Union, pp 3-4.

¹² Submission 1, Mr Barrie Hill, p 7.

our own energy needs.¹³ The market penetration of renewables and its impact on prices is another purported correlation emerging from the evidence.¹⁴ In its submission to the inquiry, *Down Under Nuclear Energy* referred to the 'thoughtless subsidisation of intermittent renewable energy' as one of the most significant factors placing upward pressure on power prices in Australia.¹⁵

- 1.11** Second, taken together, the groundswell of awareness and concern about emissions and the increasingly vocal calls for the decarbonisation of electricity generation have put these issues firmly in the mainstream of political discourse. The inquiry received evidence advocating for nuclear as a low-emissions generation technology that could play a major role in emissions reduction and in decarbonising our electricity sector. For example, evidence given by Bright New World,¹⁶ Nuclear for Climate Australia,¹⁷ Mr Barry Murphy¹⁸ and Dr John Patterson¹⁹ draws a correlation between nuclear energy and climate change abatement.
- 1.12** Third, the NSW Government has committed to an aspirational objective of achieving net-zero emissions by 2050, consistent with the Commonwealth Government's emissions targets.²⁰ While this policy commitment is technology-neutral, it signals a clear intention to encourage innovation and investment in low-carbon technologies in order to make inroads into emissions reduction in New South Wales.
- 1.13** Finally, the State's coal fired power assets are reaching the end of their life, with four of the State's five remaining coal-fired power stations set to cease operations by 2035, starting with the Liddell Power Station in April 2023.²¹ With the impending closures, there is a real sense that our electricity system is in transition, from an overwhelming reliance on abundant coal and fossil fuels – which has to date been effective in providing affordable, reliable baseload power – to the next generation with fundamentally different foundational assets, whatever that may look like.²²

Committee comment

- 1.14** The committee believes that the introduction of the bill in the Legislative Council sends a clear message that the time for legislators and policy-makers to take meaningful action and start planning for our future energy security is now. It presents an opportunity to look at all the facts and consider whether nuclear power could be part of the solution.

¹³ Submission 70, The Australian Workers' Union, p 4.

¹⁴ Evidence, Mr Satyajeet Marar, Director of Policy, Australian Taxpayers' Alliance, 11 November 2019, p 61.

¹⁵ Submission 42, *Down Under Nuclear Energy*, p 19.

¹⁶ Submission 61, Bright New World, p 4.

¹⁷ Submission 52, Nuclear for Climate Australia, p 1.

¹⁸ Submission 8, Mr Barry Murphy, p 5.

¹⁹ Evidence, Dr John Patterson, 18 November 2019, p 50.

²⁰ The Office of Environment & Heritage (NSW), *Achieving net-zero emissions by 2050*, Fact sheet, 2016, p 1.

²¹ Department of Planning, Industry and Environment, *Overview of the NSW electricity strategy*, NSW Government, 2019, p 4.

²² Submission 58, Engineers Australia, p 9.

Other inquiries into nuclear

1.15 The New South Wales inquiry is not happening in isolation but is part of a much broader debate about nuclear power afoot in various legislatures and governments across Australia. This section provides an overview of previous and concurrent inquiries into uranium mining and nuclear energy, illustrating the emerging public policy dialogue about nuclear energy in Australia.

Other parliamentary inquiries

1.16 Federally, the Standing Committee on the Environment and Energy – a committee of the House of Representatives – recently conducted an inquiry into the prerequisites for nuclear energy in Australia. Commencing in August 2019, the inquiry was tasked with investigating and reporting on the circumstances and prerequisites necessary for any future government's consideration of nuclear energy generation including Small Modular Reactors.²³ The committee reported to the Commonwealth Government in December 2019. It recommended that the Commonwealth Government consider nuclear technology as part of Australia's future energy mix and consider lifting the current moratorium on nuclear energy partially – for new and emerging nuclear technologies only.²⁴

1.17 In August 2019, the Legislative Council within the Victorian Parliament tasked the Environment and Planning Committee to inquire into the potential benefits in removing prohibitions enacted by the *Nuclear Activities (Prohibitions) Act 1983* (Victoria). According to its terms of reference, the focus of the inquiry is to:

- investigate the potential for Victoria to contribute to low emissions energy production by allowing exploration and production of uranium and thorium;
- identify economic, environmental and social benefits for Victoria;
- identify opportunities for Victoria to participate in the nuclear fuel cycle; and
- identify any barriers to participation, including limitations caused by federal or local laws and regulations.²⁵

1.18 The committee is required to respond within 12 months.²⁶

²³ Standing Committee on the Environment and Energy, *Inquiry into the prerequisites for nuclear energy in Australia*, Parliament of Australia, [no date], www.aph.gov.au/Parliamentary_Business/Committees/House/Environment_and_Energy/Nuclear_renergy.

²⁴ Standing Committee on the Environment and Energy, House of Representatives, Australian Parliament, *Not without your approval: a way forward for nuclear technology in Australia*, Report of the inquiry into the prerequisites for nuclear energy in Australia, (2019), p v.

²⁵ Environment and Planning Committee, *Terms of reference: Inquiry into Nuclear Prohibition*, Parliament of Victoria (6 November 2019), <https://www.parliament.vic.gov.au/epc-lc/inquiries/article/4347>.

²⁶ Environment and Planning Committee, *Report: Inquiry into Nuclear Prohibition*, Parliament of Victoria, (29 October 2019), <https://www.parliament.vic.gov.au/epc-lc/inquiries/article/4350>.

The Nuclear Fuel Cycle Royal Commission (South Australia)

- 1.19** In 2015, the South Australian Government established the Nuclear Fuel Cycle Royal Commission, headed by Royal Commissioner, the Honourable Kevin Scarce AC CSC RAN, to investigate the potential for increasing South Australia's participation in the nuclear fuel cycle.²⁷
- 1.20** Specifically, the Commission considered the possibility of an expanded role for South Australia in the following areas of activity:
- expanded exploration, extraction and milling of minerals containing radioactive materials;
 - the further processing of minerals and the processing and manufacture of material containing radioactive and nuclear substances;
 - the use of nuclear fuels for electricity generation; and
 - the establishment of facilities for the storage and disposal of radioactive and nuclear waste.²⁸
- 1.21** The Commission commended its report – *The Nuclear Fuel Cycle Royal Commission Report* – to the Governor of South Australia in May 2016.
- 1.22** With respect to the use of nuclear fuels for electricity generation, the Commission made the following findings:
- the existence of sufficient evidence, accepted by the Commission, of safe operation and improvements to reactor design and safety such that nuclear power should not be discounted as an energy option on the basis of safety; and
 - that, taking into account the South Australian energy market characteristics and rules at the time of the inquiry and the costs of going nuclear, it would not be commercially viable to develop a nuclear power plant in South Australia beyond 2030, but there may be a future role for nuclear as a low-carbon energy source as Australia works to decarbonise its electricity sector.²⁹
- 1.23** In view of these findings, the Commission recommended that the South Australian Government 'pursue removal at the federal level of existing prohibitions on nuclear power generation to allow it to contribute to a low-carbon electricity system, if required.'³⁰
- 1.24** In acknowledging the advancements in reactor designs, safety and innovation, the Commission called on the South Australian Government to collaborate with the Australian government to 'commission expert monitoring and reporting on the commercialisation of new nuclear reactor designs that may offer economic value for nuclear power generation.'³¹
- 1.25** On the topic of radioactive waste, the Commission accepted evidence that deep geological disposal is the 'best available approach' to the long term disposal of used fuel – noting the existence of 'advanced' waste containment programs in various places around the world – and

²⁷ The Nuclear Fuel Cycle Royal Commission, *Nuclear Fuel Cycle Royal Commission Report*, 2016, p xi.

²⁸ The Nuclear Fuel Cycle Royal Commission, *Nuclear Fuel Cycle Royal Commission Report*, 2016, p xi.

²⁹ The Nuclear Fuel Cycle Royal Commission, *Nuclear Fuel Cycle Royal Commission Report*, 2016, p xiv.

³⁰ The Nuclear Fuel Cycle Royal Commission, *Nuclear Fuel Cycle Royal Commission Report*, 2016, p xv.

³¹ The Nuclear Fuel Cycle Royal Commission, *Nuclear Fuel Cycle Royal Commission Report*, 2016, p xv.

found that 'South Australia has the necessary attributes and capabilities to develop a world-class waste disposal facility, and to do so safely.'³²

- 1.26** In summary, the Commission concluded that South Australia can safely increase its participation in nuclear activities.
- 1.27** On 15 August 2019, during its visit to Adelaide and the Beverly Uranium Mine, the committee met with Commissioner Scarce and other government stakeholders to discuss issues relating to various aspects of the nuclear fuel cycle, including the findings and recommendations of the Nuclear Fuel Cycle Royal Commission.

The Switkowski review

- 1.28** In 2006, the then Prime Minister John Howard appointed a taskforce to undertake a comprehensive review of uranium mining, value-added processing and opportunities for nuclear energy in Australia. Chaired by Dr Ziggy Switkowski AO, the taskforce reported in December 2006.³³
- 1.29** The review – known colloquially as the 'Switkowski review' – made a number of wide ranging findings and recommendations, some of which generally pointed to a possible role for nuclear energy in Australia's future energy mix in a carbon constrained system:

Nuclear power today is a mature, safe and clean means of generating baseload electricity. Nuclear power is an option that Australia would need to consider seriously among the range of practical options to meet its growing energy demand and to reduce its greenhouse signature.³⁴

- 1.30** On the issue of viability and costs of nuclear in Australia, the taskforce presented mixed findings. It found that, according to cost estimates modelled using inputs valid in 2006, nuclear power in Australia would be considerably more expensive to produce than coal fired power if carbon is not priced.³⁵ It found, however, that nuclear power is the least-cost low-emissions technology for providing baseload power, and would be competitive in carbon constrained electricity supply scenarios in Australia.³⁶

³² The Nuclear Fuel Cycle Royal Commission, *Nuclear Fuel Cycle Royal Commission Report*, 2016, p xv.

³³ Australian Government, *Uranium Mining, Processing and Nuclear Energy: Opportunities for Australia?*, Report to the Prime Minister by the Uranium Mining, Processing and Nuclear Energy Review Taskforce, 2006.

³⁴ Australian Government, *Uranium Mining, Processing and Nuclear Energy: Opportunities for Australia?*, Report to the Prime Minister by the Uranium Mining, Processing and Nuclear Energy Review Taskforce, 2006, p 13.

³⁵ Australian Government, *Uranium Mining, Processing and Nuclear Energy: Opportunities for Australia?*, Report to the Prime Minister by the Uranium Mining, Processing and Nuclear Energy Review Taskforce, 2006, p 5.

³⁶ Australian Government, *Uranium Mining, Processing and Nuclear Energy: Opportunities for Australia?*, Report to the Prime Minister by the Uranium Mining, Processing and Nuclear Energy Review Taskforce, 2006, p 5.

- 1.31 Furthermore, the review concluded that nuclear power should not be discounted on the basis of safety, environmental impacts, waste or nuclear weapons proliferation.³⁷

Overview of uranium mining

- 1.32 This section starts with a history of how the prohibition on uranium mining came into existence in New South Wales, followed by an overview of the legal settings for uranium mining in other Australian jurisdictions.

Prohibition on uranium mining in NSW

- 1.33 Uranium mining is currently prohibited in New South Wales. Prospecting for uranium, however, is permitted provided it is undertaken in accordance with a valid exploration licence issued under the *Mining Act 1992*, and uranium can be mined in the course of mining for another mineral.³⁸
- 1.34 Uranium mining has been prohibited in New South Wales since the commencement of the *Uranium Mining and Nuclear Facilities (Prohibition) Act 1986* on 9 January 1987. The objects of this Act are:
- (a) to prohibit mining for uranium; and
 - (b) to prohibit the construction or operation of nuclear reactors and other facilities in the nuclear fuel cycle,
- in order to protect the health, safety and welfare of the people of New South Wales and the environment in which they live.³⁹
- 1.35 Section 7(1) of the Act states that 'a person shall not mine for uranium' and sets the maximum penalty for an offence against this section at 1,000 penalty units.⁴⁰
- 1.36 Parliamentary debate on the Uranium Mining and Nuclear Facilities (Prohibition) Bill 1986 in December 1986 is instructive in understanding the social and political climate in which the Act was made. In his second reading speech in the Legislative Assembly, the then Minister for Energy and Technology, the Hon Peter Cox MP, made reference to the increasing levels of awareness of the 'dangers associated with the nuclear fuel cycle', informing the House that the objective of the bill is to protect 'the health, safety and welfare of the people of New South Wales and the environment in which we live.'⁴¹

³⁷ Australian Government, *Uranium Mining, Processing and Nuclear Energy: Opportunities for Australia?*, Report to the Prime Minister by the Uranium Mining, Processing and Nuclear Energy Review Taskforce, 2006, p 2.

³⁸ Geoscience Australia, *Onshore Legislation*, [no date], <https://www.ga.gov.au/scientific-topics/energy/legislation/onshore-legislation#heading-2>. See also: Evidence, Mr Alex King, Executive Director, Resources Policy, Planning and Programs, Department of Planning, Industry and Environment, 11 November 2019, pp 6-7.

³⁹ *Uranium Mining and Nuclear Facilities (Prohibition) Act 1986*, s 3.

⁴⁰ *Uranium Mining and Nuclear Facilities (Prohibition) Act 1986*, s 7.

⁴¹ The Hon Peter Cox MP, Second reading speech: Uranium Mining and Nuclear Facilities (Prohibition) Bill 1986, 1 December 1986.

- 1.37** Other proponents of the 1986 bill referred to Chernobyl, Three Mile Island, and a 'large body of evidence which links the mining of uranium with the production of nuclear weapons', to bolster the stated rationale, purpose and need for prohibiting legislation.⁴²
- 1.38** On 14 September 2012, the *Mining Legislation Amendment (Uranium Exploration) Act 2012* commenced in law. This amending legislation repealed the prohibition on uranium exploration in New South Wales by amending the *Uranium Mining and Nuclear Facilities (Prohibition) Act 1986*, the *Mining Act 1992*, as well various other Acts and planning instruments.⁴³
- 1.39** As a result of this amendment, it became legal to prospect for uranium in New South Wales pursuant to a valid exploration licence issued under the *Mining Act 1992*, but the prohibition on uranium extraction remained in place.
- 1.40** In 2014, following the repeal of the exploration ban in New South Wales, six companies were invited to apply for a uranium exploration licence through an expression of interest process. The then Minister for Resources and Energy and Special Minister for State, the Hon Anthony Roberts MP, stated that:
- Exploration will allow the NSW Government to better understand the extent of the State's resources and any potential economic benefits.
- [...]
- The six companies will be invited to apply for exploration licences in one of three NSW locations with possible uranium deposits – around Broken Hill, near Cobar and south of Dubbo.⁴⁴
- 1.41** Of the six companies invited to participate in the expression of interest, one submitted an application which was subsequently withdrawn in April 2016. Since the lifting of the ban on exploration in 2012, no uranium exploration licence has ever been issued in New South Wales.⁴⁵
- 1.42** In New South Wales, mining licensing and titling for all mineral resources is regulated under the *Mining Act 1992*. Proposed mining activities may require additional approvals under various other planning instruments and Acts, including the *Environment Protection and Biodiversity Conservation Act 1999* (Cth).⁴⁶

⁴² The Hon J.R. Hallam, Second reading speech: Uranium Mining and Nuclear Facilities (Prohibition) Bill 1986, 4 December 1986.

⁴³ *Mining Legislation Amendment (Uranium Exploration) Act 2012*.

⁴⁴ Media release, Hon Anthony Roberts MP, former Minister for Resources and Energy and Special Minister of State, 'Expression of Interest process finalised for uranium exploration licences', 11 September 2014.

⁴⁵ NSW Parliamentary Research Service, *Uranium Mining and Nuclear Energy in New South Wales*, Issues paper, 2019, pp 54 and 95.

⁴⁶ Resources and Geoscience, *Coal and mineral exploration*, www.resourcesandgeoscience.nsw.gov.au/miners-and-explorers/applications-and-approvals/environmental-assessment/exploration.

Uranium mining laws in other Australian jurisdictions

- 1.43** Legislation dealing with uranium mining is set by state legislatures – and therefore varies across states and territories – with overarching Commonwealth laws regulating different aspects of the uranium mining industry in jurisdictions where uranium mining is permitted.
- 1.44** In Victoria, uranium mining is prohibited under the *Nuclear Activities (Prohibitions) Act 1983* (Vic).⁴⁷
- 1.45** In Queensland, the current regulatory regime does not permit uranium mining, with the last uranium being mined in 1982.⁴⁸
- 1.46** In October 2012, the then Queensland Premier, Campbell Newman, announced that the Queensland Government would support the recommencement of uranium mining in Queensland, reversing a 'policy ban' that had been in place since 1982. To support this policy reversal, the Uranium Mining Implementation Committee was established to recommend a best practice policy framework for the recommencement of uranium mining in Queensland.⁴⁹ The committee concluded that:
- ... Queensland's existing framework for the regulation of mining and radiation safety is generally appropriate for the recommencement of uranium mining in this state and that a new legislative framework is not required. The Committee has, however, made recommendations on how the existing framework can be adapted to ensure the recommencement of uranium mining meets best practice.⁵⁰
- 1.47** The Queensland Government's response to and/or progress towards implementing the committee's recommendations was not able to be ascertained for this inquiry.
- 1.48** State laws in Western Australia currently permit uranium mining. However, in 2017, the Western Australian Government implemented a policy ban on uranium mining for all new mining leases.⁵¹ The policy ban did not affect pre-existing uranium projects which were granted Ministerial approval prior to 2017. These previously approved projects are detailed in the next chapter.
- 1.49** In Tasmania, there are no legislative prohibitions on uranium mining.⁵² Mining titling/licencing in Tasmania is regulated under the *Mineral Resources Development Act 1995* (Tas).

⁴⁷ *Nuclear Activities (Prohibitions) Act 1983* (Vic), noting that a parliamentary inquiry is underway to consider repealing the ban on uranium mining.

⁴⁸ Evidence, Mr Ian Macfarlane, Chief Executive, Queensland Resources Council, Australian Parliament., House of Representatives, Inquiry into the Prerequisites for Nuclear Energy, 30 September 2019, p 1.

⁴⁹ Uranium Mining Implementation Committee, *Recommencement of uranium mining in Queensland: A best practice framework*, 2013, pp i and iii.

⁵⁰ Uranium Mining Implementation Committee, *Recommencement of uranium mining in Queensland: A best practice framework*, 2013, p 1.

⁵¹ Media release, Hon Bill Johnston MLA, Minister for Mines and Petroleum; Energy; Industrial Relations, 'McGowan Government announces uranium policy', 20 June 2017.

⁵² Submission 59, Australian Nuclear Science and Technology Organisation, p 14.

- 1.50** There are no legal impediments to uranium mining in the Northern Territory. As a territory, the Commonwealth has jurisdiction over controlled substances (including uranium) and joint agreements between the Northern Territory and Commonwealth Governments can allow for uranium to be within mineral titles issued under the *Mining Act 1980* (NT).⁵³ Uranium mining operations in the Northern Territory are profiled in the next chapter.
- 1.51** In South Australia, uranium exploration and mining is enabled in state legislation, and uranium exploration is actively supported in policy by the South Australian Government.
- 1.52** Uranium exploration and mining in South Australia is governed by:
- the *Mining Act 1971*;
 - the *Radiation Protection and Control Act 1982*;
 - the *Roxby Downs (Indenture Ratification) Act 1982*; and
 - the *Environmental Protection and Biodiversity Conservation Act 1999* (Cth)⁵⁴
- 1.53** The State regulatory regime is jointly administered by the Department for Energy and Mining and the Environment Protection Authority,⁵⁵ reflecting a generalised delineation of titling/licensing functions and environmental regulation of mineral resources.
- 1.54** In relation to its regulatory framework for uranium specifically, the South Australian Government has stated that it has:
- streamlined the project approvals process, improving transparency and boosting industry and community confidence that regulatory processes are effective, and promoting efficiency in mining operations while effectively ensuring the safety and protection of all South Australians and the environment.⁵⁶
- 1.55** As part of the approval process for new mines in South Australia, the proponent must submit a program for environmental protection and rehabilitation (PEPR) for approval by regulators before mining operations for any mineral resource (including uranium) can commence.⁵⁷
- 1.56** Issues surrounding uranium mining in South Australia were explored in stakeholder discussions held by the committee during its visit to Adelaide and the Beverly Uranium Mine in August 2019. In particular, such discussions offered valuable insights into the environmental regulation and safety of uranium mining – as well as its economic benefits and impacts – in an Australian jurisdiction where it is permitted and actively supported through government policy.

⁵³ Geoscience Australia, *Onshore Legislation*, [no date], <https://www.ga.gov.au/scientific-topics/energy/legislation/onshore-legislation>.

⁵⁴ South Australian Government, Department for Energy and Mining, *Uranium*, [no date], http://energymining.sa.gov.au/minerals/mineral_commodities/uranium.

⁵⁵ NSW Parliamentary Research Service, *Uranium Mining and Nuclear Energy in New South Wales*, Issues paper, 2019, p 105.

⁵⁶ South Australian Government, Department for Energy and Mining, *Uranium*, [no date], http://energymining.sa.gov.au/minerals/mineral_commodities/uranium.

⁵⁷ South Australian Government, Department for Energy and Mining, *Uranium*, [no date], http://energymining.sa.gov.au/minerals/mineral_commodities/uranium.

1.57 Sitting above all state and territory laws as overarching environmental legislation is the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act). Proposed mining operations across all states and territories may require Ministerial approval under the EPBC Act if such operations – or their potential environmental impacts – are of a class/nature prescribed by Part 3 of this Act.⁵⁸

Overview of nuclear facilities

1.58 This section provides an overview of the legal settings for nuclear facilities in Australia – including the prohibition of these facilities in New South Wales – while also detailing Australia's current nuclear applications in the area of nuclear research and medicine.

Prohibition on nuclear facilities in New South Wales

1.59 Current prohibitions on the construction and operation of nuclear facilities in New South Wales are enacted in both State and Commonwealth legislation. In order to understand how the blanket prohibition on nuclear facilities is given force in New South Wales – and the possible effect of any future amendment to or repeal of State laws – it is necessary to consider the interaction of various pieces of legislation.

1.60 At a State level, Subsection 2 of Section 8 of the *Uranium Mining and Nuclear Facilities (Prohibition) Act 1986* provides that 'A person shall not construct or operate a nuclear facility', where 'nuclear facility' is defined in Subsection 1 as:

- a) a facility for the conversion of uranium ore into uranium hexafluoride or any other chemical in order to enable its enrichment,
- b) an isotope separation plant or other facility for the enrichment of nuclear material,
- c) a fabrication plant or other facility for transforming nuclear material into a form suitable for use as fuel in a nuclear reactor,
- d) a nuclear reactor, whether or not designed for the purpose of generating electricity,
- e) a reprocessing plant or other facility for the chemical separation of fuel that has been irradiated in a nuclear reactor, or
- f) a separate storage installation for the storage or disposal of any nuclear material (including radioactive waste material) in the nuclear fuel cycle, being nuclear material used in or resulting from any of the facilities described in paragraphs (a)–(e).⁵⁹

1.61 The maximum penalty for an offence against Section 8 is 1,000 penalty units.⁶⁰

⁵⁸ Resources and Geoscience, *Coal and mineral exploration*, NSW Government, <https://www.resourcesandgeoscience.nsw.gov.au/miners-and-explorers/applications-and-approvals/environmental-assessment/exploration>; Department of Agriculture, Water and the Environment, *What is protected under the EPBC Act*, Australian Government, <http://www.environment.gov.au/epbc/what-is-protected>; *Environment Protection and Biodiversity Conservation Act 1999* (Cth).

⁵⁹ *Uranium Mining and Nuclear Facilities (Prohibition) Act 1986*, s 8.

⁶⁰ *Uranium Mining and Nuclear Facilities (Prohibition) Act 1986*, s 8.

1.62 Section 9 of the same Act provides that:

Without affecting the generality of this Act, nothing in any other Act authorises an authority of the State (including an electricity generator within the meaning of the Energy Services Corporations Act 1995) to construct or operate, or to approve or permit the construction or operation of, a nuclear reactor for the purpose of generating electricity or any other form of energy.⁶¹

1.63 The Act provides an exemption to the Section 8 Subsection 2 provisions for the following activities:

- a) the construction or operation, under an Act of the Commonwealth, of a nuclear facility by the Australian Atomic Energy Commission or by any authority of the Commonwealth that replaces that Commission,
- b) the construction or operation of a facility for the storage or disposal of any radioactive waste material resulting from the use of nuclear materials for research or medical purposes or for any other purpose authorised under the Radioactive Substances Act 1957, or
- c) the operation of a nuclear powered vessel.⁶²

1.64 Similar provisions are in force at the Commonwealth level, enshrined in both the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) and the *Australian Radiation Protection and Nuclear Safety Act 1998* (Cth).**1.65** The *Australian Radiation Protection and Nuclear Safety Act 1998* (Cth) was enacted with the intention of protecting 'the health and safety of people, and to protect the environment, from the harmful effects of radiation'. It gives rise to a prohibition on 'nuclear installations' via provisions set out in Section 10, which states that the CEO must not issue a licence for the construction or operation of the following 'nuclear installations':

- a nuclear fuel fabrication plant;
- a nuclear power plant;
- an enrichment plant;
- a reprocessing facility.⁶³

1.66 The same prohibition is reinforced in Section 140A of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth), which reads:

The Minister must not approve an action consisting of or involving the construction or operation of any of the following nuclear installations:

- (a) a nuclear fuel fabrication plant;
- (b) a nuclear power plant;
- (c) an enrichment plant;
- (d) a reprocessing facility.⁶⁴

⁶¹ *Uranium Mining and Nuclear Facilities (Prohibition) Act 1986*, s 9.

⁶² *Uranium Mining and Nuclear Facilities (Prohibition) Act 1986*, s 8.

⁶³ *Australian Radiation Protection and Nuclear Safety Act 1998* (Cth), ss 3 and 10.

⁶⁴ *Environment Protection and Biodiversity Conservation Act 1999* (Cth), s 140A.

- 1.67 As they stand, New South Wales State and Commonwealth laws are aligned and consistent in imposing prohibitions on nuclear facilities and nuclear installations. Section 109 of the Commonwealth Constitution provides that Commonwealth laws prevail over State laws and that State laws are invalid to the extent of any inconsistency.⁶⁵ As a consequence, this would suggest that if the NSW Parliament passes the bill currently before the Legislative Council – or passes any other legislation seeking to enable the construction and operation of nuclear facilities – the Commonwealth legislation would take precedence and there would be no immediate effect with respect to repealing prohibitions on nuclear.⁶⁶

Current nuclear applications in Australia

- 1.68 Australia currently operates a nuclear reactor for research and medical purposes and has had a nuclear footprint in research and medical applications since the 1950s, with the opening of Australia's first research reactor in Sydney in 1958.⁶⁷ These nuclear applications are permitted by exemption to the prohibitions established in the State and Commonwealth Acts outlined above.
- 1.69 Australia's nuclear infrastructure is operated by the Australian Nuclear Science and Technology Organisation (ANSTO), which succeeded the Australian Atomic Energy Agency in 1987.⁶⁸ ANSTO and its functions are established by the *Australian Nuclear Science and Technology Organisation Act 1987* (Cth). As Australia's lead nuclear science, technology and engineering authority, ANSTO possesses significant nuclear capabilities and expertise and, in addition to its operational activities, plays a role in providing expert technical and policy advice on nuclear science, technology and engineering.⁶⁹
- 1.70 ANSTO's expertise and standing within the international nuclear science and engineering community is reflected by its membership on the Generation IV International Forum and Australia's de facto permanent membership of the International Atomic Energy Agency's Board of Governors as the sole designated representative from the south-east Asia and Pacific region.⁷⁰
- 1.71 ANSTO has overseen the design and construction, commissioning and operation of nuclear research reactors safely and efficiently for over 60 years, providing it with substantial reactor operations capability and knowledge.⁷¹
- 1.72 The latest iteration in ANSTO's research reactors is the Open Pool Australian Lightwater (OPAL) Reactor, the main uses of which are:

⁶⁵ NSW Parliamentary Research Service, *Uranium Mining and Nuclear Energy in New South Wales*, Issues paper, 2019, p 91.

⁶⁶ NSW Parliamentary Research Service, *Uranium Mining and Nuclear Energy in New South Wales*, Issues paper, 2019, p 102.

⁶⁷ NSW Parliamentary Research Service, *Uranium Mining and Nuclear Energy in New South Wales*, Issues paper, 2019, p 62.

⁶⁸ NSW Parliamentary Research Service, *Uranium Mining and Nuclear Energy in New South Wales*, Issues paper, 2019, p 62.

⁶⁹ Submission 59, Australian Nuclear Science and Technology Organisation, p 1.

⁷⁰ Submission 59, Australian Nuclear Science and Technology Organisation, pp 1-2.

⁷¹ Submission 59, Australian Nuclear Science and Technology Organisation, p 3.

- the production of commercial quantities of radioisotopes for industry and medical applications;
- materials research using neutron beams;
- analysis of minerals and samples using neutron activation techniques; and
- irradiation of silicon used in the manufacture of semi-conductors.⁷²

1.73 ANSTO operations are regulated by the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA).

1.74 The committee was welcomed on its site visit to ANSTO on 24 July 2019, when it toured the OPAL reactor, the minerals research laboratory and the Synroc Pilot Plant, a waste treatment solution discussed in Chapter 4. The site visit provided an opportunity for the committee to see a nuclear reactor in operation, to obtain direct insights into issues of safety and waste, and to showcase some of ANSTO's innovations in nuclear science and technology.

Case study: Canada

1.75 Throughout the inquiry, several inquiry participants referred to Canada, an established nuclear nation, in order to illustrate the potential benefits that Australia is missing out on as a result of the moratorium on nuclear power. It was noted that Canada and Australia share much in common in terms of political values, size, natural resource endowment and population patterns. This evidence is summarised in the case study below. This is provided as a point of reference for the issues discussed in subsequent chapters of this report.

Case study - Nuclear power in Canada⁷³

According to the World Nuclear Association, approximately 15 per cent of Canada's electricity comes from nuclear power, with nineteen reactors mostly operating in Ontario. Canada is a leader in nuclear research and technology, exporting locally developed reactors as well as radioisotopes for medical uses. In 2017, 60 per cent of Canada's electricity was generated from hydro, followed by 15 per cent from nuclear power and 9 per cent from coal, with the remaining amount generated by gas, wind and solar.

Nuclear safety in Canada

⁷² NSW Parliamentary Research Service, *Uranium Mining and Nuclear Energy in New South Wales*, Issues paper, 2019, p 62.

⁷³ Evidence, Dr Adrian Paterson, Chief Executive Officer, Australian Nuclear Science and Technology Organisation, 11 November 2019, p 10; Evidence, Mr Patrick Gibbons, Principal Advisor, Minerals Council of Australia, 18 November 2019, p 2; Submission 61, Bright New World, p 16; Submission 67, Minerals Council of Australia, pp 5 and 10; Submission 44, Women in Nuclear Australia, p 11; The Electricity Map, www.electricitymap.org; Canadian Nuclear Association, *The Canadian nuclear factbook 2020*, 2020; Canadian Nuclear Association, *Myth Busted! Nuclear is Actually Second-Cheapest Source of Electricity*, December 2014, <https://cna.ca/news/myth-busted-nuclear-is-actually-second-cheapest-source-of-electricity>; World Nuclear Association *Nuclear power in Canada*, www.world-nuclear.org/information-library/country-profiles/countries-a-f/canada-nuclear-power.aspx; Correspondence from Mr Robert Pritchard, Executive Director, Energy Policy Institute of Australia, to Chair, 24 January 2020.

The Canadian Nuclear Safety Commission (CNSC) oversees the use of nuclear energy and materials to protect the health, safety and security of Canadians and the environment and to implement Canada's international commitments on the peaceful use of nuclear energy.

Canada's nuclear sector has an excellent safety record, and its nuclear facilities are among the safest and most secure in the world — due in large part to the CNSC's effective regulation. The CNSC's regulatory regime is underpinned by robust licensing and compliance activities. A CNSC licence is needed to undertake a nuclear activity or project, with separate licence authorisations required at each stage of a major nuclear facility's life. The CNSC evaluates licence applications to ensure that safety measures are technically and scientifically sound, that all requirements are met, and that the appropriate safety systems are in place to protect people and the environment. The CNSC monitors licensee performance against fourteen separate safety and control areas. In addition to licensing, the CNSC performs a range of enforcement and compliance functions and has the power to revoke a licence or even recommend criminal prosecution for non-compliance.

Cost of electricity in Canada

According to the Canadian Nuclear Association, nuclear power is one of the lowest cost generation sources estimated at CAD7.7 cents per kilowatt hour, second only to hydro at CAD6.2 cents per kilowatt hour. Gas and wind are about twice as expensive as nuclear, and solar is more than six times as expensive. The average price for electricity in Ontario, a state with a large nuclear footprint, was CAD8.5 cents per kilowatt hour in 2013.

Carbon emissions in Ontario compared to New South Wales

According to the open source Electricity Map, an online tool which provides live data on carbon emissions for different countries based on how the electricity is being generated, nuclear power in the state of Ontario represents 55.41 per cent of available electricity, followed by 25.34 per cent from hydro and 16.02 per cent from wind. A total of 97 per cent of Ontario's available electricity comes from low carbon sources (essentially, nuclear plus renewables). Ontario's carbon emissions from electricity generation are estimated to be 30 grams of carbon dioxide or equivalent per kilowatt hour.

In stark contrast to these figures, in New South Wales where 78.51 per cent of available electricity comes from coal and only 19 per cent is provided by low carbon sources, the State's carbon emissions from electricity generation are estimated to be 673 grams of carbon dioxide or equivalent per kilowatt hour.

These data were valid at the time of writing but are constantly updated through the Electricity Map in real time. Nevertheless, the Electricity Map data demonstrates in principle that parts of the world with very low emissions either have abundant hydropower resources and/or significant nuclear resources, such as Ontario in Canada.

Jobs and economic benefits of nuclear power

According to the World Nuclear Association, Canada's nuclear reactors contribute CAD\$6.6 billion per year to Gross Domestic Product, create CAD\$1.5 billion in government revenue and generate some CAD\$1.2 billion in exports. The nuclear power industry employs 21,000 directly, 10,000 indirectly as contractors and is responsible for another 40,000 jobs indirectly. Many of these are highly paid and highly skilled roles.

Development of nuclear batteries for remote areas in Canada

A specific type of small nuclear reactor – also known as a nuclear battery – is currently being researched and developed in Canada. A 'plug-and-play' reactor, this design is a small plant that can be transported into rural areas, installed and operated for a period of time, and then removed and replaced immediately with another nuclear battery. Whilst still a conceptual design, the Canadian Government has provided a regulatory environment to encourage private investment to progress the research, development and commercialisation of these designs.

Similar to Australia, there are large parts of Canada that are relatively isolated and have low population densities. Electricity supply to these areas can be challenging and is often reliant on gas or diesel. The intention of the Canadian research and development program for nuclear batteries is to replace diesel-burning electricity facilities next to small communities in the cold areas of Canada.

Clean air benefits

Nuclear power in Ontario has delivered significant air quality benefits, leading to a reduction in the number of annual smog days from 53 in 2005 to 0 in 2015.

Committee comment

- 1.76** The committee acknowledges that the *Uranium Mining and Nuclear Facilities (Prohibition) Act 1986* may be considered an artefact of its time, a post-Chernobyl era characterised by concern about the environmental and health impacts of nuclear, as well as fears of nuclear war and the proliferation of nuclear weapons.
- 1.77** We are aware that calls for the decarbonisation of electricity generation offers a favourable point in time to promote social licence for nuclear as a low carbon technology.
- 1.78** The committee notes recent and concurrent inquiries into nuclear in the Victorian and Federal Parliaments, indicating a certain maturity and willingness by legislators and decision makers to put consideration of nuclear on the public policy agenda in Australia.
- 1.79** The committee believes that the impact of increases in electricity prices goes beyond the well-understood financial pressures on retail consumers and household budgets – it threatens to undermine the competitiveness and attractiveness of New South Wales as a place for manufacturing, agriculture and other energy-intensive industries.

Chapter 2 Uranium mining

This chapter explores the key considerations for repealing the ban on uranium mining in New South Wales, bringing together expert evidence on the specificities of uranium – as distinct from other resources currently produced in the State – and the prerequisites needed for uranium mining to safely commence should the bill be enacted as law.

Uranium mining in Australia

- 2.1** Australia has the world's largest known resources of uranium, accounting for approximately 30 per cent of the global inventory and is the world's third largest uranium producer.⁷⁴
- 2.2** Australia has a long history of uranium mining dating back to the Rum Jungle and Radium Hill mines which operated in the 1950s.⁷⁵ Prior to that, uranium ores were mined at Radium Hill and Mount Painter in the 1930s.⁷⁶
- 2.3** Approximately 90 per cent of Australia's total economic demonstrated resources (EDR) of uranium lies within seven deposits: Olympic Dam and Beverley in South Australia, Jabiluka and Ranger in the Northern Territory and Yeelirrie, Mulga Rock and Kintyre in Western Australia.⁷⁷
- 2.4** Australia's total uranium production in 2017 was from three operating uranium mines: Olympic Dam (South Australia), Four Mile (South Australia) and Ranger (Northern Territory).⁷⁸ These three mines are the only operational uranium mines in Australia, despite a total of five mines being licensed to operate.⁷⁹
- 2.5** The Four Mile Mine is located between the Northern Flinders Ranges and Lake Frome, approximately 550 kilometres north of Adelaide and adjacent to the Beverley and Beverley North mines, which are currently in care and maintenance mode.⁸⁰ It is an in-situ

⁷⁴ Submission 49, Geoscience Australia, p 4.

⁷⁵ NSW Parliamentary Research Service, *Uranium Mining and Nuclear Energy in New South Wales*, issues paper, 2019, p 54.

⁷⁶ Government of South Australia, *The facts about uranium mining in South Australia*, [no date], p 2.

⁷⁷ Submission 49, Geoscience Australia, p 5.

⁷⁸ Submission 49, Geoscience Australia, p 5.

⁷⁹ Submission 59, Australian Nuclear Science and Technology Organisation, p 9.

⁸⁰ Department for Energy and Mining, *Beverley and Beverley North Uranium Mine*, Government of South Australia, www.energymining.sa.gov.au/minerals/mining/mines_and_quarries/beverley_and_beverley_north_mines.

leaching/recovery mine and has been producing uranium since 2014.⁸¹ Operated by Quasar Resources Pty Ltd, the Four Mile mine produced 1,900 tonnes of uranium oxide in 2018-19.⁸²

2.6 The Olympic Dam deposit is the largest uranium deposit in the world, containing more than 2 million tonnes of uranium oxide.⁸³ The deposit was discovered in 1975 with uranium production officially beginning in 1988.⁸⁴ Located 560 kilometres north of Adelaide in the far north of South Australia, the mine at Olympic Dam is one of the largest mines in the world and, moreover, is the second largest producing uranium mine.⁸⁵ Operated by BHP Group Olympic Dam Operations Pty Ltd, the Olympic Dam mine produced 3,565 tonnes of uranium oxide in 2018-19.⁸⁶

2.7 The Ranger Mine in the Northern Territory is an open pit uranium mine which commenced operations in 1980 after the Australian Government determined the project was in the national interest, with full production starting in 1981.⁸⁷ Located approximately 230 kilometres east of Darwin, the Ranger Mine is operated by Rio Tinto and Energy Resources of Australia Ltd and produced 1,695 tonnes of uranium in 2018, equivalent to 3 per cent of total world uranium production.⁸⁸

2.8 Despite the policy ban on uranium projects in Western Australia (discussed in Chapter 1), four uranium projects previously received Ministerial approval and are in abeyance as a result of subdued market conditions:

- The Cameco Australia Yeelirrie Uranium Project was granted environmental approval on 16 January 2017. The Yeelirrie uranium deposit is the largest known uranium deposit in Western Australia. Cameco, a Canadian minerals company, has indicated that it will wait for more favourable market conditions to decide whether to proceed with this development.⁸⁹

⁸¹ Department for Energy and Mining, *Four Mile Uranium Mine*, Government of South Australia, [http://energymining.sa.gov.au/minerals/mining/mines_and_quarries/four_mile_uranium_mine#q=four mile](http://energymining.sa.gov.au/minerals/mining/mines_and_quarries/four_mile_uranium_mine#q=four%20mile); World Nuclear Association, *Australia's uranium*, <https://www.world-nuclear.org/information-library/country-profiles/countries-a-f/australia.aspx>.

⁸² Department for Energy and Mining, *South Australia's major operating/approved mines: Resource estimates and production statistics*, Government of South Australia, 6 December 2019, p 2, <https://map.sarig.sa.gov.au/CrystalRunner/Report/Export/1?exportName=MajorProjects>.

⁸³ Department for Energy and Mining, *Uranium*, Government of South Australia, http://www.energymining.sa.gov.au/minerals/mineral_commodities/uranium.

⁸⁴ Government of South Australia, *The facts about uranium mining in South Australia*, [no date], p 2.

⁸⁵ Submission 59, Australian Nuclear Science and Technology Organisation, p 13.

⁸⁶ Department for Energy and Mining, *South Australia's major operating/approved mines: Resource estimates and production statistics*, Government of South Australia, 6 December 2019, p 1, <https://map.sarig.sa.gov.au/CrystalRunner/Report/Export/1?exportName=MajorProjects>.

⁸⁷ NSW Parliamentary Research Service, *Uranium Mining and Nuclear Energy in New South Wales*, Issues paper, 2019, p 123.

⁸⁸ World Nuclear Association, *World uranium mining production*, August 2019, <https://www.world-nuclear.org/information-library/nuclear-fuel-cycle/mining-of-uranium/world-uranium-mining-production.aspx>.

⁸⁹ Department of Mines, Industry Regulation and Safety, *Uranium*, Government of Western Australia, accessed 6 December 2019, <https://www.dmp.wa.gov.au/Uranium-1459.aspx>.

- The Toro Energy Wiluna Project represents an expansion of an earlier uranium development via the addition of adjacent deposits to the original mine plan. The expanded mine was approved by the Western Australian Environment Minister on 9 January 2017.⁹⁰
- Located in the East Pilbara, the Cameco Australia Kintyre Uranium Project was granted environmental approval in March 2015. Cameco has indicated that it will wait for more favourable market conditions to decide whether to proceed with this development.⁹¹
- Approved by the Western Australian Minister for the Environment on 19 December 2016, the Mulga Rock Project is a proposed open pit uranium mine located 240 kilometres from Kalgoorlie which, if it proceeds, would produce uranium from four separate deposits. The proponent, Vimy Resources, released a feasibility study for the Mulga Rock Project in January 2018⁹² and was expected to decide whether to invest in the project thereafter.⁹³

2.9 In New South Wales, there are existing operations which produce uranium as a by-product of mining for other minerals. The uranium produced from these operations is currently treated as waste and is buried back at depth. The NSW Government impressed upon the committee that, if the prohibitions were to be lifted, these operations could move relatively quickly to turn that waste into a viable product.⁹⁴

2.10 The value and importance of uranium production for Australia's export revenue and national productivity are detailed later in this chapter.

2.11 Since 2011, Australia's uranium exploration has been in a state of decline owing to historically low uranium commodity prices.⁹⁵ The market conditions and commodity prices for uranium are discussed in further detail later in this chapter.

Key considerations for uranium mining in New South Wales

2.12 This section considers the case for lifting the ban on uranium mining in New South Wales through a discussion of the State's potential uranium resources, its potential economic benefits to the State and the current state of the uranium market. Issues surrounding workforce capability, environmental impacts and industry logistics are also outlined with a view to assessing

⁹⁰ Department of Mines, Industry Regulation and Safety, *Uranium*, Government of Western Australia, <https://www.dmp.wa.gov.au/Uranium-1459.aspx>.

⁹¹ Department of Mines, Industry Regulation and Safety, *Uranium mining in Western Australia*, Government of Western Australia, accessed 6 December 2019, <https://www.dmp.wa.gov.au/Uranium-1459.aspx>.

⁹² Vimy Resources, *Definitive feasibility study Mulga Rock*, accessed 9 December 2019, <https://vimyresources.com.au/2018-dfs-summary/>.

⁹³ Department of Mines, Industry Regulation and Safety, *Uranium mining in Western Australia*, Government of Western Australia, accessed 6 December 2019, <https://www.dmp.wa.gov.au/Uranium-1459.aspx>.

⁹⁴ Evidence, Mr Alex King, Executive Director, Resources Policy, Planning and Programs, Department of Planning, Industry and Environment, 11 November 2019, p 6.

⁹⁵ Submission 49, Geoscience Australia, p 6.

whether uranium mining could safely commence within existing regulatory and safety frameworks, and with existing industry capabilities.

Potential deposits in New South Wales

- 2.13** Questions of commercial viability and the potential benefits to the State of future uranium production rest on the extent and location of any potential uranium deposits within New South Wales. Expert commentary on the State's potential uranium deposits was therefore elicited in evidence.
- 2.14** It was noted that, to date, the NSW Government has undertaken 'very little' geological survey work to identify potential uranium deposits owing to the pre-2012 prohibition on uranium exploration.⁹⁶ Geological Survey of NSW, an agency within the Department of Planning, Industry and Environment, collects and manages geological data for a variety of purposes, including to inform the resource industry about the State's geology and its mineral and energy resources.⁹⁷ Geological Survey of NSW focusses its efforts on resources that are permitted to be extracted in the first instance and, as a result, the extent and location of the State's potential uranium deposits are not well known.⁹⁸
- 2.15** In this context, the NSW Government gave evidence about the prospects and likely occurrences of uranium in New South Wales, stating that the 'prospect is good' and speculating that 'there is a good chance we would have a reasonable market'.⁹⁹ Mr Alex King, Executive Director, Resources Policy, Planning & Programs, Department of Planning, Industry and Environment emphasised that, despite the lack of information:
- .. geologically speaking New South Wales does have good potential for uranium. There is information about occurrences principally in the Far West and Broken Hill region. Some in the Central West region and some in the north-east. The ones in the Far West, Broken Hill, are by some way the most viable for extraction.¹⁰⁰
- 2.16** Likely occurrences of uranium in New South Wales are shown in the Geological Survey of NSW map at Figure 1, provided by the NSW Government in response to questions taken on notice. The map has been prepared using pre-existing exploration, geological modelling and extrapolation based on the tendency for uranium to occur in certain types of rocks and places.¹⁰¹

⁹⁶ Evidence, Mr Michael Wright, Deputy Secretary, Resources and Geoscience, Department of Planning, Industry and Environment, 11 November 2019, p 3.

⁹⁷ NSW Government, *Geological Survey of NSW*, Resources and Geosciences, <https://www.resourcesandgeoscience.nsw.gov.au/miners-and-explorers/geoscience-information/geological-survey-of-nsw>.

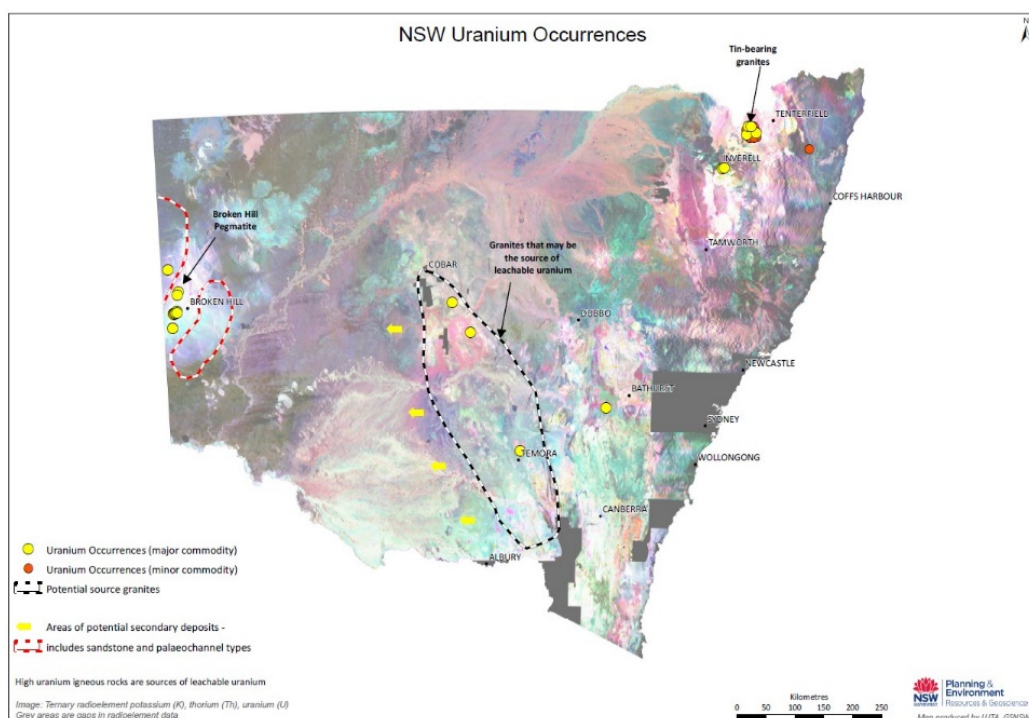
⁹⁸ Evidence, Mr Michael Wright, Deputy Secretary, Resources and Geoscience, Department of Planning, Industry and Environment, 11 November 2019, p 3.

⁹⁹ Evidence, Mr Alex King, Executive Director, Resources Policy, Planning and Programs, Department of Planning, Industry and Environment, 11 November 2019, p 7.

¹⁰⁰ Evidence, Mr Alex King, Executive Director, Resources Policy, Planning and Programs, Department of Planning, Industry and Environment, 11 November 2019, p 4.

¹⁰¹ Evidence, Mr Alex King, Executive Director, Resources Policy, Planning and Programs, Department of Planning, Industry and Environment, 11 November 2019, p 7.

Figure 1 NSW uranium occurrences¹⁰²



- 2.17 It is not enough, however, to establish that uranium exists in the earth's crust within state boundaries. In formulating a view on the potential benefits to the State, the more significant question is whether any such deposits are economically viable or recoverable – since only the most economically viable deposits will attract the funding necessary for development.¹⁰³
- 2.18 The economic viability of the State's potential uranium deposits – including the occurrences shown in Figure 1 – was not able to be established in evidence with any degree of certainty. Mr Michael Wright, Deputy Secretary, Resources and Geoscience, Department of Planning, Industry and Environment conceded that:

... there is further exploration activity that would need to be conducted to form up a better view about the value and size of the uranium occurrences in the State. It may well be that they are economically viable and could support a significant industry in New South Wales.¹⁰⁴

¹⁰² Answers to questions on notice, Department of Planning, Industry and Environment, 9 December 2019, p 5.

¹⁰³ Submission 49, Geoscience Australia, p 6.

¹⁰⁴ Evidence, Mr Michael Wright, Deputy Secretary, Resources and Geoscience, Department of Planning, Industry and Environment, 11 November 2019, p 4.

- 2.19** In attempting to generalise about the State's likely uranium endowment, the committee noted the close proximity of South Australian uranium mines to the New South Wales border,¹⁰⁵ along with the concentration of commercial interest around Broken Hill when the exploration ban was lifted in 2012-13, as two important indicators of the State's potential uranium resources.¹⁰⁶
- 2.20** The NSW Minerals Council referred to anecdotal feedback from geologists to advance a very preliminary, qualified view on the likely location of potential resources in western New South Wales. Mr David Frith, Director, Industry and Environment, informed the committee that:
- The anecdotal feedback I have had from geologists is that there is potential resources in the western parts of New South Wales and I think I saw from [Division of Resources and Geoscience]'s evidence that that was the area where most of the expressions of interest were lodged. So it would appear that there is a potential resource out there but we really need to undertake the exploration work to find out what that resource might be.¹⁰⁷
- 2.21** Citing a Geoscience Australia map of 2010, Women in Nuclear Australia submitted that there was only one known potential uranium deposit at Toongi in the mid north-west of the State – a paleozoic uranium deposit associated with an alkaline intrusive.¹⁰⁸ They also referred to an existing operational uranium mine along the New South Wales-South Australia border within the vicinity of a large cenozoic uranium deposit.¹⁰⁹
- 2.22** The deposit at Toongi is estimated to be between 3,000 and 10,000 Petajoules of Identified Resources of uranium, or the equivalent of 0.2-0.8 per cent of Australia's total Identified Resources of 1,241,091 Petajoules.¹¹⁰
- 2.23** At a statewide level, it is estimated that New South Wales is home to the equivalent of 1 per cent of Australia's total uranium resources.¹¹¹
- 2.24** Several inquiry participants expressed the view that the current legal settings in New South Wales – that is, a partial prohibition where exploration is permitted but extraction is still prohibited – act as a disincentive for mining companies to invest in uranium exploration and prospecting.¹¹² In response to questioning by the committee, Mr Wright of the Department of Planning, Industry and Environment referred to discussions his agency has had with peak

¹⁰⁵ Submission 45, Mr Tony Irwin, p 1.

¹⁰⁶ Evidence, Mr Michael Wright, Deputy Secretary, Resources and Geoscience, Department of Planning, Industry and Environment, 11 November 2019, p 4.

¹⁰⁷ Evidence, Mr David Frith, Director, Industry and Environment, NSW Minerals Council, 18 November 2019, p 4.

¹⁰⁸ Submission 44, Women in Nuclear Australia, p 8.

¹⁰⁹ Submission 44, Women in Nuclear Australia, p 8.

¹¹⁰ NSW Parliamentary Research Service, *Uranium Mining and Nuclear Energy in New South Wales*, Issues paper, 2019, p 8.

¹¹¹ Standing Committee on State Development, NSW Legislative Council, *Site visit report: Beverly uranium mine and Adelaide, South Australia 14 and 15 August*, Uranium Mining and Nuclear Facilities (Prohibitions) Repeal Bill 2019, p 3.

¹¹² See for example: Submission 49, Geoscience Australia, p 6.

bodies, suggesting that mining companies are highly unlikely to explore for a mineral that they cannot actually mine.¹¹³

- 2.25** Similarly, reflecting on the 2012 amendments to the *Uranium Mining and Nuclear Facilities (Prohibition) Act 1986* discussed in Chapter 1, Mr Frith informed the committee of the difficulties in securing finance to look for a mineral that cannot be extracted, telling members that: '... if you are a junior explorer trying to raise money to spend on exploration, it is going to be extremely difficult when there is no ability to extract any resource that you find in the future.'¹¹⁴
- 2.26** Expressing a similar view, Dr Ziggy Switkowski AO, former Chairman of ANSTO and the 2006 Switkowski review, observed that there is likely not a lot of understanding of the State's resource levels for uranium as a direct result of the prohibitions.¹¹⁵

Committee comment

- 2.27** The committee notes the existence of uranium deposits in New South Wales and finds that the existing prohibition on uranium mining is a barrier to knowing the full extent and location of those resources. In order to further understand all economically viable resources, the committee recommends that the NSW Government encourages and supports uranium exploration in New South Wales.

Finding 1

That the existing prohibition on uranium mining is a barrier to knowing the extent of uranium resources in New South Wales.

Recommendation 1

That the NSW Government encourages and supports uranium exploration in order to further understand all economically viable uranium resources in New South Wales, including their extent and location.

Potential economic benefits for New South Wales

- 2.28** In shoring up their support for the bill, several inquiry participants maintained that investment in uranium exploration and production (should the ban be lifted) would create jobs and promote regional development in rural and regional New South Wales. For example, the Australian

¹¹³ Evidence, Mr Michael Wright, Deputy Secretary, Resources and Geoscience, Department of Planning, Industry and Environment, 11 November 2019, p 5.

¹¹⁴ Evidence, Mr David Frith, Director, Industry and Environment, NSW Minerals Council 18 November 2019, p 4.

¹¹⁵ Evidence, Dr Ziggy Switkowski AO, Private citizen, 11 November 2019, p 49.

Taxpayers' Alliance¹¹⁶ and the Australian Nuclear Association¹¹⁷ both advanced this view, drawing attention to the economic upside and potential growth if legal barriers to investment were to be removed. In a similar vein, other industry stakeholders encouraged the committee to look beyond mining companies to consider the broader service providers that participate in the sector in order to properly understand the mining sector's potential to provide jobs and promote regional development in rural areas.¹¹⁸

2.29 The Australian Workers' Union emphasised the jobs potential and future growth of investment in uranium mining, noting that there are approximately 2,100 jobs in uranium mining across Australia with the potential for that number to exceed 10,000 over the next decade.¹¹⁹ The same Union argued:

... considering the thousands of construction projects associated with each new project, Australia's uranium industry could employ tens of thousands of people to help design, construct, and operate mines over the next decade. To be clear, those are estimates ... predicated on the current legislative framework ... A lifting of bans could see these figures great exceed all estimates.¹²⁰

2.30 This evidence described the potential benefits in broad generalities. Other evidence on the exact nature and extent of those benefits was more cautious and did not present a clear picture of the precise value to the State's economy.

2.31 For example, in response to questioning by the committee, Mr Frith stated that the potential royalty take for the State would depend on the extent of the resource, which is largely unknown '[b]ecause we have not been able to explore for it for about 30 years.' As a consequence, it is difficult to understand what the royalty implications might be.¹²¹

2.32 The NSW Government exercised a similar level of caution in giving evidence on the anticipated royalty stream to the State from uranium production. Mr Wright advised the committee that:

Given that we are not clear at this point in time around the size of the resources in the State and the extent to which they will be taken up by mining companies, it is difficult to speculate. Obviously, should uranium commence in New South Wales there would be a royalty stream to the State from the extraction of that resource.¹²²

2.33 In response to questioning about jobs and investment, the NSW Government referred the committee to the NSW Minerals Strategy – a strategy to promote investment in exploration in

¹¹⁶ Submission 65, Australian Taxpayers' Alliance, p 2.

¹¹⁷ Submission 27, Australian Nuclear Association, p 1.

¹¹⁸ Evidence, Mr Patrick Gibbons, Principal Advisor, Energy, Minerals Council of Australia, 18 November 2019, p 9.

¹¹⁹ Submission 70, The Australian Workers' Union, p 7.

¹²⁰ Submission 70, The Australian Workers' Union, p 34.

¹²¹ Evidence, Mr David Frith, Director, Industry and Environment, NSW Minerals Council, 18 November 2019, p 9.

¹²² Evidence, Mr Michael Wright, Deputy Secretary, Resources and Geoscience, Department of Planning, Industry and Environment, 11 November 2019, p 6.

the metals sector in New South Wales – submitting that uranium mining could contribute to meeting the State's targets if it was permitted and if viable resources were found.¹²³

Value of uranium mining in other Australian and international jurisdictions

- 2.34** In the absence of firm data on the exact location and extent of economically recoverable uranium resources, it was clear to the committee that any speculation on the precise value of royalties, exports and State productivity of any future uranium production, would be largely academic. Accepting such limitations, the committee turned its attention to other relevant considerations with a view to extrapolating questions of potential economic benefits by inference. One such consideration was the value of uranium mining in Australian and international jurisdictions where it is currently permitted.
- 2.35** For example, the Minerals Council of Australia referred to the economic benefits experienced in Canada as a result of the government's decision to promote and support uranium mining and nuclear energy. In particular, it noted that the 'multi-billion dollar industry' resulting from this decision generated annual revenues of over CAD\$6 billion (AUD\$6.3 billion) as well as 5,000 jobs in the uranium mining sector alone. As one of the world's largest uranium producers, Canada exports 85 per cent of its production worth AUD\$1.2 billion per annum. Describing the similarities between Canada and Australia as large countries with relative small populations and 'impressive mineral resources', the Minerals Council of Australia argued that 'New South Wales and Australia could imitate this success with great results for regional communities, jobs and our national prosperity.'¹²⁴
- 2.36** In 2017-18, Australia's uranium exports (8,100 tonnes) were worth AUD\$650 million.¹²⁵ The Australian Workers' Union puts this figure at AUD\$675 million in current export revenue, representing 1.1 per cent growth over the last 5 years.¹²⁶
- 2.37** South Australia is host to 25 per cent of the world's uranium resources and 80 per cent of Australian uranium resources.¹²⁷ In the decade from 2007 to 2016, uranium mining contributed more than AUD\$3.5 billion in export revenue to the South Australian economy, and AUD\$141 million in royalties to South Australians.¹²⁸
- 2.38** Operations at the Ranger mine in the Northern Territory have generated more than AUD\$500 million in royalties since production commenced in 1980-81. In 2018 alone, the operator of the mine, Energy Resources Australia, paid AUD\$10.7 million in royalties. Annually, the company contributes more than AUD\$100 million in salaries and local spend in the Jabiru region.¹²⁹

¹²³ Evidence, Mr Michael Wright, Deputy Secretary, Resources and Geoscience, Department of Planning, Industry and Environment, 11 November 2019, p 5.

¹²⁴ Submission 67, Minerals Council of Australia, p 10.

¹²⁵ NSW Parliamentary Research Service, *Uranium Mining and Nuclear Energy in New South Wales*, Issues paper, 2019, p 54.

¹²⁶ Submission 70, The Australian Workers' Union, p 34.

¹²⁷ Tabled document, Department for Energy and Mining South Australia, *The South Australian Uranium Mining Regulatory Approach*, presentation to the Standing Committee on State Development, 15 August 2019, p 4.

¹²⁸ Department of Energy and Mining, *Uranium*, Government of South Australia, http://energymining.sa.gov.au/minerals/mineral_commodities/uranium#uranium.

¹²⁹ Submission 59, Australian Nuclear Science and Technology Organisation, p 10.

- 2.39** A joint submission by the Friends of the Earth Australia, the Australian Conservation Foundation and the Nature Conservation Council of NSW offers an alternative perspective on the value and importance of uranium production for Australia's economy. It purports that industry growth estimates for uranium mining are often inaccurate and inflated, resulting in a skewed representation of the importance of uranium production for Australia's export revenue and productivity. Together, these inquiry participants refer to various economic data which they offer as a correction to the inflated and inaccurate estimates given by industry, leading them to conclude that '[u]ranium has made a negligible contribution to Australia's export revenue and employment. Decline is more likely than growth.'¹³⁰
- 2.40** In forming up an opinion on the potential benefits of entering the uranium export market, it is relevant to consider the forecast global customer demand for uranium as fuel for uses and applications approved by the Commonwealth Australian Safeguard and Non-proliferation Office (ASNO).
- 2.41** Currently, Australian produced uranium is exported to Canada, China, Japan, the Republic of Korea, Taiwan and the United States, as well as members of the European Union including France, Germany, Sweden and Belgium.¹³¹ Our largest consumer market is the United States (17,847 tonnes), followed by France (9,216 tonnes).¹³² Understanding what is happening in these customer countries – including whether their demand for uranium as fuel is set to grow or decline – may provide relevant inputs into any preliminary conclusions about the viability and economic potential for uranium production in New South Wales.
- 2.42** Globally, 55 new reactors are under construction, of which 46 are in countries with existing nuclear power programs, with China (11), India (7), and the Russian Federation (6) leading. Additionally, 28 countries have signalled that they are considering, or are actively planning, the introduction of nuclear power, including Egypt, Kenya, Niger, Nigeria, and Saudi Arabia.¹³³
- 2.43** The link between forecast global demand for uranium and the market appetite for uranium projects was made explicit in evidence by Mr Patrick Gibbons of the Minerals Council of Australia. Mr Gibbons referred to an anticipated 'roll out' of new nuclear power plants around the world and the opportunity this presents for Australia to take advantage of a concomitant increase in demand for uranium:

Where this goes is, nuclear energy, it is being built in places like China, Russia. There will be a rollout of people building nuclear power plants around the world. It is a question of how quickly they do it. It is then a question of how much will uranium demand be increasing as a consequence of that.¹³⁴

¹³⁰ Submission 64, Friends of the Earth Australia, Australian Conservation Foundation and Nature Conservation Council of NSW, p 70.

¹³¹ NSW Parliamentary Research Service, *Uranium Mining and Nuclear Energy in New South Wales*, Issues paper, 2019, pp 54-55.

¹³² Department of Industry, Innovation and Science, *Resources and Energy Quarterly: September 2019*, Quarterly report, September 2019, p 74.

¹³³ Submission 59, Australian Nuclear Science and Technology Organisation, p 18.

¹³⁴ Evidence, Mr Patrick Gibbons, Principal Advisor, Energy, Minerals Council of Australia, 18 November 2019, p 8.

2.44 The Australian Nuclear Science and Technology Organisation (ANSTO) concurred with this evidence, submitting that, in its view, there will be long-term and ongoing global demand for uranium:

... if you look at the prospects for the adoption of nuclear power by existing nuclear countries and by the countries which have identified themselves to the International Atomic Energy Agency as being interested in or pursuing the development of capability to do that, I think there will be long-term and ongoing demand for uranium as a source of fuel.¹³⁵

2.45 Women in Nuclear Australia echoed this view, pointing out that demand in China will absorb a certain amount of global supply and, as a consequence, the rest of the world will potentially have a greater need for uranium.¹³⁶

2.46 Drawing on World Nuclear Association data, the Australian Taxpayers' Alliance details a range of new nuclear power plants under construction globally, including in the following customer countries:

- China's civilian nuclear power program is in a growth phase, with a total of 38 operating reactors on the mainland. There were eight new grid connections in 2015, five in 2016, and twenty new reactors under construction.
- Japan has two new reactors under construction.
- South Korea, an established nuclear nation, plans to bring a further three reactors into operation by 2019.
- In the United States, there are two new reactors under construction with a further two in the planning phase.
- France is building one new reactor at Flamanville, which was due to enter operation in 2019.¹³⁷

2.47 Nuclear power in Germany is in a state of decline, with a commitment to phase out all nuclear power stations by 2022.¹³⁸

2.48 According to the Commonwealth Department of Industry, Innovation and Science, uranium demand is expected to grow moderately over the next two years, from 85,300 tonnes in 2018 to 90,400 tonnes by 2021, partly as a result of a positive growth outlook for nuclear power in the United States.¹³⁹

2.49 Environmental groups opposed to the bill did not concur with such estimates, instead presenting a stark picture of the global uranium industry and a less than bullish outlook on the

¹³⁵ Evidence, Dr Adrian Paterson, Chief Executive Officer, Australian Nuclear Science and Technology Organisation, 11 November 2019, p 12.

¹³⁶ Evidence, Dr Kath Smith, Executive Committee Member, Women in Nuclear Australia, 18 November 2019, p 13.

¹³⁷ Submission 65, Australian Taxpayers' Alliance, pp 12-13.

¹³⁸ Submission 68, The Australia Institute, p 22.

¹³⁹ Department of Industry, Innovation and Science, *Resources and Energy Quarterly: September 2019*, Quarterly report, September 2019, pp 76-78.

state of Australia uranium production.¹⁴⁰ According to this evidence, the global uranium industry is one characterised by:

- operating losses for some uranium mines, and the closure of others;
- sharp declines in uranium exploration;
- sustained and continuing falls in the uranium commodity price discouraging new investment; and
- declining demand, inventory accumulation and oversupply of uranium.¹⁴¹

Committee comment

2.50 The committee notes that the revenue potential to the NSW Government through mining royalties for any future uranium mining industry cannot be quantified with any certainty until the extent of the State's uranium deposits is better understood.

Current state of the market

2.51 Evidence explaining the current state of the uranium market and commercial appetite for uranium production placed significant weight on the uranium commodity price crash following the 2011 Fukushima event.

2.52 Following the Fukushima event, uranium prices fell to historically low levels, with prices decreasing 38 per cent from USD\$68 per pound in 2011 to USD\$42 per pound in 2012. Uranium exploration expenditure in Australia fell 49 per cent from AUD\$216.4 million in 2011 to AUD\$110.2 million in 2012. This was followed by continued year-on-year falls in both price and exploration expenditure.¹⁴²

2.53 Several inquiry participants – including the Australian Taxpayers' Alliance,¹⁴³ the NSW Government¹⁴⁴ and the Minerals Council of NSW¹⁴⁵ – referred to the effect of historically low uranium prices in undermining commercial appetite for new uranium developments.

2.54 In giving evidence to the committee, Mr Dave Sweeney, Nuclear Policy Analyst with the Australian Conservation Foundation, referred to the depressed uranium commodity price and Australia's shrinking market share of uranium exports to bolster his opposition to the bill before the Legislative Council. Mr Sweeney described an industry in stagnation and decline, with diminishing commercial appetite for uranium exploration and a host of unrealised uranium

¹⁴⁰ Submission 64, Friends of the Earth Australia, Australian Conservation Foundation and Nature Conservation Council of NSW, p 68.

¹⁴¹ Submission 64, Friends of the Earth Australia, Australian Conservation Foundation and Nature Conservation Council of NSW, pp 68-70.

¹⁴² Submission 49, Geoscience Australia, p 6.

¹⁴³ Evidence, Mr Satyajee Marar, Director of Policy, Australian Taxpayers' Alliance, 11 November 2019, p 61.

¹⁴⁴ Evidence, Mr Michael Wright, Deputy Secretary, Resources and Geoscience, Department of Planning, Industry and Environment, 11 November 2019, p 2-3.

¹⁴⁵ Evidence, Mr David Frith, Director, Industry and Environment, Minerals Council of NSW, 18 November 2019, p 4.

developments that were deemed commercially unviable, including the proposed Cameco mines at Kintyre and Yeelirrie discussed earlier in this chapter. Mr Sweeney asserted that the deteriorating state of the industry has nothing to do with inadequate public subsidies, overly onerous regulatory constraints or a lack of government support – but instead is a function of a 'profound lack of uranium market fundamentals.'¹⁴⁶

2.55 Referring to the uranium projects in Western Australia which have not proceeded, Mr Frith of the NSW Minerals Council explained the effect of falling uranium prices on market buoyancy, impressing upon the committee that '[i]t has not exactly been the environment for stepping up capital investment to increase production and increase volumes in the current market conditions.'¹⁴⁷

2.56 In his oral testimony, Mr Dayne Eckermann of Bright New World weighed in on debate about the state of the market, challenging the suggestion that despite there being no prohibition on mining in Western Australia, the industry has failed to advance:

In terms of those mines in Western Australia—the uranium ones that have not gone ahead—it is more that the mechanics of the market conditions for uranium as a commodity are quite depressed at the moment and then that the economic viability of these projects is not ascertained as yet. Those projects have gone through all their processes to assess whether they are suitable to be developed in Western Australia but the thing that is holding them back is basically the economics of uranium at the moment. We saw that here in South Australia when the market became depressed and we had mines here go into care and maintenance.¹⁴⁸

2.57 Mr James Fleay of Down Under Nuclear Energy highlighted the upside of historically low uranium prices, telling the committee that 'low uranium prices are fantastic news' for advocates for nuclear power in Australia, since it drives down fuel and operating costs:

... while uranium prices might be depressed and that might be hard to get uranium mining projects off the ground, that is fantastic for power. I would say that that is a very good reason to introduce competition into the market and say, "You have lower uranium prices. It makes nuclear power more competitive." You want to bring electricity prices down. That is part of the equation.¹⁴⁹

2.58 Taking a longer term outlook, uranium prices are predicted to grow incrementally, driven by reduced global supply and new reactor constructions in China, South Asia and Eastern Europe.¹⁵⁰ The NSW Government also foreshadowed a recovery in the price of uranium 'in the next couple of years' to approximately AUD\$40 per pound.¹⁵¹

¹⁴⁶ Evidence, Mr Dave Sweeney, Nuclear Policy Analyst, Australian Conservation Foundation, 11 November 2019, p 29.

¹⁴⁷ Evidence, Mr David Frith, Director, Industry and Environment, Minerals Council of NSW, 18 November 2019, p 6.

¹⁴⁸ Evidence, Mr Dayne Eckermann, General Manager, Bright New World, 11 November 2019, p 44.

¹⁴⁹ Evidence, Mr James Fleay, Chief Executive Officer, Down Under Nuclear Energy, 11 November 2019, p 45.

¹⁵⁰ Department of Industry, Innovation and Science, *Resources and Energy Quarterly: September 2019*, Quarterly report, September 2019, p 75.

¹⁵¹ Evidence, Mr Michael Wright, Deputy Secretary, Resources and Geoscience, Department of Planning, Industry and Environment, 11 November 2019, p 4.

- 2.59** Against this anticipated recovery in uranium prices, uranium production in Australia is set to decline from 2020 according to the Commonwealth Department of Industry, Innovation and Science, resulting in falling uranium export earnings. The Ranger Mine in the Northern Territory is also set to cease production in January 2021, affecting Australian production and output.¹⁵²

Committee comment

- 2.60** The committee acknowledges that, as observed in other jurisdictions where uranium mining is permitted, the commercial interest in uranium mining projects is largely determined by market forces, most notably the commodity price of uranium. However, we note that a necessary pre-condition for market interest is to repeal the prohibition on uranium mining to allow the mining sector to determine whether conditions in New South Wales warrant investment in uranium exploration, prospecting and production.

Industry prerequisites for workplace safety and capacity

- 2.61** In considering whether the ban on uranium mining should be lifted, one line of inquiry focussed on the workforce readiness of the minerals sector and whether the State's existing regulatory and safety frameworks are appropriate and adequate for the safe commencement of uranium mining in New South Wales.
- 2.62** As discussed in Chapter 1, the Queensland Government contemplated a similar question in 2012 following the reversal of its policy ban on uranium mining.¹⁵³
- 2.63** In its submission to the inquiry, the Australian Nuclear Association maintained that the majority of occupational risks and environmental impacts of uranium mining are largely the same as existing mining operations:

Most of the risks, hazards and environmental impact of uranium mining are similar to those of other mines already regulated and licenced in NSW. A uranium mine would also need to meet NSW radiation safety regulations which apply to the workers at the mine and the public. Radiation regulations needed for mining uranium are very well established and already applied in industries managing radioactive materials and in mines with significant naturally occurring radioactivity. There is considerable experience interstate and overseas on the successful and effective regulation and licensing of uranium mines.

The modern uranium mining industry has a good safety record. Radiation dose records are compiled by major mining companies under the scrutiny of regulatory authorities.. Aside from radiation, the occupational health and safety hazards of modern uranium mining are no greater than, nor distinct from, other comparable mining operations.¹⁵⁴

¹⁵² Department of Industry, Innovation and Science, *Resources and Energy Quarterly: September 2019*, Quarterly report, September 2019, p 75.

¹⁵³ Uranium Mining Implementation Committee, *Recommencement of uranium mining in Queensland: A best practice framework*, 2013.

¹⁵⁴ Submission 27, Australian Nuclear Association, p 2.

2.64 This position was shared by Mr King of the NSW Department of Planning, Industry and Environment. In giving evidence to the committee on how uranium mining might differ from other mining, Mr King told the committee that:

It is not significantly different. Hazards in uranium mining are the same as any form of mining—so, falls from height, heavy duty equipment operation and so on. Naturally occurring uranium is not very radioactive in its raw form. There are some additional dangers. I think I mentioned dust inhalation and gas inhalation, which can be managed through breathing equipment and ventilation. But largely it is not significantly more dangerous than other forms of mining and certainly could be managed easily within the existing regulatory framework and work safety.¹⁵⁵

2.65 Another inquiry participant, Dr John Patterson, concurred with this evidence, arguing that there are no uranium-specific risks, radiation hazards and environmental impacts that would warrant the maintenance of the ban.¹⁵⁶ However, Dr Patterson acknowledged that there would be some additional safety requirements:

A uranium mine, especially if underground like Olympic Dam in SA, would also need to meet NSW radiation safety regulations which apply to the workers at the mine and the public, including possible radon exposure. [...] Any uranium mine would use modern mining practices and have to meet current mining regulations including the Code of Practice and Safety Guide for Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing (Radiation Protection Series No.9).

[...] Aside from radiation, particularly radon in the atmosphere underground, the occupational health and safety hazards of modern uranium mining are no greater than, nor distinct from, other comparable mining operations.¹⁵⁷

2.66 With respect to worker safety, ANSTO asserted that 'major occupational risks to mine workers are similar to those of other mining operations, and include hazards associated with heavy equipment and machinery, hazardous chemicals, and working at heights or in confined spaces', but also identified a significant 'radiological hazard' to mine workers from the inhalation of radioactive dusts or radon gas.¹⁵⁸

2.67 Similarly, the NSW Minerals Council referred to the 'many similarities' between uranium mining and other types of mining to support its contention that the existing workforce in New South Wales is already well equipped for uranium mining and that worker safety considerations for dealing with low-level radioactive materials is not an unfamiliar issue for the State's mining sector:

In terms of whether we have the workforce here that could be used in uranium mining, I think the answer is definitely yes. In terms of some of the safety implications as well, there are already mines in New South Wales that are dealing with low-level radioactive

¹⁵⁵ Evidence, Mr Alex King, Executive Director, Resources Policy, Planning and Programs, Department of Planning, Industry and Environment, 11 November 2019, p 6.

¹⁵⁶ Submission 54, Dr John Patterson, p 1.

¹⁵⁷ Submission 54, Dr John Patterson, p 1.

¹⁵⁸ Submission 59, Australian Nuclear Science and Technology Organisation, p 8.

material as part of the mining process, particularly for mineral sands. It is not an issue that is unfamiliar to the general expertise of the New South Wales mining industry.¹⁵⁹

- 2.68** A dissenting view is advanced in evidence by the Medical Association for Prevention of War, which strongly opposes the bill before the Legislative Council. One of its justifications for opposing the bill is purported to be the adverse health effects to workers in uranium mines:

It is well established that workers at uranium mines in Australia and other parts of the world have suffered increased incidences of cancers, particularly lung cancer, and other health problems such as heart disease as a result of their workplace exposure. The radioactive gas, radon, was identified as the cause in the 1950s. Studies of underground miners, especially those exposed to high concentrations of radon, have consistently demonstrated the development of lung cancer in both smokers and non-smokers.¹⁶⁰

- 2.69** On the question of workforce readiness, Women in Nuclear Australia identified opportunities in uranium mining for the reskilling of workers transitioning out of the coal sector.¹⁶¹ Any future workforce reskilling was therefore identified as an opportunity rather than a constraint or justification for retaining the ban on uranium mining.

- 2.70** In response to questioning about workforce capacity, the NSW Government gave evidence that the mining sector would be well placed to apply existing skills and expertise to any future uranium industry. Mr Wright advised the committee that:

the mining sector in New South Wales, as you know, is very well advised. We have deep expertise within industry for both metal and coalmining generally. In so far as that skills set can be applied to uranium mining, we are probably well positioned.¹⁶²

Environmental impacts of uranium mining

- 2.71** For uranium mining to safely commence within the State's existing regulatory framework, it was clear to the committee it would need to be satisfied that the environmental impacts of uranium mining are no greater than – or are not fundamentally different in nature to – environmental impacts associated with other minerals currently mined in the State. Understanding the environmental impacts of uranium mining thus formed an important line of inquiry, with stakeholders advancing disparate views.

- 2.72** One of the more detailed and balanced explanations of the environmental risks of uranium mining was given in evidence by ANSTO. ANSTO acknowledges the 'potential for harm to the environment' from the by-products of uranium extraction techniques, such as acid leaching, and highlights the need for appropriate industry licensing and regulation to ensure the safe accumulation and/or management of such by-products to protect from environmental harm.¹⁶³

¹⁵⁹ Evidence, Mr David Frith, Director, Industry and Environment, NSW Minerals Council, 18 November 2019, p 8.

¹⁶⁰ Submission 56, Medical Association for Prevention of War, p 10.

¹⁶¹ Submission 44, Women in Nuclear Australia, p 22.

¹⁶² Evidence, Mr Michael Wright, Deputy Secretary, Resources and Geoscience, Department of Planning, Industry and Environment, 11 November 2019, p 3.

¹⁶³ Submission 59, Australian Nuclear Science and Technology Organisation, p 8.

2.73 In examining questions of environmental impact, the committee sought to establish if there is anything special or unique about uranium that would warrant extra-ordinary or additional planning, regulation and/or licensing arrangements to safeguard against environmental harm. The NSW Government advised the committee that any future or proposed uranium projects would be subject to the same development consents, licensing and titling processes, environmental regulations and other controls which currently apply to mining operations across the State. Mr King indicated that:

... [uranium mining] would be subject to all the same safeguards including development consent, mining lease processes, exploration licences, environmental protection plans and so on. In the 2012 round we did add an extra requirement that every explorer develop a radiation management plan on top of those other existing permits and processes. I imagine we could do something similar if there was a similar process in the future. You also require a range of consents and permits from the EPA and handling of radioactive material, which you do not necessarily require for non-radioactive materials. It is possible. It is something that happens for medical research and so on and other states do it. There are no fundamental barriers there but there are some additional licensing requirements.¹⁶⁴

2.74 Along similar lines, ANSTO maintained that uranium mining is no different to other types of mining with respect to safety and environmental regulation, and that its use of chemical processes for extraction is already governed by 'criteria' which ensures such processes are managed appropriately.¹⁶⁵

2.75 According to ANSTO, there are certain environmental impacts that are peculiar to uranium owing to its unique chemistry and radioactivity – for example, the accumulation of uranium in aquatic species in high concentrations, which risks further contamination in the food chain.¹⁶⁶ Another potential impact is acid mine drainage, which is not unique to uranium mining per se, but can be present due to the use of acid/chemicals in leaching techniques for uranium. If not managed properly, this can damage the ecological system and contaminate water resources through the discharge of sulphuric acid, heavy metals, metalloids and radionuclides.¹⁶⁷

2.76 Proper consideration of environmental risk must look beyond the inherent risks from the safe and orderly operation of a uranium mine. Importantly, as is true for all mining operations, systems, containments and safeguards can and do fail, resulting in exposure incidents or events which can have adverse environmental consequences.¹⁶⁸ The risk/contamination pathways for such incidents are explained by ANSTO:

The principal environmental exposure pathway for all mining operations is via surface water, because of its ability to provide a transport mechanism for contaminants, for

¹⁶⁴ Evidence, Mr Alex King, Executive Director, Resources Policy, Planning and Programs, Department of Planning, Industry and Environment, 11 November 2019, p 5.

¹⁶⁵ Evidence, Dr Robert Gee, General Manager, ANSTO Materials, Australian Nuclear Science and Technology Organisation, 11 November 2019, p 13.

¹⁶⁶ Submission 59, Australian Nuclear Science and Technology Organisation, p 11.

¹⁶⁷ Submission 59, Australian Nuclear Science and Technology Organisation, p 11.

¹⁶⁸ Department for Energy and Mining, *Beverly North uranium mine incident summary report*, [no date], Government of South Australia, http://www.energymining.sa.gov.au/minerals/mining/mines_and_quarries/beverly_and_beverly_north_mines/beverly_north_uranium_mine_incident_report#q=incident.

example, through the discharge of process or waste water into streams or groundwater. Wastewater can contain chemicals, metals, and, in the case of uranium mining, radionuclides of a higher-than-background level, which may present environmental risks if containment systems fail. Environmental exposures also may occur through the air (dust or radon gas are common pathways), contaminated soil, sediments, or via gamma radiation emitted by radionuclides in contaminated materials.¹⁶⁹

2.77 Evidence from ANSTO gave detailed consideration to the facts about the occupational and environmental risks of uranium mining. However, ANSTO noted that:

... adverse impacts to the environment are less likely to occur today as responsible mining practices seek to identify risks and to implement strategies to prevent, mitigate, and/or manage those risks across the life-cycle of a mine.¹⁷⁰

2.78 In a joint submission to the inquiry, Friends of the Earth Australia, the Australian Conservation Foundation and the Nature Conservation Council of NSW expressed concerns about the environmental performance of uranium mines in other Australian jurisdictions. The joint submission referred to alleged environmental spills, containment failures and inadequate tailings management at the Olympic Dam and Beverley mines in South Australia.¹⁷¹ According to this submission, the environmental consequences of such incidents included ground water contamination and bird deaths from birds drinking toxic liquid tailings.¹⁷² The same submission raises concerns about the environmental effects of in-situ leaching, an extraction technique where uranium is brought to the surface by pumping leaching solution through the ore body. An alternative to conventional mining, in-situ leaching produces waste water containing toxic elements which needs to be safely managed and/or disposed of.¹⁷³

2.79 Another important environmental consideration relates to site rehabilitation for uranium mines when they reach the end of their operational lives. Some opponents of the bill highlighted what they consider to be failures in mine-site rehabilitation for legacy uranium mines in other Australian jurisdictions, and their harmful effects on human beings and the environment.¹⁷⁴ The joint submission by Friends of the Earth Australia, the Australian Conservation Foundation and the Nature Conservation Council of NSW marshals evidence from the Switkowski review (discussed in Chapter 1) to highlight concerns about the long term impacts of the Olympic Dam mine and the purported lack of appropriate planning and financial insurance arrangements to cover site rehabilitation costs.¹⁷⁵

¹⁶⁹ Submission 59, Australian Nuclear Science and Technology Organisation, p 11.

¹⁷⁰ Submission 59, Australian Nuclear Science and Technology Organisation, p 11.

¹⁷¹ Submission 64, Friends of the Earth Australia, Australian Conservation Foundation and Nature Conservation Council of NSW, pp 73 and 81.

¹⁷² Submission 64, Friends of the Earth Australia, Australian Conservation Foundation and Nature Conservation Council of NSW, pp 74 and 81.

¹⁷³ Submission 64, Friends of the Earth Australia, Australian Conservation Foundation and Nature Conservation Council of NSW, p 81.

¹⁷⁴ Submission 64, Friends of the Earth Australia, Australian Conservation Foundation and Nature Conservation Council of NSW, pp 85-88.

¹⁷⁵ Submission 64, Friends of the Earth Australia, Australian Conservation Foundation and Nature Conservation Council of NSW, p 75.

Transportation and export of uranium

- 2.80** If the bill is enacted in law, thereby allowing uranium mining to take place in New South Wales, adequate consideration would need to be given to ancillary requirements for the transportation and export of economically produced uranium – mildly radioactive in its raw form – as distinct from the usual post-extraction arrangements for other mineral resources.
- 2.81** In Australia, the transportation of radioactive materials is regulated under the *Australian Radiation Protection and Nuclear Safety Act 1998*. This Act authorises the CEO of the Australian Radiation Protection and Nuclear Safety Agency to grant approval to a 'Controlled Person' for the transport of radioactive material by road, rail and inland water ways. Licence holders must comply with the *Code for the Safe Transport of Radioactive Material (2019) (Radiation Protection Series C-2, Rev. 1)*.¹⁷⁶
- 2.82** While the low level radioactivity of uranium sets it apart from other minerals/metals and creates additional requirements for its safe transportation, the committee heard evidence that such requirements would not present any insurmountable challenges, and that it would simply be a case of transporting 'some elements differently'.¹⁷⁷ South Australia has more than 30 years of experience in the safe handling and transportation of uranium, a track record which lends considerable weight to this evidence.¹⁷⁸
- 2.83** Safeguards and nuclear non-proliferations policy is set by the Commonwealth government via ASNO, an office of the Commonwealth Department of Foreign Affairs and Trade (DFAT). ASNO exists to ensure Australia's international nuclear safeguard and non-proliferation obligations are met as a signatory to various international treaties and bilateral agreements.¹⁷⁹ ASNO administers Australia's Uranium Export Policy which provides assurance that exported uranium and its derivatives cannot benefit the development of nuclear weapons or be used in other military programs. A key pillar of this policy is that customer countries for Australian uranium exports must be a party to the international Nuclear Non-Proliferation Treaty.¹⁸⁰
- 2.84** In seeking to explain the specificity of uranium as well as any additional industry constraints legislators should be mindful of, several inquiry participants identified that any future uranium industry would need to operate within the nuclear safeguard and non-proliferation compliance framework enforced by ASNO. For example, Mr King of the Department of Planning, Industry and Environment, informed the committee of:

¹⁷⁶ Australian Radiation Protection and Nuclear Safety Agency, *Regulatory guide: Transport of radioactive material v3*, Australian Government, p 2.

¹⁷⁷ Evidence, Mr Patrick Gibbons, Principal Advisor, Energy, Minerals Council of Australia, 18 November, p 9.

¹⁷⁸ Department for Energy and Mining, *Uranium*, Government of South Australia, http://energymining.sa.gov.au/minerals/mineral_commodities/uranium#advantage.

¹⁷⁹ Department of Foreign Affairs and Trade, *About the Australian safeguards and non-proliferation office*, Australian Government, <https://dfat.gov.au/international-relations/security/asno/Pages/about-the-australian-safeguards-and-non-proliferation-office.aspx>.

¹⁸⁰ Department of Foreign Affairs and Trade, *Australia's uranium export policy*, Australian Government, <https://dfat.gov.au/international-relations/security/non-proliferation-disarmament-arms-control/policies-agreements-treaties/Pages/australias-uranium-export-policy.aspx>.

... additional constraints and licences you need to obtain, including that, if you wanted to export the product, you have to have additional licences from the Commonwealth relating to the prohibitions around the use of nuclear materials and export of those—and customs and so on—but I think those are not particularly hard to overcome.¹⁸¹

2.85 In a similar vein, Women in Nuclear Australia commented that safeguard regulations surrounding the processing and transport of uranium would need to be managed in accordance with legislation administered by ASNO.¹⁸²

2.86 A final consideration of logistics was entered into evidence via examination of the suitability and capacity of existing port facilities to take shipments of uranium were it to be produced in New South Wales in the future. In response to questioning by the committee, Mr Frith of the Minerals Council of NSW was not confident that any existing port facilities in New South Wales would have the capacity to load uranium but deduced that, under existing arrangements, it would be feasible to export through ports in South Australia:

If we overturned the ban and we could plan around these things, there may be opportunities to exported through New South Wales ports. Based on current arrangements, we would have to assume through South Australia.¹⁸³

Committee comment

2.87 The committee accepts that mining for all mineral resources presents risks to workers and the environment. We note that unprocessed uranium is mildly radioactive and, as such, uranium mining may require some additional health, safety and environmental regulations over and above the existing regulations in place for other minerals in New South Wales.

2.88 The committee believes that there was general consensus from inquiry participants that, while uranium transport and export activities would be subject to additional safeguards, constraints and regulatory approvals, these unique logistical challenges and constraints could be managed with adequate planning and through pre-existing licencing and approval pathways, as demonstrated in other states such as South Australia.

2.89 The committee recommends that the NSW Government works with the relevant Commonwealth agencies and industry bodies to assess whether existing frameworks for worker safety, radiation regulation and environmental regulation are appropriate and adequate for the commencement of uranium mining in New South Wales, identifying any gaps that would need to be addressed. In evaluating the readiness of New South Wales, the government is to review regulatory frameworks for uranium mining in South Australia and consider whether any special licencing conditions would be needed to protect from environmental harm.

¹⁸¹ Evidence, Mr Alex King, Executive Director, Resources Policy, Planning and Programs, Department of Planning, Industry and Environment, 11 November 2019, pp 6-7.

¹⁸² Submission 44, Women in Nuclear Australia, p 17.

¹⁸³ Evidence, Mr David Frith, Director, Industry and Environment, NSW Minerals Council, 18 November 2019, p 58.

Recommendation 2

That the NSW Government works with the relevant Commonwealth agencies and industry bodies to assess whether existing frameworks for worker safety, radiation regulation and environmental regulation are appropriate and adequate for the commencement of uranium mining in New South Wales, identifying any gaps that would need to be addressed.

Chapter 3 Energy in New South Wales

This chapter provides an overview of the electricity system in New South Wales while outlining some of the key challenges the State is facing in securing its energy future. It starts with an introduction to the National Electricity Market across Australia's eastern and southern states followed by a discussion of the energy policy landscape. This discussion includes consideration of the unfolding transition in the State's generation assets, from fossil fuel technologies to lower emission technologies such as wind and solar, and the challenges this poses for legislators and policy-makers. The role that nuclear power could play in this transition to a low-carbon future is also considered in this chapter.

The New South Wales electricity system

3.1 The electricity system in New South Wales is complex and multifaceted, with a suite of rules, policies and regulatory frameworks governing how it operates. Understanding how this system works, its main supply chains and the mechanisms in place to optimise the delivery of affordable and reliable electricity to end retail and business consumers, helps set the scene for consideration of whether there is a role for nuclear power in the future.

The electricity supply chain at a glance

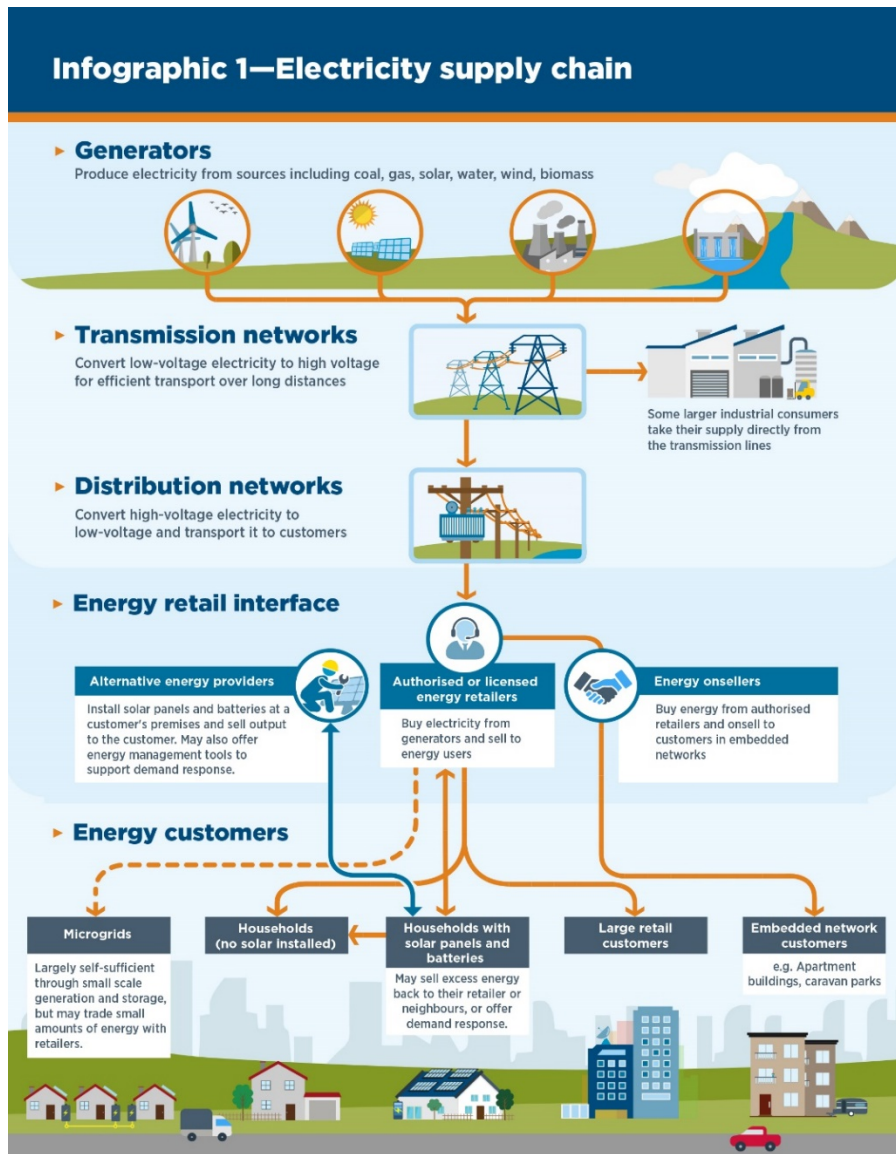
3.2 The electricity supply chain typically consists of five components:

- **Generators:** generation assets produce electricity from a variety of sources such as coal, gas, solar and water, and are connected to customers via transmission and distribution networks.
- **Transmission networks:** these networks enable electricity to be moved from where it is generated at power stations to substations closer to where it is eventually used. They include high voltage poles and wires as well as interconnectors that move energy between States.
- **Distribution networks:** these networks enable electricity to be moved from substations to where it is used by households and businesses, through low voltage poles and wires.
- **Retailers:** retailers sell bundled electricity products made up of electricity purchased from wholesale markets as well as network costs.
- **Customers:** customers in industry, businesses and residential purchase electricity from retailers, although some large consumers can purchase electricity directly from the wholesale market.¹⁸⁴

3.3 The electricity supply chain is illustrated in Figure 2.

¹⁸⁴ NSW Parliamentary Research Service, *Uranium Mining and Nuclear Energy in New South Wales*, Issues paper, 2019, pp 9-10; Department of Planning, Industry and Environment, *NSW Electricity Strategy: Our plan for a reliable, affordable and sustainable electricity system*, NSW Government, 2019, p 2.

Figure 2 The electricity supply chain¹⁸⁵



Overview of the National Electricity Market (NEM)

3.4 The National Electricity Market (NEM) is the wholesale market where generators sell electricity to retailers. The NEM is comprised of five interconnected States that also act as price regions: New South Wales (including the Australian Capital Territory); Queensland; South Australia; Tasmania; and Victoria. Electricity can be purchased in the NEM through either a spot market or contract market.¹⁸⁶

¹⁸⁵ Australian Energy Regulator, *State of the Energy Market 2018*, 2018, Australian Government, p 28.

¹⁸⁶ NSW Parliamentary Research Service, *Uranium Mining and Nuclear Energy in New South Wales*, Issues paper, 2019, p 11.

- 3.5** Electricity in the spot market is bought and sold at the spot price, determined by matching supply of electricity with consumption instantaneously and in real time. Spot prices in the NEM are currently updated every thirty minutes.¹⁸⁷ Generators offer to supply the market with specified amounts of electricity at specified prices for set time limits. The Australian Energy Market Operator (AEMO), the operator of the NEM, accepts the cheapest bids first and dispatches those bids to meet demand. Generators therefore need to be able to offer their electricity at a competitive price in order to ensure selection for dispatch. AEMO pays generators for electricity and recovers the cost from retailers.¹⁸⁸
- 3.6** The physics of the system means the electricity supplied by generators must exactly match how much electricity is being used by consumers, or blackouts can happen.¹⁸⁹ Professor Stephen Wilson of the University of Queensland described the real time dynamic of continuously balancing supply and demand in short intervals of time, stressing the low margin for error in the electricity system:
- The most important thing to remember about electricity is that you have to balance the supply and demand continuously in real-time, every second of every minute of every hour of every day. If you cannot do that, the whole system can fall over. It is not like, "oh, we forgot to buy milk. The supermarket ran out and there was none in 7-Eleven, so we miss out in our house. But everyone else got their milk." It is not like that with electricity. If you cannot maintain that knife edge balance of supply and demand continuously, you can find yourself in a cascading blackout and the system can go black within 60 seconds.¹⁹⁰
- 3.7** Electricity retailers can also enter into contracts with generators to buy electricity at a fixed price to reduce their exposure to the highs and lows of the spot market. These contracts fix the wholesale price retailers pay for electricity over the course of a year or several years.¹⁹¹
- 3.8** Unlike the generation and retail segments where entities compete with each other for business, the transmission and distribution networks are operated as a monopoly structure, since there is only ever a single network in any given area. Businesses which operate transmission and distribution networks are therefore regulated to replicate the incentives of a competitive market.¹⁹²

¹⁸⁷ Australian Energy Market Commission, *Spot and contract markets*, www.aemc.gov.au/energy-system/electricity/electricity-market/spot-and-contract-markets.

¹⁸⁸ NSW Parliamentary Research Service, *Uranium Mining and Nuclear Energy in New South Wales*, Issues paper, 2019, p 15.

¹⁸⁹ Australian Energy Market Commission, *Spot and contract markets*, www.aemc.gov.au/energy-system/electricity/electricity-market/spot-and-contract-markets.

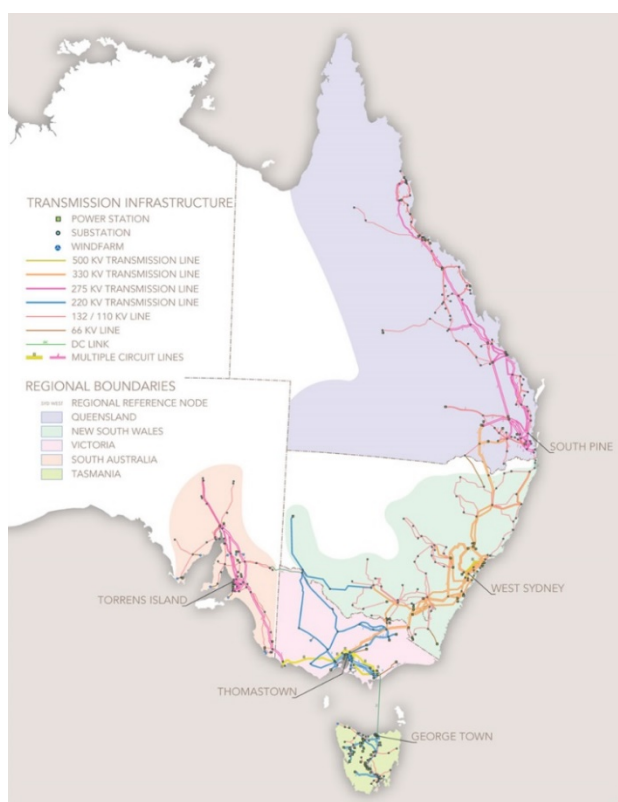
¹⁹⁰ Evidence, Professor Stephen Wilson, Centre for Energy Futures, University of Queensland, 18 November 2019, p 45.

¹⁹¹ Australian Energy Market Commission, *Spot and contract markets*, www.aemc.gov.au/energy-system/electricity/electricity-market/spot-and-contract-markets.

¹⁹² NSW Parliamentary Research Service, *Uranium Mining and Nuclear Energy in New South Wales*, Issues paper, 2019, p 11.

- 3.9 As of August 2019, there were 398 participants in the NEM, including generators, network service providers (NSPs), and retailers.¹⁹³
- 3.10 The NEM is managed, operated and regulated in a way that meets security, reliability and safety performance standards. This is achieved through a range of market characteristics and prerequisites, including by:
- ensuring the NEM is operating within its set technical limits;
 - the provision of sufficient generation capacity and network capability to meet current and future demand; and
 - ensuring the safety of NEM assets and infrastructure.¹⁹⁴
- 3.11 Additionally, having sufficient dispatchability in the system and being able to forecast/predict system conditions with a high degree of confidence, are also key to reinforcing the security and reliability of the NEM.¹⁹⁵ The concept of dispatchability is discussed in further detail below.

Figure 3 The National Electricity Market¹⁹⁶



¹⁹³ NSW Parliamentary Research Service, *Uranium Mining and Nuclear Energy in New South Wales*, Issues paper, 2019, p 16.

¹⁹⁴ NSW Parliamentary Research Service, *Uranium Mining and Nuclear Energy in New South Wales*, Issues paper, 2019, p 16-17.

¹⁹⁵ NSW Parliamentary Research Service, *Uranium Mining and Nuclear Energy in New South Wales*, Issues paper, 2019, p 18.

¹⁹⁶ Australian Energy Market Commission, *National Electricity Market*, www.aemc.gov.au/energy-system/electricity/electricity-system/national-electricity-market.

The NSW Electricity Strategy

- 3.12** In November 2019, the NSW Government released the *NSW Electricity Strategy: Our plan for a reliable, affordable and sustainable electricity system* (the Strategy).
- 3.13** The Strategy sets out an action plan to secure the State's future electricity in the face of system-wide changes such as:
- the retirement of the State's coal-fired generators and the transition to alternative low-emissions sources;
 - the proliferation of solar panels and batteries in homes and businesses (a trend that is expected to continue) and its implications for the grid;
 - overcrowding of the grid; and
 - rising electricity prices.¹⁹⁷
- 3.14** The Strategy highlights that 'the NSW Government has adopted a technology neutral approach as to how electricity is generated to meet peak demand. However, both New South Wales and Commonwealth laws prohibit the development of nuclear power stations.'¹⁹⁸
- 3.15** The Strategy sees firmed renewables as the future backbone of the electricity system in New South Wales, stating that:
- Today, wind and solar are the cheapest forms of new electricity generation. These technologies are the most environmentally friendly. When paired with batteries, pumped hydro or gas-fired generators, they can reliably supply electricity when the sun is not shining and the wind is not blowing, and are the lowest cost option to replace power stations as they close.¹⁹⁹
- 3.16** The Strategy lays out how the electricity mix is currently changing:
- The share of wind and solar in the NSW electricity generation mix has tripled in the past five years, with just over 7 per cent of the State's electricity coming from wind and solar (including rooftop solar). This share of generation is expected to grow as 14 large-scale renewable energy projects totalling about 2,100 MW currently under construction enter the market and more households install solar panels.²⁰⁰
- 3.17** The Strategy sets out a number of new and existing actions to make the electricity system better-equipped to deliver reliable, affordable and sustainable power to end users in business and the community. Among the actions already under way is the NSW Government's \$75 million

¹⁹⁷ Department of Planning, Industry and Environment, *Overview of the NSW Electricity Strategy*, NSW Government, 2019, pp 4-5, <https://energy.nsw.gov.au/media/1926/download>.

¹⁹⁸ Department of Planning, Industry and Environment, *NSW Electricity Strategy: Our plan for a reliable, affordable and sustainable electricity system*, NSW Government, 2019, p 6, <https://energy.nsw.gov.au/media/1921/download>.

¹⁹⁹ Department of Planning, Industry and Environment, *Overview of the NSW Electricity Strategy*, NSW Government, 2019, p 4, <https://energy.nsw.gov.au/media/1926/download>.

²⁰⁰ Department of Planning, Industry and Environment, *NSW Electricity Strategy: Our plan for a reliable, affordable and sustainable electricity system*, NSW Government, 2019, p 4, <https://energy.nsw.gov.au/media/1921/download>.

Emerging Energy Program, a program that provides grants to innovative large-scale electricity generation and storage projects. By providing funding to a mix of technologies, the Emerging Energy Program seeks to cultivate diversity in the energy mix and drive more competition in the wholesale electricity market.²⁰¹

- 3.18** The Strategy commits the NSW Government to a range of new actions to remove barriers to investment in new technology and network infrastructure and operations, including the rolling out of Renewable Energy Zones and the establishment of a Renewable Energy Zone body.²⁰²
- 3.19** Additionally, the Strategy outlines other measures to place downward pressure on prices, promote demand-side efficiencies and make the electricity system more resilient, including:
- A new Energy Security Safeguard which will consist of an energy efficiency scheme to achieve energy savings targets and a demand reduction scheme which will support technologies (such as batteries) that can shift demand away from peak periods. This is an expansion and re-branding of the NSW Government's Energy Savings Scheme.
 - The development of a regulatory framework focussed on bringing new, lower cost generation into the New South Wales market before existing power stations close.
 - The introduction of an Energy Security Target to provide certainty to the market about how much new electricity is needed to deliver a reliable energy system into the future. This will be set at an amount that is enough for the State to handle heatwave conditions, plus an extra buffer in case of unplanned outages.²⁰³
- 3.20** The Strategy is billed as the NSW Government's plan to make the future of electricity reliable, affordable and clean, thereby addressing the governing principles of the energy trilemma discussed below. The Strategy is understandably silent on the prospects of nuclear power since it is a prohibited technology.

Energy issues in New South Wales

- 3.21** This section provides an overview of energy issues in New South Wales through a discussion of emissions reduction targets, the energy trilemma and the State's current energy mix.

Emissions reduction targets

- 3.22** Various emissions reductions targets and agreements are driving governments to look for ways to limit carbon emissions, re-orient energy policy settings, encourage investment in innovation and transition economies to more sustainable methods of production. For New South Wales and Australia, where abundant coal reserves have been relied on to provide large amounts of baseload power, deeply decarbonising the State's electricity system and finding low emissions

²⁰¹ Department of Planning, Industry and Environment, *Overview of the NSW Electricity Strategy*, NSW Government, 2019, p 8, <https://energy.nsw.gov.au/media/1926/download>.

²⁰² Department of Planning, Industry and Environment, *Overview of the NSW Electricity Strategy*, NSW Government, 2019, p 11, <https://energy.nsw.gov.au/media/1926/download>.

²⁰³ Department of Planning, Industry and Environment, *Overview of the NSW Electricity Strategy*, NSW Government, 2019, p 12, <https://energy.nsw.gov.au/media/1926/download>.

energy sources will play a key role in these efforts. Evidence received by the committee emphasised the importance of decarbonising our electricity system as an area of significant potential in addressing the effects of climate change.²⁰⁴

3.23 In December 2015, 195 countries agreed on the United Nations Paris Agreement on climate change. The key objectives of the Paris Agreement include:

- a goal to limit the increase in global temperatures to well below 2 degrees and pursue efforts to limit the rise to 1.5 degrees;
- a commitment to achieve net-zero emissions, globally, by the second half of the century; and
- differentiated expectations for developed nations, including Australia, that they will reduce their emissions sooner than developing nations.²⁰⁵

3.24 The NSW Government has endorsed the Paris Agreement and has committed to ensuring all actions and efforts taken at a State level will complement national action. Through the 2016 *NSW Climate Change Policy Framework*, the NSW Government foreshadows that some of the heavy lifting will be done in the energy sector – both by encouraging homes and businesses to be more energy efficient and by investing in new low emission energy sources.²⁰⁶

3.25 The NSW Government has committed to an aspirational objective of achieving net-zero emissions by 2050, consistent with the Commonwealth Government's emissions targets. While this policy commitment is technology-neutral, it signals a clear intention to encourage innovation and investment in low-carbon technologies in order to make inroads into emissions reduction in New South Wales.²⁰⁷

3.26 Nationally, the Australian Government has committed to reducing greenhouse gas emissions to 26-28 per cent below 2005 levels by the year 2030.²⁰⁸

The energy trilemma

3.27 The energy trilemma is one conceptual framework that can be used for examining and understanding energy issues in New South Wales.

3.28 The energy trilemma framework comprises three interdependent dimensions:

- **energy security**, referring to the reliability of system infrastructure and the ability of an energy system to meet current and future demand;

²⁰⁴ See for example: Submission 52, Nuclear for Climate Australia, p 6; Submission 67, Minerals Council of Australia, p 4.

²⁰⁵ The Office of Environment & Heritage (NSW), *NSW Climate Change Policy Framework*, 2016, p 3.

²⁰⁶ The Office of Environment & Heritage (NSW), *NSW Climate Change Policy Framework*, 2016, p 4.

²⁰⁷ The Office of Environment & Heritage (NSW), *Achieving net-zero emissions by 2050*, Fact sheet, 2016, p 1.

²⁰⁸ The Department of Agriculture, Water and the Environment, *Australia's 2030 climate change target*, Fact sheet, Australian Government, 2015, p 1.

- **energy equity**, referring to the accessibility and affordability of energy across the population; and
- **environmental sustainability**, referring to the achievement of energy efficiencies across all aspects of an energy system and the development of energy supply from low-carbon sources.²⁰⁹

3.29 This conceptual framework implies that implementing improvements in one dimension has potential positive and negative implications for the other two dimensions.²¹⁰ As a discussion point in evidence, the framework came to define the problem or challenge facing the State's future energy needs - that is, in simple terms, energy needs to be secure and reliable, affordable and low-emissions/clean.²¹¹

3.30 Several inquiry participants in favour of the bill drew on the energy trilemma framework to assess the merits of nuclear energy as a possible source of energy in New South Wales. For example, Bright New World suggested that the integration of large amounts of variable renewable energy into a network that was never designed for this technology has adversely impacted at least two dimensions of the trilemma. For Bright New World, nuclear power offers a solution to address this trilemma, as it has a low environmental footprint, can provide process heat for industrial purposes and has the ability to power advanced manufacturing and sciences industry.²¹²

Current energy mix and trends in New South Wales

3.31 In understanding the State's current energy mix, it is necessary to consider both generation capacity and generation output. Generation capacity refers to the maximum amount of power that a generation technology can produce under ideal operating circumstances (the maximum possible power), expressed in megawatts.²¹³ Generation output refers to the total electricity a technology actually generates over a set period of time, expressed in megawatt or gigawatt hours.

3.32 With respect to *generation capacity*, fossil fuels are still the backbone of the New South Wales system. As at July 2019, fossil fuels accounted for 63.3 per cent of generation capacity in the State, the second highest proportion of any State in the NEM following Queensland with 69.1 per cent.²¹⁴

3.33 The dominant role of fossil fuels in network capacity is reflected in recent figures for *actual generation*. In 2017-18, coal fired power stations generated 57,317 gigawatt hours of electricity in

²⁰⁹ World Energy Council, *World Energy Index 2018*, cited in NSW Parliamentary Research Service, *Uranium Mining and Nuclear Energy in New South Wales*, Issues paper, 2019, p 6.

²¹⁰ NSW Parliamentary Research Service, *Uranium Mining and Nuclear Energy in New South Wales*, Issues paper, 2019, p 5.

²¹¹ See for example: Submission 44, *Women in Nuclear Australia*, p 3.

²¹² Submission 61, *Bright New World*, p 4.

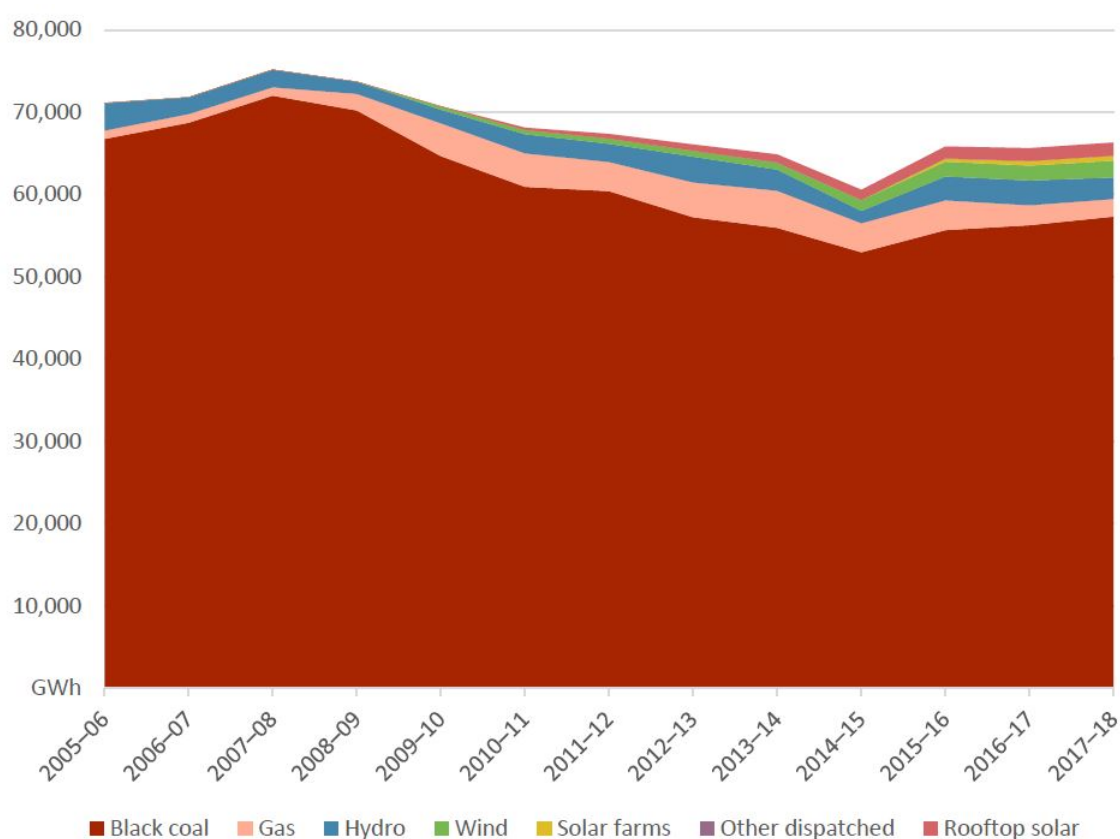
²¹³ The Climate Council, *The difference between installed capacity (mw) and energy generation (mwh)*, 27 August 2013, www.climatecouncil.org.au/resources/the-difference-between-installed-capacity-mw-and-energy-generation-mwh.

²¹⁴ NSW Parliamentary Research Service, *Uranium Mining and Nuclear Energy in New South Wales*, Issues paper, 2019, p 23.

New South Wales, representing 86.4 per cent of total electricity generated. Gas fired power stations provided an additional 2,121 gigawatt hours, taking the total attributable to fossil fuels to 59,439 gigawatt hours or 89.6 per cent of total actual generation. Hydroelectric power stations accounted for 3.9 per cent, the most of any renewable generation, followed by wind at 3.1 per cent, rooftop solar at 2.4 per cent and solar farms at 0.9 per cent.²¹⁵

3.34 Trends in the State's actual electricity generation by fuel type over time are shown in Figure 4 below.

Figure 4 Electricity generation in New South Wales by fuel type²¹⁶



3.35 Between 2012-13 and 2017-18, three coal fired power stations were retired from service in New South Wales. Munmorah Power Station was retired in July 2012, Redbank Power Station was retired in August 2014, and the Wallerawang C station was retired in November 2014. In

²¹⁵ NSW Parliamentary Research Service, *Uranium Mining and Nuclear Energy in New South Wales*, Issues paper, 2019, p 29.

²¹⁶ NSW Parliamentary Research Service, *Uranium Mining and Nuclear Energy in New South Wales*, Issues paper, 2019, p 30.

addition, the Mount Piper Power Station was downgraded in 2016. In total, 5,454 megawatts of capacity was lost as a result of these closures and downgrade over the same time period.²¹⁷

- 3.36** A variety of circumstances led to these closures, all of which occurred prior to their end-of-life from a technical and engineering point of view. Munmorah was closed because it was no longer economically viable, Redbank closed because its parent company went into receivership, and Wallerawang C was retired due to reduced energy demand, high operating costs and high coal prices. The retirement of coal fired power stations is set to continue, with the Liddell Power Station scheduled to close by April 2023.²¹⁸
- 3.37** The slated closure of Liddell in 2023 weighed heavily on discussion and evidence throughout the inquiry, with concerns about where the new/replacement capacity would come from.²¹⁹ As the State's fossil fuel footprint contracts, inquiry participants suggested that nuclear power could form part of a solution for adding new generation capacity to the network to offset losses from anticipated closures and withdrawals.
- 3.38** The Energy Policy Institute of Australia impressed upon the committee the enormity and immediacy of the energy policy dilemma:

EPIA warns however that it could be economically suicidal for the national and state economies if the existing coal-fired or gas-fired generation fleets in the National Electricity Market were to close down prematurely and cause electricity demand curtailment. A reliable, fully functioning power system that is able to balance supply and demand continuously is indispensable for the welfare of the community.²²⁰

The energy trilemma in New South Wales – are we losing our competitive advantage?

- 3.39** A common thread in evidence received by the committee relates to what several inquiry participants perceived to be a recent deterioration in energy affordability and reliability in New South Wales – that is, a deterioration in two of the three dimensions of the energy trilemma.²²¹ As noted in Chapter 1, the committee heard evidence that average electricity prices have risen by more than 90 per cent between 2009 and 2019.²²² Another argument advanced by proponents of the bill was that the electricity system is becoming increasingly unstable and is losing sufficient baseload power, resulting in a heightened risk of black outs.²²³

²¹⁷ NSW Parliamentary Research Service, *Uranium Mining and Nuclear Energy in New South Wales*, Issues paper, 2019, pp 24-25.

²¹⁸ NSW Parliamentary Research Service, *Uranium Mining and Nuclear Energy in New South Wales*, Issues paper, 2019, pp 25-26.

²¹⁹ See for example: Evidence, Mr David Frith, Director, Industry and Environment, NSW Minerals Council, 18 November 2019, p 7.

²²⁰ Submission 7, Energy Policy Institute of Australia, p 1.

²²¹ See for example: Submission 1, Mr Barrie Hill, p 7.

²²² See for example: Submission 70, The Australian Workers' Union, p 9; Submission 67, Minerals Council of Australia, p 7.

²²³ See for example: Submission 58, Engineers Australia, p 11; Submission 70, The Australian Workers' Union, p 16.

3.40 In the opinion of Dr Ziggy Switkowski AO, Australia's electricity system has seen a steady decline in affordability and reliability, from its heyday as an 'energy rooster' to what it is today, a mere 'feather duster'.²²⁴

3.41 Beyond the predictable impact on households and family budgets, a distinct correlation emerged in evidence positing interdependencies between the State's future energy security and the fundamental make-up of its future economy. This evidence looked beyond immediate impacts to residential consumers, instead focussing on the broader impacts to the strength, resilience and competitiveness of the economy. Such a correlation was writ large in evidence by the Australian Workers' Union. In its submission to the inquiry, this union declared, emphatically, that '[r]ising power prices and unreliability of supply is on the verge of collapsing Australia's manufacturing base. Thousands of AWU member jobs are at risk.'²²⁵

3.42 By implication, the question of legislating sensibly for energy now – that is, getting the right energy mix to underwrite affordability and supply – is a question that goes to the very heart of what kind of future economy is envisaged for the State. For example, whether the goal is a strong manufacturing and industrial economy, an overwhelmingly knowledge-based economy or a largely recreational economy – this will shape our future energy requirements, and legislators should keep these questions in mind when legislating for the State's energy future. Dr Kath Smith of Women in Nuclear Australia explained how this question is in fact a far reaching economic one:

.. what sort of economy do you want for New South Wales in 2030 or 2040 or 2050? Do you want it to be industrial-manufacturing? Do you want it to be a knowledge economy? Do you want it to be a recreational economy. That is a question that is beyond our scope of expertise, but one that, if you can leave all of those open, that is probably the best way to go.²²⁶

3.43 A number of inquiry participants expressed concern that New South Wales is losing its competitive edge as an industrial and manufacturing economy as a result of rising power prices and supply issues. For instance, the Australian Nuclear Association submitted that 'Australia is increasingly faced with power prices that are destroying the competitiveness of our manufacturing sector.'²²⁷

3.44 Adding his support for the bill, Mr Misha Zelinski, Assistant National Secretary of the Australian Workers' Union, commented on the impact of high energy prices on the manufacturing industry, undermining profitability and wage growth:

It is no secret. When you talk to any heavy manufacture they will say that they are under the pump when it comes to energy. ... When you look at our energy market or policy—or lack thereof—we could not have designed a bigger stuff up than what we currently have. We have a plan to go nowhere.

... we seem to have an ideological drive—for no clear reason—to deny ourselves what every other country has, which is nuclear power. We have no plan whatsoever. ... We

²²⁴ Evidence, Dr Ziggy Switkowski AO, Private citizen, 11 November 2019, p 49.

²²⁵ Submission 70, The Australian Workers' Union, p 2.

²²⁶ Evidence, Dr Kath Smith, Executive Committee Member, Women in Nuclear Australia, 18 November 2019, p 17.

²²⁷ Submission 27, Australian Nuclear Association, p 7.

are already starting to see closures around the country that are related to energy. We talk to manufacturing CEOs—I will not disclose who—and they tell us all the time that their number one problem is energy prices. There are three problems from our members' point of view. The first is the viability of the sites. The second is that high energy prices mean lower profits and lower wages. The third is that when they go home after not receiving a pay rise they then see that their energy bill has gone up. They get it twice.²²⁸

- 3.45** The Minerals Council of Australia expressed the view that New South Wales and Australia have lost their competitive advantage in energy, with rising energy costs undermining the competitiveness of local manufacturing and driving jobs overseas:

Over the past decade household and industrial electricity costs in Australia have risen by more than 90 per cent. This is driving jobs and prosperity from Australia as businesses seek to make major investments in other countries where energy is affordable and reliable.

[...]

Reducing energy costs is critical, particularly if New South Wales is to maintain and increase the number of high-paying jobs in manufacturing where energy is a major input. Many of these jobs are, or would be, located in regional New South Wales.²²⁹

- 3.46** Of particular interest to the committee was the Minerals Council of Australia's account of a 2017 trade delegation from Pennsylvania (United States) which sought to target Australian manufacturing firms with the promise of affordable and reliable energy. This was highlighted to illustrate the immediacy of the threat to Australian manufacturing and the State's competitive advantage in attracting investment, amplifying the Council's call to action. Mr Patrick Gibbons explained:

In our submission we referred to a trade mission that came out from the State of Pennsylvania at the end of 2017. As part of the targeting of Australian businesses—and they were targeting New South Wales manufacturing firms in particular—their key pitch to those firms was, "Come to Pennsylvania because we can provide cheap and reliable energy." They were looking at what was happening in Australia and a lot of it stemmed from the closure of our larger baseload plants.

[...]

I think this is going to be an ongoing issue for Australia. Large industry, which requires 24/7 power—and it has to be internationally competitive—looks at Australia and it is a bit difficult to start making a business case for investment.²³⁰

²²⁸ Evidence, Mr Misha Zelinsky, Assistant National Secretary, Australian Workers' Union, 18 November 2019, p 56.

²²⁹ Submission 67, Minerals Council of Australia, p 7.

²³⁰ Evidence, Mr Patrick Gibbons, Principal Advisor, Energy, Minerals Council of Australia, 18 November 2019, p 3.

Committee comment

- 3.47** The committee accepts the correlation between energy issues and broader questions of the State's economic fundamentals. Planning for energy affordability, reliability and supply goes hand-in-hand with planning for the State's future economic goals. If the goal is to be an internationally competitive manufacturing economy, an appropriate mix of generation technologies is required to address trending affordability and reliability issues and power a competitive manufacturing base. Also, given the urgent importance of emissions reduction, the NSW Government should be actively considering all options to take steps to mitigate this risk.

Finding 2

That securing affordable, sustainable and reliable baseload power now and into the future is essential to powering the State's manufacturing and other energy-intensive industries thereby ensuring that the State maintains a competitive advantage as it works towards reducing emissions. Given the urgent importance of emissions reduction, the NSW Government should be actively considering all options to take steps to mitigate this risk.

- 3.48** The committee considers that, with policy settings geared to achieve a significant reduction in emissions – 'net-zero emissions by 2050' – the question then becomes something akin to the one driving this inquiry: that is, could nuclear power have a role in decarbonising the State's electricity system and helping to meet emissions reductions targets in New South Wales?

Nuclear as a solution to the State's energy issues

- 3.49** This section explores whether nuclear power could be a solution to the State's energy issues, including its ability to address the energy trilemma.

The capacity factor

- 3.50** The 'capacity factor' concept is closely related to the generation metrics and indicators discussed earlier in this chapter and is commonly used to assess the efficiency of electricity generation assets. The capacity factor recognises that no generation asset can operate 100 per cent of the time.²³¹
- 3.51** The capacity factor of a generation asset is calculated by taking the amount of energy produced over a set period of time and dividing it by the maximum possible production of that asset over the same period of time.²³²
- 3.52** For several inquiry participants, nuclear power's high capacity factor gave it a compelling advantage over renewables:

²³¹ NSW Parliamentary Research Service, *Uranium Mining and Nuclear Energy in New South Wales*, Issues paper, 2019, p 27.

²³² Evidence, Mr Robert Parker, Vice President, Australian Nuclear Association, 11 November 2019, p 19.

- Referring to the high capacity factor of nuclear relative to renewables, Mr Martin Thomas of the Australian Academy of Technology and Engineering asserted that every investment in one megawatt of nuclear power is equivalent to an investment in six to nine megawatts of renewables.²³³
- Dr Adrian Paterson, Chief Executive Officer of the Australian Nuclear Science and Technology Organisation (ANSTO), commented that nuclear power plants based on a grouping of several reactors have a very high capacity factor – 'close to 100 per cent' – and that nuclear globally is in the high eighties and early nineties.²³⁴
- Dr Mark Ho, President of the Australian Nuclear Association told the committee that '[n]uclear has a capacity factor of up to 92 per cent compared to lower capacity factors for coal, wind and solar.'²³⁵ This assertion was repeated by his colleague, Mr Robert Parker, who pointed out that, by contrast, the capacity factor for solar can be as low as 9 per cent.²³⁶

The future: nuclear or variable renewables?

- 3.53** Understanding the capacity factor of nuclear power relative to variable renewable sources led into broader consideration of whether renewables alone – or renewables with firming – could be capable of meeting the State's future energy supply needs as its coal fired power footprint contracts. This was a point of contention amongst inquiry participants.
- 3.54** In expressing their opposition to the bill, environmental and other groups argued that the future of energy is in renewables:
- The Medical Association for the Prevention of War considered that questions of nuclear power are a time wasting distraction from the urgent need to switch to proven renewables, pointing to studies in the United States which claim that 100 per cent of existing energy supply in that country could be replaced by renewables by 2050.²³⁷
 - The Australia Institute expressed the view that renewable generation combined with demand management and storage can meet Australian energy needs, and that renewable technology has a distinct advantage over nuclear power in so far as it has a positive learning curve – that is, renewable energy costs have plummeted over time and are likely to continue to do so.²³⁸

²³³ Evidence, Mr Martin Thomas, Australian Academy of Technology and Engineering, 18 November 2019, p 21.

²³⁴ Evidence, Dr Adrian Paterson, Chief Executive Officer, Australian Nuclear Science and Technology Organisation, 11 November 2019, p 14.

²³⁵ Evidence, Dr Mark Ho, President, Australian Nuclear Association, 11 November 2019, p 18.

²³⁶ Evidence, Mr Robert Parker, Vice President, Australian Nuclear Association, 11 November 2019, p 19.

²³⁷ Submission 56, Medical Association for the Prevention of War, pp 2 and 21.

²³⁸ Submission 68, The Australia Institute, pp 4-5.

- In weighing up nuclear and renewables, the Joint Civil Society – a coalition of environmental groups, religious organisations, unions and other groups – highlighted Australia's extensive renewable energy options and resources, public support for renewables and their cost advantage as the 'cheapest form of new generation electricity'. For these inquiry participants, such considerations led to the conclusion that '[r]enewable energy is affordable, low risk, clean and popular. Nuclear is simply not', and that '[o]ur shared energy future is renewable.'²³⁹

3.55 Mr Chris Gambian, Chief Executive of the Nature Conservation Council of NSW, outlined the case for renewable energy in New South Wales, referring to his organisation's future vision for a clean electricity system:

[This] represents a vision for energy generation, storage and transmission that would see New South Wales able to move to 100 per cent renewable sources by 2030. It is an ambitious but necessary goal and includes options that include rooftop solar, which can produce up to 25 per cent of the State's energy needs by 2030 and create 14,000 jobs; and large-scale investment in storage technologies that will ensure power is available when it is needed most. This includes lithium-ion batteries but also includes solar thermal plants and off-river pumped hydro. Pumped hydro in particular is appealing because it would allow existing coal mines to be repurposed after their life ends. This is a huge opportunity to transition the Hunter Valley in particular as the domestic economy as well as the world moves away from coal over the next 30 years.²⁴⁰

3.56 The suggestion that renewables with firming could meet 100 per cent of the State's future energy needs was not universally accepted by inquiry participants.

3.57 Referring to the 2018 Commonwealth Scientific and Industrial Research Organisation (CSIRO) analysis of electricity generation cost data in Australia, *GenCost 2018: Updated projections of electricity generation technology costs*, the Australian Taxpayers' Alliance belied claims that firmed renewables are more cost effective than nuclear power, pointing to the low capacity factor of renewables and the intensive need for battery back-up. Mr Satyajeet Marar explained:

.... the CSIRO assumes firmed renewable capacity of I think it was two to six hours. That is a very small fraction of the capacity you actually need.

That is nowhere near enough to provide affordable and reliable power. When you actually take that capacity factor, which is 25 per cent, and move it up 95 per cent, the cost which [the CSIRO] cited, which I think is \$1,100, goes up to \$5,000.²⁴¹

3.58 Mr Martin Thomas, Fellow of the Australian Academy of Technology and Engineering, affirmed the view that relying solely on renewables plus storage to power the kind of diversified first-world economy we would expect in Australia would be 'very high risk'.²⁴²

²³⁹ Submission 55, Joint Civil Society, pp 1-2.

²⁴⁰ Evidence, Mr Chris Gambian, Chief Executive, Nature Conservation Council of NSW, 11 November 2019, p 28.

²⁴¹ Evidence, Mr Satyajeet Marar, Director of Policy, Australian Taxpayers' Alliance, 11 November 2019, p 59.

²⁴² Evidence, Mr Martin Thomas, Australian Academy of Technology and Engineering, 18 November 2019, p 26.

- 3.59** In a similar vein, Professor Stephen Wilson of the University of Queensland told the committee the '[v]ariable renewable resources, non-dispatchable with very low capacity factors, will not be able to deliver affordable, reliable electricity' and that decarbonising Australia's economy without nuclear power would be 'close to impossible'.²⁴³
- 3.60** Acknowledging the enormity of the emissions reduction task ahead, the NSW Minerals Council did not believe that renewables with storage alone would provide the answer, stating that '[a]chieving emission reductions in the electricity sector is unlikely to be achieved by renewables and storage alone.'²⁴⁴
- 3.61** For several inquiry participants, the ability of renewables to provide reliable electricity to the grid was limited by their intermittent nature. Renewables such as wind and solar are weather dependent. An argument the committee heard from proponents of nuclear power turned on the question of what happens when whether conditions are not favourable – that is, 'when the wind stops blowing and the sun stops shining'.²⁴⁵ For example, according to SMR Nuclear Technology, the contingent nature of wind farms make them unreliable and difficult to predict, and this is one of their disadvantages when compared to nuclear power:

Renewables, by contrast, are totally weather-dependent. The output from a wind turbine rapidly decreases as the wind drops. Although this can be forecast to some extent, the drop can sometimes be quicker than expected. For example the AEMO report into conditions on 10 February 2017 (the very hot day in NSW) identified that the wind dropped faster than forecast, leading to a shortage of supply.²⁴⁶

- 3.62** Similarly, Nuclear for Climate Australia questioned the overall value and potential of renewables, pointing to a range of limitations surrounding their inherent intermittency, higher system wide costs, and their low capacity factors:

...Two key factors combine to progressively drive up the cost of solar and wind renewable generation options.

1. The intermittent output requires the provision of quick-start open cycle gas turbine capacity to augment existing hydroelectric capacity and new pumped storage capacity. The use of grid level electrical storage batteries is not currently a viable economic option.

2. As renewable generation increases the transmission costs also markedly increase. Lower capacity factors of renewable energy cause lower utilisation of the transmission network and therefore higher transmission costs. Analysis shows that benefits from wind and solar PV diversity across the NEM are quite marginal and come nowhere near providing a base load capability.²⁴⁷

²⁴³ Evidence, Professor Stephen Wilson, Centre for Energy Futures, University of Queensland, 18 November 2019, pp 41 and 44.

²⁴⁴ Submission 51, NSW Minerals Council, p 1.

²⁴⁵ Evidence, Dr John Patterson, 18 November 2019, p 53.

²⁴⁶ Submission 4, SMR Nuclear Technology, p 7.

²⁴⁷ Submission 52, Nuclear for Climate Australia, p 13.

- 3.63** Mr David Frith, Director, Industry and Environment, NSW Minerals Council conceded that a future electricity system purely consisting of wind and solar combined with storage may be technically possible but 'economically destructive.' Mr Frith explained:

I think it may be technically feasible, but from the research that I have read it would appear to be economically destructive, for industry in particular. As this study—and I think you have heard some evidence regarding some modelling done by Dr Robert Barr as well from Electric Power Consulting—when you take in to account the exponentially increasing amounts of storage that are required, the additional capacity of intermittent renewables, solar and wind, that are required as you try to get to that 100 per cent, or even up to perhaps 50 per cent or 60 per cent penetration, other kinds of technology then become competitive.²⁴⁸

Committee comment

- 3.64** On the balance of evidence, the committee is not convinced that wind and solar firming with gas, batteries and pumped hydro could provide 100 per cent of the State's future low-emission electricity needs while keeping costs down for residential and business consumers. A mix of technologies presents a more plausible scenario, optimised by technology-neutral policy settings which put all generation technologies on the table for consideration and assessment.

Finding 3

That wind and solar firming with gas, batteries and pumped hydro would not be an adequate solution to meet the State's future needs for affordable and reliable electricity following the decommissioning of our ageing coal fired generation assets.

Nuclear's environmental and emissions footprint

- 3.65** One of the benefits of nuclear power highlighted in evidence is its ability to generate electricity with very low or zero operating emissions²⁴⁹ – a key advantage emphasised in evidence to advance the environmental case for nuclear power in the context of decarbonisation. As one submission author put it, '[i]f emission reduction is accepted as a serious imperative then only nuclear power provides this outcome in a reliable cost-effective manner.'²⁵⁰
- 3.66** ANSTO offered compelling evidence on the environmental footprint of nuclear power, noting the contribution it makes to preventing global emissions:

Nuclear power is a carbon dioxide (CO₂)-free energy source at the point of generation. While precise estimates of the global emissions avoided due to the use of nuclear power vary, one study has found that 'global nuclear power has prevented an average of 1.84 million air pollution-related deaths and 64 gigatonnes of CO₂-equivalent (GtCO₂-eq) greenhouse gas (GHG) emissions that would have resulted from fossil fuel burning.' It

²⁴⁸ Evidence, Mr David Frith, Director, Industry and Environment, NSW Minerals Council, 18 November 2019, p 6.

²⁴⁹ See for example: Submission 59, Australian Nuclear Science and Technology Organisation, p 36.

²⁵⁰ Submission 1, Mr Barrie Hill, p 12.

generally is acknowledged that nuclear energy avoids the production of more than 600 million tonnes of total carbon emissions and 2.5 billion tonnes of CO₂, each year. Put differently, nuclear power currently saves approximately 10 per cent of total CO₂ emissions from world energy use.²⁵¹

- 3.67** In its submission to the inquiry, SMR Nuclear Technology expressed the view that, despite 'billions of dollars' spent on wind and solar, Australia has had very limited success in reducing its emissions from electricity. According to this inquiry participant, nuclear power – a clean source of energy – could address this lack of success and make greater inroads in emissions reduction in the electricity sector. To shore up this claim, it was noted that, globally, 2,563 terawatt hours was generated by nuclear power reactors in 2018, saving over 2 billion tonnes CO₂-e emissions.²⁵²
- 3.68** Women in Nuclear Australia observed that one third of Australia's greenhouse gas emissions comes from electricity generation, suggesting to the committee that, as a clean energy source, nuclear power offers an opportunity to greatly reduce Australia's emissions from the electricity sector.²⁵³
- 3.69** In support of this argument, Women in Nuclear Australia cites 2014 statistics published by the Intergovernmental Panel on Climate Change which compares lifecycle emissions for a range of electricity generation sources, including renewables. According to these figures, nuclear power has one of the lowest lifecycle emissions of all generation sources and is equivalent to offshore wind.²⁵⁴ In adding their support for the environmental/emissions credentials of nuclear power, Bright New World referred to the same 2014 data to conclude that nuclear power 'has one of the lowest life-cycle emissions intensities of all electricity generation sources.'²⁵⁵
- 3.70** A comparison of total lifecycle emissions of the different generation technologies is shown in Figure 5. Total lifecycle analysis considers the entire fuel chain from mining to decommissioning.

²⁵¹ Submission 59, Australian Nuclear Science and Technology Organisation, p 36.

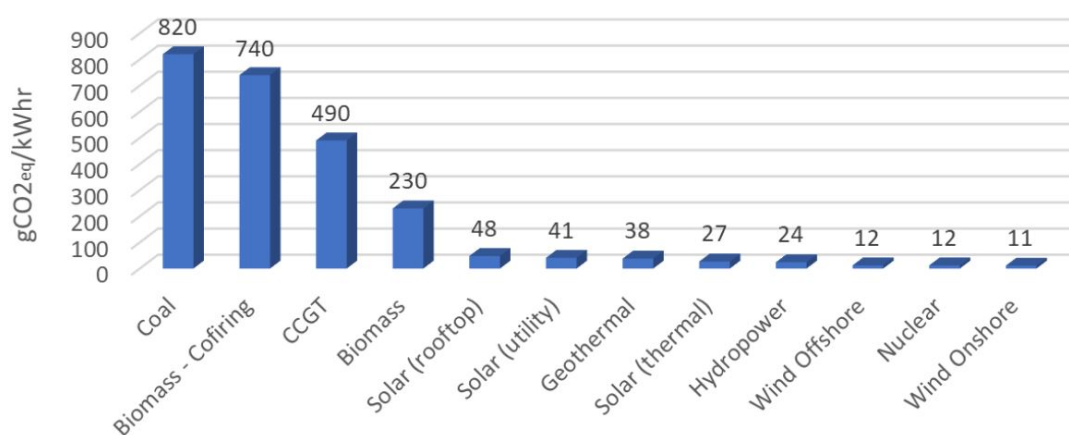
²⁵² Submission 4, SMR Nuclear Technology, p 3.

²⁵³ Submission 44, Women in Nuclear Australia, pp 10-11.

²⁵⁴ Submission 44, Women in Nuclear Australia, p 10.

²⁵⁵ Submission 61, Bright New World, pp 4 and 7.

Figure 5 Lifecycle emissions expressed in grams of carbon dioxide equivalent per kilowatt hour²⁵⁶



- 3.71** The Australian Nuclear Association affirmed this view, referring to emissions performance in existing nuclear nations to illustrate the potential contribution nuclear power could make in cutting emissions from electricity production in New South Wales and Australia. It was noted that in France, for instance, where nuclear power supplied 72 per cent of electricity in 2016, the emissions intensity from electricity production was measured at 58 grams of carbon dioxide per kilowatt hour, compared to a measure of 440 grams of carbon dioxide per kilowatt hour for its neighbour Germany.²⁵⁷

Dispatchability and nuclear power as firming for renewables

- 3.72** Several inquiry participants referred to the concept of dispatchability when commenting on energy issues and the prospect of nuclear power.²⁵⁸ As noted above, a secure and reliable electricity system relies on sufficient dispatchability to safeguard supply to the system and respond to variations in demand.
- 3.73** The dispatchability of a generator is a measure of the extent to which the generator may be relied upon to follow a target. It implies consideration of how controllable an energy source is, how firm it is and how flexible it is. Generation technologies that can be powered up or powered down relatively quickly in response to variations in demand are considered load-following – that is, they can follow a target.²⁵⁹
- 3.74** By contrast, some generation technologies are designed to provide even and continuous baseload power – the base or minimum load of power to a grid – but by their nature, cannot

²⁵⁶ Submission 42, Down Under Nuclear Energy, p 14.

²⁵⁷ Submission 27, Australian Nuclear Association, p 3.

²⁵⁸ See for example: Evidence, Mr David Frith, Director, Industry and Environment, NSW Minerals Council, 18 November 2019, p 7.

²⁵⁹ NSW Parliamentary Research Service, *Uranium Mining and Nuclear Energy in New South Wales*, Issues paper, 2019, p 19.

vary their output easily to respond to peaks and troughs in demand. Generators which provide baseload power are therefore reliable and controllable, but relatively inflexible.²⁶⁰

- 3.75** Throughout the inquiry, the committee heard arguments that nuclear power plants are incapable of load-following and therefore would not be a fit-for-purpose technology for the State's future energy mix. For instance, Dr Jim Green, National Anti-Nuclear Campaigner with Friends of the Earth Australia, advised the committee that nuclear power plants are 'notoriously bad' at load-following and are rarely used for that purpose.²⁶¹ While acknowledging the need for back-up energy sources to support variable renewables, Dr Green commented that other technologies would be a more suitable complement to renewables than nuclear power which, in his view, is largely unproven/untested:

Essentially that is a technical question and the technical response is that nuclear power plants are terrible at load following, which means they are not a good complement at all for variable renewables. The nuclear industry's response to that, which you presumably heard this morning, is that the next generation of nuclear power plants will be good at load following. Again, it is just speculation. That may come to pass; if it does come to pass, fine—we have got a new set of inputs into decision-making on these issues—but it is absolutely not the case now. Nuclear power plants are notoriously bad at load following and are rarely used for that purpose. That is why we need a whole suite of different options—variable renewables, baseload renewables, pumped hydro storage, battery storage et cetera, et cetera, run-of-the river hydroelectricity. All these different options are looking very promising for Australia.²⁶²

- 3.76** Dr Green's views were in direct opposition to views expressed by nuclear advocacy and education groups, the nuclear industry, and nuclear-science related associations.
- 3.77** According to SMR Nuclear Technology, NuScale Power and the Australian Nuclear Association, one of the advantages of Small Modular Reactors (SMRs) – a miniaturised and simplified reactor detailed in the next chapter – is their ability to load-follow, making them a suitable complement for weather-dependent variable renewables.²⁶³
- 3.78** For other inquiry participants, nuclear power and other low carbon technologies (such as variable renewables) were far from mutually exclusive, but were technologies that could work alongside each other in the State's future energy mix.²⁶⁴ In particular, Nuclear for Climate Australia credited most of the latest generation designs with more favourable load-following capabilities, arguing that nuclear can reduce reliance on gas back-up for variable renewable sources:

The flexibility provided by nuclear power facilitates the development of variable renewable energy while limiting reliance on gas backup. This is already the case today for the French nuclear plants in the Western Europe electricity grid. Most modern

²⁶⁰ NSW Parliamentary Research Service, *Uranium Mining and Nuclear Energy in New South Wales*, Issues paper, 2019, p 19.

²⁶¹ Evidence, Dr Jim Green, National Anti-Nuclear Campaigner, Friends of the Earth Australia, 11 November 2019, p 37.

²⁶² Evidence, Dr Jim Green, National Anti-Nuclear Campaigner, Friends of the Earth Australia, 11 November 2019, p 37.

²⁶³ Submission 4, SMR Nuclear Technology, p 9; Submission 18, NuScale Power, p 2.

²⁶⁴ See for example: Submission 44, Women in Nuclear Australia, p 5.

Generation III+ nuclear power plants which include SMRs, are designed to enable more favourable load following capabilities.²⁶⁵

- 3.79** ANSTO reiterated this view, observing that SMR-based nuclear power plants have certain features and capabilities which would make them particularly well suited to New South Wales, including the ability to load-follow:

The smaller size of SMRs and SMR-based plants offers distinct advantages of particular relevance to New South Wales—and Australia more broadly—when considering future grid design and the integration of various low-carbon technologies in the electricity generation and distribution system. These advantages include:

- the potential of most SMR designs to operate in load following regimes in concert with variable renewable energy sources; [...]²⁶⁶

- 3.80** Dr Mark Ho of the Australian Nuclear Association went even further to suggest that: 'Nuclear is the only low-carbon, non-storage firming option for intermittent wind and solar generation.'²⁶⁷

Committee comment

- 3.81** The committee notes the conflicting views expressed by inquiry participants about the ability of nuclear power to load-follow and is supportive of further work in this area to establish the suitability of nuclear power to firm renewables.
- 3.82** Overall, the committee considers nuclear power to be a compelling technology that may be useful in energy policy which seeks to address the three dimensions of the energy trilemma. We acknowledge that nuclear power provides for:
- net-zero emissions (*environmental sustainability*);
 - a secure and reliable energy supply (*energy security*); and
 - an ability to support a competitive industrial and manufacturing economy (*affordability and equity*).

Finding 4

Overall, the committee considers nuclear power to be a compelling technology that may be useful in energy policy which seeks to address the three dimensions of the energy trilemma. We acknowledge that nuclear power provides for:

- net-zero emissions (*environmental sustainability*);
 - a secure and reliable energy supply (*energy security*); and
 - an ability to support a competitive industrial and manufacturing economy (*affordability and equity*).
-

²⁶⁵ Submission 52, Nuclear for Climate Australia, p 7.

²⁶⁶ Submission 59, Australian Nuclear Science and Technology Organisation, p 21.

²⁶⁷ Evidence, Dr Mark Ho, President, Australian Nuclear Association, 11 November 2019, p 18.

Chapter 4 Nuclear energy in New South Wales?

This chapter considers the case for and against nuclear energy as a potential generation technology in New South Wales as well as the key prerequisites that would need to be in place should it be adopted. The committee heard cogent arguments on both sides of the debate about the viability and suitability of nuclear energy from economic, environmental and social perspectives, with often conflicting data brought to the fore to support a range of views. In considering these varying perspectives, this chapter examines the merits of nuclear energy using criteria such as safety, cost, construction times and waste, turning ultimately to the critical question: does nuclear stack up? Understanding the prerequisites with respect to industry regulations and workforce capability also formed a significant line of inquiry for the committee. Expert evidence and observations on the essential elements for any future regulatory regime and skilled nuclear workforce are also summarised in this chapter.

Nuclear technologies defined

- 4.1 This section provides a brief outline of nuclear power technologies, including an introduction to Small Modular Reactors.

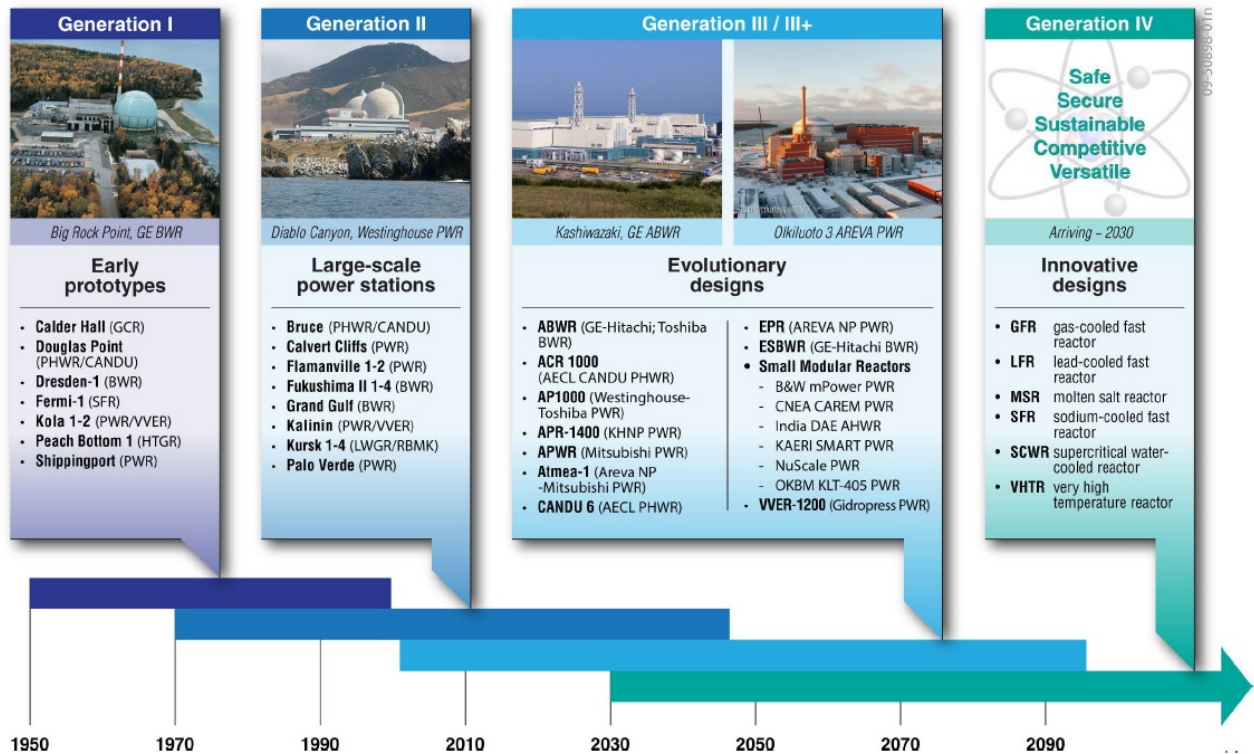
Nuclear technologies at a glance

- 4.2 Whereas conventional electricity generation technologies use fossil fuels to generate thermal energy, nuclear power uses heat generated from controlled nuclear fission – the splitting of atoms – to produce steam which, in turn, rotates a turbine to produce electricity.²⁶⁸ According to the United States Nuclear Energy Institute, one of nuclear power's defining attributes is its ability to produce large amounts of electricity without carbon emissions.²⁶⁹
- 4.3 There is much variation in both proven nuclear energy technologies in use around the world as well as emerging, next generation designs. Nuclear energy technologies vary in size/scale, megawatt capacity, reactor design and technological generation. There is also significant variation in technological maturity, with some technologies still a design on paper and others having many years of proven operations in nuclear nations. Since various nuclear technologies were entered into evidence, some level of understanding of the differences and variations is deserving of consideration.
- 4.4 Throughout the inquiry, nuclear technologies were described and classified by inquiry participants in terms of the technology generation they belong to. This classification framework consists of four categories, being Generation I, Generation II, Generation III/III+ and Generation IV, as detailed in Figure 6 below.

²⁶⁸ Submission 13, Mr Zac Petersen, p 3.

²⁶⁹ Submission 25, United States Nuclear Energy Institute, p 2.

Figure 6 Nuclear power technologies by generation and deployment timeline²⁷⁰



4.5 Within each 'generation family', reactor engineering/design varies as does the size/scale and megawatt output. Generation III designs are currently in operation in nuclear nations around the world and, according to evidence, are differentiated from earlier technologies by the introduction of passive safety features and load-following capabilities, two design features discussed in further detail below.²⁷¹ Whereas Generation I and Generation II reactors relied on skilled operators to operate their safety systems in the event of an incident, Generation III and III+ designs are working to a design principle of 'passive safety', the significance of which was explained by analogy in oral testimony by Professor Lyndon Edwards of the Australian Nuclear Science and Technology Organisation (ANSTO):

... for instance, in aerospace or even, say, the family car, even though the reactor today might look like the reactor of 30 years or 40 years ago, it is entirely different. The analogy of safety is exactly the same. The first and second generation reactors relied on safety systems operated by skilled operators. That is not unusual—we like skilled operators at the front of our aircraft and in front of the car. We have not gone to automatic systems there. The three and three-plus are going to what is called passive safety and they have automatic systems. They are like the sort of automatic car—they do not need the skilled operators to operate anything in the case of an accident or incident; it happens automatically.²⁷²

²⁷⁰ John E. Kelly, US Department of Energy, International Perspective on the Future of Nuclear Power, (paper presented at 23rd International Conference on Nuclear Engineering, 19 May 2015), p 14.

²⁷¹ Submission 52, Nuclear for Climate Australia, p 27.

²⁷² Evidence, Professor Lyndon Edwards, National Director, Australian Generation IV International Forum Research, Australian Nuclear Science and Technology Organisation, 11 November 2019, p 9.

4.6 Generation IV represents the next iteration in nuclear reactor technologies, introducing further advancements in reactor safety, fuel efficiency, waste minimisation and sustainability. According to ANSTO, a member on the Generation IV International Forum, the enhanced features of Generation IV technologies include:

- inherently safe designs that would be considered by nuclear safety regulators to be ‘walk-away safe’;
- the ability to ‘burn’ radioactive waste to close the fuel cycle;
- the ability to supply high-temperature process heat to decarbonise industrial activities, including desalination and hydrogen production;
- a reduction in reactor build costs and construction times; and
- strengthened non-proliferation mechanisms.²⁷³

4.7 The Generation IV International Forum is an international taskforce established by the United States Department of Energy to collaborate and share research and development for the next generation of leading-edge nuclear technologies. ANSTO was invited to join the forum in recognition of its nuclear and materials engineering capabilities.²⁷⁴

4.8 In characterising their enhanced safety features, Down Under Nuclear Energy credits most of the emerging technologies with the 'triple crown' of nuclear safety. That is, in the event of an incident, these reactors require no external power, no additional water and no human operator intervention to achieve indefinite cooling.²⁷⁵

4.9 Professor Edwards, Australia's representative on the Generation IV International Forum, informed the committee of the advanced safety features of developing Generation IV systems/designs:

The problem you have with a large reactor is that you have so much residual heat after you shut it down that you need water, which is the best way to cool anything, including the tragic fires we are seeing today in New South Wales. If you make the reactor small then you can use another cooling medium, air, which is freely available everywhere. That means that you can have an air-cooled reactor. That means it can be what we might call "inherently safe" or "walkaway safe". In other words, you do not have to do anything. There is always enough cooling power in the air and the structures so that it can never melt down.²⁷⁶

4.10 New Generation IV designs are not yet operational or commercially available, but are still in various stages of research and development.²⁷⁷

²⁷³ Submission 59, Australian Nuclear Science and Technology Organisation, p 19.

²⁷⁴ Submission 59, Australian Nuclear Science and Technology Organisation, p 19.

²⁷⁵ Submission 42, Down Under Nuclear Energy, p 12.

²⁷⁶ Evidence, Professor Lyndon Edwards, National Director, Australian Generation IV International Forum Research, Australian Nuclear Science and Technology Organisation, 11 November 2019, p 9.

²⁷⁷ See for example: Submission 58, Engineers Australia, p 12.

Small Modular Reactors (SMRs)

- 4.11** Inquiry participants in favour of the bill placed significant potential in Small Modular Reactors (SMRs) as a class of reactors considered to be most appropriate and cost-effective for the Australian context.
- 4.12** A member of the Generation III/III+ family, SMRs are defined as nuclear reactors which generate 300 megawatts or less and are designed with modular technology using module factory fabrication.²⁷⁸
- 4.13** SMRs are designed for factory fabrication, serial construction and modular assembly of a numbers of units in a single plant or site. Many SMRs are based on conventional nuclear engineering and design – 'borrowing heavily from previous technology' – but on a much smaller scale and using simplified designs. A single unit measures approximately 20 metres in height and 5 metres in diameter.²⁷⁹
- 4.14** Mr James Fleay of Down Under Nuclear Energy cautioned against treating SMRs as a homogenous family of technologies, advising the committee that the acronym obscures vast differences in design and technology readiness:
- ... some discrimination is required when discussing SMRs as this acronym obscures vast differences in technology readiness, lead time and deployment costs between different designs. A SMR design that is a miniaturisation and an elegant simplification of traditional light-water reactor technology cannot be considered new technology ...²⁸⁰
- 4.15** Such discrimination was necessary to contextualise the maturity and readiness of a range of smaller output technologies loosely grouped together under the SMR designation, as Mr Fleay explained:

Within the acronym SMR you have a family of reactors. Some of them are little more than a design on paper. Others have spent US\$1 billion on developing designs, prototyping, licensing and all that sort of thing. So at one end you have a light water reactor—the tradition technology that has been miniaturised and simplified. It is the same fuel technology. It is the same physics code. It is very similar regulatory requirements. The technology step out is very minimal. At the other end you have things like molten salt reactors with thorium fuels, you have sodium-cooled reactors, you have fast neutron reactors, all of which are prospective but people should be aware that they are at least a decade if not two decades away. There is a very long way to go for that class of SMRs. But the light water reactor SMRs or the boiling water reactor SMRs—that is not a big technology step out at all.²⁸¹

²⁷⁸ Tabled document, Dr Kath Smith, *Small nuclear power reactors*, World Nuclear Association, updated November 2019, p 1.

²⁷⁹ Submission 42, Down Under Nuclear Energy, p 27; Evidence, Mr James Fleay, Chief Executive Officer, Down Under Nuclear Energy, 11 November 2019, p 43.

²⁸⁰ Evidence, Mr James Fleay, Chief Executive Officer, Down Under Nuclear Energy, 11 November 2019, p 40.

²⁸¹ Evidence, Mr James Fleay, Chief Executive Officer, Down Under Nuclear Energy, 11 November 2019, p 43.

4.16 Inquiry participants in favour of the bill underscored a range of advantages, design features and improvements associated with SMRs, advocating for their future adoption in New South Wales.²⁸² Their advantages over conventional large-scale reactors include:

- lower initial capital costs and shorter construction timeframes;
- greater scalability and flexibility;
- improved passive safety features such that SMRs are 'walk-away' or 'passively' safe;
- less spent fuel/waste;
- smaller footprint and less need for real estate;
- smaller emergency planning zone;
- reduced regulatory and licensing costs;
- ability to provide reliable, low emissions power in remote locations;
- ability to load-follow;
- simpler to operate;
- reduced risk of reactor damage from external hazards, intrusions or weather events;
- minimal visual impacts in landscape, as SMRs can be located underground; and
- eliminated need for external power supply in the event of an emergency shut-down and reactor cooling.²⁸³

4.17 The committee received a presentation from NuScale Power, a nuclear power technology company in the United States, providing an overview of their work on developing and commercialising SMRs for the United States market. NuScale Power's technology offering is outlined in the case study below.

Case study - The NuScale Small Modular Reactor²⁸⁴

NuScale Power is a nuclear technology company specialising in the development and commercialisation of Small Modular Reactors (SMRs) in the United States. The NuScale SMR offering is a miniaturised version of a conventional pressurised light water reactor, featuring a fully factory-fabricated small modular reactor and containment system capable of generating 60 megawatts of electricity. This is proposed as the powerhouse/engine for NuScale's patented scalable power plant design consisting of 12 NuScale SMRs – or 'power modules' – with a combined power output of 720 megawatts. Whereas large nuclear power plants typically require very large containment buildings, the scalable NuScale plant consisting of multiple SMRs does not require any containment building, as each power module is enveloped within a high-pressure steel containment. The NuScale SMR system has been sized to be able to be completely factory fabricated.

²⁸² See for example: Submission 45, Professor Tony Irwin, p 4.

²⁸³ Submission 45, Professor Tony Irwin, p 4; Submission 4, SMR Nuclear Technology, pp 7-10; Evidence, Mr Tom Mundy, Chief Commercial Officer, NuScale Power, 26 September 2019, pp 2-6.

²⁸⁴ Evidence, Mr Tom Mundy, Chief Commercial Officer, NuScale Power, 26 September 2019, pp 2-6; Submission 18, NuScale Power, pp 1-3.

To date, NuScale Power has invested more than USD\$900 million in the development of its technology and program. The design and development process is well advanced and is approaching the construction and fabrication phase.

The NuScale system is currently undergoing design certification review by the United States Nuclear Regulatory Commission (NRC), with approval expected in late 2021. Utah Associated Municipal Power Systems, a municipal power company in the western United States, is the first customer for the NuScale technology and will commercialise the first SMR power plant in Idaho in 2026. Site mobilisation at the Idaho site will occur in 2021, with nuclear construction commencing in 2023.

The purported advantages and benefits of the NuScale SMR offering over conventional large scale nuclear power plants are outlined below. These are based on vendor claims for the NuScale technology.

Safety

In the event of a complete loss of power, NuScale's design safely shuts down and self-cools, indefinitely, with no need for operator action or intervention, no need for AC or DC power, and no need for additional water. The NuScale system can also operate in island mode, meaning a facility does not need to be connected to an off-site power supply in order for it to continue to operate. The power that the facility itself produces can be used for the electricity needs of the facility.

Ability to load-follow

The NuScale technology features the ability to load-follow. The output of the facility can be varied to complement and support grid stability and the capacity needs of the system as renewable energy sources and outputs fluctuate.

Security of facility

With the NuScale model, the reactor modules and fuel pool are located below ground in a Seismic Category 1 building capable of withstanding seismic events, hurricanes, tornados and floods. The reactor building is also able to withstand aircraft impact as specified by the United States Nuclear Regulatory Commission.

Lower initial capital costs

The NuScale plant is claimed to have significantly lower overnight capital costs on a dollar per megawatt-hour basis than conventional large scale nuclear power plants. This is by virtue of its simplified design and the fact that it is fully factory-fabricated and shipped ready for installation.

Shorter construction timeframes

The construction timeframes for the NuScale plant are claimed to be shorter than those of conventional large scale nuclear power plants. This is because of the simplicity of design and the fact that the entirety of the nuclear supply system and containment are made in a factory. The construction period for a NuScale plant is estimated to be 36 months.

Scalability

While the NuScale plant is designed to accommodate 12 power modules, there is flexibility and scope to vary how many modules are installed based on specific customer requirements. The NuScale plant

can consist of anywhere between one and twelve power modules, depending on generation/output needs. The scalable nature of the NuScale system allows the flexibility to start small and add additional power modules over time, with each new module providing 60 megawatts of capacity.

Smaller emergency planning zone/footprint

The United States Nuclear Regulatory Commission currently requires nuclear power plants in the United States to have a 10-mile emergency planning zone from the centre of the reactor building. It is claimed that, as a result of its enhanced safety features, the NuScale SMR-based plant would make a compelling case for an exemption to this requirement and instead limit the emergency planning zone to the site boundary of the facility.

Versatile for other industrial applications

In addition to electricity generation, NuScale SMRs can be used to produce process heat for a variety of industrial applications, such as desalination and hydrogen production.

- 4.18** The merits and benefits of SMRs were not universally accepted by all inquiry participants. Dissenting views on SMRs were advanced in evidence by environmental groups, union representatives and other stakeholders, as outlined in the next section.

Committee comment

- 4.19** The committee notes the advanced safety and design features of the latest generation of nuclear power technologies – including Small Modular Reactors – as a class of technologies which have benefited from several decades of advancements in nuclear science, technology and engineering.
- 4.20** The committee accepts that Generation III/III+ and Generation IV are a significant advancement on older generation reactor designs that were in operation when the *Uranium Mining and Nuclear Facilities (Prohibitions) Act 1986* was enacted.

Finding 5

The committee finds that Generation III/III+ and Generation IV are a significant advancement on older generation reactor designs that were in operation when the *Uranium Mining and Nuclear Facilities (Prohibitions) Act 1986* was enacted.

Viability and suitability of nuclear energy in New South Wales

4.21 This section provides a summary of the evidence on the viability of nuclear power on the basis of safety, initial capital costs, generation costs, construction time, waste and weapons proliferation.

Safety

4.22 Opinions on the safety of nuclear power were far from unanimous, with opinion divided between proponents and opponents of the bill currently before the Legislative Council. Arguments touched on not only issues of nuclear safety under normal and safe operating conditions, but also the probability and impacts of accidents, incidents or failures – that is, when or if systems fail.

4.23 Inquiry participants within nuclear advocacy and education groups, the nuclear industry, and nuclear-science related associations were united in their assertion that nuclear power is extremely safe and accidents are very statistically rare.²⁸⁵

4.24 For example, the Minerals Council of Australia sought to impress upon the committee that accidents in the nuclear power industry are extremely uncommon, a contention borne out by accident statistics since the advent of nuclear power in the 1950s:

Nuclear energy has generated electricity safely since the first commercial reactor began operation in the UK in 1956.

With more than 17,000 cumulative reactor years over the past six decades, nuclear energy generation has resulted in fewer accidents and many fewer deaths and worker injuries than other energy generation sources.

This includes the aftermath of the earthquake and tsunami which hit Fukushima in 2011. Although tragically 16,000 deaths were attributed to these natural disasters, there were no deaths from radiation exposure in the immediate aftermath.²⁸⁶

4.25 Moreover, drawing on data from the South Australian Nuclear Fuel Cycle Royal Commission (discussed in Chapter 1), the Minerals Council of Australia submitted that modern nuclear power plants operate within their applicable regulatory parameters and pose zero risk to environmental and human health.²⁸⁷

4.26 Past nuclear incidents – in particular, those at Chernobyl and Fukushima – figured highly in debates about the safety of nuclear power.²⁸⁸

4.27 In advocating for the safety of the nuclear industry, Bright New World referred to the United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) to place the number of immediate deaths among plant staff and emergency workers at Chernobyl in the

²⁸⁵ See for example: Submission 44, Women in Nuclear Australia, p 5; Submission 67, Minerals Council of Australia, p 11; Submission 13, Mr Zac Petersen, p 8.

²⁸⁶ Submission 67, Minerals Council of Australia, p 11.

²⁸⁷ Submission 67, Minerals Council of Australia, p 11.

²⁸⁸ See for example: Submission 65, Australian Taxpayers' Alliance, p 4.

order of 28 fatalities. Citing the same UNSCEAR investigation, the Bright New World evidence proposes that, among the several hundred thousand people involved in recovery operations, there is no evidence of health effects that can be attributed to radiation exposure.²⁸⁹

- 4.28** Advancing a similar argument, the Australian Nuclear Association stated the facts about the number of deaths from Chernobyl and Fukushima accidents to make a case for the safety record of the nuclear power industry since its inception:

The Chernobyl accident is the only accident in the history of nuclear power generation in which deaths have occurred from radiation. It is important to note that the Chernobyl nuclear power plant type would not have been licenced outside the former Soviet Union.

With regard to Fukushima there is no clear evidence of any deaths attributable to the emission of radiation from the three meltdowns that occurred and radiation doses to the public were ten times lower than the dose at which any direct health impacts become evident.²⁹⁰

- 4.29** These Fukushima statistics carry the imprimatur of the same UNSCEAR investigation cited above, which concluded that there were no radiation-related deaths or acute radiation-related diseases amongst workers and the general public as a result of the Fukushima disaster.²⁹¹

- 4.30** One of the safety narratives to emerge in evidence from proponents of nuclear power relates to the cumulative improvements in reactor design and safety that have been ushered in with each new generation of nuclear technology. For example, reflecting on innovations in reactor safety and design, Professor Edwards of ANSTO described a process of technological learning where, like the aircraft industry or the family car, each accident or incident leads to the technology becoming incrementally safer. As a result, today's nuclear reactors benefit from many years of 'technological learning' and are nothing like the reactors of 30 or 40 years ago.²⁹²

- 4.31** Down Under Nuclear Energy, a nuclear energy start-up aiming to bring nuclear energy to Australia, urged the committee to ensure that any risk assessment of nuclear power and its safety credentials is grounded in an understanding of the latest generation of reactor designs – not reactors designed in the 1960s:

... we need to discuss risk of accidents with current generation reactors or what is known as Gen III and Gen IV. These include small modular reactors. It is as silly to look at risk in terms of problems with second generation reactors designed in the 1960's as it is to look at airline safety with reference to the Hindenburg zeppelin disaster. In essence, current and coming reactors are completely contained and have passive safety systems. This means that in case of an accident such as an earthquake or monster tsunami the reactors cooling system functions without any external intervention or the need for external power.

²⁸⁹ Submission 61, Bright New World, p 14.

²⁹⁰ Submission 27, Australian Nuclear Association, p 6.

²⁹¹ UNSCEAR, *Levels and effects of radiation exposure due to the nuclear accident after the 2011 great east-Japan earthquake and tsunami*, 2014, cited in Submission 61, Bright New World, p 13.

²⁹² See for example: Evidence, Professor Lyndon Edwards, National Director, Australian Generation IV International Forum Research, Australian Nuclear Science and Technology Organisation, 11 November 2019, p 9.

In the case of more advanced designs and small modular reactors a meltdown is virtually impossible.²⁹³

- 4.32** Analogies with the aircraft/aerospace industry resonated with other inquiry participants when discussing issues of safety and risk. The Australian Nuclear Association used this analogy to outline a process of continuous technological improvement based on operating experience:

As with the aircraft industry nuclear power plant designs are continually being improved based on the operating experience of current nuclear power plants. The most significant design improvements in both large scale Generation III and SMRs is the introduction of safety features which enable these reactors to automatically shut down and remove decay heat using passive controls. This means that the reactors remain safe without external power supply or human intervention for an extended time.²⁹⁴

- 4.33** In response to questioning by the committee, Dr John Patterson, a nuclear physicist, highlighted the advanced safety features of the latest generation of reactors – making them far safer than the old generations – while underlining that perfect safety cannot be guaranteed for any technology in modern life:

Can I just say that the latest generation reactors are fail-safe in the sense that they can shut themselves down automatically; they can cool down by air cooling without needing to have water cooling. So they are very much safer than the older generation. I have to admit that you cannot guarantee perfect safety. For example, aircraft fly and we all go in them, but they cannot be guaranteed to be safe either. It is part of modern life, and there is a small risk involved with even crossing the road.²⁹⁵

- 4.34** According to Dr Patterson, this analogy between nuclear technology and other forms of technology in modern life offers a salient conclusion: that is, the risks associated with nuclear are often greatly exaggerated but are in fact not fundamentally different in nature or order to risks involved in other human-engineered technologies, such as commercial aircraft, which as a society we are prepared to wholly accept. Dr Patterson explains:

What we are saying is that with nuclear, some of these risks are greatly exaggerated out of all proportion. In the case of a nuclear power plant in normal operation, the radiation level outside of it would be minimal. There is concrete barriers and shields around the nuclear reactor itself as well as stainless steel to enclose all the workings of it. It is very safe. As I said, you cannot guarantee absolute safety but on the other hand you can make it come very close to it. We can reach that level in Australia as well as they can overseas. There has not been any major accidents apart from the two we mentioned earlier that I am aware of. There was the Three Mile Island one a fair while ago that did not result in a large scale escape. It did not cause any casualties. It was pretty much contained.²⁹⁶

²⁹³ Submission 42, Down Under Nuclear Energy, p 12.

²⁹⁴ Submission 27, Australian Nuclear Association, p 6.

²⁹⁵ Evidence, Dr John Patterson, 18 November, p 53.

²⁹⁶ Evidence, Dr John Patterson, 18 November, pp 53-54.

- 4.35** For other inquiry participants, it was salutary to note the robust and comprehensive regulations in place for nuclear industries around the world, and that such regulations make the industry one of the most highly regulated industries in the world from a safety point of view.²⁹⁷
- 4.36** Environmental groups, union representatives, anti-war activists and other inquiry participants did not accept or share these assessments of nuclear safety, arguing instead that nuclear should continue to be prohibited on the basis of safety concerns (amongst other things).
- 4.37** The Joint Civil Society, a coalition of environmental groups, religious organisations, unions and other organisations, submitted that when nuclear power fails, it does so 'on a massive scale' and '[t]he human, environmental and economic costs of nuclear accidents like Chernobyl and Fukushima have been massive and continue.'²⁹⁸
- 4.38** In its submission to the inquiry, Friends of the Earth Australia scrutinises the safety claims made for SMRs, marshalling evidence from the Union of Concerned Scientists, a non-profit organisation of scientists and students in the United States, to draw attention to what it considers to be a number of safety concerns inadequately addressed by the United States regulator, including for the NuScale design discussed earlier in this chapter.²⁹⁹
- 4.39** In opposing the bill before the Legislative Council, the Medical Association for the Prevention of War (MAPW) raised a number of concerns about the impact of nuclear power on human health. In particular, MAPW's opposition focused on the harmful effects of ionising radiation on human DNA, proceeding with the assertion that people living near nuclear power plants are at a much higher risk of developing cancer as a result of radiation exposure.³⁰⁰
- 4.40** The same inquiry participant offered their own risk assessment of the probability of major nuclear accidents – arguing that the probability has actually increased in today's times – thereby challenging industry claims about nuclear safety:
- The estimated probability of major nuclear accidents, which was considered very small in the past, has increased significantly. Given that, in the history of nuclear energy, hundreds of reactors have operated for a total of 14,400 years (counting each year of operation by one reactor as a reactor-year), a core-damage accident has happened once every 1,309 years of operation with a total of 12 core melts.
- With approximately 400 reactors operating worldwide, the rate would yield a core melt an average of once every three calendar years, and an even more disastrous accident with release of radioactivity once every 9 years.³⁰¹
- 4.41** A joint submission by Friends of the Earth Australia, the Australian Conservation Foundation and the Nature Conservation Council of NSW advances similar views on the effects of ionising radiation in building a case to continue the legislative prohibitions on nuclear power. It

²⁹⁷ See for example: Submission 4, SMR Nuclear Technology, p 4; Submission 62, Australian Academy of Technology and Engineering, p 1.

²⁹⁸ Submission 55, Joint Civil Society, p 2.

²⁹⁹ Submission 40, Friends of the Earth Australia, pp 54-55.

³⁰⁰ Submission 56, Medical Association for the Prevention of War, p 9.

³⁰¹ Submission 56, Medical Association for the Prevention of War, p 16.

anticipates claims from pro-nuclear groups about the safe threshold for doses of radiation, calling them into question with reference to findings by UNSCEAR:

The Committee will likely receive submissions stating or implying that there is a threshold below which exposure to ionising radiation is harmless. Such views are at odds with expert scientific opinion, including:

- The United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) states in a 2010 report that "the current balance of available evidence tends to favour a non-threshold response for the mutational component of radiation-associated cancer induction at low doses and low dose rates."³⁰²

4.42 In considering issues of safety, other inquiry participants suggested that any serious/fair analysis of nuclear safety should consider the risks in context and relative to other generation technologies – that is, for comparative analysis. For example, Mr Terje Petersen encouraged the committee to consider mortality rates for the nuclear power industry in the context of other electricity generation technologies:

In looking at the risks associated with nuclear energy it is important to do comparative analysis. Alternate technologies like solar, wind, hydro and coal can at times also cause death, produce toxins, displace wilderness and lead to major accidents. The deadliest power plant accident in history was in fact a failed hydroelectric dam in China. The burning of coal releases radiation. The use of solar panels creates long lived toxic waste.³⁰³

4.43 In light of this evidence, Mr Petersen concludes that nuclear is the safest way to make electricity when measured by the number of fatalities per unit of energy produced.³⁰⁴

4.44 Likewise, ANSTO submitted that nuclear accidents are rare when compared to other generation technologies and that, even when the effects of such accidents are considered, nuclear power is still a safe technology compared to other energy sources. According to ANSTO, nuclear power has been found to result in 'the lowest number of fatalities of any major electricity source, many times lower than coal, natural gas, and oil, and lower than biomass.'³⁰⁵ This assertion is illustrated in Figure 7 which shows the health effects of electricity generation in Europe across different energy sources, expressed as deaths per terawatt hour.

³⁰² Submission 64, Friends of the Earth Australia, the Australian Conservation Foundation and the Nature Conservation Council of NSW, p 55.

³⁰³ Submission 10, Mr Terje Petersen, p 1 and p 4.

³⁰⁴ Submission 10, Mr Terje Petersen, p 4.

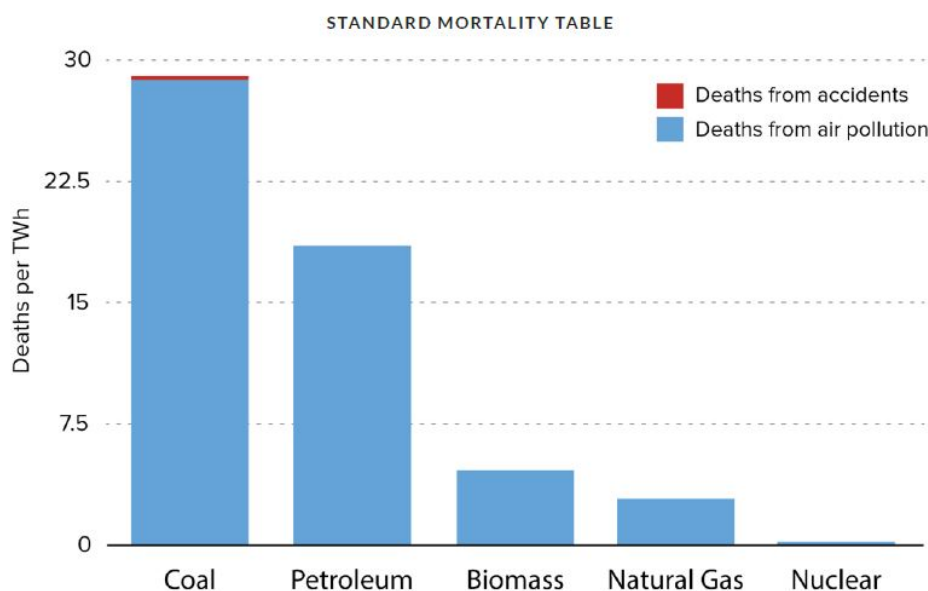
³⁰⁵ Submission 59, Australian Nuclear Science and Technology Organisation, p 44.

Figure 7 Comparative health effects of electricity generation in Europe³⁰⁶

Source	Deaths from Accidents		Air Pollution-Related Effects		
	The Public	Occupational	Deaths*	Serious Illness†	Minor Illness‡
Lignite	0.02 (0.005–0.08)	0.10 (0.025–0.4)	32.6 (8.2–130)	298 (74.6–1193)	17,676 (4419–70,704)
Coal	0.02 (0.005–0.08)	0.10 (0.025–0.4)	24.5 (6.1–98)	225 (56.2–899)	13,288 (3322–53,150)
Gas	0.02 (0.005–0.08)	0.001 (0.0003–0.004)	2.8 (0.70–11.2)	30 (7.48–120)	703 (176–2813)
Oil	0.03 (0.008–0.12)	–	18.4 (4.6–73.6)	161 (40.4–645.6)	9551 (2388–38,204)
Biomass	–	–	4.63 (1.16–18.5)	43 (10.8–172.6)	2276 (569–9104)
Nuclear	0.003	0.019	0.052	0.22	–

Data are mean estimate (95% CI). *Includes acute and chronic effects. Chronic effect deaths are between 88% and 99% of total. For nuclear power, data include all cancer-related deaths. †Includes respiratory and cerebrovascular hospital admissions, congestive heart failure, and chronic bronchitis. For nuclear power, data include all non-fatal cancers and hereditary effects. ‡Includes restricted activity days, bronchodilator use cases, cough, and lower-respiratory symptom days in patients with asthma, and chronic cough episodes. TWh=1012 Watt hours.

- 4.45 The assertion that nuclear is the safest form of energy production was repeated by other inquiry participants,³⁰⁷ with a purported fatality rate many times lower than fossil fuels, as illustrated in Figure 8.

Figure 8 Standard mortality table³⁰⁸

³⁰⁶ Submission 59, Australian Nuclear Science and Technology Organisation, p 44.

³⁰⁷ See for example: Submission 42, Down Under Nuclear Energy, p 12; Submission 4, SMR Nuclear Technology, p 4.

³⁰⁸ Submission 42, Down Under Nuclear Energy, p 13.

- 4.46 It was also suggested to the committee that nuclear has saved almost two million lives by displacing fossil fuel and reducing air-borne emissions.³⁰⁹

Committee comment

- 4.47 The committee acknowledges that all human engineered technologies carry a certain level of risk with respect to safety. Absolute safety can never be guaranteed. Accepting that, the committee considers that, with the introduction of passive safety features, advanced and emerging nuclear technologies are vastly safer than earlier generations and pose minimal risk to human and environmental health.

Finding 6

On the balance of expert evidence gathered for this inquiry, the committee finds that emerging nuclear technologies, particularly Generation III/III+ and Generation IV:

- benefit from significant advancements in reactor safety and design since the enactment of the *Uranium Mining and Nuclear Facilities (Prohibition) Act 1986*;
- are significantly lower risk than earlier nuclear technologies; and
- are considerably safer than other forms of electricity generation in the level of risk they pose to human health and the environment as a result of reducing airborne emissions.

-
- 4.48 The committee furthermore notes the recommendations recently handed down by the House of Representatives Standing Committee on the Environment and Energy (a committee of the Australian Parliament) calling on the Australian Government to undertake a comprehensive technological assessment of Generation III+ and Generation IV nuclear energy reactors to inform consideration of their suitability for adoption in the Australian context.

- 4.49 In this context, we recommend that the NSW Department of Planning, Industry and Environment liaise with the Australian Nuclear Science and Technology Organisation to monitor the regulatory approval and commercialisation of Small Modular Reactors in the United States and elsewhere (as appropriate) and report findings to the NSW Government as they become available. In addition, we recommend that the NSW Chief Scientist and Engineer report to the NSW Government on broader developments in nuclear energy on a regular basis.

Recommendation 3

That:

- the Department of Planning, Industry and Environment liaise with the Australian Nuclear Science and Technology Organisation to monitor the regulatory approval and commercialisation of Small Modular Reactors in the United States and elsewhere (as appropriate) and report findings to the NSW Government as they become available; and
- the NSW Chief Scientist and Engineer report to the NSW Government on broader developments in nuclear energy on a regular basis.

³⁰⁹ Submission 42, Down Under Nuclear Energy, p 12.

Cost of nuclear

- 4.50** Another consideration that exercised much debate among witnesses was whether the high costs for new-build nuclear make it uneconomical, commercially unviable and uncompetitive when compared to the costs for other generation technologies.

Initial start-up/capital costs

- 4.51** Historically, an effective argument for anti-nuclear groups has been that nuclear power plants are simply too expensive to build, with capital costs considered prohibitively high. Similar observations and conclusions have been reached not only by those with anti-nuclear agendas, but also by previous reviews into nuclear power commissioned by Australian governments. As noted in Chapter 1, in 2016, the South Australian Nuclear Fuel Cycle Royal Commission found that, in consideration of the substantial costs of going nuclear, it would not be commercially viable to develop a nuclear power plant in South Australia beyond 2030.³¹⁰ Similarly, the Switkowski review reported in 2006 that nuclear power in Australia would be considerably more expensive to produce than coal fired power if carbon is not priced.³¹¹
- 4.52** In his opening statement to the committee, Dr Jim Green, National Anti-Nuclear Campaigner, Friends of the Earth Australia, explains his position on why prohibitions on nuclear should remain in place, arguing that nuclear power does not pass any reasonable economic test:

... [the prohibitions] have saved Australia and saved New South Wales from the catastrophic cost over-runs with every reactor project in Western Europe and the United States over the past decade. It is a sad truth that every one of those reactor projects is at least A\$10 billion over budget. That's \$10 billion—with a 'B'.³¹²

- 4.53** Dr Green refers to real world examples, including the Hinkley Point project in the United Kingdom, to give weight to his assertion that nuclear power would only be possible in Australia with 'massive taxpayer subsidies':

... in the UK, the lifetime subsidies for the Hinkley Point project alone—a 3.2 gigawatt project—are estimated by the European Union to be A\$55 billion for a two-reactor project. Other credible estimates put those lifetime subsidies at A\$91 billion.³¹³

- 4.54** Dr Green concludes by quoting the senior vice president of Exelon, the largest nuclear power company in the United States, as saying that Exelon does not intend to build any more nuclear power plants in the United States because they are too expensive to construct:

That is in the US where they have a vast amount of infrastructure and expertise but nuclear has clearly priced itself out of the market. The calculations in Australia would

³¹⁰ The Nuclear Fuel Cycle Royal Commission, *Nuclear Fuel Cycle Royal Commission Report*, 2016, p xiv.

³¹¹ Australian Government, *Uranium Mining, Processing and Nuclear Energy: Opportunities for Australia?*, Report to the Prime Minister by the Uranium Mining, Processing and Nuclear Energy Review Taskforce, 2006, p 5.

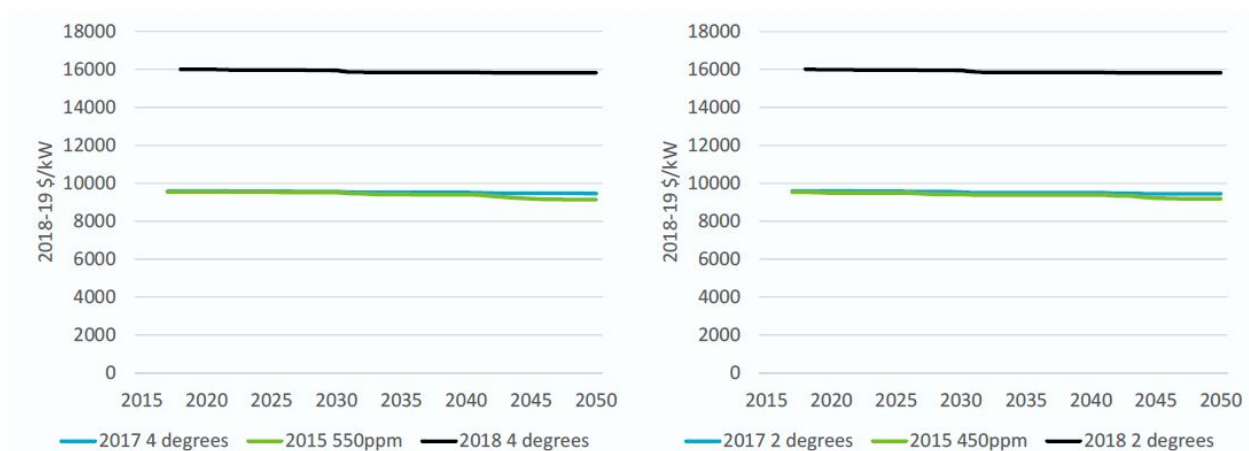
³¹² Evidence, Dr Jim Green, National Anti-Nuclear Campaigner, Friends of the Earth Australia, 11 November 2019, p 27.

³¹³ Evidence, Dr Jim Green, National Anti-Nuclear Campaigner, Friends of the Earth Australia, 11 November 2019, p 27.

certainly be worse because we do not have that infrastructure, we do not have that expertise and we are blessed with renewable energy resources.³¹⁴

- 4.55** This view was shared by the Australia Institute in its submission to the inquiry, arguing that the high costs of nuclear power are widely recognised by groups on both sides of the nuclear debate and are the main obstacle to new-build nuclear energy.³¹⁵
- 4.56** The Australian Energy Market Operator (AEMO) and the Commonwealth Scientific and Industrial Research Organisation (CSIRO) offer a comparative assessment of capital costs for nuclear in Australia via their December 2018 joint report, *GenCost 2018: Updated projections of electricity generation technology costs*. The GenCost initiative is an annual process for updating electricity generation cost data for Australia.³¹⁶
- 4.57** For modelling purposes, the GenCost 2018 report assumed two scenarios to 2050: one in which the global policy goal is to limit temperature increases to no more than 2 degrees Celsius; and the other in which the goal is to limit temperature increases to no more than 4 degrees Celsius.³¹⁷
- 4.58** Under both scenarios, the GenCost 2018 report estimates the capital costs of nuclear – specifically Small Modular Reactors – to be AUD\$16,000 per kilowatt in 2020, with no predicted decline in capital costs over the period to 2050 (as represented by the flat trajectory in Figure 9).

Figure 9 Projected capital costs for nuclear under 4-degree and 2-degree scenarios³¹⁸



- 4.59** The GenCost 2018 capital estimates for nuclear power were a point of contention, with many inquiry participants expressing concerns and reservations about their validity:

³¹⁴ Evidence, Dr Jim Green, National Anti-Nuclear Campaigner, Friends of the Earth Australia, 11 November 2019, p 28.

³¹⁵ Submission 68, The Australia Institute, p 8.

³¹⁶ CSIRO, *GenCost 2018: Updated projections of electricity generation technology costs*, Australian Government, December 2018.

³¹⁷ CSIRO, *GenCost 2018: Updated projections of electricity generation technology costs*, Australian Government, December 2018, p 9.

³¹⁸ CSIRO, *GenCost 2018: Updated projections of electricity generation technology costs*, Australian Government, December 2018, p 16; the 2017 and 2015 projections relate to large scale nuclear and do not offer a valid comparison with the 2018 projections which relate to Small Modular Reactors.

- Dr Donald Higson, a qualified chemical engineer with expertise in nuclear safety, suggested that these figures are three times higher than reality and could not be justified.³¹⁹
- Mr Satyajeet Marar of the Australian Taxpayers' Alliance told the committee the GenCost 2018 report is 'deeply flawed'.³²⁰
- Mr Martin Thomas of the Australian Academy of Technology and Engineering, while acknowledging that the CSIRO is a national treasure, told the committee that nuclear energy is not its field and its estimate of AUD\$16,000 per kilowatt for nuclear power was 'absolutely patently badly wrong'.³²¹
- Mr Steven Rodgers, Senior Policy Advisor, Engineers Australia, asserted that CSIRO does not have the capability when it comes to nuclear.³²²
- Professor Tony Irwin calls into question the source of the GenCost 2018 capital cost projections, noting that 'the World Nuclear Association was not consulted on this matter' and suggesting that they were based on a 300 megawatt Gen IV reactor constructed in 2035 and not the type of Gen III+ SMR that would most likely be built in Australia. According to Prof Irwin, a more realistic figure would be the USD\$3,600 per kilowatt detailed 'bottom up' estimate by Fluor for an Nth-of-a-kind NuScale SMR plant, which translates to AUD\$5,100 per kilowatt.³²³
- Bright New World asserts that the 'stated capital expenditure (AUD\$16,000 per kilowatt) and levelised cost of electricity for SMR nuclear is indefensible and does not withstand scrutiny'.³²⁴

4.60 Engineers Australia weighed in on the debate about the GenCost 2018 figures, submitting that they were not based on the type of reactor that would most likely be deployed in Australia:

In Australia the most recent public assessment is provided by the GenCost2018 report by CSIRO and AEMO. It assumes the capital costs for SMR technology is \$16,000/kW in 2020 (and experiences no major price decline over time). We note this number is more than double other cost estimates worldwide. We have sought additional clarification on the basis for this costing. Initial advice is that the number is based on a GHD estimate for AEMO of costs for a future Gen IV reactor to be constructed in 2035 and not for the type of reactor which would most likely be deployed in Australia.³²⁵

4.61 By contrast, Dr Green of Friends of the Earth Australia submitted that, far from exaggerating or overestimating the costs of new-build nuclear, the GenCost 2018 projections were actually very generous to the pro-nuclear position, and that real world costs would actually be much higher:

³¹⁹ Evidence, Dr Donald Higson, 11 November 2019, p 42.

³²⁰ Evidence, Mr Satyajeet Marar, Director of Policy, Australian Taxpayers' Alliance, 11 November 2019, p 59.

³²¹ Evidence, Mr Martin Thomas, Australian Academy of Technology and Engineering, 18 November 2019, p 20.

³²² Evidence, Mr Steven Rodgers, Senior Policy Advisor, Engineers Australia, 18 November 2019, p 22.

³²³ Submission 45, Professor Tony Irwin, p 3.

³²⁴ Submission 61, Bright New World, p 23.

³²⁵ Submission 58, Engineers Australia, p 11.

There has been a big spat about the CSIRO and AEMO costings with respect to small modular reactors. Their costing is \$16,000 per kilowatt of installed capacity, and the nuclear lobbyists are furious with that and strongly contesting it. What I would say is that if you average the cost of small modular reactors, which are actually under construction in China, Russia and Argentina, that average is higher than the figure given by CSIRO and AEMO. Also, if you look at the reactors being built in the United States—the large reactors—one again, the CSIRO and AEMO figure for nuclear is lower than the real-world cost for reactors that are actually under construction in the US.³²⁶

4.62 Dr Joanne Lackenby, President of Women in Nuclear Australia, acknowledged that upfront capital costs for nuclear are higher than other technologies, but explained that the longevity of today's nuclear power plants – some remaining in service for as long as 100 years – offers a value proposition for the initial investment over the life of a plant. Dr Lackenby noted that, over the same period of time, other generation technologies would need to be replaced multiple times.³²⁷

4.63 Vendor claims for the NuScale SMR model estimate the overnight capital cost for its twelve-module 720 megawatt plant to be USD\$3 billion on a first-of-a-kind basis (that is, for its first customer). This equates to USD\$4,300 per kilowatt. These costs were provided with the following caveat:

This is all based on US costs using US supply chains, US-sourced equipment on a US site. This number will vary in other parts of the world, where the supply chain varies. If we use international best pricing on the supply chain and a different source of labour, in many places around the world labour is less expensive than it is in the US. I stress that these numbers are US-based.³²⁸

4.64 The cost 'learning curve' was referred to in evidence to describe trends and patterns for nuclear technology deployment over time. Typically, as any given technology develops and evolves, and the learnings from previous deployments are realised, this provides opportunities to bring capital costs down for future deployments of that same technology. This is what's known as a 'positive learning curve'. Opponents of the bill - such as the Australia Institute and joint environmental groups – maintained that nuclear power has a 'negative learning curve' – that is, capital costs have actually got more expensive, not less expensive, over time.³²⁹

Levelised cost of electricity

4.65 Capital cost of electricity generation, expressed as cost per megawatt hour, is one metric for measuring and comparing different generation technologies. Another common metric is Levelised Cost of Electricity (LCOE). LCOE is a calculation arrived at by dividing up-front capital and operational costs by the units of electricity generated over the project's economic life.³³⁰ In most cases, LCOE takes into account capital, fuel, and operation and maintenance

³²⁶ Evidence, Dr Jim Green, National Anti-Nuclear Campaigner, Friends of the Earth Australia, 11 November 2019, p 28.

³²⁷ Evidence, Dr Joanne Lackenby, President, Women in Nuclear Australia, 18 November 2019, p 18.

³²⁸ Evidence, Mr Tom Mundy, Chief Commercial Office, NuScale Power, 26 September 2019, p 5.

³²⁹ See for example: Submission 64, Friends of the Earth Australia, Australian Conservation Foundation and Nature Conservation Council of NSW, p 15; Submission 68, The Australia Institute, p 15.

³³⁰ Submission 68, The Australia Institute, p 9.

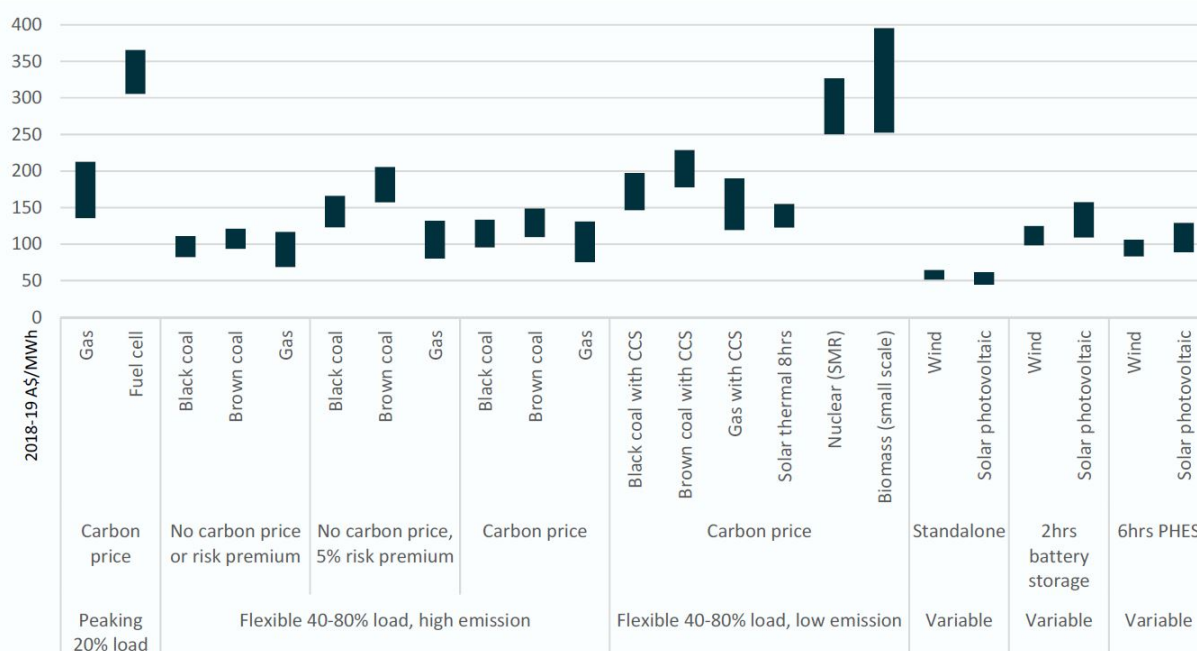
costs, as well as an assumed utilisation rate for each technology type. However, LCOE typically does not capture or reflect the various externalities of each generation technology.³³¹

4.66 Throughout the inquiry, there was wide variation in the LCOE estimates for nuclear power in Australia, with LCOE figures ranging from AUD\$325 per megawatt hour at the high end of the spectrum to AUD\$60 per megawatt hour at the low end of the spectrum.³³²

4.67 In giving evidence to the committee, Mr Tom Mundy of NuScale Power stated that the LCOE for its first project based on the NuScale SMR design is USD\$65 per megawatt hour, but qualified this assertion by highlighting that their first customer is a government instrumentality able to access finance at lower costs. The LCOE for non-government utilities would therefore likely be higher depending on a number of client-specific factors.³³³ Mr Mundy also conceded that NuScale had not undertaken any comparative costings specifically for the Australian market.³³⁴

4.68 The GenCost 2018 report assessed the LCOE for nuclear – on the basis of SMRs – as one of the highest cost generation technologies within the suite of technologies modelled for the 2018 study. LCOE comparisons with other generation technologies are shown in Figure 10.

Figure 10 Calculated LCOE by technology and category for 2020.³³⁵



³³¹ Submission 59, Australian Nuclear Science and Technology Organisation, pp 33-34.

³³² See for example: Submission 67, Minerals Council of Australia, p 5; CSIRO, *GenCost 2018: Updated projections of electricity generation technology costs*, Australian Government, December 2018, p 28.

³³³ Evidence, Mr Tom Mundy, Chief Commercial Officer, NuScale Power, 26 September 2019, p 8.

³³⁴ Evidence, Mr Tom Mundy, Chief Commercial Officer, NuScale Power, 26 September 2019, p 6.

³³⁵ CSIRO, *GenCost 2018: Updated projections of electricity generation technology costs*, Australian Government, December 2018, p 28.

4.69 Again, the LCOE modelling published by CSIRO and AEMO was not unanimously accepted by all inquiry participants.

4.70 According to the Australian Nuclear Association, nuclear power is competitive with fossil fuel and renewables when assessed using the LCOE metric:

The International Energy Agency analysed different electricity technologies and found that nuclear power is competitive in terms of the levelised cost of electricity (LCOE) with fossil fuel and renewables. The long potential operating life and low operating costs of nuclear offset the high construction costs.³³⁶

4.71 The Minerals Council of Australia offered an LCOE calculation for SMRs that was significantly lower than the CSIRO and AEMO modelling. It asserted:

Once manufacturing has been established, the Levelised Cost of Electricity (LCOE) from SMRs could be as low as around A\$60/MWh. This would likely make SMRs the cheapest zero emissions power source capable of providing 24/7 energy of any technology, including renewables with storage and coal with [Carbon Capture and Storage].³³⁷

4.72 Under examination, Mr Patrick Gibbons, Principal Advisor for the Minerals Council of Australia, was asked to clarify the basis for this LCOE calculation. Mr Gibbons remarked:

The study we cited was a study by the Canadian Small Modular Reactor [SMR] Roadmap. Basically in there it had a range of numbers. We are saying it could be as low as \$60, but I think in our submission we have provided a table where we provide what the range is—it is \$60 to \$110. The Canadian roadmap is a serious piece of work done last year and it is basically looking at various technologies, going and talking to the individual companies and getting what is basically a bottom-up cost assessment of when they put all this stuff together how much it is going to be producing for.³³⁸

4.73 Several witnesses gave evidence about the limitations of LCOE as a valid metric for assessing and comparing electricity generation costs across the different generation technologies.³³⁹

4.74 For example, Mr Robert Parker, Vice President of the Australian Nuclear Association, advised the committee that LCOE does not capture or take into account externalities such as the excess capacity requirement for technologies with low capacity factors, the cost of back-up plants for firming, and transmission costs within the grid:

Levelised cost of electricity is at the system, as the generator connection point to the transmission grid. After that, you quite correctly raised other issues such as ancillary services in those.

Those are additional costs that go into what we call the system levelised cost. For example in New South Wales we are spending about \$1.50 a megawatt hour on an

³³⁶ Submission 27, Australian Nuclear Association, p 4.

³³⁷ Submission 67, Minerals Council of Australia, p 5.

³³⁸ Evidence, Mr Patrick Gibbons, Principal Advisor, Energy, Minerals Council of Australia, 18 November 2019, p 7.

³³⁹ See for example: Evidence, Professor Stephen Wilson, Centre for Energy Futures, University of Queensland, 18 November 2019, p 44.

ancillary cost and we are spending the best part of \$42 per megawatt hour on our transmission and distribution. These are over and above the levelised cost. Levelised cost stops at the point where that generator is connected to the grid.

[...]

What happens when these backup plants have to go into the cost of energy, their capital costs, their recurring overheads drive up our energy prices. So it is all of these extra bits of backup and ancillary that drive up our total system levelised cost.³⁴⁰

- 4.75** Other inquiry participants implied that using LCOE calculations to compare generation technologies leads to skewed results for nuclear power, as it does not build in factors such as: transmissions costs; the cost of back-up for variable or intermittent technologies; and the excess capacity costs for technologies that typically do not generate to their full capacity.³⁴¹ It was suggested that, if these externalities were factored into cost calculations, nuclear power would be competitive with other technologies on a cost per megawatt hour basis:

System Levelised Cost of Electricity (SLCOE) being the final system cost which incorporates all the types of generation in the mix. The commonly quoted Levelised Cost of Electricity (LCOE) is frequently thought of as being a constant value. It is not. The LCOE varies according to how much time the output of a generator actually contributes to the system and of course, how much of its energy is either curtailed or wasted. The output from the model developed by Dr Robert Barr fully accounts for the varying LCOE of each generator and adds an allowance for additional transmission to produce a final system cost or SLCOE.³⁴²

- 4.76** Echoing this view, Mr Fleay of Down Under Nuclear Energy impugned cost of generation metrics which were 'selective' or 'meaningless', asserting instead that '[w]ith a wide range of electricity options that each have different deployment and operating attributes, total system costs are now widely acknowledged as the only meaningful basis of comparison.'³⁴³ Dr Ziggy Switkowski AO, in giving evidence on whether the introduction of nuclear power would bring down electricity costs to end consumers, emphasised that cost comparisons for the various technologies must 'properly account for externalities', for example the cost of back-up to cover for intermittencies in renewable generation.³⁴⁴
- 4.77** Similarly, SMR Nuclear Technology asserted that, considering the economics of different generation technologies, it is essential to understand the distinction between generation costs and power system costs and to adjust for the low capacity factors, additional transmission cost and firming costs of renewable energy forms.³⁴⁵
- 4.78** Modelling using the System Levelised Cost of Electricity (SLCOE) was admitted into evidence and was commended to the committee by several written submissions as an alternative to the

³⁴⁰ Evidence, Mr Robert Parker, Vice President, Australian Nuclear Association, 11 November 2019, p 19.

³⁴¹ See for example: Submission 4, SMR Nuclear Technology, p 8.

³⁴² Submission 1, Mr Barrie Hill, Appendix 2, p 35.

³⁴³ Evidence, Mr James Fleay, Chief Executive Officer, Down Under Nuclear Energy, 11 November 2019, p 40.

³⁴⁴ Evidence, Dr Ziggy Switkowski AO, Private citizen, 11 November 2019, p 53.

³⁴⁵ Submission 4, SMR Nuclear Technology, p 8.

CSIRO and AEMO modelling published in the GenCost 2018 report.³⁴⁶ This alternative economic model was referred to throughout the inquiry as modelling by Robert Barr.³⁴⁷

4.79 Drawing on the Robert Barr model, Mr Barrie Hill, an expert in nuclear engineering, offers an economic evaluation of the feasible options for replacing Australia's ageing electricity assets using economic analysis which, it is claimed, 'incorporates all local engineering and cost data accurately reflecting the Australian east coast grid demand, technically viable generation options, and electricity transmission requirements.' On the basis of this evaluation, Mr Hill concludes that the introduction of nuclear power would lead to similar whole of system costs of electricity for consumers as other new reliable supply options albeit with significantly lower emissions.³⁴⁸ Mr Hill commends to the committee that 'the implementation of a nuclear power investment program by government provides the lowest cost, lowest emission outcome for Australia's future electricity sector.'³⁴⁹

Committee comment

4.80 The committee notes that, given the conflicting data on the overnight capital and operational costs for nuclear power in the Australian context, further independent and detailed analysis and modelling is required to properly evaluate the viability of nuclear energy from an economic perspective. This modelling should take into account:

- all relevant inputs and variables as well as the specificities of the New South Wales electricity system;
- the costs for any new connection, transmission or other system/network infrastructure that would be required over and above the State's existing network infrastructure; and
- the projected impact on New South Wales climate emissions and any opportunities or costs that entails or avoids.

4.81 The committee notes the recommendations recently handed down by the House of Representatives Standing Committee on the Environment and Energy (a committee of the Australian Parliament) calling on the Australian Government to undertake an independent assessment of the economic viability of nuclear energy in the Australian context. While there may be opportunities to borrow from this assessment, the committee is of the view that any future economic assessment of nuclear energy should be specific to the New South Wales context and therefore recommends that separate modelling be undertaken.

³⁴⁶ Tabled document, Mr Barry Murphy, *Reliable and affordable electric power generation*, short report by Dr Robert Barr, Mr Barry Murphy, Dr Mark Ho, Mr Martin Thomas and Mr Barrie Hill, November 2019.

³⁴⁷ Evidence, Mr David Frith, Director, Industry and Environment, NSW Minerals Council, 18 November 2019, p 6; Evidence, Mr Robert Parker, Vice President, Australian Nuclear Association, 11 November 2019, p 18.

³⁴⁸ Submission 1, Mr Barrie Hill, p 1.

³⁴⁹ Submission 1, Mr Barrie Hill, p 17.

Recommendation 4

That the NSW Government commissions independent and detailed analysis and modelling to properly evaluate the viability of nuclear energy from an economic perspective, taking into account:

- all relevant inputs and variables as well as the specificities of the New South Wales electricity system;
- the costs for any new connection, transmission or other system/network infrastructure that would be required over and above the State's existing network infrastructure; and
- the projected impact on New South Wales climate emissions and any opportunities or costs that entails or avoids.

Construction times

4.82 One of the arguments the committee heard in making a case against nuclear power was that the construction times for new-build nuclear – in a state where there is not already any existing nuclear industry – are so lengthy and protracted as to render it unfeasible.

4.83 For instance, the Australia Institute offers a stark evaluation of the performance of the nuclear industry globally in delivering new power plants on time and within budget, characterising an industry in which delays and cost blow-outs are widespread and common:

Long construction times and delays have plagued the nuclear industry throughout its history. This is a major factor behind cost blowouts. [...] All large infrastructure projects are prone to construction and cost blowouts, but nuclear blowouts are particularly widespread and costly. Two-thirds of all nuclear power plants currently under construction are already delayed, and nearly half of those had seen increased delays in the year to 2017-18. [...] Reactors completing construction over the last decade took on average 10 years to build. Construction times ranged from 4.1 years to 43.5 years.³⁵⁰

4.84 The Australia Institute concludes that – since any future nuclear power plant in Australia would be first-of-a-kind – construction times in Australia are likely to be above the global average, and that nuclear power in Australia is 'not a realistic option for more than a decade and possibly not even for the next.'³⁵¹

4.85 Friends of the Earth Australia, the Australian Conservation Foundation and the Nature Conservation Council of NSW also commended to the committee a bleak industry scorecard for nuclear, highlighting what they consider to be a number of problematic projects currently under construction including:

- In Finland, the construction of a pressurized water reactor is 10 years behind schedule;
- In France, the construction of a pressurized water reactor is seven years behind schedule; and

³⁵⁰ Submission 68, The Australia Institute, p 13.

³⁵¹ Submission 68, The Australia Institute, p 14.

- In China, the construction of high temperature gas cooled reactor is behind schedule and over budget.³⁵²

4.86 In a similar vein, MAPW claimed that the construction of a nuclear reactor in Australia would be prohibitively slow – in its view, at least 15 years even for SMR construction – and therefore too slow to address the urgent imperative for climate action. This was one of a range of concerns that justified retaining the legislative prohibition on nuclear power according to MAPW.³⁵³

4.87 In advancing his support for the bill, Mr Zac Peterson acknowledged the extraordinarily long construction times for nuclear power and submitted that there was no correlation between construction times and the operational lives of past nuclear power plants. However, Mr Peterson argued that this does not warrant excluding nuclear power from consideration:

[Construction] times can range between 5-30 years, with an average of 7.5 years, and 85% of reactors being below the 10-year mark. There was also no correlation found between construction time and years run for, and most commonly problem reactors had very long construction times and were of the Russian/Soviet VVER V models. This construction time is more than other forms of electricity and is often criticised as we supposedly don't have time in the wake of climate catastrophe for nuclear. [...] So yes, construction time is a large issue, but in terms of the issues we have at hand it is not nearly enough to justify the rejection of nuclear, not even a reason to consider it.³⁵⁴

4.88 In balancing supporting and opposing arguments for nuclear energy, Dr Ziggy Switkowski AO expressed the view that, from a standing start, the development and implementation of Australia's first nuclear reactor for electricity generation would be a long and involved process, explaining that:

Given Australia begins from a standing start, the first reactor (of any commercial scale) would take about 15 years to reach normal operation (and generate revenues) through the stages of: changes to legislation, skill building, design, community consultation, site selection, environmental approvals, vendor selection, construction, accreditation and operation. Given overseas experience, the risk is in the direction of longer times.³⁵⁵

4.89 As a counterpoint to this evidence, several inquiry participants proffered SMRs as technologies that can potentially overcome the issue of construction time owing to efficiencies achieved by factory fabrication, assembly line construction and simplicity in design.³⁵⁶

4.90 Highlighting these efficiencies, Mr Mundy of NuScale Power told the committee that the construction timeframes for the NuScale technology are much shorter than those for large scale plants:

³⁵² Submission 64, Friends of the Earth Australia, the Australian Conservation Foundation and the Nature Conservation Council of NSW, pp 15, 14 and 5.

³⁵³ Submission 56, Medical Association for the Prevention of War, p 2.

³⁵⁴ Submission 13, Mr Zac Peterson, pp 4-5.

³⁵⁵ Submission 69, Dr Ziggy Switkowski AO, Private citizen, p 2.

³⁵⁶ See for example: Submission 4, SMR Nuclear Technology, p 8; Submission 42, Down Under Nuclear Energy, p 27; Evidence, Dr Kath Smith, Executive Committee Member, Women in Nuclear Australia, 18 November 2019, p 17.

The construction time frames, because of the simplicity and the fact that the entirety of the nuclear supply system and containment are made in a factory, the construction duration and the schedule are much shorter than you find for current big plants. We are talking about a 36-month construction period as opposed to five, six, seven, eight years that some of these bigger plants have taken to build the facilities themselves.³⁵⁷

- 4.91** Taking a similar outlook on timeframes for advanced nuclear, Mr Gibbons of the Minerals Council of Australia repudiated claims that a viable reactor in Australia would be 20 to 30 years down the track, arguing instead that SMRs could be operating in Australia in a matter of years not decades:

The argument then I think swings onto, you know, these things will not be 20 or 30 years down the track. Small modular reactors—I think you have had a presentation from NuScale, which is the closest to commercialisation. It is expecting to be going through the US regulatory approval process sometime next year. It is expecting sometime in around 2026 or 2027 to be having the first reactors coming off the line. In the Australian and New South Wales context you should be looking at –

[...]

In the Australian and New South Wales context there is no reason we should not be able to look at this, say, around about 2030.³⁵⁸

Committee comment

- 4.92** The committee acknowledges the differing views on the construction time for new-build nuclear power. As recommended earlier, we support continued monitoring of the commercialisation and construction of SMRs in the United States, including the first NuScale Power implementation in Idaho, as this will provide a real world opportunity to test claims about their shorter construction timeframes.

Waste

- 4.93** In evaluating whether or not nuclear energy could play a role in New South Wales, another key consideration raised in evidence was the issue of waste – in particular, whether proven solutions exist to manage spent fuel waste should nuclear energy be adopted in the State.
- 4.94** Evidence gathered on the issue of waste commonly referred to three distinct levels of radioactive waste based on International Atomic Energy Agency classifications: namely, low level, intermediate level and high level waste. Each of these categories of waste have their unique storage/management practices and requirements.³⁵⁹
- 4.95** Low level waste is generated in hospitals and in industrial applications, as well as in the nuclear fuel cycle. It typically comprises paper, rags, tools, clothing, and filters, which contain small

³⁵⁷ Evidence, Mr Tom Mundy, Chief Commercial Officer, NuScale Power, 26 September 2019, p 5.

³⁵⁸ Evidence, Mr Patrick Gibbons, Principal Advisor, Energy, Minerals Council of Australia, 18 November 2019, p 5.

³⁵⁹ See for example: Submission 45, Professor Tony Irwin, p 2; Submission 52, Nuclear for Climate Australia, p 23.

amounts of mostly short-lived radioactivity. Low-level waste does not require shielding during handling and transport, and is suitable for disposal in near surface or surface facilities.³⁶⁰

4.96 Intermediate level waste is more radioactive than low level waste and typically comprises resins, chemical sludges, and metal fuel cladding, as well as contaminated materials from reactor decommissioning and the waste arising from the reprocessing of research reactor fuel. Unlike low level waste, intermediate level waste requires a certain level of shielding when being handled.³⁶¹

4.97 High level waste arises from the burning of uranium fuel in a nuclear reactor, and contains the fission products and transuranic elements generated in the reactor core. As a result of its decay heat, high level waste significantly increases its temperature and the temperature of its surrounds and therefore requires both cooling and shielding.³⁶²

4.98 It was noted that, at present, the Lucas Heights reactor operated by ANSTO does produce nuclear waste, but not high level waste.³⁶³ Dr Patterson explained to the committee how Australia's nuclear waste is currently dealt with:

At the moment the nuclear spent fuel from Lucas Heights is sent over to France where it is reprocessed and, as far as I understand, they do not extract any plutonium from it either; they get rid of the high-level waste and they send us back the remainder, which is then stored in concrete canisters at Lucas Heights.³⁶⁴

4.99 If Australia/New South Wales were to adopt nuclear power, this would, by necessity, produce high level waste in the form of spent nuclear fuel which would need to be managed and stored appropriately. In understanding what these requirements might look like, the committee considered evidence about how nuclear nations currently deal with spent fuel from nuclear power plants as high level waste.

4.100 The committee noted that a common international practice for managing radioactive waste involves holding it in cooling ponds in the first instance, before transferring it to dry casks for on-site storage.³⁶⁵ Fuel is commonly discharged from the reactor, held in cooling ponds for five to ten years, then transferred to a dry storage casks for 30 to 40 years before it is safe to be disposed of. The radiotoxicity of spent fuel reduces by 70 per cent in the first ten years of storage.³⁶⁶ Dr Switkowski AO described this practice succinctly and in laypersons' terms:

The fuel rods go into a reactor. They come out of two or three years with the enriched uranium being consumed. They are very radioactive. They are queued up in something that looks like an Olympic sized swimming pool about 10 metres deep. They sit there for between five and 15 years because they are very radioactive and they are thermally hot by virtue of the disintegrations that were going on.

³⁶⁰ Submission 59, Australian Nuclear Science and Technology Organisation, p 36.

³⁶¹ Submission 59, Australian Nuclear Science and Technology Organisation, p 36.

³⁶² Submission 59, Australian Nuclear Science and Technology Organisation, p 36.

³⁶³ Submission 59, Australian Nuclear Science and Technology Organisation, p 36.

³⁶⁴ Evidence, Dr John Patterson, 18 November 2019, p 52.

³⁶⁵ See for example: Evidence, Dr John Harries, Secretary, Australian Nuclear Association, 11 November 2019, p 21; Evidence, Dr Donald Higson, 11 November 2019, p 45.

³⁶⁶ Submission 59, Australian Nuclear Science and Technology Organisation, p 39.

So let's say they are in the pool for 10 years. The most radioactive stage is then expended. They are then taken to a facility. They are crunched up and mixed in with ceramic, concrete or other forms of vitrification and outcomes a cylinder. The cylinder is about a metre wide and about three metres high. It looks like a concrete cylinder. They put it in a paddock adjacent to the reactor, and queue them up. You might get three or four a year. Gardeners work around them. They ride their ride-on mowers. If you stand up and touch them they are vaguely warm so you know something is going on in there, and it is just the disintegration. They are largely benign. They are awaiting permanent storage ...³⁶⁷

- 4.101** This describes the common industry practice for holding or storing radioactive waste in an interim state to attenuate its toxicity, awaiting permanent disposal. This process is not an ultimate solution for dealing with waste in the long term. One of the questions examined, as a logical extension of the waste issue, was what happens to radioactive waste after it has been stored on-site and what permanent solutions are available for its disposal. There was consensus among inquiry participants that the most appropriate permanent solution to deal with high level radioactive waste involves disposal in deep geological repositories.³⁶⁸
- 4.102** One of the arguments the committee heard from opponents of the bill was that, globally, there is no proven, effective and lasting solution for the permanent disposal of radioactive waste. For example, Dr Green of Friends of the Earth Australia, maintained that the legislative prohibitions on nuclear should remain in place because '... no-one could have any confidence that satisfactory solutions could be found for waste streams. Globally, no country has a repository for high-level nuclear waste.'³⁶⁹ This assertion was repeated in evidence by other inquiry participants opposed to the bill.³⁷⁰
- 4.103** For Dr Switkowski AO, the question of whether there exists proven solutions around the world to permanently deal with radioactive waste was a pertinent one which may not justify maintaining the bans on nuclear, but nevertheless warrants attention in contemplating the prospects of nuclear power in New South Wales. Referring to the political complexities of managing radioactive waste, Dr Switkowski AO remarked that '[n]o country has yet commissioned and completed a spent fuel or high level waste facility. Australia has struggled even to get traction to build a small low level facility in Central Australia.'³⁷¹
- 4.104** Arguments that identified waste as a justification for continuing the prohibitions on nuclear were challenged in evidence by Women in Nuclear Australia. In its submission to the inquiry, Women in Nuclear Australia emphasised that the radioactivity of nuclear waste diminishes over time, losing 99.9 per cent of its radioactivity in the first 40 years, while noting that deep underground facilities are currently being developed around the world:

³⁶⁷ Evidence, Dr Ziggy Switkowski AO, Private citizen, 11 November 2019, pp 50-51.

³⁶⁸ See for example: Submission 59, Australian Nuclear Science and Technology Organisation, p 39; Submission 67, Minerals Council of Australia, p 6; Submission 4, SMR Nuclear Technology, p 7.

³⁶⁹ Evidence, Dr Jim Green, Anti-nuclear Campaigner of Friends of the Earth Australia, 11 November 2019, p 27.

³⁷⁰ See for example: Submission 56, Medical Association for the Prevention of War, p 2; Submission 68, The Australia Institute, p 37.

³⁷¹ Submission 69, Dr Ziggy Switkowski AO, Private citizen, p 3.

Unlike other toxic wastes, the principle hazard associated with nuclear waste is radioactivity, which diminishes over time. Used nuclear fuel loses 99.9% of its radioactivity in the first 40 years, making it easier to handle and manage. Storage underwater and in dry casks is common international practice. Sweden and Finland (both of whom have chosen an “open fuel cycle”, i.e. to not reprocess/recycle their used fuel) are building deep underground facilities to dispose of their waste. Perceptions that there is no effective solution to manage radioactive waste are incorrect. There are a number of countries with well-established policies for waste disposal. Used fuel can also be seen as a valuable resource as the uranium, plutonium and, in future, minor actinides, can be recycled and reused in nuclear fuel.³⁷²

- 4.105** According to the weight of expert evidence, France, Finland and Sweden are the closest to constructing deep geological repositories for the disposal of nuclear waste.³⁷³ In particular, ANSTO advised the committee that:

Finland, France, and Sweden are the most advanced states in terms of planning for, and constructing, geological facilities—either for the direct disposal of fuel assemblies in a multi-barrier system in the case of Finland and Sweden, or for the disposal of reprocessed, vitrified waste residues in the case of France. Finland has received a construction licence for its geological disposal facility, which is expected to be operational in the early 2020s. France and Sweden have submitted licence applications and aim to commence operation in 2030 (in the case of France) or construction within the next decade (in the case of Sweden).³⁷⁴

- 4.106** Nuclear for Climate Australia also identified Finland and Sweden as leaders in efforts to construct and license disposal facilities, but also cited the United States Waste Isolation Pilot Plant as proof of concept.³⁷⁵
- 4.107** With respect to the repositories in Finland and France, Mr Dayne Eckermann of Bright New World advised the committee that these facilities are well advanced – with canisters being tested underground 'as we speak' – while noting that France reprocesses its spent fuel to make new fuel, thereby shortening the lifespan of the remaining nuclear waste.³⁷⁶
- 4.108** Nuclear for Climate Australia submitted that 'New South Wales has large areas with very stable geology which could be suitable for deep geological disposal or spent fuel or high level waste.'³⁷⁷ Other inquiry participants also pointed to the possibility of deep geological disposal of waste.³⁷⁸
- 4.109** Dr Switkowski AO, for instance, considered the prospect of establishing a deep geological repository in Australia, arguing that from an engineering point of view, the design and construction of such a repository would be relatively 'straightforward':

³⁷² Submission 44, Women in Nuclear Australia, p 15.

³⁷³ See for example: Evidence, Dr Kath Smith, Executive Committee Member, Women in Nuclear Australia, 18 November 2019, p 16; Evidence, Dr Donald Higson, 11 November 2019, p 46; Submission 4, SMR Nuclear Technology, p 7; Evidence, Dr John Harries, Secretary, Australian Nuclear Association, 11 November 2019, p 22.

³⁷⁴ Submission 59, Australian Nuclear Science and Technology Organisation, p 39.

³⁷⁵ Submission 52, Nuclear for Climate Australia, p 25.

³⁷⁶ Evidence, Mr Dayne Eckermann, General Manager, Bright New World., 11 November 2019, p 46.

³⁷⁷ Submission 52, Nuclear for Climate Australia, p 24.

³⁷⁸ Submission 65, Australian Taxpayers' Alliance, p 4; Submission 70, Australian Workers' Union, p 27.

Even without knowing the details of any one of the States' population distributions and geographies—I think I heard an earlier commentary on this—look at what you need. You need to find an area which is geologically stable; you need it to be away from running water; you need it to be generally away from people. Three-quarters of the continent, I think, satisfies that criteria.

[...]

The engineering of a permanent facility is very straightforward. In a way, if it were not for the fact that people think that there might be value in the future of these radio-active components, all you would need to do is to drill a hole 500 metres deep, which is not a deep mine. I am being colourful, but you could just drop these in there and put in a bit of concrete and some soil and go away. It is really that simple.³⁷⁹

- 4.110** In response to requests for clarification by the committee, Dr Lackenby of Women in Nuclear Australia explained to the committee that radioactive material on the higher end of the spectrum has a shorter lifetime and therefore breaks down unlike other forms of industrial waste:

My understanding is that things like heavy metal and asbestos do not break down with time. That may not be technically correct and it may be a broad statement to make. But with the radioactive material, the more radioactive it is, the shorter its lifetime. If you can imagine that a very radioactive atom is like a small kid who is full of energy—they get rid of their energy very quickly and then become stable. Things like uranium have a longer lifetime because they are not very radioactive. They just sit there and give off some radiation now and then. The more radioactive a substance is, the shorter its lifetime. The less radioactive a substance is, the longer its lifetime.³⁸⁰

- 4.111** In a similar vein, Bright New World highlighted the performance of the nuclear waste industry worldwide, asserting that there has been no unplanned release since 1971:

The Nuclear Fuel Cycle Royal Commission's final report extensively assesses the nuclear waste industry and demonstrates there are accepted practices and facilities to manage and handle the waste, with minimal environmental impact. In the 40 years of nuclear waste transportation in Australia there have not been any accidents during the transport of nuclear material that have caused a significant release of radiation or harm to the environment. Globally this experience is echoed with no significant releases of radiation to the environment from 25,000 cargoes of used fuel since 1971.

Nuclear waste from power generation, particularly spent nuclear fuel, is a well understood and managed hazard. It is fully encapsulated, stored, recycled or disposed in purpose-built facilities handled by experts in radiation protection and nuclear safety. With this management, expertise and professionalism, the risk to the public from spent nuclear fuel is negligible.³⁸¹

³⁷⁹ Evidence, Dr Ziggy Switkowski AO, Private citizen, 11 November 2019, p 51.

³⁸⁰ Evidence, Dr Joanne Lackenby, President, Women in Nuclear Australia, 18 November 2019, p 19.

³⁸¹ Submission 61, Bright New World, p 11.

- 4.112** The committee considered other evidence indicating that advanced reactor designs promise to use fuel more efficiently and minimise waste.³⁸² ANSTO, for instance, maintained that Generation IV designs offer the potential of 'burning' radioactive waste to close the fuel cycle.³⁸³
- 4.113** One of the technologies showcased during the committee's visit to ANSTO on 24 July 2019 was the Synroc Waste Treatment Facility, a first-of-a-kind plant for the treatment of intermediate level waste derived from the production of radioisotopes for medical imaging. Once construction of the facility is complete, it will utilise ANSTO's Synroc technologies to transform waste through various leading-edge treatments into a final durable solid compact with the required performance characteristics suitable for final disposal. The Synroc technology mimics the natural ability of rocks to contain radioactivity, and reduces by volumes on average by up to 90 per cent compared to traditional waste treatment methods such as cementation. The technology was first investigated in the 1980s and can handle both solid and liquid nuclear wastes.³⁸⁴
- 4.114** For some union representatives, part of their opposition to the bill was driven by concerns over poor social outcomes for Indigenous communities potentially impacted by radioactive waste management arrangements. Referring to the as-yet unrealised National Radioactive Waste Management Facility – a process that has been going on for 30 years³⁸⁵ – the Maritime Union of Australia argued that nuclear power in Australia would generate far more waste than Australia's existing research reactor without any solution for what to do with it, noting:

... the Australian government has not been able to find anywhere to put it that does not generate considerable anxiety and opposition from Traditional Owners and community members. The attempts of successive federal government to construct a nuclear waste facility have been thwarted by persistent community campaigns and legal actions. [...]

Significant government resources are currently being thrown at advancing the assessment of three shortlisted sites in South Australia - one on Adnyamathanha country in the Flinders Ranges and two in the Kimba region of the Eyre Peninsula. The SA waste dump plan has caused great anxiety and stress for Traditional Owners and local community members near the sites. [...]

Adnyamathanha Traditional Owner Regina McKenzie describes the Flinders Ranges as "arngurla yarta" (spiritual land), and describes how "the proposed dumpsite contains thousands of Aboriginal artefacts. Our ancestors are buried there. We don't want a

³⁸² For a comparison of solar PV waste and spent fuel waste from a 12-module NuScale plant, see: Submission 4, SMR Nuclear Technology, p 6.

³⁸³ Submission 59, Australian Nuclear Science and Technology Organisation, p 19.

³⁸⁴ Australian Nuclear Science and Technology Organisation, *About Molybdenum-99 and Technetium-99m*, Fact sheet, Australian Government, p 2; Standing Committee on State Development, NSW Legislative Council, *Site visit report: Australian Nuclear Science and Technology Organisation (ANSTO), Lucas Heights 24 July 2019*, Uranium Mining and Nuclear Facilities (Prohibitions) Repeal Bill 2019, p 3; Australian Nuclear Association, *13th conference on nuclear science and engineering in Australia: Nuclear for a low carbon future*, Conference handbook, 27 September 2019, p 25.

³⁸⁵ Evidence, Dr John Harries, Secretary, Australian Nuclear Association, 11 November 2019, p 21; on 1 February 2020, Minister Canavan, Minister for Resources and Northern Australia, announced that Napandee in Kimba had been selected to host Australia's National Radioactive Waste Management Facility.

nuclear waste dump here on our country and worry that if the waste comes here it will harm our environment and muda (our lore, creation)."³⁸⁶

- 4.115** Dr Donald Higson, Mr Dayne Eckermann of Bright New World, Mr John Harries of the Australian Nuclear Association all formed the view that the issue of radioactive waste is primarily a political issue, not a technical one.³⁸⁷ That is, the political challenges posed by the issue of radioactive waste were considered far more intractable than the technical challenges.

Committee comment

- 4.116** The committee notes that, while feasible technical solutions are being developed around the world for deep geological storage and other forms of storage, the management of high level radioactive waste in the form of spent nuclear fuel remains a political challenge, especially around the siting of any future permanent management or disposal facility.
- 4.117** However, the committee is encouraged by waste management innovations in Australia and internationally, especially in France, Finland and Sweden where deep geological repositories are being developed.
- 4.118** On balance, the evidence gathered by the committee on the issue of waste indicated that, while this is something that would require detailed consideration and planning if nuclear energy is to be adopted, this should not impede consideration of nuclear energy as part of the State's future energy mix. The Synroc innovations by ANTSO speak to the potential for Australia to become an innovator and leader in radioactive waste management.

Weapons

- 4.119** Concerns about the proliferation of nuclear weapons were among the issues raised by inquiry participants against the bill. Leading the charge is a submission to the inquiry by the International Campaign to Abolish Nuclear Weapons Australia (ICAN), which sets out evidence in support of a correlation between civilian nuclear power programs and weapons proliferation, advancing the assertion that no civilian nuclear power program is ever proliferation-proof.³⁸⁸
- 4.120** ICAN's case against nuclear power is premised on the following tenets:
- the documented historical link between civilian nuclear power programs and weapons programs in countries such as South Africa, Pakistan, India, Israel and North Korea
 - that the basic technologies for nuclear power and weapons are the same, providing opportunities to produce weapons-grade uranium at various stages of the nuclear fuel cycle, including at the fuel enrichment stage, during the operation of a nuclear reactor, and in the treatment and reprocessing of spent reactor fuel
 - that, contrary to industry claims, no type of nuclear reactor is proliferation-proof

³⁸⁶ Submission 43, Maritime Union of Australia, p 7.

³⁸⁷ See for example: Evidence, Dr John Harries, Secretary, Australian Nuclear Association, 11 November 2019, p 21; Evidence, Dr Donald Higson, 11 November 2019, p 46; Evidence, Mr Dayne Eckermann, General Manager, Bright New World, 11 November 2019, p 46.

³⁸⁸ Submission 48, International Campaign to Abolish Nuclear Weapons Australia, p 3.

- that the international nuclear safeguard system is inadequately funded and therefore does not inspire confidence that safeguards against weapons proliferation can be totally policed
- the risk that any move towards nuclear power in Australia could be read – or more accurately misread – as a proliferative signal to our international neighbours, thereby encouraging other states in our region to seek nuclear technologies with the future option of developing weapons³⁸⁹

4.121 Citing anti-nuclear campaigners, ICAN rejects industry claims that SMRs minimise or eliminate the risk of proliferation, suggesting instead that they could become the technology of choice for proliferators owing to their lower initial capital costs.³⁹⁰

4.122 Adding their voice to concerns about weapons proliferation, MAPW placed significant emphasis on the dual purpose nature of nuclear technologies, observing that even if a nuclear state has not developed nuclear weapons, the dual purpose of nuclear technologies means that the capacity to do so is there.³⁹¹

4.123 With the exception of the Australian Worker's Union, union groups that participated in the inquiry shared concerns about weapons proliferation, reflecting the union movement's long-held policy positions on nuclear power.³⁹² Strong opposition to the bill from environmental groups was also motivated in part by concerns about nuclear weapons.³⁹³

4.124 In contrast, several inquiry participants underscored Australia's commitments and obligations under international safeguard and non-proliferation treaties, its internationally recognised non-proliferation efforts and its esteemed standing on nuclear security in the international community to combat arguments about the proliferation risk of nuclear power.³⁹⁴ For instance, Women in Nuclear Australia acknowledged the dual purpose nature of reprocessing facilities, but asserted that the introduction of nuclear power in New South Wales would not lead to increased risk of weapons proliferation:

Nuclear energy does not increase the risk of proliferation of nuclear weapons. While enrichment and reprocessing facilities can be dual purpose and used in the production of weapons, Australia is committed to the Nuclear Non-Proliferation Treaty (NPT) and is a good global citizen abiding and supporting the International Atomic Energy Agency's (IAEA's) safeguards programs which are effective at policing proliferation activities. If New South Wales introduced nuclear power into its energy mix, then it could provide more technical support to the IAEA's safeguard program within the region. In addition, nuclear technologies in reactor and fuel design are working towards fuel and waste products that are not proliferation risks.³⁹⁵

³⁸⁹ Submission 48, International Campaign to Abolish Nuclear Weapons Australia, pp 1-9.

³⁹⁰ Submission 48, International Campaign to Abolish Nuclear Weapons Australia, p 5.

³⁹¹ Submission 56, Medical Association for the Prevention of War, p 5.

³⁹² See for example: Evidence, Mr Matt Murphy, National Industry Coordinator, Electrical Trades Union, 18 November 2019, pp 32-33; Submission 43, Maritime Union of Australia, p 9.

³⁹³ See for example: Submission 40, Friends of the Earth Australia, p 41.

³⁹⁴ See for example: Submission 59, Australian Nuclear Science and Technology Organisation, p 48.

³⁹⁵ Submission 44, Women in Nuclear Australia, p 20.

- 4.125** This view was shared by the Australian Taxpayers' Alliance in its submission to the inquiry, which concludes that the development of a nuclear power program in New South Wales would not result in proliferation risks because Australia is a signatory to the international Non-Proliferation Treaty (NPT).³⁹⁶
- 4.126** Dr Patterson remarked that the strong regulations in place in Australia would never allow nuclear power technologies to be used for weapons:
- I think the link is that plutonium is a by-product of the nuclear fuel cycle and presumably it could be separated out as it has been done by a few countries, but I cannot see our Australian regulators ever allowing that to happen. ... I think it is a furphy, I really do. There is no prospect in our regulatory system by the Australian regulator of allowing that to happen. That is my theory anyway.³⁹⁷
- 4.127** In addition, Mr Gibbons of the Minerals Council of Australia stated emphatically that 'there are really stringent international and bilateral treaties in place' which prevent Australian uranium being used for weapons proliferation.³⁹⁸

Committee comment

- 4.128** The committee commends Australia's non-proliferation efforts and notes that Australia has mechanisms in place to uphold its nuclear safety and non-proliferation standing on the world stage. There was committee consensus that, owing to Australia's obligations under various agreements and treaties, the adoption of nuclear energy in New South Wales would result in negligible risk for weapons proliferation or nuclear security.

Prerequisites for a nuclear power industry in New South Wales

- 4.129** This section summarises evidence on the prerequisites for any future regulatory regime including the skills and capacities of any future nuclear workforce.

Regulatory framework for nuclear energy

- 4.130** In investigating the prospects of nuclear energy, understanding the regulatory requirements for any future nuclear power industry emerged as one of the priorities for committee deliberation. In hearings, the committee examined several expert witnesses on the extent of scaling up that would be required in order to set up a robust regulatory regime to support the safe and efficient operations of any future nuclear energy industry.
- 4.131** Mr Rodgers of Engineers Australia and Dr Higson both agreed that Australia's regulatory regime would need some 'scaling up' and 'expansion' in order to establish the proper regulatory

³⁹⁶ Submission 65, Australian Taxpayers' Alliance, p 10.

³⁹⁷ Evidence, Dr John Patterson, 18 November 2019, p 52.

³⁹⁸ Evidence, Mr Patrick Gibbons, Principal Advisor, Energy, Minerals Council of Australia, 18 November 2019, p 11.

infrastructure to ensure the safe and compliant operation of any future nuclear power industry in the State.³⁹⁹

- 4.132** While it was generally acknowledged that there would be some work to do in the regulatory space, it was suggested to the committee that New South Wales would not be starting from zero. Several witnesses expressed the view that Australia's existing regulatory and nuclear science and technology agencies would be a solid starting point for any future regulatory regime. For example, Mr Patrick Gibbons suggested that ANSTO and Australian Radiation Protection and Nuclear Safety Agency (ARPANSA) would be well placed to work with international regulators in nuclear nations to put appropriate regulatory arrangements in place:

... it is also about our existing regulatory bodies—the Australian Nuclear Science and Technology Organisation [ANSTO] and the Australian Radiation Protection and Nuclear Safety Agency [ARPANSA]—working with their international counterparts to develop a similar approach on this. They would be working with North American and European regulators to do it. It is something they should be able to do.⁴⁰⁰

- 4.133** Contemplating the same question, Mr Thomas of the Australian Academy of Technology and Engineering was of the opinion that Australia should not start afresh but should instead build on the organisations, expertise and skilled human resources that Australia already has to set up a world class regime, a process he deduced would take approximately three years. Referring to conversations he had with ARPANSA and Australian Safeguards and Non-proliferation Office (ASNO), Mr Thomas volunteered the following:

I said, "What do you think ARPANSA and ASNO could contribute to the Australian regulatory system?" Someone had put up the idea that we start afresh. The answer was "Absolutely not". The two of them, speaking together... were confident that given the adequate support, which would be staff and financial support from the government of the day, they would be able to build an organisation which—as I mentioned in my opening, they are now world-class in what they do—would be able to build a world-class regulatory organisation.

To assist in this they would obviously refer to other nations of our type, Canada and others, who have set up their own. The United States would be, or was, particularly enthusiastic about assisting us with that. I think it is a matter of giving those people, ARPANSA and ASNO, the remit to establish a world-class regulatory situation. Of course we have got to have it. The advice I was given was that this would take probably about three years. That three years need not be prior to other commitments but certainly in parallel to it, part of the process of getting to a working power station, a very important part.⁴⁰¹

- 4.134** Mr Eckermann of Bright New World volunteered his thoughts on Australia's nuclear capabilities, describing to the committee vendor sentiments and stakeholder perceptions of Australia as a 'mature' nuclear science and technology nation that would be starting from a relatively strong base:

³⁹⁹ Evidence, Dr Donald Higson, 11 November 2019, p 43; Evidence, Mr Steven Rodgers, Senior Policy Advisor, Engineers Australia, 18 November 2019, p 22.

⁴⁰⁰ Evidence, Mr Patrick Gibbons, Principal Advisor, Energy, Minerals Council of Australia, 18 November 2019, p 10.

⁴⁰¹ Evidence, Mr Martin Thomas, Australian Academy of Technology and Engineering, 18 November 2019, p 23.

What we have heard from these vendors is that they see Australia as a quite mature country in terms of nuclear science technology. We already have a facility over there at ANSTO. ANSTO is a really highly regarded science and technology organisation that these vendors say, you know, "You basically have everything here ready to go. It is just a matter of the Government signalling to the rest of the world that we are open for business." I am giving you another example here. The United Arab Emirates back in 2007 decided that they would pursue nuclear power in their country. They had practically nothing. They had the International Atomic Energy Agency [IAEA] come in and advise them and help them on developing and building an entire nuclear regulatory operations system from the ground up.

When we talk to vendors about Australia they look at us and they see us with a radiation regulator that is already here, a nuclear science and technology organisation that is well regarded, we have a highly skilled workforce here, we have experience with large civil projects and the only real thing could be having the IAEA come in and look at what we have and suggest what the next best-practice institutions or processes are and basically go from there. So they do see us as a place that would be suitable for nuclear technologies.⁴⁰²

- 4.135** Addressing the question of how New South Wales might embark on setting up a regulatory regime, Mr Fleay referred to the technology licensing work that has been undertaken by regulators in the United States, Canada and the United Kingdom, telling the committee that New South Wales should draw on and take advantage of this licensing expertise and knowledge, rather than reinventing the wheel. Mr Fleay explained:

... we would not want to reinvent that because if we were going to try to license reactors that had already been licensed, that is quite a big step up in expertise that I do not think we would have access to quickly. We would need to take credit for the regulatory regimes in those countries, and then our expertise would be more in site licensing, as opposed to technology licensing.⁴⁰³

- 4.136** On a less encouraging note, the Australia Institute cautioned that the enormity and complexity of setting up a regulatory regime, and the time this would take, should not be underestimated:

Well before a generator starts construction, the Australian government would need to draft and consult on a robust legislative and regulatory framework to regulate the generators and all parts of the supply chain, as well as third-party liability coverage. This would need to be reviewed and passed through Parliament. There would be extensive public debate about this regulation and public debate about where nuclear power generators would be located. There would need to be financial mechanisms to ensure funding for decommissioning, remediation, monitoring and closure of plants.⁴⁰⁴

Workforce capacity

- 4.137** Understanding whether Australia's science, technology, engineering, and mathematics (STEM) workforce possess the skills and expertise needed to design, construct and operate a nuclear

⁴⁰² Evidence, Mr Dayne Eckermann, General Manager, Bright New World, 11 November 2019, p 42.

⁴⁰³ Evidence, Mr James Fleay, Chief Executive Officer, Down Under Nuclear Energy, 11 November 2019, p 44.

⁴⁰⁴ Submission 68, Australia Institute, p 14.

power plant formed a crucial piece of evidence in examining the case for nuclear power in New South Wales. Inquiry participants offered a range of views on this issue, many of them very positive about the prospect of developing a highly skilled workforce to operate nuclear power reactors in New South Wales and Australia.

- 4.138** Down Under Nuclear Energy took aim at arguments suggesting that the Australian workforce is somehow lacking, taking them to task by highlighting Australia's achievements in the Liquid Natural Gas arena as a testament to the ability of our workforce to excel in new endeavors/industries. According to this evidence, Australia has the potential to develop a comparative advantage in nuclear technology and could become an exporter of nuclear expertise. Mr Fleay explained:

The idea that the Australian workforce is somehow inferior and cannot develop the skills and capacity to manage nuclear technology seems to be in the background of some arguments for retaining the prohibition. We reject this. Our workforce not only has the capacity to develop the skills required but also the potential to develop a comparative advantage in nuclear management and technology that would drive exports in the region. For example, prior to 1989, Australia had no expertise in the design, construction, operation and regulation of LNG facilities. Thirty years later, Australia is home to some of the most advanced LNG operating and engineering capacity. This includes a world class workforce that has been a key factor in attracting steady investment in the sector.

Unlike the starting position of the LNG skills base, Australia already has some highly regarded nuclear expertise.⁴⁰⁵

- 4.139** According to this evidence, with the introduction of small reactors, there would be a process of up-skilling and capacity building through all levels of the sector, from universities to engineering workshops.⁴⁰⁶
- 4.140** Concurring with this view, Dr Switkowski AO saw significant potential in Australia's existing workforce, asserting that Australia already has a technically capable workforce and a higher education sector which could provide trained personnel for a nuclear industry.⁴⁰⁷ For Dr Switkowski AO, any future transition to nuclear power would be made easier by the fact that New South Wales has several decades of experience with medical/research reactors:

I think that is distinctive about New South Wales—that this reactor and primary reactors have been here since 1955-ish. There is good experience. The universities, particularly Sydney, New South Wales to some extent as well as the Australian National University [ANU], provide very talented people. My suspicion or expectation is that if they were permitted to get involved in developing the technology by researching in the nuclear fuel cycle they could make a significant contribution, as happened during the war years with Australian scientists.⁴⁰⁸

- 4.141** Mr Gibbons of the Minerals Council of Australia was another witness to identify significant potential in the State's existing nuclear science and technology workforce. In response to

⁴⁰⁵ Submission 42, Down Under Nuclear Energy, p 23.

⁴⁰⁶ Submission 42, Down Under Nuclear Energy, p 4.

⁴⁰⁷ Submission 69, Dr Ziggy Switkowski AO, Private citizen, p 2.

⁴⁰⁸ Evidence, Dr Ziggy Switkowski, 11 November 2019, p 49.

questioning about the potential for New South Wales to become a player in the nuclear fuel cycle, Mr Gibbons commented that:

In New South Wales you have got the medical research reactor; you have got all the infrastructure that sits around that. You have got a really high-skilled workforce sitting down at Lucas Heights and around there. We have got the capacity to do this. We should be doing this. To answer your question, Mr Fang, we should be doing it.⁴⁰⁹

- 4.142** The committee examined Professor Stephen Wilson of the University of Queensland on the issue of Australia's workforce capacity, seeking his views on suggestions that Australia's workforce was not up to the task. Professor Wilson was emphatic in his response:

We do have skills and capabilities in Australia; we are not starting from zero. The fact that we have the ANSTO facility and a reactor means that as a nation we have kept alive the real option, which we can then exercise. We are not starting from ground zero by any means. We have a whole range of skills and capabilities that are relevant and deployable to the construction of a nuclear power plant. We clearly have the time to enhance and augment those through the education system and through selective strategic hiring between now and the date that we start physically building the project. I do not see that as a problem or a constraint.⁴¹⁰

- 4.143** Other oral testimony detailed ANSTO's standing in the international scientific community as a 'respected global player' – despite the fact that Australia at present has a relatively small nuclear footprint. It was noted that, as a State, we possess scientific, technical, geological and engineering competencies which would make us well placed to participate in various stages of the nuclear fuel cycle. Professor Edwards explained:

... if you are looking for evidence of this then I would look to the Generation IV International Forum itself. In order to be accepted, we had to be accepted unanimously by all the present members. We are the only member of the Generation IV International Forum that does not actually utilise nuclear power. I think the commentary at the time was, yes, we could ... Everybody was clear that Australia could make a significant contribution. I think part of that was our general scientific, technical, geological and engineering competence in Australia, a significant part of which, of course, is located in New South Wales.⁴¹¹

- 4.144** The committee examined Dr Adrian Paterson, Chief Executive Officer of ANSTO, on how long it would take to train a domestic workforce, and whether we would need to import expertise from overseas. In response, Dr Paterson mounted a spirited defense of Australia's engineering workforce, while detailing the growth and professional development of ANSTO's engineering capabilities over the last decade:

The first thing is the assumption that Australia wants to play in a league of nations where we cannot do the top end of engineering I think is a bad assumption. I think we should always aspire to be able to do all forms of engineering that impact our economy.

⁴⁰⁹ Evidence, Mr Patrick Gibbons, Principal Advisor, Energy, Minerals Council of Australia, 18 November 2019, p 5.

⁴¹⁰ Evidence, Professor Stephen Wilson, Centre for Energy Futures, University of Queensland, 18 November 2019, p 45.

⁴¹¹ Evidence, Professor Lyndon Edwards, National Director, Australian Generation IV International Forum Research, Australian Nuclear Science and Technology Organisation, 11 November, p 12.

ANSTO over the last decade has built up our engineering workforce. When we built the Open-Pool Australian Light-water [OPAL] reactor we had a very capable nuclear procurement capability where we could actually source the knowledge to be a good buyer, but over the last decade we have tried to develop a competent workforce for engineering design and engineering application of nuclear knowledge in that way and we now have around about 150 engineers who are deployed in one way or another around the aspects of that. That is in a bigger group of about 350 engineers at ANSTO.

ANSTO is one of the largest engineering employers in New South Wales and those engineers also do research, they look at longer-range questions and so on. ANSTO as an engineering organisation has had an aspiration to build up that capability. ... So I think that number of 150 who have got design capabilities that can lead to construction of nuclear facilities is right and I think that over time as the aspirations of Australia might change, the ability to scale that is already demonstrated.

I think it would be highly interesting and valuable for nuclear engineers who train in Australia to have an experience, for example, of spending time with the engineering development of these new classes of reactor, for example. Our membership of the Generation IV International Forum makes that highly probable in the next decade. So I believe we should have high aspirations for nuclear engineering capability in Australia, if only to be an intelligent observer of the world but maybe an intelligent participant as well.⁴¹²

Committee comment

- 4.145** Accepting the weight of evidence, the committee is satisfied that New South Wales would be well placed to establish a world class regulatory regime for the introduction of nuclear energy by building on the State's existing nuclear science and technology capabilities and by scaling up Australia's existing regulatory frameworks for radiation and nuclear applications.
- 4.146** The committee notes the recommendations recently handed down by the House of Representatives Standing Committee on the Environment and Energy (a committee of the Australian Parliament) calling on the Australian Government to undertake an assessment to identify the major requirements that would need to be in place before Australia was ready to adopt nuclear power.

Finding 7

That, in order to set up a nuclear energy industry in New South Wales, a world class regulatory regime would need to be established, supported by the requisite workforce capability and skills and a 'harmonised' regulatory framework to provide certainty for private investment.

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- 4.147** The committee acknowledges that Australia's engineers, nuclear physicists and other scientists are highly esteemed as serious players on the international nuclear science and technology scene. The presence of many of these individuals working in New South Wales forms an important part of our research and engineering community, and provides the competitive advantage to

⁴¹² Evidence, Dr Adrian Paterson, Chief Executive Officer, Australian Nuclear Science and Technology Organisation, 11 November 2019, p 14.

New South Wales of closely following international developments in energy technology. In particular the nuclear research cluster at the Australian Nuclear Science and Technology Organisation is valuable.

- 4.148** Further to this, the committee believes that a comprehensive workforce gap analysis and capacity inventory would be required if a nuclear power industry in New South Wales is to commence, and has made a recommendation to this effect.

Finding 8

That Australia's engineers, nuclear physicists and other scientists are highly esteemed as serious players on the international nuclear science and technology scene. The presence of many of these individuals working in New South Wales forms an important part of our research and engineering community, and provides the competitive advantage to New South Wales of closely following international developments in energy technology. In particular the nuclear research cluster at the Australian Nuclear Science and Technology Organisation is valuable.

Recommendation 5

That the NSW Government commissions:

- a comprehensive workforce gap analysis to identify the workforce capabilities, skills and expertise that would be needed to support a future nuclear power industry in New South Wales; and
- a workforce capacity inventory which identifies the existing clusters of research and workforce capabilities which already exist in New South Wales which are part of the international nuclear industry.

Conclusion

- 4.149** The committee notes the wide variation in nuclear technologies and the need to discriminate between earlier large scale nuclear reactors and emerging small scale designs when evaluating considerations such as costs, safety and construction time. Evaluations must be based on the latest generation technologies, not obsolete reactor designs that would never be built today.
- 4.150** In light of the evidence received throughout the inquiry, the committee considers nuclear energy to be a viable possibility for the State's future generation needs, one which warrants serious consideration as a low emissions source of energy in the State's future energy mix.
- 4.151** The committee is encouraged by the State's existing nuclear science, engineering and technology capabilities, drawn from several decades of experience operating a reactor for medical and research purposes. This experience and expertise offers a promising foundation which could be leveraged to set up a world class regulatory regime to provide for the safe operation of any future nuclear power plant in New South Wales.

- 4.152** On the balance of evidence, the committee considers nuclear energy to be compelling technology where energy policy prioritises the twin objectives of net zero emissions and the delivery of secure, reliable and affordable energy to power a competitive industrial and manufacturing economy.
- 4.153** The committee could find no compelling justifications from an environmental or human safety point of view which would warrant the blanket exclusion of nuclear energy, especially in its emerging small scale applications, from serious policy consideration in New South Wales.
- 4.154** As with all contentious policy issues, obtaining social licence from the citizens of New South Wales will be essential to any future introduction of nuclear energy in the State, as discussed in the following chapter.
- 4.155** The committee supports the repeal of the *Uranium Mining and Nuclear Facilities (Prohibitions) Act 1986* in its entirety as this will:
- allow the market to test the commercial viability of uranium production in New South Wales through speculation and investment in prospecting; and
 - remove one legislative barrier/impediment to any future public policy dialogue about the feasibility of nuclear power in New South Wales from an economic/commercial, social and environmental perspective.
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Recommendation 6

That the NSW Government supports the repeal of the *Uranium Mining and Nuclear Facilities (Prohibitions) Act 1986* in its entirety.

- 4.156** The committee notes that even with the repeal of the New South Wales legislation in its entirety, the Commonwealth prohibitions on nuclear facilities will remain in place. To this end, we also recommend that the NSW Government pursues the repeal of the Commonwealth prohibitions on nuclear facilities by making representations to the Commonwealth Minister with portfolio responsibility for the relevant prohibiting legislation.
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Recommendation 7

That the NSW Government pursues the repeal of the Commonwealth prohibitions on nuclear facilities by making representations to the Commonwealth Minister with portfolio responsibility for the relevant legislation.

- 4.157** Finally, in conclusion on the Uranium Mining and Nuclear Facilities (Prohibitions) Repeal Bill 2019, we recommend that the Legislative Council proceed with debate on the bill, having regard to the findings and recommendations contained in this report.
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Recommendation 8

That the Legislative Council proceed with debate on the bill, having regard to the findings and recommendations contained in this report.

Chapter 5 Social consent for nuclear energy

Nuclear energy is a contentious and polarising issue. This chapter examines issues surrounding social acceptance and consent for nuclear energy, starting with a discussion of evidence on current levels of public support and the impact of high profile nuclear incidents on public attitudes/perceptions. Issues of risk assessment and perception are also considered with a view to demystifying nuclear and breaking long-held associations of nuclear with single point events in the public conscience. Collectively, the evidence summarised in this chapter provides a starting point for where the challenging pathway to social acceptance of nuclear might commence.

Public attitudes and support for nuclear energy

5.1 This section is a synthesis of the evidence on public attitudes and support for nuclear energy. It considers the effects of past nuclear incidents and the role of the media in shaping public perceptions of nuclear energy. Debates on the current levels of public support for nuclear energy are also explored through a discussion of the results of recent polling.

The Chernobyl effect

5.2 In much of the evidence, there was consensus (either implicitly or explicitly) that public attitudes to nuclear energy have been shaped by a number of high profile nuclear incidents which have occurred in previous decades.⁴¹³

5.3 Chief amongst these is the Chernobyl incident which occurred on 26 April 1986, the same year the *Uranium Mining and Nuclear Facilities (Prohibitions) Act 1986* commenced. The Chernobyl incident is the worst nuclear incident in history and the first to receive the maximum level 7 rating on the International Nuclear Event Scale (INES). The incident was caused by inherent reactor instability owing to its design, an inadequate safety culture, and the deliberate overriding of safety systems by operators during an unauthorised test of the reactor's control systems. The reactor was undergoing a safety test to simulate the effects of an electrical power outage when the accident occurred. The overheating of the reactor resulted in two chemical explosions and a fire that caused the deaths of two workers.⁴¹⁴

5.4 The subsequent death toll and the ensuing health, environmental and social impacts of the Chernobyl accident are highly contested and are touched on in the previous chapter.⁴¹⁵ Similarly, among inquiry participants, there was not always a meeting of minds on the significance of Chernobyl.

5.5 For inquiry participants in favour of the bill, Chernobyl was used in evidence to illustrate the vast improvements in reactor safety and design and the expansion and strengthening of nuclear industry regulations as a result of the accident, with claims that the nuclear industry is now the

⁴¹³ See for example: Submission 61, Bright New World, p 16;

⁴¹⁴ Submission 59, Australian Nuclear Science and Technology Organisation, p 46; Submission 13, Mr Zac Petersen, pp 6-7.

⁴¹⁵ See for example: Submission 13, Mr Zac Petersen, p 7.

most 'highly regulated industry in the world' from a safety point of view.⁴¹⁶ As observed by Professor Lyndon Edwards of the Australian Nuclear Science and Technology Organisation (ANSTO), with respect to nuclear power technologies '... as we get accidents and incidents, we learn about it and it gets safer. We are all about technological learning.'⁴¹⁷

5.6 For inquiry participants opposed to the bill, Chernobyl was evidence of the inherent risks of nuclear power and its potential for accidents with disastrous consequences.⁴¹⁸

5.7 Several inquiry participants acknowledged the enormity of the Chernobyl incident and the fear of nuclear it instilled in the public, but made a point of promulgating the facts about the accident in an effort to promote a more rational understanding of risks. For example, Down Under Nuclear Energy appealed to the use of reason, rationality and facts to cut through what it considers to be 'scare campaigns and misinformation' about nuclear energy over previous decades.⁴¹⁹ In relation to the Chernobyl accident specifically, Down Under Nuclear Energy joined with other inquiry participants, including the Australian Nuclear Association⁴²⁰, in emphasising the inherent defects, deficiencies and design flaws in the Chernobyl reactor, observing that such a design would never have been allowed outside the former Soviet Union:

This is an old RBMK reactor. It was built under the peculiar conditions that applied to the USSR in the 1970's. It had no containment or commercial safety features and several inherent risk factors that do not exist in any other commercial reactor. It is important to point out the graphite-moderated technology of the Chernobyl reactor has never been allowed in western nations due to its inherent lack of safety.⁴²¹

5.8 ANSTO gave evidence on the significant influence that nuclear accidents have had on public sentiment about nuclear energy, with Dr Adrian Paterson, Chief Executive Officer, stating that: 'One is always keenly aware when talking about nuclear energy that these single-point events have a very strong influence on public understanding and public sentiment in relation to nuclear.'⁴²²

5.9 In an effort to explain antinuclear sentiment in Australia, Professor Stephen Wilson of the University of Queensland suggested that a deeply ingrained fear factor may help explain some people's emotional and irrational responses to nuclear power. In his opinion, the way the public formulates views on contentious issues such as nuclear – and the process of drawing conclusions for or against – can be driven by intense emotional responses rather than reason:

Some people do have an emotional response to this issue, no question. I think there is a bigger question here that is very important for the State of New South Wales and for Australia as a nation, which is how do we as individuals arrive at our views on

⁴¹⁶ See for example: Submission 4, SMR Nuclear Technology, p 4; Submission 62, Australian Academy of Technology and Engineering, p 1.

⁴¹⁷ Evidence, Professor Lyndon Edwards, National Director, Australian Generation IV International Forum Research, Australian Nuclear Science and Technology Organisation, 11 November 2019, p 9.

⁴¹⁸ See for example: Submission 56, Medical Association for Prevention of War, p 2;

⁴¹⁹ Submission 42, Down Under Nuclear Energy, p 23.

⁴²⁰ Submission 27, Australian Nuclear Association, p 6.

⁴²¹ Submission 42, Down Under Nuclear Energy, p 12.

⁴²² Evidence, Dr Adrian Paterson, Chief Executive Officer, Australian Nuclear Science and Technology Organisation, 11 November 2019, p 8.

controversial questions like this, and how as a nation do we make decisions on topics like this that can become emotional, that can become ideological. How do we discuss these things with each other without becoming emotional? I think they are really important questions for us as a society to engage with and to find a way to have these conversations that gets us to a decision that we can be comfortable with as a nation and that will be in our wider national interest.⁴²³

Trends

5.10 Notwithstanding such sentiment, Professor Wilson offered anecdotal evidence of what he considered to be a shift in attitudes to nuclear in Australia:

... I do sense that a shift has happened and is underway in attitudes in this country. I think fewer people are afraid of nuclear energy today than was the case 20 or 30 years ago. I made the comment that I am struggling to find antinuclear students at the university, which surprised me when I came to that realisation.⁴²⁴

5.11 The committee heard other evidence of the early signs of a shift in public perception and attitudes to nuclear energy, including from the Australian Taxpayers' Alliance which refers to a number of opinion polls to support their contention that 'support for and openness towards nuclear power generation' is gathering momentum in Australia.⁴²⁵

5.12 Likewise, the Australian Nuclear Association referred to a 'gentle increase' in public support for nuclear supported by polling data. Looking ahead, Mr Robert Parker, the Association's Vice President, suggested that support would continue to 'gently' increase as a result of the 'increased dynamic of the discussion and the narrative in the community' engendered by current and recent inquiries into nuclear in various parliaments.⁴²⁶

5.13 In its submission to the committee, Bright New World summarises the results of social media surveys conducted in 2019 by ABC Brisbane and Channel 9 News, both of which show a majority of respondents in favour of Australia turning to nuclear power (57% according to the ABC Brisbane poll and 65% according to the Channel 9 News poll). On the basis of such results – as well as the Essential and Roy Morgan polls discussed below – Bright New World concludes that there is now a national consensus to remove the prohibitions on nuclear power.⁴²⁷

5.14 For other inquiry participants, the pronouncement that a national consensus now exists in Australia was an assertion rather than a statement of fact. For example, Professor John Quiggin of the University of Queensland asserts that if there is indeed a national consensus, it is an overwhelmingly negative one:

⁴²³ Evidence, Professor Stephen Wilson, Centre for Energy Futures, University of Queensland, 18 November 2019, p 43.

⁴²⁴ Evidence, Professor Stephen Wilson, Centre for Energy Futures, University of Queensland, 18 November 2019, p 41.

⁴²⁵ Submission 65, Australian Taxpayers' Alliance, p 11.

⁴²⁶ Evidence, Mr Robert Parker, Vice President, Australian Nuclear Association, 11 November 2019, p 25.

⁴²⁷ Submission 61, Bright New World, pp 30-31.

To the extent that a national consensus on nuclear power exists in Australia, it is negative. All major parties currently support the maintenance of the existing ban on nuclear power. A reversal of this position is a necessary precondition of the expansion of nuclear power. In the absence of a positive consensus, no construction firm, finance institution or generation enterprise would be willing to take the risk of investing in nuclear power.⁴²⁸

Essential polls on nuclear energy: 2019 and 2012

- 5.15** In the course of the inquiry, several participants highlighted evidence providing insight into the current level of public support for nuclear power in Australia.
- 5.16** According to an Essential poll in June 2019⁴²⁹ – one of the most recent polls on nuclear energy – 44 per cent of the poll participants support nuclear energy and 40 per cent oppose it. According to the same poll results, 51 per cent of those polled believe that nuclear power would help lower prices and 26 per cent disagreed.⁴³⁰
- 5.17** Importantly, the 2019 poll also asked respondents if they would be comfortable living close to a nuclear power plant. Only 28 per cent of respondents indicated that they would whereas 60 per cent indicated that they would not.⁴³¹
- 5.18** To contextualise these results, in 2012, an Essential poll asked poll participants whether or not they agree that nuclear power is a good way to reduce greenhouse gas emissions. 40 per cent of participants either strongly agreed or agreed. 35 per cent either disagreed or strongly disagreed, and 25 per cent did not know.⁴³²

Roy Morgan poll on nuclear energy

- 5.19** According to a Roy Morgan online poll conducted in September 2019, 51 per cent of respondents believed Australia should develop nuclear power to reduce Australia's carbon dioxide emissions, while 34 per cent believed it should not. 15 per cent of respondents could not say either way.⁴³³
- 5.20** The same online poll was conducted in July 2011, providing a baseline for comparison with the 2019 results. Support for nuclear power as a means of reducing Australia's emissions was up 16 percent from 2011, while opposition fell 24 per cent.⁴³⁴

⁴²⁸ Submission 11, Professor John Quiggin, VC Senior Research Fellow, University of Queensland, p 7.

⁴²⁹ Essential conducts regular polls on various issues every week. The response rate varies each week, but usually delivers 1000+ interviews.

⁴³⁰ Submission 44, Women in Nuclear Australia, p 16; Submission 64, Friends of the Earth Australia, Australian Conservation Foundation and Nature Conservation Council of NSW, p 58.

⁴³¹ Submission 68, Australia Institute, p 38.

⁴³² NSW Parliamentary Research Service, *Uranium Mining and Nuclear Energy in New South Wales*, issues paper, 2019, p 85.

⁴³³ Tabled document, Dr Kath Smith, *A narrow majority of Australians want to develop nuclear power to reduce carbon dioxide emissions*, Roy Morgan poll results, October 2019, p 1.

⁴³⁴ Tabled document, Dr Kath Smith, *A narrow majority of Australians want to develop nuclear power to reduce carbon dioxide emissions*, Roy Morgan poll results, October 2019, p 1.

5.21 Interestingly, when asked whether Australia should develop nuclear power plants for electricity supply – that is, without the reference to carbon dioxide emissions reduction – only 45 per cent of respondents expressed support for nuclear, while 40 per cent were opposed according to the 2019 poll.⁴³⁵ Support for nuclear therefore fell when the question was divorced from the context of reducing Australia's carbon dioxide emissions.

5.22 A document tabled by Dr Joanne Lackenby of Women in Nuclear Australia makes a similar observation, referring to research by Ms Jessica Lovering of the Breakthrough Institute in the United States which suggests that public opinion on nuclear power is sensitive to how you frame a survey question:

Framing questions around the topic of climate change increases support in survey responses, [Jessica Lovering] said. "A big study in the US asked, 'Do you support nuclear power?' and also 'Do you support nuclear power as a solution to climate change?' and the result increased by five percentage points ... The UK has one of the most significant effects where, if you frame the question around climate, it increases support for nuclear by 20 percentage points."⁴³⁶

Gender divide in support for nuclear

5.23 Variation in support for nuclear energy between men and women exercised some discussion in public hearings and evidence.⁴³⁷

5.24 Analysis of the 2019 Roy Morgan poll results revealed a significant gender divide in support for nuclear power. When asked if they support Australia developing nuclear power to reduce Australia's carbon dioxide emissions:

- 38 per cent of female respondents were in favour, 40 per cent were not in favour and 22 per cent could not say either way;
- 65 per cent of male respondents were in favour, 28 per cent were not in favour, and only 7 per cent could not say either way.⁴³⁸

5.25 Women in Nuclear Australia expanded upon the meaning and significance of these results in response to questioning by the committee. Dr Lackenby acknowledged that globally, the polls indicate that fewer women support nuclear than men, while noting the higher percentage of female respondents who were undecided (22 per cent of women as opposed to 7 per cent of men). Offering interpretation, Dr Lackenby suggested that the relatively higher number of undecided female respondents indicates that women are more likely to reserve judgment if they believe they do not know the answer or do not properly understand an issue.⁴³⁹

⁴³⁵ Tabled document, Dr Kath Smith, *A narrow majority of Australians want to develop nuclear power to reduce carbon dioxide emissions*, Roy Morgan poll results, October 2019, p 1.

⁴³⁶ Tabled document, Dr Joanne Lackenby, *How world view affects public perception of nuclear power*, *World Nuclear News*, 18 October 2019, p 1.

⁴³⁷ See for example: Submission 54, Dr John Patterson, p 3.

⁴³⁸ Tabled document, Dr Kath Smith, *A narrow majority of Australians want to develop nuclear power to reduce carbon dioxide emissions*, Roy Morgan poll results, October 2019, p 1.

⁴³⁹ Evidence, Dr Joanne Lackenby, President, Women in Nuclear Australia, 18 November 2019, p 13.

Other factors influencing support for nuclear

- 5.26** In addition to gender considerations, inquiry participants drew the committee's attention to various other factors influencing support for nuclear power, including an individual's worldview, the generation they belong to and whether or not they live in proximity to nuclear facilities.
- 5.27** For example, the committee received evidence which posits a correlation between an individual's worldview and their perception of risks for nuclear power.⁴⁴⁰ According to this evidence, the gender gap on the perceived risks of nuclear power is unrelated to education, familiarity with technology and age – and that simply educating people is not enough to address the gender gap in support for nuclear. Instead, a fuller explanation is offered by how an individual's worldview shapes their opinions and risk perceptions of not only nuclear power, but a range of other issues.⁴⁴¹
- 5.28** In categorising an individual's worldview, this evidence referred to two axes – the first axis being where an individual sits on a spectrum between a hierarchical and an egalitarian worldview, and the second axis being where an individual sits on a spectrum between individualism and 'communalism.' This suggests that people who are hierarchical and individualist tend to support nuclear power as they perceive the risk as being relatively low, whereas people who are egalitarian and 'communalists' are likely to oppose nuclear power owing to their perception of risks.⁴⁴²
- 5.29** According to ANSTO, public support for nuclear activities is highest in communities that are located in close proximity to nuclear facilities:

International research has found that public support for, and positive sentiment toward, nuclear activities is highest in communities that are located in close proximity to nuclear facilities. This is attributable to reported perceptions of benefits, including employment opportunities and social and economic activity. Public support for nuclear power, in particular, also has been found to be higher when the public is aware of its role in combatting climate change.⁴⁴³

- 5.30** This claim was repeated by Women in Nuclear Australia and Dr Ziggy Switkowski AO in oral testimony before the committee.⁴⁴⁴ According to Dr Switkowski AO, people who live in the vicinity of nuclear reactors are more likely to be supportive of nuclear because they benefit from employment and have first-hand lived experience coexisting near a nuclear site without any concerns or issues:

In the time that I was involved with ANSTO, say 10 years ago, surveys that were done of various municipalities around the country had the community that was most

⁴⁴⁰ Tabled document, Dr Joanne Lackenby, *How world view affects public perception of nuclear power*, *World Nuclear News*, 18 October 2019, p 1.

⁴⁴¹ Tabled document, Dr Joanne Lackenby, *How world view affects public perception of nuclear power*, *World Nuclear News*, 18 October 2019, p 2.

⁴⁴² Tabled document, Dr Joanne Lackenby, *How world view affects public perception of nuclear power*, *World Nuclear News*, 18 October 2019, p 2.

⁴⁴³ Submission 59, Australian Nuclear Science and Technology Organisation, p 49.

⁴⁴⁴ Evidence, Dr Kath Smith, Executive Committee Member, Women in Nuclear Australia, 18 November 2019, p 13; Evidence, Dr Ziggy Switkowski AO, Private citizen, 11 November 2019, p 49.

supportive of the nuclear fuel cycle—that of the Sutherland shire, where a reactor is located. That is no longer a surprise because the people who live in the vicinity of reactors are often working with the reactor site or have family members that work there, or have lived there a decade or two happily and are not inhibited by some of the concerns that others express about nuclear power.⁴⁴⁵

- 5.31** Generational variations in support for nuclear were also advanced in evidence. It was noted by Dr Kath Smith of Women in Nuclear Australia that 'the younger generations tend to be more interested in climate change and are therefore looking for options that will address climate change.'⁴⁴⁶ In a similar vein, Down Under Nuclear Energy submitted that the younger generation is 'unburdened by childhood fears about nuclear war' and is thus more likely to be unconvinced of any arbitrary ban on technologies that can reduce carbon emissions.⁴⁴⁷
- 5.32** Referring to the legacy of Chernobyl for generations who lived through it as it happened, Professor Wilson supported the notion that that particular generation's experiences were relevant in understanding their opposition to nuclear power. He submitted that '[t]he experiences we had, that formed us as we were growing up' are relevant to generational differences in views on nuclear energy.⁴⁴⁸
- 5.33** Dr John Patterson, a nuclear physicist, also gave evidence on the importance of young people as a crucial demographic for promoting social acceptance of nuclear power:

What needs to happen, I really do believe, is the young people need to take part in realising that nuclear is a major way of combating climate change. I do believe the young generation is really strong on climate change. They want to see something done. With a little more education—they already get a lot, I guess—they would come to see nuclear as not a huge bogey.⁴⁴⁹

The role of media and popular culture in shaping public attitudes

- 5.34** It was suggested to the committee that public attitudes to nuclear power may also be influenced by exaggerated media representations. Throughout evidence, there were several references to the role of the media in spreading mistruths, fear and exaggerated risks about nuclear power.⁴⁵⁰
- 5.35** For example, in his submission to the committee, Mr Barrie Hill referred to evidence suggesting that community views on 'controversial matters' that are outside an individual's direct practical knowledge are often formed by 'sensational media and are generally two decades out of date.'⁴⁵¹ With respect to nuclear power specifically, Mr Hill maintains that the Australian public has, for many years, been subject to negative representations of nuclear power 'through the education

⁴⁴⁵ Evidence, Dr Ziggy Switkowski AO, Private citizen, 11 November 2019, p 49.

⁴⁴⁶ Evidence, Dr Kath Smith, Executive Committee Member, Women in Nuclear Australia, 18 November 2019, p 14.

⁴⁴⁷ Submission 42, Down Under Nuclear Energy, p 23.

⁴⁴⁸ Evidence, Professor Stephen Wilson, Centre for Energy Futures, University of Queensland, 18 November 2019, p 46.

⁴⁴⁹ Evidence, Dr John Patterson, 18 November 2019, p 52.

⁴⁵⁰ See for example: Dr John Patterson, 18 November 2019, p 52.

⁴⁵¹ Submission 1(a), Mr Barrie Hill, p 2.

system and the media' while simultaneously being deprived of factual information about nuclear power, including the advances in nuclear technology over time:

The media continue to sensationalise past nuclear accidents for a wide range of reasons but very rarely provide any educational material on the advances that have been made over time as a result of such accidents. Recent programs on aircraft crash investigations have not caused many people to stop flying because the accident information is usually well balanced by reference to the general advances that have been made over time.⁴⁵²

- 5.36** Arguments about the role of misinformation in perpetuating fear of nuclear were also advanced in oral testimony, with Dr John Patterson telling the committee that people's positions on nuclear have been influenced by the dissemination of inaccurate information, including by the media:

... the public by and large do not appear to understand nuclear or radiation. I believe they have been fed a lot of lies and half-truths, which makes them very fearful. [...]

The media do not always look for factual and helpful explanations. They try to point at the controversies; ... Unfortunately, the controversy involves Chernobyl and Fukushima, and these get repeated time and time again. Both of those reactors would not be approved today. They are both old technology and the Russians particularly had some horrible old things and they just would not be built today. But trying to colour our views of the latest generation nuclear reactors, like the NuScale small modular reactors, in terms of these old bogeys is not fair and it just creates this unnecessary fear.⁴⁵³

- 5.37** References to the HBO miniseries *Chernobyl* emerged in evidence at various stages throughout the inquiry, most commonly to furnish arguments about the influence of the media in shaping public attitudes to nuclear.⁴⁵⁴ Departing with some of the more negative reflections on *Chernobyl*, Professor Wilson of the University of Queensland offered an alternative perspective on the TV miniseries. A former opponent of nuclear power, Professor Wilson acknowledged that media representations of nuclear accidents such as those portrayed by *Chernobyl* are 'exactly the sort of thing that influences people's thinking.'⁴⁵⁵ However, he also credited the miniseries with a 'demystifying element', telling the committee that '[i]t's a bit like aversion therapy, you are afraid of spiders so you face the spiders.'⁴⁵⁶

Committee comment

- 5.38** The committee notes the anecdotal evidence of a shift in social acceptance and consent for nuclear. We believe that further studies and data are required to understand the level of support

⁴⁵² Submission 1(a), Mr Barrie Hill, p 2.

⁴⁵³ Evidence, Dr John Patterson, 18 November 2019, p 52.

⁴⁵⁴ See for example: Evidence, Dr Kath Smith, Executive Committee Member, Women in Nuclear Australia, 18 November 2019, p 18; Submission 35, Mr Geoff Russell, p 3.

⁴⁵⁵ Evidence, Professor Stephen Wilson, Centre for Energy Futures, University of Queensland, 18 November 2019, p 45.

⁴⁵⁶ Evidence, Professor Stephen Wilson, Centre for Energy Futures, University of Queensland, 18 November 2019, p 45.

for nuclear within New South Wales – and to understand critical success factors in influencing public opinion through education.

- 5.39** The committee is of the view that community concern for the emissions intensity of Australia's electricity generators offers a favourable point in time to promote social licence for nuclear as a low carbon technology, and we believe that legislators, government agencies, advocacy groups and the scientific community all have a role to play in ascertaining and communicating the facts in regards to uranium mining and nuclear power.

Community engagement and education on nuclear energy

- 5.40** This section provides an overview of the evidence on community engagement and education on nuclear energy. In particular, it summarises the expert opinions and insights on the need for better understanding among the general public of the science surrounding nuclear power and ionising radiation. This was considered key to any future efforts to galvanise public support for nuclear energy in Australia.

Promoting the benefits of nuclear

- 5.41** For Women in Nuclear Australia, raising awareness of the benefits of peaceful nuclear applications was considered integral to promoting support for nuclear power, and was thus proposed as a critical factor in obtaining social acceptance for any future nuclear power industry in Australia. Such benefits include the critical medicines produced by Australia's only research reactor discussed in Chapter 1, but also the potential environmental benefits of nuclear power in reducing greenhouse gas emissions and deeply decarbonising electricity generation:

I think that the benefits associated with the Open Pool Australian Lightwater [OPAL] research reactor in Sydney are well known. The benefits to people being nuclear medicine, research et cetera. So with the nuclear energy prospect for New South Wales for me it is largely about making known what the benefits are to the people in the community that come with nuclear energy, including the environmental benefits.⁴⁵⁷

- 5.42** A similar argument was advanced in evidence by Dr John Patterson who told the committee that, in his experience, '... when the advantages of nuclear power are explained to a receptive audience, a large majority of them will support it.'⁴⁵⁸
- 5.43** The value and importance of nuclear medicine, and the critical role it plays in the modern health system, was also emphasised by the Minerals Council of Australia:

The OPAL reactor produces around 10,000 doses per week which are used by 250 medical facilities in Australia and New Zealand.

On average, one in two Australians will need a nuclear medicine scan during their lifetime. These are used to diagnose heart, thyroid, lung, and kidney conditions, along

⁴⁵⁷ Evidence, Dr Joanne Lackenby, President, Women in Nuclear Australia, 18 November 2019, p 13.

⁴⁵⁸ Evidence, Dr John Patterson, 18 November 2019, p 51.

with tumours, fractures and sporting injuries. About one-third of all hospital procedures involve radiation or radioactivity.⁴⁵⁹

- 5.44** ANSTO also underscored the importance of education and outreach in enhancing public understanding of peaceful nuclear applications, including nuclear power and its benefits. ANSTO explains:

... there is significant concern about the nature of the risks of nuclear fuel cycle activities (and their consequences) stemming from human exposure to ionising radiation - including the pathways and controls that are established to ensure the safety of radiation workers and members of the public. Education and outreach, therefore, are foundational to increasing knowledge of the fuel cycle, including nuclear power, and to public understanding of the benefits that might accrue from the peaceful uses of nuclear science and nuclear technology.⁴⁶⁰

Popular misconceptions of radiation and its effects

- 5.45** According to several inquiry participants, opposition to and fear of nuclear power can stem in part from popular misconceptions of or a lack of understanding about human exposure to radiation.⁴⁶¹ It was emphasised to the committee that radiation is not something that only exists in uranium mines, nuclear research reactors or nuclear power plants. Unbeknownst to many people, it is present in different natural environments and landscapes, as well as everyday foods, objects and activities.
- 5.46** For example, reflecting on the challenge of overcoming negative perceptions of nuclear power, Mr Barry Murphy asserted that non-scientists do not properly understand radiation, and that public misconceptions about radiation partly explain why many people hold negative views on nuclear power. According to Mr Murphy, correcting such misconceptions would go some of the way in overcoming negative perceptions of nuclear:

... when it comes to radiation it seems to me that ... we all have a misconception about that. It all comes from the sun. If you watched TV last night, they were all lying on the beach in the radiation. We get an average of 3.5 millisieverts per year; this is a biological measure of radiation. Finland, for example, gets twice that but yet they have a lower cancer rate than we do by quite a margin. We are all subject to background radiation from airlines and so on. Cornwall gets 7.8. Somebody noted the other day that if it were Fukushima, Cornwall would have to be shut down. There are a lot of things like that that we simply have to put the hard yards in to try to help people to know more. I especially say that about political people, with all due respect.⁴⁶²

- 5.47** In his submission to the committee, Mr Geoff Russell argues that, for many, perceptions of the risks associated with nuclear power remain embedded in outdated and inaccurate science on the effects of radiation on human DNA, leading him to conclude that '[t]here will be no community consensus on nuclear power while understanding of the risks associated with radiation remain

⁴⁵⁹ Submission 67, Minerals Council of Australia, p 9.

⁴⁶⁰ Submission 59, Australian Nuclear Science and Technology Organisation, p 49.

⁴⁶¹ See for example: Evidence, Mr Barry Murphy, 18 November 2019, p 51.

⁴⁶² Evidence, Mr Barry Murphy, 18 November 2019, p 51.

stuck in the past.⁴⁶³ Mr Russell takes aim at the antinuclear movement, implying that it has spread misinformation about the impacts of radiation on human health. Referring to the significant advances in scientific knowledge since the 1950s and 1960s when the antinuclear movement began, Mr Russell asserts that claims which 'once represented the best available science are now just plain wrong, but continue to be recycled in activists groups and the general community.'

5.48 In Australia, the average background radiation dose is approximately 1.5 millisieverts per year, with sources of exposure including the sun, rocks, buildings, soils, food, and other humans.⁴⁶⁴ Granite benchtops, bananas and cheese were some of the everyday items identified in evidence as being radioactive to varying degrees, along with things like flying in aircraft and CT scans.⁴⁶⁵

5.49 ANSTO characterised the modern era as one in which there are more instances of background radiation. Dr Paterson, ANSTO's Chief Executive Officer, explained:

Probably the two biggest impacts on modern humans in relation to radiation is now the number of flights we have in aeroplanes because the higher you get the more neutrons go through you. By the time you get to sea level most of the neutrons are gone. So we are living in an era where there is more radiation around us and then medical uses, where in order to save lives, you expose people to significant radiation.⁴⁶⁶

5.50 By way of comparison, the committee noted from a presentation by Heathgate Resources Pty Ltd, operator of the Beverley Four Mile mine, that the present day annual exposure to ionising radiation for an Australian uranium mine worker is 1.0 millisieverts per year – whereas domestic airline pilots are exposed to 2.0 millisieverts per year, exposure from a CT scan is somewhere in the order of 5.0 millisieverts and the natural background radiation in Cornwall (United Kingdom) measures 7.8 millisieverts.⁴⁶⁷

5.51 Women in Nuclear Australia made a similar point about the lack of awareness of background radiation and the importance of maintaining perspective. Referring to the radioactivity of stored waste from the nuclear fuel cycle, Dr Smith told the committee that:

... [i]t is not to useful to talk about how long [stored waste] would take to get back to background level. We need to compare it to other levels of radiation that people are exposed to on a regular basis. From bananas to cheese to air travel, there needs to be a lot more lay examples of radiation sources that people are routinely exposed to and have no qualms about.⁴⁶⁸

⁴⁶³ Submission 35, Mr Geoff Russell, p 1.

⁴⁶⁴ Submission 59, Australian Nuclear Science and Technology Organisation, p 7.

⁴⁶⁵ See for example: Evidence, Dr Adrian Paterson, Chief Executive Officer, Australian Nuclear Science and Technology Organisation, 11 November 2019, p 16; Evidence, Dr Kath Smith, Executive Member, Women in Nuclear Australia, 18 November 2019, p 19.

⁴⁶⁶ Evidence, Dr Adrian Paterson, Chief Executive Officer, Australian Nuclear Science and Technology Organisation, 11 November 2019, p 17.

⁴⁶⁷ Dr Andrea Marsland-Smith, *ISR Uranium Mining: Frome Basin South Australia*, presentation to the Standing Committee on State Development, Heathgate Resources Pty Ltd, 14 August 2019, p 11; see also Australian Nuclear Science and Technology Organisation, *Natural background radiation*, Australian Government, <https://www.ansto.gov.au/education/nuclear-facts/what-is-radiation>.

⁴⁶⁸ Evidence, Dr Kath Smith, Executive Member, Women in Nuclear Australia, 18 November 2019, p 19.

Existing outreach and community education initiatives

- 5.52** By virtue of their remit, the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), Women in Nuclear Australia and ANSTO were well positioned to give evidence on their community engagement and outreach activities aimed at educating the community about nuclear, its benefits and the science on radiation.
- 5.53** In giving evidence, ARPANSA detailed to the committee its Talk to a Scientist program, a public program allowing members of the public to ask ARPANSA scientists questions about radiation – including concerns they may have about radiation exposure – and receive scientific answers. The program has been in place for a number of years and, according to the ARPANSA testimony, has had a large/successful uptake.⁴⁶⁹
- 5.54** In examining the ARPANSA witnesses, the committee was interested in understanding how community education programs might address the general lack of awareness about background levels of radiation from lay examples such as air travel and natural geological sources. ARPANSA explained to the committee that the education and information delivered through the Talk to a Scientist program is generally guided by what is at the forefront of community interest, and that there has not been a high degree of interest in ionising radiation from background sources.⁴⁷⁰ Mr Ryan Hemsley, ARPANSA's Director of Government and International Relations, noted, however, that:
- Radiation is everywhere, it is something that is in our daily lives, and we have a very active communication program on social media and through our website and through other media to try and explain to the public about certain aspects of radiation, but it depends on what is forefront of community interest.⁴⁷¹
- 5.55** Women in Nuclear Australia provided a brief overview of their outreach activities, mainly consisting of speaking engagements at schools and community groups to promote understanding and awareness of peaceful nuclear applications, such as the work of ANSTO and the value to society of nuclear medicine. Women in Nuclear Australia noted that their community outreach activities have been restricted by the bans on nuclear energy, making it difficult for its members to speak about a topic that is currently subject to legal prohibitions/restrictions.⁴⁷²
- 5.56** ANSTO has significant expertise in community education and engagement, offering a range of programs and resources for students, teachers and the general public on nuclear science, technology and innovation. An important part of this work is promoting the lesser known benefits of nuclear science including in medicine, environmental research, food and agriculture

⁴⁶⁹ Evidence, Mr Ryan Hemsley, Director, Government and International Relations, Australian Radiation Protection and Nuclear Safety Agency, 11 November 2019, p 57.

⁴⁷⁰ Evidence, Mr Ryan Hemsley, Director, Government and International Relations, Australian Radiation Protection and Nuclear Safety Agency, 11 November 2019, p 57.

⁴⁷¹ Evidence, Mr Ryan Hemsley, Director, Government and International Relations, Australian Radiation Protection and Nuclear Safety Agency, 11 November 2019, p 57.

⁴⁷² Evidence, Dr Joanne Lackenby, President, Women in Nuclear Australia, 18 November 2019, p 15.

and industrial applications.⁴⁷³ ANSTO's leading role in nuclear education is summarised in the following terms:

ANSTO's engagement with the Australian public has introduced new ways to discuss and think about nuclear issues, by taking the time to engage and educate non-scientific audiences about the benefits of nuclear science and technology, and about how the application of nuclear technologies relates to daily lives. ANSTO plays a leading role in nuclear education and is helping to grow a more informed generation of Australians about nuclear.⁴⁷⁴

- 5.57** As part of its nuclear education efforts, ANSTO publishes detailed information on its website about natural background radiation, including non-harmful background doses from things like granite tiles in homes, air travel and bananas.⁴⁷⁵
- 5.58** The committee also heard evidence about joint community education programs between ANSTO and ARPANSA targeting residents and students of the Sutherland Shire and Lucas Heights.⁴⁷⁶ For example, the ANSTO Education Team offers STEM education programs to primary schools in the St George and Sutherland Shire regions of Sydney.⁴⁷⁷

Future community engagement strategies to obtain social acceptance

- 5.59** Should the bill be enacted in law, any future nuclear proposals in New South Wales would require the support of the community. Consequently, the committee sought to elicit expert opinions on effective community education, engagement and outreach strategies which might be considered to promote understanding, acceptance and social licence for nuclear energy in New South Wales.
- 5.60** A recent example of community engagement on the topic of nuclear is provided below in the case study on the selection of a site for a new National Radioactive Waste Management Facility.

⁴⁷³ Australian Nuclear Science and Technology Organisation, *Science education*, Australian Government, www.ansto.gov.au/science-education.

⁴⁷⁴ Submission 59, Australian Nuclear Science and Technology Organisation, p 2.

⁴⁷⁵ Australian Nuclear Science and Technology Organisation, *Natural background radiation*, Australian Government, www.ansto.gov.au/education/nuclear-facts/what-is-radiation#natural-background-radiation.

⁴⁷⁶ Evidence, Mr Ryan Hemsley, Director, Government and International Relations, Australian Radiation Protection and Nuclear Safety Agency, 11 November 2019, p 57.

⁴⁷⁷ Australian Nuclear Science and Technology Organisation, *Natural background radiation*, Australian Government, www.ansto.gov.au/education/primary/incursions.

Case study - National Radioactive Waste Management Facility⁴⁷⁸

Australia's radioactive waste (which is low-level and intermediate-level waste) is managed at around 100 locations around Australia, including the Australian Nuclear Science and Technology Organisation (ANSTO), the Commonwealth Scientific and Industrial Research Organisation (CSIRO), industrial sites and hospitals. The Commonwealth Government is proposing to build a single facility in regional South Australia to permanently dispose of low-level waste and temporarily store intermediate-level waste.

The selection process for a suitable site involved community consultation and technical assessment over 4 years. The site selection process considered safety and regulations, cultural heritage, the environment, social and economic impact and facility land requirements.

The Department of Industry, Science, Energy and Resources sought feedback and advice from the communities involved in the site selection process on key aspects including:

- site design;
- environmental monitoring;
- jobs; and
- business opportunities.

Information sessions for members of nearby communities were held on multiple issues, including:

- nuclear production and waste management managers from ANSTO;
- Aboriginal cultural heritage experts;
- site suitability experts from Geoscience Australia;
- radiation safety experts from Rio Tinto; and
- experts on nuclear science and medicine.

Community sentiment was sought through public submissions throughout the site selection process.

In November 2019, the District Council of Kimba conducted a non-binding postal ballot in relation to the construction of a National Radioactive Waste Management Facility at one of three nominated sites, two of which were within its local government area. 734 people participated in the ballot with a total of 61.6 per cent in favour of the facility.

In February 2020, the Commonwealth Government identified Napandee, near Kimba in South Australia, to host the facility.

⁴⁷⁸ Department of Industry, Science, Energy and Resources, *Australian Radioactive Waste Management Framework*, 2018, Australian Government, p 4; Department of Industry, Science, Energy and Resources, *Selecting a radioactive waste site*, page updated 13 February 2020, <https://www.industry.gov.au/strategies-for-the-future/managing-radioactive-waste/selecting-a-radioactive-waste-site>; District Council of Kimba, *Q&A and key dates for Kimba National Radioactive Waste Management Facility ballot*, <http://www.kimba.sa.gov.au/page.aspx?u=408&c=10111>; Media release, Senator the Hon Matt Canavan, former Minister for Resources and Northern Australia, 'National radioactive waste management facility – Kimba community ballot', 7 November 2019;

Communication

- 5.61** Dr Kath Smith of Women in Nuclear Australia emphasised the importance of community-to-community communication and a diversity of voices in promoting acceptance of nuclear energy in local 'host' communities. Dr Smith drew the committee's attention to experiences from host communities in Africa and Finland as examples of where communication was delivered peer-to-peer via diverse voices, as opposed to top-down models where messaging is disseminated from those in power:

When the Canadians were selling nuclear power reactors into Africa they invited some of the Indigenous population from Canada to go and talk to the people in Africa. So I think community-to-community communication is a great way forward. I also think that you cannot have just the voices of a particular group like the one here—strong professional people of a certain age—because the voices have to be diverse, in all meanings of that word.

[...]

In Finland, which has built the first one of the generation 3-plus reactors and is now building a second one north of the Arctic Circle, they had a lot of community consultation. They actually had a shop front in the town that was considering being a volunteer community. ... The people who were manning the shop were of a similar socio-economic and cultural background to the people that they were talking to. So there was communication on every level. There was [also] communication from the government ... So you can have it from the top but you need it from the grass roots as well.

- 5.62** Reinforcing this testimony, Women in Nuclear Australia also stressed the importance of 'ongoing, persistent, technically sound and empathetic communication with communities, and New South Wales as a whole' as the best method to engage the community.⁴⁷⁹ Its submission to the inquiry argues that dispelling the myths about nuclear through education and communication should be central to any future engagement of New South Wales citizens in decisions and consultation about nuclear power – and that the nuclear industry, including organisations such as Women in Nuclear Australia, has an important role to play in this process.⁴⁸⁰

Acceptance through familiarity

- 5.63** Mr Robert Parker of the Australian Nuclear Association remarked that, in his experience speaking to community groups about nuclear issues, acquainting people with a dialogue on nuclear is paramount:

... if I have one lesson it is familiarity. If you keep the message going and it can come from a source—it could be, for example, the New South Wales energy commission—and it could put out information so that within the community a dialogue occurs, the more people who get used to that dialogue the more they have their thinking moments in their private time. That is when they change their mind. I will never change their

Media release, Senator the Hon Matt Canavan, former Minister for Resources and Northern Australia, 'National Radioactive Waste Management Facility – Napandee site', 1 February 2020.

⁴⁷⁹ Submission 44, Women in Nuclear Australia, p 2.

⁴⁸⁰ Submission 44, Women in Nuclear Australia, pp 10 and 18-19.

mind. They will assemble information and they will make up their mind in their good time but the dialogue needs to be had.⁴⁸¹

Education 'on all fronts' and demystifying radiation

- 5.64** Dr Mark Ho, President of the Australian Nuclear Association, advanced the view that education 'on all fronts' is needed to make inroads into social acceptance while also acknowledging the role of strong leadership by government:

I think we need to move forward on all fronts in terms of our education. I was a beneficiary of the New South Wales education system. I did physics and chemistry. I remember that there was a nuclear component in one of the physics electives. [...] I think all these are very, very fundamental for a modern society to make intelligent decisions, right? So I would say that including our research efforts, should the New South Wales Government or the Federal Government also want to lift the ban on nuclear power, yes, I would say that an education program would be part and parcel.⁴⁸²

- 5.65** According to several inquiry participants,⁴⁸³ education should specifically target misconceptions of radiation exposure as part of a broader effort to recalibrate the public's risk perception of nuclear power – and in particular, the tendency to see radiation as something confined to industrial and nuclear settings rather than as something that is present in everyday life. For this purpose, Dr Paterson suggested practical ways to introduce people to the idea of background levels of radiation:

My feeling is that you can start this in about year 5 or 6 at school and expose people to taking their cell phone, putting a black sticker on, putting an app on it and they can go and measure their granite benchtop at home, they can measure their bananas, which are probably the most radioactive stuff. If you do lots of bananas you are more radioactive than if you do not eat bananas. So you get people introduced to the idea of low-level background radiation.⁴⁸⁴

- 5.66** In the opinion of Mr James Fleay of Down Under Nuclear Energy, simply informing the public and equipping people with the facts would go a long way to overcoming negative perceptions of nuclear energy and would enable sensible, well-informed discussion of the issues. Moreover, Mr Fleay does not believe that people are unwilling or unable to understand the issues surrounding nuclear, but they merely lack the knowledge that would enable understanding through sensible debate:

It would be reasonable to assume that an honest attempt at education would be remarkably successful. To lack knowledge is not the same as being unable to understand the issues if they are properly discussed. It would only be necessary to make a sensible attempt to simply inform the public of the real dangers, or lack of dangers, and give the facts about Chernobyl and Fukushima. This would go a long way to removing the irrational and at times hysterical reactions to nuclear based on claims about Chernobyl

⁴⁸¹ Evidence, Mr Robert Parker, Vice President, Australian Nuclear Association, 11 November 2019, p 25.

⁴⁸² Evidence, Dr Mark Ho, President, Australian Nuclear Association, 11 November 2019, p 25.

⁴⁸³ See for example: Evidence, Dr Kath Smith, Executive Committee Member, Women in Nuclear Australia, 18 November 2019, p 19; Submission 35, Mr Geoff Russell, p 2.

⁴⁸⁴ Evidence, Dr Adrian Paterson, Chief Executive Officer, Australian Nuclear Science and Technology Organisation, 11 November 2019, p 16.

killing millions, hospitals full of mutated babies and Fukushima polluting large areas of Japan.⁴⁸⁵

The role of leaders in influencing opinion and building trust

- 5.67** The proposition that better education about radiation would lead to greater social acceptance of nuclear power was challenged in evidence by Dr John Harries, Secretary of the Australian Nuclear Association. Offering a contrary review to that of his President, Dr Harries submitted that people are more likely to formulate opinions and perceptions about risk by taking their cue from 'opinion leaders', and this opinion-influencing process would be more effective in promoting social acceptance of nuclear than education:

I do not think education is the way. People get their perceptions of a whole lot of hazardous issues from their leaders or from a group of people. There are opinion leaders. I think it is a mistake to think that we could educate people about radiation. Radiation has been around forever. This question of how much radiation people can take—people are very happy to go and get their MRIs and their CT scans and they are very happy to fly in planes. But to talk about an extremely low level radiation from an operating reactor at, say, the Australian Nuclear Science and Technology Organisation, which you almost cannot measure, and there is a totally different perception there. So I am just tipping a bit back from thinking that education in the way that we would talk to people—we talk to communities and ANSTO had a lot of people talking to communities and making school visits—we have to be open and honest about it, but there is no straightforward education solution.⁴⁸⁶

- 5.68** Another inquiry participant, namely Mr Michael Angwin, former Chief Executive Officer of the Australian Uranium Association, offered a noteworthy treatise on the issues surrounding social acceptance and support for nuclear power, starting with the premise that, without the trust and support of the State's citizens, the development of a nuclear energy industry in New South Wales will not be possible.⁴⁸⁷ Drawing on the psychology of risk perception, Mr Angwin suggests that, because human risk assessment involves both rational and irrational processes, disseminating more and more factual information about the safety of nuclear power will have limited effect in altering the public's perception of it.
- 5.69** Mr Angwin submits that any future efforts to promote acceptance of nuclear energy must begin with trust:

The answer is to be found in the emotions, not in facts alone: the antidote to fear is trust; trust is not given in response to promises but in response to behaviour.

Accordingly, if the nuclear industry is to acquire the support of its stakeholders, and mainstream and normalise its life in the community, it – and the governments, institutions and laws that support it – will have to overcome fear by gaining trust through behaviour.⁴⁸⁸

⁴⁸⁵ Submission 42, Down Under Nuclear Energy, p 24.

⁴⁸⁶ Evidence, Dr John Harries, Secretary, Australian Nuclear Association, 11 November 2019, p 25.

⁴⁸⁷ Submission 15, Mr Michael Angwin, p 1.

⁴⁸⁸ Submission 15, Mr Michael Angwin, p 5.

Community consultation on nuclear projects/proposals

5.70 ANSTO notes that it would be essential for any new nuclear activities in New South Wales to obtain broad community support, commending to the committee an international body of work on community engagement specifically for the establishment of nuclear industries, with a suggested starting point in the best practice guidance published by the Organisation for Economic Cooperation and Development Nuclear Energy Agency Forum on Stakeholder Confidence.⁴⁸⁹ In referencing this body of work, ANSTO impressed upon the committee that community engagement on nuclear cannot be rushed and must be adequately resourced:

The international experience shows that community engagement activities should not be the subject of arbitrary timeframes and inadequate resourcing, and that communities and other stakeholders can play a constructive role in project planning and delivery. Examples of public contributions to the establishment and operation of nuclear facilities include the provision of local knowledge regarding environmental and heritage factors, design enhancements, and the supply of labour and services throughout the supply chain.⁴⁹⁰

5.71 According to ANSTO, a comprehensive plan for community engagement at the local, regional and national level would be an imperative prerequisite for any future proposal to establish nuclear facilities in New South Wales. This would ensure the community is provided with sufficient familiarity with and understanding of nuclear technology to make informed decisions.⁴⁹¹

5.72 With respect to community engagement models, Dr Smith of Women in Nuclear Australia advocates consideration of community consultative committees for well-informed and considered debate on the issues surrounding nuclear power.⁴⁹² Dr Smith identified considerable value in improving the public's energy literacy, telling the committee that, as a community, '...we need to think about the energy environment and energy markets and our literacy needs to be that much better.'⁴⁹³ Such enhanced energy literacy was considered necessary to enable more meaningful discussion of nuclear energy and uranium mining.⁴⁹⁴

5.73 The committee was also made aware of instances where community consultation on nuclear proposals has been managed less-than-successfully, highlighting missteps or pitfalls to be avoided. The Australian Nuclear Association commented on the community engagement and consultation processes for the South Australian Nuclear Fuel Cycle Royal Commission discussed in Chapter 1, including on any key 'take-aways' legislators should heed. Mr Parker summarised the sentiment about where those processes got 'derailed':

The biggest disappointment that the royal commissioner, Kevin Scarce, expressed directly to us was that it should not have gone to a public forum as quickly as it did. As I just described, it is a slow burn of education. What they did is they took the findings,

⁴⁸⁹ Submission 59, Australian Nuclear Science and Technology Organisation, p 49.

⁴⁹⁰ Submission 59, Australian Nuclear Science and Technology Organisation, p 49.

⁴⁹¹ Submission 59, Australian Nuclear Science and Technology Organisation, p 49.

⁴⁹² Submission 44, Women in Nuclear Australia, pp 10, 18.

⁴⁹³ Evidence, Dr Kath Smith, Executive Committee Member, Women in Nuclear Australia, 18 November 2019, p 18.

⁴⁹⁴ Submission 44, Women in Nuclear Australia, p 24.

which are very good, and his express desire was that that should have taken two or three years of dialogue within South Australia. But what happened is that they got the report and they went straight out to a citizen's jury within a couple of months. Then they had a few chat fests over a few weekends and, lo and behold, the panel got loaded and down it went. It should have been a slow burn within the community and it was setting itself up for that until they some how had a rush of blood to the head and off they went to the citizen's jury. That is where it derailed. It needed, as Kevin Scarce observed, two to three years of education for people to get used to the idea and for them to make the merits of it. So don't do it too quickly.⁴⁹⁵

- 5.74** Bright New World cautioned against top-down approaches to community consultation and engagement for new nuclear developments, arguing they result in poor consultation outcomes and are counterproductive to meaningful engagement with communities:

There is a persistent request during these nuclear inquiries as to where nuclear power will be sited. It is a request borne from an outdated policy where projects are announced and defended from opposition. These top down approaches may work for some developments, however for projects with complex concepts that require public engagement they will result in reactionary responses based on emotive reasoning.

Bright New World urges the committee to reject requests for naming sites for nuclear power, until there has been enough time for the Australian public to first understand what is being proposed. A methodology Bright New World prefers is for general siting conditions to be communicated as per IAEA guidelines, a proponent to describe their project, and call for community nominations for sites that meet IAEA siting criteria. Once communities have volunteered the proponent and the community can undertake an in-depth consultation process.⁴⁹⁶

Committee comment

- 5.75** The committee acknowledges that a significant challenge facing legislators and policy-makers in continuing the public dialogue about nuclear in New South Wales is how to:

- promote a more informed understanding of radiation and risks in everyday life;
- demystify nuclear and break long-held associations of nuclear with single point events in the public conscience; and
- offer a relatable narrative for the advancements in nuclear technology since the enactment of the *Uranium Mining and Nuclear Facilities (Prohibition) Act 1986*.

- 5.76** To this end, the committee recommends that the Department of Planning, Industry and Environment liaise with the Australian Nuclear Science and Technology Organisation to Organisation to use existing public outreach and education programs to implement broader community education initiatives about nuclear energy, highlighting:

- safety and technological advances in this industry since the 1980s;

⁴⁹⁵ Evidence, Mr Robert Parker, Vice President, Australian Nuclear Association, 11 November 2019, p 26.

⁴⁹⁶ Submission 61, Bright New World, p 30.

- how nations such as Canada and France have used nuclear power as part of their decarbonisation strategies;
- the success of the Lucas Heights nuclear reactor in the southern suburbs of Sydney; and
- any other relevant issues.

Recommendation 9

That the Department of Planning, Industry and Environment liaise with the Australian Nuclear Science and Technology Organisation to use existing public outreach and education programs to implement broader community education initiatives about nuclear energy, highlighting:

- safety and technological advances in this industry since the 1980s;
 - how nations such as Canada and France have used nuclear power as part of their decarbonisation strategies;
 - the success of the Lucas Heights nuclear reactor in the southern suburbs of Sydney; and
 - any other relevant issues.
-

Appendix 1 Submissions

No.	Author
1	Mr Barrie Frederick Hill
1a	Mr Barrie Frederick Hill
2	Ms Keri James
3	Ms Dereka Ogden
4	SMR Nuclear Technology Pty Ltd
4a	SMR Nuclear Technology Pty Ltd
5	Mr Grant Mistler
5a	Mr Grant Mistler
6	Name suppressed
7	Energy Policy Institute of Australia
8	Mr Barry Murphy
9	Mrs Beryl Ford
10	Mr Terje Petersen
11	Professor John Quiggin
12	Azark Project
12a	Azark Project
13	Mr Zac Petersen
14	Mr Paul Harris
15	Mr Michael Angwin
16	Nuclear Economics Consulting Group
17	Mr Gregor Riese
18	NuScale Power
19	Nelson Parade Action Group
20	Dr Donald Higson
20a	Dr Donald Higson
21	Mr Logan Smith
22	Name suppressed
23	Flibe Energy, Inc.
24	Smithson Planning
25	Nuclear Energy Institute
26	Mr Steven Noble
27	Australian Nuclear Association

No.	Author
28	Name suppressed
29	Ms Sabena Winston
30	Jillian Hely
31	Confidential
32	Name suppressed
33	Mrs Shannon Blackmore
34	Ms Annelise Macs
35	Mr Geoff Russell
36	Name suppressed
37	Massachusetts Institute of Technology
38	Mr Grant Barnes
39	Mr Junbo Tao
40	Friends of the Earth Australia
41	Ms Jean Nichten
42	Down Under Nuclear Energy
43	Maritime Union of Australia
44	Women in Nuclear (WiN) Australia Inc.
45	Mr Tony Irwin
46	Mr Tristan Prasser
47	Mr Ian Hore-Lacy
48	International Campaign to Abolish Nuclear Weapons Australia Inc.
49	Geoscience Australia
50	Name suppressed
51	NSW Minerals Council
52	Nuclear for Climate Australia
53	Mr Peter Cunningham
54	Dr John Patterson
55	Joint Civil Society
56	Medical Association for Prevention of War
57	Name suppressed
58	Engineers Australia
59	Australian Nuclear Science and Technology Organisation - ANSTO
60	Name suppressed
61	Bright New World
62	Australian Academy of Technology and Engineering - NSW Division

No.	Author
63	Miss Katherine Stewart
64	Friends of the Earth Australia, Australian Conservation Foundation, Nature Conservation Council of NSW
65	Australian Taxpayers' Alliance
66	Electrical Trades Union
67	Minerals Council of Australia
68	The Australia Institute
69	Dr Ziggy Switkowski AO
70	The Australian Workers' Union
71	GE Hitachi Nuclear Energy
72	Ms Helen Cook

Appendix 2 Witnesses at hearings

Date	Name	Position and Organisation
Thursday 26 September 2019 Macquarie Room Parliament House, Sydney	Mr Tom Mundy	Chief Commercial Officer, NuScale Power
	Ms Cheryl Collins	Director, Sales NuScale Power
	Mr Tony Irwin	Technical Director, SMR Nuclear Technology
	Mr Robert Pritchard	Executive Director Energy Policy Institute of Australia
Monday 11 November 2019 Macquarie Room Parliament House, Sydney	Mr Michael Wright	Deputy Secretary, Resources and Geoscience Department of Planning, Industry and Environment
	Mr Alex King	Executive Director, Resources Policy, Planning and Programs Department of Planning, Industry and Environment
	Dr Adrian Paterson	Chief Executive, Australian Nuclear Science and Technology Organisation (ANSTO)
	Professor Lyndon Edwards	National Director, Australian Generation IV International Forum Research, ANSTO
	Dr Robert Gee	General Manager, ANSTO Materials, ANSTO
	Mr Steven McIntosh	Senior Manager, Government and International Affairs, ANSTO
	Dr Mark Ho,	President, Australian Nuclear Association
	Mr Robert Parker	Vice President, Australian Nuclear Association
	Dr John Harries	Secretary, Australian Nuclear Association
	Mr Chris Gambian	Nature Conservation Council of NSW
	Mr Dave Sweeney	Australian Conservation Foundation
Dr Jim Green	Friends of the Earth Australia	

Date	Name	Position and Organisation
	Dr Donald Higson	Private citizen
	Mr Dayne Eckermann	General Manager, Bright New World (<i>via teleconference</i>)
	Mr James Fleay	CEO, Down Under Nuclear Energy
	Dr Ziggy Switkowski AO	Private citizen
	Mr Ryan Hemsley	Director, Government and International Relations, Australian Radiation Protection and Nuclear Safety Agency
	Mr Robert Godfrey	Director, Facility Safety, Australian Radiation Protection and Nuclear Safety Agency
	Mr Satyajeet Marar	Director of Policy, Australian Taxpayers' Alliance
Monday 18 November 2019 Macquarie Room Parliament House, Sydney	Mr David Frith	Principal Advisor, NSW Minerals Council
	Mr Patrick Gibbons	Director, Industry and Environment, Minerals Council of Australia
	Dr Joanne Lackenby	President, Women in Nuclear Australia
	Dr Kath Smith	Executive Committee Member, Women in Nuclear Australia
	Mr Steven Rodgers	Senior Policy Advisor, Energy and Public Affairs, Engineers Australia
	Mr Martin Thomas	Australian Academy of Technology & Engineering
	Mr Matt Murphy	National Industry Co-ordinator, Electrical Trades Union
	Professor Stephen Wilson	Centre for Energy Futures, University of Queensland
	Mr Barry Murphy	Private citizen
	Dr John Patterson (<i>via teleconference</i>)	Private citizen
Mr Misha Zelinsky	National Assistant Secretary, The Australian Workers' Union	

Appendix 3 Minutes

Minutes no. 2

Thursday 20 June 2019

Standing Committee on State Development

McKell Room, Parliament House, Sydney, 2.01pm

1. Members present

Mr Martin, *Chair*

Mr Veitch, *Deputy Chair*

Mr Banasiak

Mr Fang

Mr Farlow

Mr Graham

Mrs Maclaren-Jones

2. Apologies

Mr Pearson

3. Draft minutes

Resolved on the motion of Mr Veitch: That draft minutes no. 1 be confirmed.

4. Correspondence

The committee noted the following items of correspondence:

Sent:

- 5 June 2019 – Letter from Chair to the Hon John Barilaro MP, Deputy Premier, Minister for Regional New South Wales, Industry and Trade, following up on the establishment of a joint committee on defence and space industries
- 6 June 2019 – Letter from Chair to the Hon John Ajaka MLC, President, raising the issue of a review of the Broadcast of Proceedings Resolution.

5. Inquiry into the Uranium Mining and Nuclear Facilities (Prohibitions) Repeal Bill 2019

5.1 Terms of reference

The committee noted the referral on 6 June 2019 of the following terms of reference:

1. That:
 - (a) the Uranium Mining and Nuclear Facilities (Prohibitions) Repeal Bill 2019 be referred to the Standing Committee on State Development for inquiry and report, and
 - (b) on tabling of the report by the Standing Committee on State Development, a motion may be moved without notice that the bill be restored to the Notice Paper at the stage it had reached prior to referral.
2. That as part of the inquiry:
 - (a) the New South Wales Parliamentary Library prepare an Issues Paper on the bill,
 - (b) the committee commission the newDemocracy Foundation to facilitate community input into the bill, such as a citizens panel or jury, to complement the traditional forms of evidence gathering by committees, such as seeking submissions and taking oral evidence, and

- (c) the committee respect the foundation's remit as an independent and non-partisan research organisation.
3. That the House notes that the newDemocracy Foundation has offered to provide this service during 2019 and 2020 for no charge to the Parliament.

5.2 Proposed timeline

Resolved on the motion of Mrs Maclaren-Jones: That the committee follow the below timeline for its inquiry:

ANSTO visit	Late July
South Australian uranium mine	August/September
Library Issues Paper	End September
Submissions close	18 October
Hearings	November/December
Report drafting	From December
newDemocracy final input	January 2020
Report to Chair	Early February
Report to members	Mid February
Report deliberative	Mid February
Report tabling	Late February

Resolved on the motion of Mr Veitch: That

- the committee note the approximate costings for a site visit to South Australia, including visiting an uranium mine and holding relevant briefings, in Adelaide is \$30,000, and
- the committee seek the approval of the President to undertake a site visit to South Australia with the purpose of visiting a uranium mine and to hold relevant briefings, including on the use of citizens juries, in Adelaide.

5.3 NSW Parliamentary Library Issues paper and newDemocracy Foundation

Resolved on the motion of Mr Banasiak That :

- the committee note the Parliamentary Library is preparing an Issues Paper on the bill, the draft table of contents and timeframe for completion being end of September 2019; and
- once the Library has published the Issues Paper, the committee also publish the paper on its website and notify stakeholders.

Resolved on the motion of Mrs Maclaren-Jones That newDemocracy be invited to give a briefing to the committee on its work and how it could facilitate community input into the bill.

5.4 Stakeholder list

Resolved on the motion of Mrs Maclaren Jones: That members nominate additional stakeholders by close of business Monday 24 June 2019, and that the committee agree to the final stakeholder list by email, unless a meeting of the committee is required to resolve any disagreement.

5.5 Advertising

The committee noted that all inquiries are advertised via social media, stakeholder emails and a media release distributed to all media outlets in New South Wales.

6. Adjournment

The committee adjourned at 2.15pm, *sine die*.

Rebecca Main
Committee Clerk

Minutes no. 3

Wednesday 24 July 2019

Standing Committee on State Development

Australian Nuclear Science and Technology Organisation (ANSTO), Lucas Heights, 9.51 am

1. Members present

Mr Martin, *Chair*

Mr Veitch, *Deputy Chair*

Mr Banasiak

Mr Farlow, *arrived at 9.53 am*

Mr Graham

Mr Latham, *arrived at 9.56 am*

Mrs Maclaren-Jones

2. Apologies

Mr Fang

3. Draft minutes

Resolved on the motion of Mr Veitch: That draft minutes no. 2 be confirmed.

4. Correspondence

The committee noted the following items of correspondence:

Received:

- 28 June 2019 – Letter from the Hon John Ajaka MLC, President to the Chair to advising that the Procedure Committee will be conducting a review of the Broadcast of Proceedings Resolution.

Sent:

- 5 July 2019 – Letter from Chair to the Hon Dan van Holst Pellekaan MP, Minister for Energy and Mining, advising of the upcoming committee visit to South Australia.

5. Inquiry into the Uranium Mining and Nuclear Facilities (Prohibitions) Repeal Bill 2019

5.1 Attendance on the site visit to ANSTO by Mr Todd Kirby

Resolved, on the motion of Mrs Maclaren-Jones: That the committee authorise the Chair's staff member, Mr Todd Kirby, to accompany the committee on the site visit to ANSTO.

Mr Farlow and Mr Latham joined the meeting.

5.2 Site visit to ANSTO

Committee members visited the ANSTO facility and received a tour and briefing.

The committee met with the following representatives from the ANSTO:

- Dr Adi Paterson, Chief Executive Officer
- Mr Steve McIntosh, Senior Manager, Government and International Affairs
- Dr Geordie Graetz, Government and International Affairs Advisor
- Mr David Vittorio, OPAL Reactor Manager
- Mr Matthew Richards, OPAL Shift Manager
- Mr Robert Gee, General Manager ANSTO Minerals
- Mr Rohan Holmes, Chemical Process Engineering
- Mr Daniel Gregg, Nuclear Wasteform Engineer

- Mr Lyndon Edwards, National Director Australian Gen IV Research
- Mr Mark Ho, Nuclear Engineer
- Ms Sjaan Kuiper, Departmental Advisor, and
- Mr Rod Dowler, Discovery Centre Leader.

6. Adjournment

The committee adjourned at 1.15 pm, until Wednesday 14 August 2019, at 6.30 am at relevant gate at Sydney Airport (*South Australia site visit*).

Rebecca Main
Committee Clerk

Minutes no. 4

Wednesday 14 August 2019

Standing Committee on State Development

Gate for Qantas flight QF0735, Sydney Domestic Airport, Sydney, at 6.30 am

1. Members present

Mr Martin, *Chair*

Mr Veitch, *Deputy Chair*

Mr Fang

Mr Farlow

Mr Graham

Mr Latham

2. Apologies

Mr Banasiak

Mrs Maclaren-Jones

3. Draft minutes

Resolved, on the motion of Mr Veitch: That draft minutes no. 3 be confirmed.

4. Correspondence

The committee noted the following items of correspondence:

Received:

- 22 July 2019 – Email from Mr Peter Remta, providing information concerning a nuclear waste disposal facility in Western Australia
- 23 July 2019 – Letter from the Honourable Dan van Holst Pellekaan MP, Minister for Energy and Mining, indicating his support for the committee's visit to South Australia
- 6 August 2019 – Letter from Deputy Premier to Chair, providing update on the establishment of joint committee on defence and space.

5. Inquiry into the Uranium Mining and Nuclear Facilities (Prohibitions) Repeal Bill 2019

5.1 Public submissions

The committee noted that the following submissions were published by the committee clerk under the authorisation of the resolution appointing the committee: submission nos. 1, 2, 3, 4, 5, 7 and 8.

5.2 Partially confidential submission (name suppressed)

The committee noted that submission no. 6 was partially published by the committee clerk under the authorisation of the resolution appointing the committee.

Resolved, on the motion of Mr Farlow: That the committee authorise the publication of submission no. 6 with the exception of the author's name, which is to remain confidential, as per the request of the author.

5.3 Attendance of the South Australia government representatives and others

Resolved, on the motion of Mr Veitch: That the committee authorise:

- representatives from the South Australian Government, South Australia Chamber of Mines & Energy and Bright New World to attend the committee's site visit to the Beverley mine, and
- South Australian Government representatives to attend the meetings on 15 August 2019.

5.4 Site visit to the Beverley uranium mine

The committee travelled to the Beverley uranium mine accompanied by the following representatives from the South Australian Government:

- Mr Lachlan Pontifex, Director Resource Policy and Engagement, Department for Energy and Mining
- Mr Greg Marshall, Director Mining Regulation, Department for Energy and Mining, and
- Mr Keith Baldry, Director Science and Radiation, Environment Protection Authority.

After arriving at the Beverley uranium mine, the committee received a tour and met with the following representatives from Heathgate, South Australia Chamber of Mines & Energy, and Bright New World:

- Dr Andrea Marsland-Smith, Head of Operations, Heathgate
- Mr Stephen Halliday, Head of External Relations & Public Affairs, Heathgate
- Ms Kathryn Levingstone, Regulatory & Compliance Superintendent, Heathgate
- Ms Rebecca Knol, CEO, South Australia Chamber of Mines & Energy, and
- Dr Ben Heard, Director, Bright New World.

6. Adjournment

The committee adjourned at 4.00 pm, until Thursday 15 August 2019, meet at 8.15 am, Lobby, Peppers Waymouth Hotel, Adelaide.

Rebecca Main
Committee Clerk

Minutes no. 5

Thursday 15 August 2019

Standing Committee on State Development

Lobby, Peppers Waymouth Hotel, Adelaide, at 8.15 am

1. Members

Mr Martin, *Chair*

Mr Veitch, *Deputy Chair*

Mr Fang

Mr Farlow

Mr Graham

Mr Latham

2. Apologies

Mr Banasiak

Mrs Maclaren-Jones

3. Inquiry into the Uranium Mining and Nuclear Facilities (Prohibitions) Repeal Bill 2019

The committee met with the following representatives from the South Australian Government, the former South Australian Nuclear Fuel Cycle Royal Commission and Response Agency, BHP and Flinders Ports:

- Rear Admiral Kevin Scarce, former South Australian Governor and Royal Commissioner to the SA Nuclear Fuel Cycle Royal Commission
- Mr Lachlan Pontifex, Director Resource Policy and Engagement, South Australian Department for Energy and Mining
- Mr Jason Downs, Manager, Engagement Solutions, South Australian Department for Innovation and Skills
- Mr Greg Marshall, Director Mining Regulation, South Australian Department for Energy and Mining
- Mr Keith Baldry, Director Science and Information, South Australian Environment Protection Authority
- Mr Paul Heithersay, Chief Executive, South Australian Department for Energy and Mining
- Mr Martin Smith, Head of HSE, Olympic Dam, BHP
- Mr Neil Camillo, Manager, Radiation and Hygiene A&I
- Mr Emmet Fay, Principal Government Relations, Olympic Dam Corporate Affairs, BHP
- Mr Jim Hondros, Consultant to BHP
- Mr David Sleath, General Manager, Flinders Adelaide Container Terminal
- Mr Joe Mastrangelo, Director, Infrastructure and Investment, South Australian Department for Energy and Mining.

4. Adjournment

The committee adjourned at 2.45 pm, until Thursday 22 August 2019 at 1.30 pm, Room 1254, Parliament House.

Rebecca Main

Committee Clerk

Minutes no. 6

Thursday 22 August 2019

Standing Committee on State Development

Room 1254, Parliament House, Sydney, 1.36 pm

1. Members present

Mr Martin, *Chair*

Mr Veitch, *Deputy Chair*

Mr Banasiak

Mr Fang

Mr Farlow

Mr Graham

Mr Latham

Mrs Maclaren-Jones

2. Correspondence

The committee noted the following item of correspondence:

Received:

- 16 August 2019 — From Mr Iain Walker, Executive Director, newDemocracy, providing an options paper regarding the use of citizens' juries in the inquiry process for the Uranium Mining and Nuclear Facilities (Prohibitions) Repeal Bill 2019.

3. Inquiry into the Uranium Mining and Nuclear Facilities (Prohibitions) Repeal Bill 2019

3.1 Public submissions

The committee noted that submissions nos 9, 10 and 11 were published by the committee clerk under the authorisation of the resolution appointing the committee.

3.2 Meeting with the newDemocracy

The committee met with Mr Iain Walker, Executive Director, newDemocracy to discuss the proposal to use newDemocracy as part of the inquiry.

Resolved, on the motion of Mr Veitch: That, the committee:

- note the options paper prepared by newDemocracy; and
- meet again to discuss how to proceed.

4. Adjournment

The committee adjourned at 2.24 pm, until Tuesday 10 September 2019, at 1.00 pm, McKell Room, Parliament House.

Rebecca Main

Committee Clerk

Minutes no. 7

Tuesday 10 September 2019

Standing Committee on State Development

McKell Room, Parliament House, Sydney, 1.00 pm

1. Members presentMr Martin, *Chair*Mr Veitch, *Deputy Chair*

Mr Banasiak

Mr Fang

Mr Graham

Mr Latham

Mrs Maclaren-Jones (via teleconference)

2. Apologies

Mr Farlow

3. Draft minutes

Resolved, on the motion of Mr Veitch: That draft minutes no. 4, 5 and 6 be confirmed.

4. Correspondence

The committee noted the following correspondence:

Received:

- 9 July 2019 — From Mr Barry Murphy to the committee, providing information on nuclear energy
- 1 August 2019 — From Dr Geordie Graetz, Government and International Affairs Advisor, Office of the Chief Executive Officer, ANSTO, providing a copy of the Generation IV International Forum Framework Agreement and a link to the electricity map website.

Sent:

- 20 August 2019 — From Committee Chair to the Hon Dan van Holst Pellekaan MP, Minister for Energy and Mining, South Australian Government, thanking the Minister and his department for organising the site visit to the Beverley uranium mine and various meetings during the committee's visit to South Australia on 14 and 15 August 2019.

5. Inquiry into the Uranium Mining and Nuclear Facilities (Prohibitions) Repeal Bill 2019**5.1 Public submissions**

The committee noted that submissions nos 12, 13, 14, 15, 16, 17 and 18 were published by the committee clerk under the authorisation of the resolution appointing the committee.

5.2 Partial publication of attachment A to submission no. 12 (commercial-in-confidence information suppressed)

Resolved, on the motion of Mr Veitch: That the committee authorise the publication of attachment A to submission no. 12 with the exception of certain information on paragraphs 26 and 27, which are to remain confidential, as per the request of the author.

5.3 Consideration of the proposal from newDemocracy

Mr Latham moved: That the committee write to Mr Iain Walker of the newDemocracy Foundation seeking to confirm the Foundation can deliver the proposed deliberative poll based on the following parameters:

1. That the Issues Paper being developed by the Parliamentary Library be:
 - a. the only resource used by newDemocracy to formulate consultation material for the deliberative poll process; and

- b. used by newDemocracay to devise questions for the deliberative poll;
2. That there be no cost (in-kind or monetary) to Parliament for the newDemocracy proposal in its entirety, including the provision of venues or incidentals, as was agreed to by the House on 6 June 2019; and
3. That the deliberative poll process conducted by newDemocracy be completed and the report presented to the committee before the end of February 2020.

Mr Fang moved: that the motion of Mr Latham be amended by inserting at the end 'That if the newDemocracy Foundation is unable to deliver the proposed deliberative poll within the parameters as set out in paragraphs 1-3, the committee:

- not proceed with commissioning newDemocracy to facilitate community input into the bill;
- supports the Chair to move a motion in the House to amend the terms of reference of the inquiry to omit paragraph's 2 (b), (c) and 3; and
- notes that the use of alternative deliberative processes for highly contentious private members' bills is a matter being considered by the Procedure Committee.'

Question: That the amendment of Mr Fang be agreed to—put and passed.

Original question, as amended:

That the committee write to Mr Iain Walker of the newDemocracy Foundation seeking to confirm the Foundation can deliver the proposed deliberative poll based on the following parameters:

1. That the Issues Paper being developed by the Parliamentary Library be:
 - a. the only resource used by newDemocracy to formulate consultation material for the deliberative poll process; and
 - b. used by newDemocracay to devise questions for the deliberative poll;
2. That there be no cost (in-kind or monetary) to Parliament for the newDemocracy proposal in its entirety, including the provision of venues or incidentals, as was agreed to by the House on 6 June 2019; and
3. That the deliberative poll process conducted by newDemocracy be completed and the report presented to the committee before the end of February 2020.

That if the newDemocracy Foundation is unable to deliver the proposed deliberative poll within the parameters as set out in paragraphs 1-3, the committee:

- not proceed with commissioning newDemocracy to facilitate community input into the bill;
- supports the Chair to move a motion in the House to amend the terms of reference of the inquiry to omit paragraph's 2 (b), (c) and 3; and
- notes that the use of alternative deliberative processes for highly contentious private members' bills is a matter being considered by the Procedure Committee.

Question put and passed.

6. Adjournment

The committee adjourned at 1.19 pm, until Thursday 26 September 2019, at 1.30 pm, Macquarie Room, Parliament House (public hearing with NuScale).

Rebecca Main
Committee Clerk

Minutes no. 8

Thursday 26 September 2019

Standing Committee on State Development

Macquarie Room, Parliament House, Sydney, 1.32 pm

1. Members presentMr Martin, *Chair*Mr Veitch, *Deputy Chair*

Mr Banasiak

Mr Buttigieg (*participating member*)

Mr Fang

Mrs Maclaren-Jones

Mr Farlow

2. Apologies

Mr Graham

Mr Latham

3. Correspondence

The committee noted the following correspondence:

Received:

- 15 September 2019 — From Mr Iain Walker, Executive Director, newDemocracy Foundation, to secretariat in response to Committee Chair's correspondence of 12 September 2019 seeking confirmation of parameters.

Sent:

- 12 September 2019 – From Committee Chair to Mr Iain Walker, Executive Director, newDemocracy Foundation, seeking confirmation of parameters for the deliberative poll proposal.
- 17 September 2019 – From Director Committees to Mr Iain Walker, Executive Director, newDemocracy Foundation, providing further information in relation to the parameters.

4. Inquiry into the Uranium Mining and Nuclear Facilities (Prohibitions) Repeal Bill 2019**4.1 Public submissions**

The committee noted that submissions nos 19, 20, 21, 23, 24, 25 and 26 were published by the committee clerk under the authorisation of the resolution appointing the committee.

4.2 Partially confidential submissions (name suppressed)

Resolved, on the motion of Mr Fang: That the committee authorise the publication of submission no. 22 with the exception of the author's name, which is to remain confidential, as per the request of the author.

4.3 Library Issues Paper

Resolved, on the motion of Mr Veitch: That the committee, once the NSW Parliamentary Library has published the Issues Paper for the Uranium Mining Bill, publish a link to the paper on the committee's website and email stakeholders and submission authors to advise of the publication of the Issues Paper and to encourage further submissions.

4.4 Public hearing

Witnesses, the public and the media were admitted.

The chair made an opening statement regarding the broadcasting of proceedings, adverse mention and other matters.

The following witnesses was sworn and examined:

- Mr Tom Mundy, Chief Commercial Officer, NuScale
- Ms Cheryl Collins, Director, Sales, NuScale
- Mr Tony Irwin, Technical Director, SMR Nuclear Technology
- Mr Robert Pritchard, Executive Director, Energy Policy Institute of Australia.

The evidence concluded and the witnesses withdrew.

The media and the public withdrew.

The public hearing concluded at 2.30 pm.

5. Adjournment

The committee adjourned at 2.30 pm, until Monday 11 November 2019, Macquarie Room, Parliament House (public hearing).

Rebecca Main

Committee Clerk

Minutes no. 9

Monday 11 November 2019

Standing Committee on State Development

Macquarie Room, Parliament House, Sydney, 9.02 am

1. Members present

Mr Martin, *Chair*

Mr Veitch, *Deputy Chair*

Mr Banasiak (*from 9.05 am*)

Mr Buttigieg (*substituting for Mr Graham*)

Mr Fang

Mr Farlow (*from 9.37 am*)

Mr Latham

Mrs Maclaren-Jones (*from 10.36 am*)

2. Draft minutes

Resolved, on the motion of Mr Veitch: That draft minutes nos 7 and 8 be confirmed.

3. Correspondence

The committee noted the following correspondence:

Received:

- 2 October 2019 – From Mr Iain Walker, Executive Director, newDemocracy Foundation, to the Chair in response to Committee Chair's correspondence of 12 September 2019 seeking confirmation of parameters.
- 16 October 2019 – From the Department of Planning, Industry and Environment (DPIE) to the secretariat advising that DPIE is not making a submission to the inquiry.
- 4 November 2019 – From Mr Tim Mahony, General Manager, Strategic Communications & Corporate Services, Australian Energy Regulator, to the secretariat declining the committee's invitation to give evidence at the public hearing on 18 November 2019.

- 6 November 2019 – From Mr Paul James, Manager, Program Management Office, National Radioactive Waste Management Facility Taskforce, to the secretariat declining the committee's invitation to give evidence at the public hearing on 11 November 2019.

4. Inquiry into the Uranium Mining and Nuclear Facilities (Prohibitions) Repeal Bill 2019

4.1 Site visit reports

Resolved, on the motion of Mr Latham: That the committee accept and publish the following site visit reports, to appear within the 'Other Documents' screen on the committee's website:

- Site Visit Report: Australian Nuclear Science and Technology Organisation (ANSTO), 24 July 2019;
- Site Visit Report: Beverley Uranium Mine, and Adelaide, South Australia, 14 and 15 August 2019.

4.2 Other documents for publication

Resolved, on the motion of Mr Veitch: That the committee accept and publish presentation slides from the following authors/organisations, to appear within the 'Other Documents' screen on the committee's website:

- Dr Benjamin Heard, Bright New World
- Dr Andrea Marsland-Smith, Heathgate Resources Pty Ltd
- Mr Greg Marshall, Department of Energy and Mining (South Australia)
- Mr Lachlan Pontifex and Mr Jason Downs, Department of Energy and Mining (South Australia)
- Mr Keith Baldry, Environment Protection Authority (South Australia).

4.3 Consideration of the new Democracy proposal

The committee noted that it would not proceed with the new Democracy proposal and that the Chair will move a motion in the House to amend the terms of reference in the sitting week of 11 to 13 November 2019 as per the committee's resolution of 10 September 2019.

4.4 Public submissions

The committee noted that submissions nos. 1(a), 4(a), 12(a), 20(a), 27, 29, 30, 33-35, 37-56, 58, 59 and 61-68 were published by the committee clerk under the authorisation of the resolution appointing the committee.

Resolved, on the motion of Mr Fang: That submission no. 69 be published.

4.5 Name suppressed submissions

Resolved, on the motion of Mr Veitch: That the committee authorise the publication of submission nos. 28, 32, 36, 57 and 60 with the exception of the author's name, which is to remain confidential, as per the request of the author.

4.6 Partially confidential submission

Resolved, on the motion of Mr Fang: That the committee authorise the publication of submission no. 5(a) with the exception of the following identifying and/or sensitive information, which is to remain confidential, as per the recommendation of the secretariat:

- paragraphs about an unrelated local planning matter not relevant to the terms of reference for this inquiry;
- the names of individuals involved in that planning matter; and
- hyperlinks to websites alleging misrepresentation of facts by the named individual.

4.7 Confidential submissions

Resolved, on the motion of Mr Veitch: That the committee keep submission no. 31 confidential, as per the request of the author.

4.8 Witness request

Resolved, on the motion of Mr Veitch: That the Electrical Trades Union and the Australian Workers' Union be invited to give evidence at the hearing on 18 November.

4.9 Public hearing

Witnesses, the public and the media were admitted.

The chair made an opening statement regarding the broadcasting of proceedings, adverse mention and other matters.

The following witnesses were sworn and examined:

- Mr Michael Wright, Deputy Secretary, Resources and Geoscience, Department of Planning, Industry and Environment
- Mr Alex King, Executive Director, Resources Policy, Planning & Programs, Department of Planning, Industry and Environment

The evidence concluded and the witnesses withdrew.

The following witnesses were sworn and examined:

- Dr Adrian Paterson, Chief Executive, Australian Nuclear Science and Technology Organisation (ANSTO)
- Professor Lyndon Edwards, National Director, Australian Generation IV International Forum Research, ANSTO
- Dr Robert Gee, General Manager, ANSTO Materials, ANSTO
- Mr Steven McIntosh, Senior Manager, Government and International Affairs, ANSTO

The evidence concluded and the witnesses withdrew.

The following witnesses were sworn and examined:

- Dr Mark Ho, President, Australian Nuclear Association
- Mr Robert Parker, Vice President, Australian Nuclear Association
- Dr John Harries, Secretary, Australian Nuclear Association

The evidence concluded and the witnesses withdrew.

The following witnesses were sworn and examined:

- Mr Chris Gambian, Nature Conservation Council of NSW
- Mr Dave Sweeney, Australian Conservation Foundation
- Dr Jim Green, Friends of the Earth Australia

The following witnesses were sworn and examined:

- Dr Donald Higson
- Mr Dayne Eckermann, General Manager, Bright New World (via teleconference)
- Mr James Fleay, CEO, Down Under Nuclear Energy

The evidence concluded and the witnesses withdrew.

The following witness was sworn and examined:

- Dr Ziggy Switkowski AO

The evidence concluded and the witness withdrew.

The following witnesses were sworn and examined:

- Mr Ryan Hemsley, Director, Government and International Relations, Australian Radiation Protection and Nuclear Safety Agency
- Mr Robert Godfrey, Director, Facility Safety, Australian Radiation Protection and Nuclear Safety Agency

The evidence concluded and the witness withdrew.

The following witness was sworn and examined:

- Mr Satyajeet Marar, Director of Policy, Australian Taxpayers' Alliance

The evidence concluded and the witness withdrew.

The media and the public withdrew.

The public hearing concluded at 5.09 pm.

5. Adjournment

The committee adjourned at 5.09 pm, until Monday 18 November 2019, Macquarie Room, Parliament House (public hearing).

Anthony Hanna
Committee Clerk

Minutes no. 10

Monday 18 November 2019
Standing Committee on State Development
Macquarie Room, Parliament House, Sydney, 9.00 am

1. Members present

Mr Martin, *Chair*
Mr Veitch, *Deputy Chair*
Mr Buttigieg (*substituting for Mr Graham*)
Mr Fang
Mr Farlow
Mr Latham
Mrs Maclaren-Jones

2. Apologies

Mr Banasiak

3. Inquiry into the Uranium Mining and Nuclear Facilities (Prohibitions) Repeal Bill 2019

3.1 Public hearing

Witnesses, the public and the media were admitted.

The chair made an opening statement regarding the broadcasting of proceedings, adverse mention and other matters.

The following witnesses were sworn and examined:

- Mr David Frith, Principal Advisor, NSW Minerals Council
- Mr Patrick Gibbons, Director, Industry and Environment, Minerals Council of Australia

The evidence concluded and the witnesses withdrew.

The following witnesses were sworn and examined:

- Dr Joanne Lackenby, President, Women in Nuclear Australia
- Dr Kath Smith, Executive Committee Member, Women in Nuclear Australia

Dr Lackenby tendered the following documents:

- World Nuclear News article dated 18 October 2019 titled *How "world view" affects public perception of nuclear power*

Dr Smith tendered the following documents:

- Excerpt (page 20) from UN Women report titled *Turning Promises into action: Gender equality in the 2030 agenda for sustainable development*
- World Nuclear Association article titled *Small Nuclear Power Reactors*, updated November 2019
- Roy Morgan article No 8144, *A narrow majority of Australians want to develop nuclear power to reduce carbon dioxide emissions*

The evidence concluded and the witnesses withdrew.

The following witnesses were sworn and examined:

- Mr Steven Rodgers, Senior Policy Advisor, Energy and Public Affairs, Engineers Australia
- Mr Martin Thomas, Australian Academy of Technology & Engineering

Mr Thomas tendered the following document:

- Conference communique and conference report from the 2013 Academy of Technological Sciences and Engineering Conference

The evidence concluded and the witnesses withdrew.

The public hearing adjourned. The media and public withdrew.

4. **Draft minutes**

Resolved, on the motion of Mr Veitch: That draft minutes no. 9 be confirmed.

5. **Correspondence**

The committee noted the following correspondence:

Received:

- 5 November 2019 – From Mr Barry Murphy to the secretariat providing Mr Murphy's CV ahead of his appearance at the public hearing on Monday 18 November 2019.
- 6 November 2019 – From Ms Donna Heaton, Executive Assistant, Australian Energy Market Commission, to the secretariat declining the committee's invitation to give evidence at the public hearing on Monday 18 November 2019.
- 11 November 2019 – From Mr Michael Beven, Marmota Energy, to the secretariat declining the committee's invitation to give evidence at the public hearing on Monday 18 November 2019.
- 12 November 2019 – From Mr Jarrad Pilkington, Manager, Energy Policy, Australian Energy Market Operator, to the secretariat declining the committee's invitation to give evidence at the public hearing on Monday 18 November 2019.
- 12 November 2019 – From Dr Donald Higson to the secretariat offering further comment following Dr Higson's appearance at the public hearing on Monday 11 November 2019.

6. Terms of reference amended

The committee noted that, on 13 November 2019, the House agreed to amend the terms of reference to omit paragraphs 2(b), 2(c) and 3, thereby removing all references to the newDemocracy Foundation.

7. Public submissions

Resolved, on the motion of Mr Fang: That submission no. 70 be published.

8. Inquiry into the Uranium Mining and Nuclear Facilities (Prohibitions) Repeal Bill 2019**8.1 Public hearing resumed**

Witnesses, the public and the media were admitted.

The following witness was sworn and examined:

- Mr Matt Murphy, National Industry Co-ordinator, Electrical Trades Union

The evidence concluded and the witness withdrew.

The following witness was sworn and examined:

- Professor Stephen Wilson, Centre for Energy Futures, University of Queensland

The evidence concluded and the witness withdrew.

The following witnesses were sworn and examined:

- Mr Barry Murphy, private individual
- Dr John Patterson, private individual (*via teleconference*)

Mr Barry Murphy tendered the following documents:

- Short report by Dr Robert Barr, Mr Barry Murphy, Dr Mark Ho, Mr Martin Thomas and Mr Barrie Hill, titled Reliable and Affordable Electric Power Generation
- Unpublished report by Mr Barry Murphy titled Nuclear Power: What Australians need to know
- Presentation slides by Mr Barry Murphy titled How advanced nuclear technology could be a vital part of Australia's clean *energy future*

The evidence concluded and the witnesses withdrew.

The following witness was sworn and examined:

- Mr Misha Zelinsky, National Assistant Secretary, The Australian Workers' Union

The evidence concluded and the witness withdrew

The media and the public withdrew.

The public hearing concluded at 4.37 pm.

9. Tendered documents

Resolved, on the motion of Mr Farlow: That the committee accept and publish the following documents tendered during the public hearing:

- World Nuclear News article dated 18 October 2019 titled How "world view" affects public perception of nuclear power, tendered by Dr Joanne Lackenby
- Excerpt (page 20) from UN Women report titled Turning Promises into action: Gender equality in the 2030 agenda for sustainable development, tendered by Dr Kath Smith
- World Nuclear Association article titled Small Nuclear Power Reactors, updated November 2019, tendered by Dr Kath Smith

- Roy Morgan article No 8144, A narrow majority of Australians want to develop nuclear power to reduce carbon dioxide emissions, tendered by Dr Kath Smith
- Conference communique and conference report from the 2013 Academy of Technological Sciences and Engineering Conference, tendered by Mr Martin Thomas
- Short report by Dr Robert Barr, Mr Barry Murphy, Dr Mark Ho, Mr Martin Thomas and Mr Barrie Hill, titled Reliable and Affordable Electric Power Generation, tendered by Mr Barry Murphy
- Unpublished report by Mr Barry Murphy titled Nuclear Power: What Australians need to know, tendered by Mr Barry Murphy
- Presentation slides by Mr Barry Murphy titled How advanced nuclear technology could be a vital part of Australia's clean energy future, tendered by Mr Barry Murphy

10. Adjournment

The committee adjourned at 4.38 pm *sine die*.

Anthony Hanna
Committee Clerk

Draft minutes no. 11

Thursday 27 February 2020

Standing Committee on State Development

McKell Room, Parliament House, Sydney, 6.36 pm

1. Members present

Mr Martin, *Chair*

Mr Veitch, *Deputy Chair*

Mr Amato (*substituting for Mr Farlow*)

Mr Buttigieg (*participating member*)

Mr Faraway (*substituting for Mr Fang*)

Mr Graham

Mr Latham

Mrs Maclaren-Jones

Mr Roberts (*substituting for Mr Banasiak*)

2. Draft minutes

Resolved, on the motion of Mr Veitch: That draft minutes no. 10 be confirmed.

3. Correspondence

The committee noted the following correspondence:

Received:

- 1 December 2019 – Email from Dr Donald Higson – forwarding copy of presentation on nuclear waste management made to the Nuclear Engineering Panel of Engineers Australia on 22 November 2019
- 9 December 2019 – Letter from Mr Steve McIntosh, Senior Manager, Government and International Affairs, Office of the CEO, Australian Nuclear Science and Technology Organisation (ANSTO), providing corrections and clarification to the transcript of evidence of Dr Adrian Paterson at the hearing on 11 November 2019
- 17 December 2019 – Letter from Mr Ryan Hemsley, Director, Government and International Relations, Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), providing clarification to the evidence of Mr Robert Godfrey at the hearing on 11 November 2019
- 18 December 2019 – Email from Mr Martin Thomas forwarding additional information – article by Tom Biegler *Australia needs clean nuclear energy (attached)*

- 29 January 2020 – Email from Mr Robert Pritchard attaching further information from the Canadian Nuclear Safety Commission (CNSC) website

Sent:

- 31 January 2020 – Letter from the Chair to Mr Iain Walker of the newDemocracy Foundation formalising agreement that the foundation's services are no longer required for the inquiry into the Uranium Mining and Nuclear Facilities (Prohibitions) Repeal Bill 2019 (*attached*).

4. Inquiry into the Uranium Mining and Nuclear Facilities (Prohibitions) Repeal Bill 2019

4.1 Public submissions

The committee noted that submission nos. 71 and 72 were published by the committee clerk under the authorisation of the resolution appointing the committee.

4.2 Answers to questions on notice

The committee noted that the following answers to questions on notice were published under the authorisation of the resolution appointing the committee:

- Mr Michael Wright and Mr Alex King of the Department of Planning, Industry and Environment, received 9 December 2019
- Dr Adrian Paterson of the Australian Nuclear Science and Technology Organisation (ANSTO), received 10 December 2019
- Dr Jim Green of Friends of the Earth Australia, received 24 November 2019
- Mr Patrick Gibbons, Minerals Council of Australia, received 19 December 2019
- Mr Steven Rodgers, Engineers Australia, received on 20 November 2019
- Mr Martin Thomas, Australian Academy of Engineering, received 25 November and 17 December 2019
- Mr Matt Murphy, Electrical Trades Union, received 17 December 2019
- Mr Ryan Hemsley, Director, Government and International Relations, Australian Radiation Protection and Nuclear Safety Agency, received 17 December 2019
- Mr Nicholas Kamper, National Economist, The Australian Workers' Union, received 16 January 2020

4.3 Clarification of evidence

Resolved, on the motion of Mr Veitch: That the committee authorise the publication of the following correspondence:

- Mr Steve McIntosh, Senior Manager, Government and International Affairs, Office of the CEO, Australian Nuclear Science and Technology Organisation (ANSTO), dated 9 December 2019, clarifying evidence provided by Dr Adrian Paterson at the hearing on 11 November 2019.
- Mr Ryan Hemsley, Director, Government and International Relations, Australian Radiation Protection and Nuclear Safety Agency (ARPANSA), dated 17 December 2019, clarifying evidence provided by Mr Robert Godfrey at the hearing on 11 November 2019.

Resolved, on the motion of Mr Veitch: That the committee authorise the addition of a footnote to the evidence of Dr Paterson and Mr Godfrey reflecting clarification to their evidence.

5. Consideration of Chair's draft report

The Chair submitted his draft report, entitled 'Uranium Mining and Nuclear Facilities (Prohibitions) Repeal Bill 2019', which, having been previously circulated, was taken as being read.

Mr Graham moved that:

- paragraph 1.14 be deleted;
- paragraph 1.76 be deleted;
- paragraph 1.77 be deleted;

- paragraph 1.78 be deleted;
- paragraph 2.27 be amended by omitting 'In order to further understand all economically viable resources, the committee recommends that the NSW Government encourage and support uranium exploration in New South Wales.';
- recommendation 1 be deleted;
- paragraph 2.88 be deleted;
- paragraph 3.64 be deleted;
- Finding 3 be deleted;
- paragraph 3.82 be deleted;
- Finding 4 be deleted;
- paragraph 4.47 be amended by omitting 'Accepting that, the committee considers that, with the introduction of passive safety features, advanced and emerging nuclear technologies are vastly safer than earlier generations and pose minimal risk to human and environmental health.';
- Finding 5 be amended by omitting the dot points which read 'are significantly lower risk than earlier nuclear technologies' and 'are considerably safer than other forms of electricity generation in the level of risk they pose to human';
- paragraph 4.118 be deleted;
- paragraph 4.128 be amended by omitting 'There was committee consensus that, owing to Australia's obligations under various agreements and treaties, the adoption of nuclear energy in New South Wales would result in negligible risk for weapons proliferation or nuclear security.';
- paragraph 4.145 be deleted;
- paragraph 4.150 be deleted;
- paragraph 4.151 be amended by omitting 'This experience and expertise offers a promising foundation which could be leveraged to set up a world class regulatory regime to provide for the safe operation of any future nuclear power plant in New South Wales.'
- paragraph 4.152 be deleted;
- paragraph 4.153 be deleted;
- paragraph 4.155 be deleted;
- Recommendation 6 be deleted;
- paragraph 4.156 be amended by omitting 'To this end, we also recommend that the NSW Government pursue the repeal of the Commonwealth prohibitions on nuclear facilities by making representations to the Commonwealth Minister with portfolio responsibility for the relevant prohibiting legislation.';
- Recommendation 7 be deleted;
- paragraph 4.157 be amended by omitting 'having regard to the findings and recommendations contained in this report.';
- Recommendation 8 be amended by omitting 'having regard to the findings and recommendations contained in this report.';
- paragraph 5.38 be amended by omitting '..notes the anecdotal evidence of a shift in social acceptance and consent for nuclear. We..'; and
- paragraph 5.39 be amended by omitting '... is of the view that community concern for the emissions intensity of Australia's electricity generators offers a favourable point in time to promote social licence for nuclear as a low carbon technology, and we..'

Question put.

The committee divided.

Ayes: Mr Graham, Mr Veitch.

Noes: Mr Amato, Mr Faraway, Mr Latham, Mrs Maclaren-Jones, Mr Martin, Mr Roberts.

Question resolved in the negative.

Mr Graham moved that Finding 2 be amended by omitting 'baseload' and inserting instead 'flexible and dispatchable'.

Question put.

The committee divided.

Ayes: Mr Graham, Mr Veitch.

Noes: Mr Amato, Mr Farraway, Mr Latham, Mrs Maclaren-Jones, Mr Martin, Mr Roberts.

Question resolved in the negative.

Resolved, on the motion of Mr Graham: that Finding 2 be amended by inserting at the end 'Given the urgent importance of emissions reduction, the NSW Government should be actively considering all options to take steps to mitigate this risk'.

Resolved, on the motion of Mr Graham: that Recommendation 3 be amended by inserting at the end 'In addition, the NSW Chief Scientist and Engineer should report to Government on broader developments in nuclear energy on a regular basis.'

Resolved, on the motion of Mr Graham: that Recommendation 4 be amended by inserting a final dot point which reads 'and the projected impact on NSW climate emissions and any opportunities or costs that entails or avoids.'

Resolved, on the motion of Mr Graham: that Finding 7 be amended by inserting at the end 'The presence of many of these individuals working in NSW forms an important part of our research and engineering community, and provides the competitive advantage to NSW of closely following international developments in energy technology. In particular the nuclear research cluster at ANSTO is valuable.'

Resolved, on the motion of Mr Graham: that Recommendation 5 be amended by omitting 'workforce capacity inventory and gap analysis to identify the workforce capabilities, skills and expertise that would be needed to support a future nuclear power industry in New South Wales ' and inserting instead:

'1) gap analysis to identify the workforce capabilities, skills and expertise that would be needed to support a future nuclear power industry in New South Wales, and

2) a workforce capacity inventory which identifies the existing clusters of research and workforce capabilities which already exist in NSW which are part of the international nuclear industry.'

Resolved, on the motion of Mr Latham: that Recommendation 9 be amended by omitting 'to leverage existing public outreach and education programs with a view to scoping broader community initiatives about nuclear and contemporary science on human exposure to radiation' and inserting instead 'to use existing public outreach and education programs to implement broader community education initiatives about nuclear energy, highlighting:

- safety and technological advances in this industry since the 1980s;
- how nations such as Canada and France have used nuclear power as part of their decarbonisation strategies;
- the success of the Lucas Heights nuclear reactor in the southern suburbs of Sydney; and
- any other relevant issues.'

Mr Latham moved that paragraph 3.82 become a finding.

Question put.

The committee divided.

Ayes: Mr Amato, Mr Farraway, Mr Latham, Mrs Maclaren-Jones, Mr Martin, Mr Roberts.

Noes: Mr Graham, Mr Veitch.

Question resolved in the affirmative.

Resolved, on the motion of Mr Latham: That:

- The draft report as amended be the report of the committee and that the committee present the report to the House;
- The transcripts of evidence, submissions, tabled documents and correspondence relating to the inquiry be tabled in the House with the report;
- Upon tabling, all unpublished transcripts of evidence, submissions, tabled documents, and correspondence relating to the inquiry, be published by the committee, except for those documents kept confidential by resolution of the committee;
- The committee secretariat correct any typographical, grammatical, spacing and formatting errors prior to tabling;
- The committee secretariat be authorised to update any committee comments where necessary to reflect changes to recommendations or new recommendations resolved by the committee;
- Dissenting statements be provided to the secretariat by 4.00pm Tuesday 3 March 2020;
- That the report be tabled on 4 March 2020.

6. Adjournment

The committee adjourned at 7.07pm *sine die*.

Anthony Hanna
Committee Clerk

Appendix 4 Dissenting statement

The Hon Mick Veitch MLC and the Hon John Graham MLC, Australian Labor Party

Labor has a longstanding and unequivocal platform position in relation to nuclear exploration, extraction and export. Labor has long opposed them.

On the basis of current technologies and costs, we remain unconvinced of the benefits nuclear power may bring. We remain mindful of the challenges caused by managing and storing spent fuel rods and radioactive waste that lasts many lifetimes. Nuclear power continues to have question marks both over its lasting environmental impact via waste as well as its cost.

Labor believes the future of energy generation for NSW lies in clean and renewable energy sources, supported by firming and storage.

There is an opportunity cost. Legislative sponsorship and investment in nuclear generation would merely serve to divert research and development away from where Labor believes it is required, namely the accelerated development of a renewable generation sector.

A Labor Government will maintain a ban on uranium exploration, extraction and export. A Labor Government will not introduce nuclear power in NSW.

We do support the concerns raised in this report about increasing energy costs for NSW consumers. As the report notes these concerns were dramatically underlined by one witness who argued that Australia went from an electricity price outlook of a 4 per cent increase per year in 2006 to an outlook for 4 per cent per month in 2019.

For this reason we commend this and other inquiries into our state's energy future. These are important issues to be addressed for our state's future. This report is best read in conjunction with the earlier report of the Select Committee on Electricity Supply, Demand and Prices in New South Wales. That report drew attention to the fact that rising electricity prices are not simply a function of a lack of generation but also of a deregulated generation and retail sectors.

We do recognise the scale of the challenge that climate change presents to our state and the planet. No government faced with this challenge should be blind to developments in technology which might help solve this life threatening problem.

Accordingly we have supported recommendations in this report which would see the Government continue to monitor new developments in energy technology.

In particular we draw attention to the presence of the ANSTO facility in Sydney. The cluster of scientists who are currently working there represent a valuable source of world class expertise in nuclear science, nuclear medicine and nuclear safety. The NSW Government should support this workforce capacity and work to strengthen it.

Our universities have research strengths which complement this knowledge, including in climate and energy science.

These centres of knowledge are vital for our state and country to navigate an uncertain future. They provide a competitive advantage to NSW allowing us to closely following international developments in energy technology. They should be fostered.

The NSW Chief Scientist and Engineer has a key role to play in ensuring that these state research and knowledge strengths are mapped, understood and strengthened over time.

Much of the discussion around nuclear energy centred on the emerging technology of Small Nuclear Reactors. Some submissions argued that modern Small Nuclear Reactors may become a safe and cost effective future technology.

We note this is inconsistent with a key report prepared by the British Department of Industry regarding the current state of that technology. The report from the UK Government, “Department of Energy and Climate Change, SMR Techno-Economic Assessment - Project 1 – SMRs: Comprehensive Analysis and Assessment SMR TEA Report: Volume 1, 2016” found that Small Nuclear Reactors could be up to 30 per cent more expensive than other nuclear power.

It is also noted that at present no Small Nuclear Reactors are operational in the developed world, with the first expected to operate in Utah, USA from 2024.

The future of NSW energy supply is central to the state’s fortunes. New developments in energy policy and technology remain central to our planet’s ability to navigate the challenge of climate change. While we disagree with the majority recommendations in this report, we welcome this debate.

Our colleague, the Hon Mark Buttigieg MLC, participated in this inquiry and supports the above statement.