

VERSION 1.0

22/11/2024

NUCLEAR LEADERSHIP AND BUILDING A NUCLEAR MINDSET IN AUSTRALIA



DEFENCE INDUSTRY LEADERSHIP PROGRAM
GROUP RESEARCH PAPER
COHORT 1, GROUP 3

CONTENTS

01

EXECUTIVE
SUMMARY

04

1. INTRODUCTION

05

2. BACKGROUND

07

3. SCOPE AND
RESEARCH
METHODOLOGY

10

4. RESEARCH
FINDINGS

33

5. RECCOMENDATIONS

41

6. CONCLUSION

42

REFERENCES

46

APPENDIX A



ACKNOWLEDGEMENT

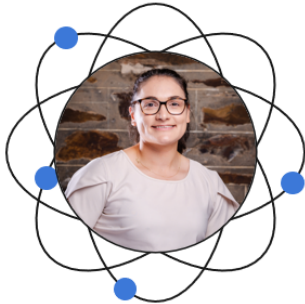
The authors engaged with representatives from the Defence Industry, State and Federal Government Agencies, Academia, and Non-Government Organisations to gain insight from lived experience, knowledge and perspectives through a series of interviews. As such, the authors would like to acknowledge contributions from the following organisations:

- Defence Teaming Centre
- Australian Department of Defence
- Western Australian Department of Jobs, Tourism, Science and Innovation
- South Australian Department of State Development
- South Australian Department of Premier and Cabinet
- Defence SA
- The University of Adelaide
- Submarine Hub for Integrated Engineering and Local Design
- ASC
- PMB Defence
- Nuclear Consulting Group
- Pomeroy Pacific

DISCLAIMER

The contents of this research report are the opinions and conclusions of the authors and do not represent the views of the author's organisations, the contributors, the contributors' organisations, the Defence Industry Leadership Program (DILP) or the Defence Teaming Centre (DTC).

AUTHORS



BARBARA SOLOMOS
Senior Mechanical Engineer
BMT



MATTHEW KENNEDY
Program Manager MQ-4C Triton
Northrop Grumman Australia



ANGELYNN LIM
Customer Service Manager
Hendon Semiconductors



DAVID KAMENIAR
Senior Associate
De Stefano & Co



DAN WELLMAN
Principal Mechanical Engineer
PMB Defence



ANDY SEMMLER (ADVISOR)
Head of Industry Development
& Engagement
ASC

EXECUTIVE SUMMARY

Set amidst the backdrop of a historic national non-nuclear position, a skeptical public and a Defence industry still wearing the scars of the cancelled Future Submarines Program, Australia embarks on uncharted territory with the investment in, and development of, nuclear-powered submarine technology under the AUKUS tri-lateral agreement. This undertaking represents a significant national challenge in the development of a nuclear workforce and supporting legal and regulatory frameworks to manage safety and security, as well as the challenges associated with nuclear education, normalisation and the building of public acceptance. To successfully deliver on this agreement, Australia must build nuclear leadership and establish a nuclear mindset.

The purpose of this report is to examine nuclear leadership and building a nuclear mindset in the context of Australian industry with regards to the AUKUS Program. The report examines the elements of the nuclear mindset set out by the Australian Submarine Agency (ASA), as well as research from sources in the public domain and structured interviews with subject matter experts to provide a series of key recommendations targeted at addressing the challenge of building nuclear mindset to ensure a successful establish and longevity of a nuclear-powered submarine industry within Australia.

The data gathered from the interviewed subject matter experts has been collated into key themes and ideas using the Thematic Analysis method (Braun & Clarke). This determined the key areas of focus for further analysis and recommendations for building a nuclear mindset. The key themes defined are:



Through the analysis of subject matter expert interviews and further directed research on these key thematic areas, the following recommendations were determined and are discussed throughout this report:

- Development of a National Nuclear Vision: a clear national vision with an underpinning strategy to embed the nuclear mindset, providing clear direction to Defence, industry and the public.
- Development of a nuclear technology public portal: to provide a single source of truth for Australia's nuclear projects, providing clear government endorsed information with a robust anti-disinformation strategy.
- Establishment of a Nuclear Technology Centre.
- Development of a "Public Mindset" document: a tailored nuclear mindset document to address the public mindset around nuclear to maximise understanding and acceptance of nuclear technology.
- Development and implementation of a clear and robust Public Engagement Strategy.
- Strategies to build nuclear mindset into the workforce, such as expanding early industry engagement with schools, higher education schemes with a nuclear focus, and creating a clear path to skill retention.

The report aims to show how focus on the key thematic areas and adoption of the proposed recommendations will help Australia develop nuclear leadership and build a nuclear mindset. This will strategically position Australia to establish and maintain a robust nuclear-powered submarine sector aligned with national interests and global best practices. Establishing these frameworks, workforce pathways and public communication channels early and proactively will pave the way for an informed public and competent, resilient workforce to ensure the success of a long-lasting nuclear-powered submarine industry in Australia.

It is critical that Australia adopts a national NUCLEAR VISION. This vision will help build public trust and elevate industry confidence for sustainable nuclear acceptance.

ACRONYMS

ANNPS Bill	Australian Nuclear Naval Power Safety Bil
ANSTO	Australian Nuclear Science and Technology Organisation
ARPANS Act	Australian Radiation Protection and Nuclear Safety Act
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
ASA	Australia Submarine Agency
ASPI	Australian Strategic Policy Institute
AUKUS	Australia, United Kingdom, and United States trilateral security partnership
AWA	AUKUS Workforce Alliance
DAD	Decide and Defend
DILP	Defence Industry Leadership Program
DTC	Defence Teaming Centre
EPBC	Environment Protection and Biodiversity Conservation
EPBC Act	Environment Protection and Biodiversity Conservation Act
IAEA	International Atomic Energy Agency
NPT	Nuclear Non-Proliferation Treaty
RAN	Royal Australian Navy
SLO	Social License to Operate
STEM	Science, Technology, Engineering, and Mathematics
USSC	United States Studies Centre

1. INTRODUCTION

1.1. PROBLEM STATEMENT

The Australian Government, as part of the AUKUS tri-lateral partnership, has announced its intent to acquire nuclear powered submarines for the Royal Australian Navy (RAN). This class of submarine is one of the most complex technologies developed, and as the first of this class of vessel to be used by the Australian Defence Force, it represents a significant challenge to successfully introduce into service, and subsequently operate, over its 40 – 50 years' operating life.

The challenges associated with the introduction of nuclear technology are multi-faceted and require an integrated approach to their resolution that encompasses more than single discipline solutions. At its core, success will be underpinned through effectively building sufficient nuclear knowledge across multiple industries, and multiple stakeholders, who can influence the engineering, legal, regulatory, security, human resources and corporate policy and practices across the entire enterprise. This is a complex endeavour as these stakeholders will interact with the technology at many different parts of its lifecycle; for example, education and skills development alone will not resolve the challenges associated with security, environmental or safety management. The resolution of these challenges, and the success of this Program, requires the right leadership across the submarine enterprise, governed by or influenced by the presence of a coherent, consistent mindset, known as a Nuclear Mindset, that shapes and directs the behaviours and actions of all stakeholders.

1.2. AIM

The Nuclear Leadership and building a Nuclear Mindset Research Project is to provide in-depth analysis and actionable strategies and recommendations, guiding stakeholders to implement effective measures enabling a nuclear mindset focused community and nuclear leadership within the Defence sector.

1.3. OBJECTIVE

The Defence Teaming Centre (DTC), as a key Defence Industry stakeholder, recognise the risks that the absence of these two elements present to the introduction of nuclear-powered submarines. In their capacity as a Defence Industry and capability advocate, they recognise an opportunity to support the Australian Government and Department of Defence to establish both. In support of that DTC outcome, the objectives of this research project are:

- Provide recommendations addressing how to build a nuclear mindset across the enterprise;
- Provide recommendations addressing how to establish the necessary leadership environment and behaviours across the enterprise;
- Provide recommendations to Government to support engagement of the Australian Public to ensure broad acceptance of nuclear capabilities within the defence force; and
- Identify strategies to integrate the principles of the nuclear mindset into professional and trade training across the industry eco-system.

2 . B A C K G R O U N D

2.1. DEFENCE STRATEGIC CONTEXT

Planning and preparation for the introduction of the AUKUS nuclear powered submarine into Australia, and the associated nuclear propulsion technology, are occurring in a deeply contested and divided environment. Public reporting across all media outlets and sources is openly critical, with headlines, such as those seen in Figure 1, routinely questioning Australia's commitment to the AUKUS program and our ability to successfully introduce the technology into operation.



Figure 1: Various public headlines have questions Australia's ability to execute the AUKUS program.

Defence industry are also recovering from the cancellation of the Attack Class submarine program; and rightly they are skeptical of the Government and Opposition parties' genuine commitment to the long-term future of the AUKUS submarine program. This is inhibiting investment and participation in anticipation of political change and the reprioritisation of funding that is committed to this activity.

Politicians across all sides, and across State and Federal lines, are openly and frequently critical of the investment in the AUKUS submarines and the ability of Australia to deliver successfully. It is not limited to junior members of parliament, or fringe elements or parties, instead senior current and former members of parliament have challenged the program.

Misinformation is spreading online, seeking to divide and fracture the Australian public; building on the reduced confidence and trust that is a direct outcome of the critical media reporting and the lack of confidence shown by Australian political leadership. Figure 2 demonstrates how this is openly seeking to warp the intent of the program deliberately conflating the AUKUS submarine program support with more contentious public concerns including nuclear weapons, fuel and civil nuclear reactors. The criticism, across all fronts, and the associated loss of public confidence and trust is working as public acceptance of nuclear technology, specifically in relation to its use to power nuclear submarines, has reduced in recent years (The Lowy Institute, 2024).



and the unsolved problem of getting rid of the waste – there are hundreds of them world-wide, slowly rusting away.



Is this what we want for Port Adelaide? For Australia?

Come to a Public Meeting
To consider the implications of the AUKUS pact for the residents of Port Adelaide.

Speakers: Prof. Al Rainnie, political economist
Sen. David Shoebridge, Federal Greens' spokesperson on Defence
Dr Amanda Ruler, Medical Assoc. for the Prevention of War
Rex Patrick, former Senator and submariner
David Noonan, conservationist with expertise on nuclear issues

Sat. April 20th, 2 p.m. St Bede's, 200 Military Rd, Semaphore

Espoused by:
No Nuclear Subs SA; Medical Assoc. for the Prevention of War; The SA Greens; Women's

the Government consider amending the Bill so that a distinction is made between Australia's acceptance of low-level nuclear waste from AUKUS partners, but non-acceptance of high-level nuclear waste.

Friends of **The public has the right to know**

Figure 2: Anti-nuclear sentiments that have been spreading across the community since the AUKUS announcement.

This shift in sentiment is occurring at an inopportune time, with the Defence Strategic Review 2023 (Department of Defence, 2023) identifying the Indo-Pacific region as the most significant geopolitical region in the world. This is a key observation, given the role that Australia will play in providing security and stability in a region that is responsible for managing over 60% of global maritime trade (Dept. of the Prime Minister and Cabinet, 2024) and more specifically for the passage of 83% of Australian imports and 90% of Australian exports (Uren, 2024).

To support the adoption of nuclear technology, and nuclear-powered submarines specifically, the Defence Strategic Review 2023 identifies that Australia must be supported by the following:

- Informed public
- National unity
- Democratic assuredness

The achievement of these outcomes can only be achieved by the adoption of a national nuclear vision; a vision that will build public trust and uplift industry confidence to ensure sustained nuclear acceptance.

3 . S C O P E A N D M E T H O D O L O G Y

3.1. SCOPE OF WORK

The introduction of nuclear-powered AUKUS submarines into the inventory of the Australian Defence Force will require transformational reform across a diverse stakeholder group to achieve the projected capability outcomes. That reform will require a clear vision, with strong leadership to bring that diverse group together. A significant challenge is establishing the right mindset, which is the right beliefs, behaviours and attitudes, within this stakeholder group such that their individual investment and contribution is focused in the appropriate areas, at the appropriate time. Key to achieving that is:

- Establishing what it is that differentiates the introduction of nuclear-powered submarines from other complex civil and defence technology programs.
- Defining what it means to have a nuclear mindset, and how that mindset can contribute to the successful introduction into service of the AUKUS submarines.
- Identifying the stakeholders that will contribute to the success or failure of the introduction into service of the AUKUS submarines; and
- Determining what motivates each stakeholder and developing strategies to maximise their engagement in this program.

This Research Project will evaluate these points, and in doing so will present strategies that can be used to achieve the appropriate nuclear mindset within the various stakeholder groups. Importantly, this Research Project will not focus on defining what the nuclear mindset is. Much work on this has already been performed by the Australian Submarine Agency (ASA), as well as other bodies across the world. This Research Project will also not address the broader issue of establishing a civil nuclear power industry in Australia. While there are some lessons to be learned from that sector, and our Project Team will look to identify them as and where appropriate, the Project Team will limit our recommendations to the narrower challenge of nuclear propulsion systems for submarines. This Research Project will focus on how the necessary mindset change across the stakeholder group can be realised. Our recommendations will be structured with a view to address the following:

- How do you achieve maximum engagement of the stakeholders?
- How do you successfully decouple submarine nuclear propulsion systems from the broader, potentially damaging, public debate on civil nuclear power generation?
- How best to motivate, encourage and drive the stakeholders to contribute, to collaborate and to be a positive force in this program?
- How do you minimise the impact of disruptive organisations and individuals, those who would rather see the introduction of AUKUS submarines ceased; and
- How do you embed this mindset such that it endures, that it can withstand change and/or challenges?

Such a change in mindset cannot be achieved without strong leadership across the enterprise. In addition to recommending how to achieve the necessary mindset change, this Research Project will also provide recommendations on how to establish the appropriate leadership culture across the enterprise. A leadership culture will be essential across all stakeholder groups. It ensures there is a clear and consistent vision that enables enterprise leaders, at all levels, to bring their own organisations and industry partners along with them. This collective effort contributes to broader engagement activities and readies stakeholders to tackle the challenge as part of a cohesive nuclear enterprise.

3.2. RESEARCH METHODOLOGY

To best answer this research question, the Project Team used qualitative research techniques backed up by a literature review. The team leveraged the breadth and depth of industry knowledge, conducting interviews with many participants across the nuclear ecosystem. Interview participants were selected using purposive sampling. Purposive sampling refers to selection of participants based on some characteristic, knowledge or experience they had relating to the topic. The interviews were conducted over a three-month period between July and September 2024. Each interview consisted of 9 set questions and approximately lasted one hour, with a list of interview questions asked found in Appendix A. A total of 14 participants were interviewed ranging from nuclear specialists to government agencies to assess a breadth of opinion. Interview participants identities were anonymised to protect their identities, and all participants agreed to have their interview transcribed and recorded. Table 1 presents the list of participants as they will be referred to in the following paper.

Table 1: Research project interview participants.

#	Position	Sector
1	Chief	Nuclear Specialist
2	A/Director General	Federal Gov. Agency
3	Director	State Gov. Agency
4	Director	State Government
5	GM	Defence SME
6	CEO	Defence SME
7	Principal	Nuclear Specialist
8	Director	Academic
9	Director	Nuclear Specialist
10	CEO	Defence NGO
11	Exec Director	State Gov. Agency
12	Director	State Gov. Agency
13	A/Exec Director	State Gov. Agency
14	Director	Nuclear Specialist

Using Braun and Clarke’s thematic analysis (Braun & Clarke, 2022) interview transcripts were assigned codes (or labels) according to key pieces of information. These codes were then grouped into themes. Similar themes were then continually grouped and distilled until a few themes remained. These grouped themes were then renamed to provide a summary and memorable title to present the message and recommendations within the body of this report. Figure 3 shows the final themes.

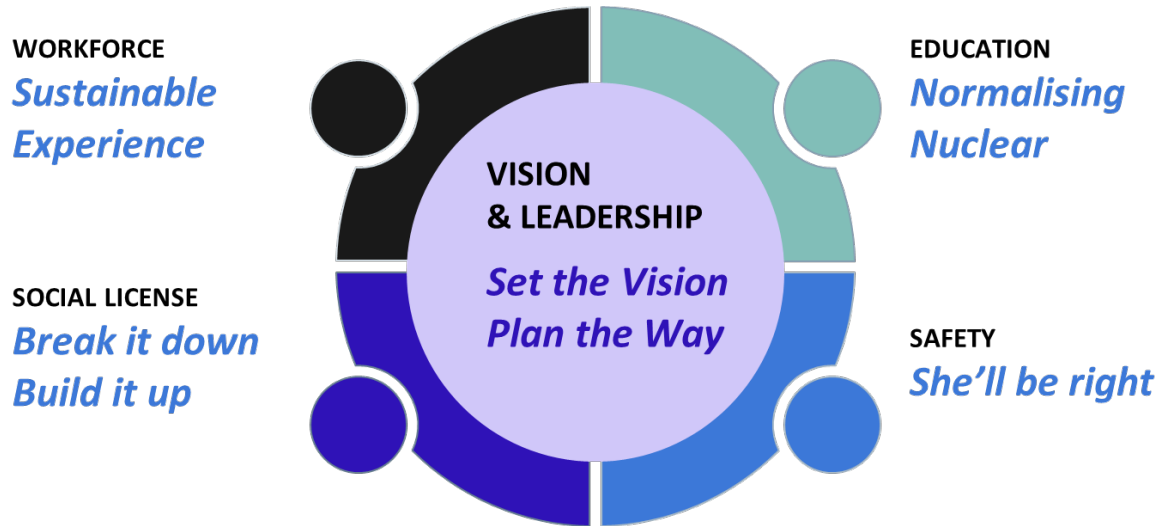


Figure 3: Final research themes.

After analysis, the Project Team concluded with an overarching parent theme of:

**SET THE VISION,
PLAN THE WAY**

Relating to the creation of a national nuclear vision and underpinning strategy to embed the nuclear mindset and give direction on how to engage with industry and the wider public.

Beneath this parent theme we discovered several sub-themes of:

**NORMALISING
NUCLEAR**

Relating to the education of the population in the field of nuclear technology with the aim of normalising and demystification of the science.

SHE’LL BE RIGHT

Relating to Australia’s casual culture of confidence that must be addressed with regards to nuclear safety.

**BREAK IT DOWN,
BUILD IT UP**

Relating to the breaking down of barriers regarding the granting of a social license to operate and then how to build trust with the various stakeholders.

**SUSTAINABLE
EXPERIENCE**

Relating to the creation of the nuclear workforce and how to develop pathways to retain them for the life of the project.

4 . R E S E A R C H F I N D I N G S

4.1. VISION AND LEADERSHIP: SET THE VISION, PLAN THE WAY

The previous sections, which detail the research methodology and establish the core themes discussed by the Project Team’s interview subjects, identified frequent and consistent discussion on the need for a Nuclear Vision. During the course of those discussions, the interview subjects spoke of the nuclear vision not in general or conceptual terms; instead they were quite specific on how they saw a national nuclear vision supporting the establishment of the necessary conditions for success across the nuclear stakeholder group and the broader community. They described these as:

- Providing all stakeholders with a clear direction.
- Enabling the development of plans for success, with measurable, achievable, short, medium and long term goals.
- Enabling long term strategic discussions that support development of Roadmaps that integrate across academia, industry, public and government.
- Convey and create the sense of urgency necessary to get the enabling in place now.
- Conveying bi-partisan support, providing the security and surety that is required to implement and invest in the roadmaps, the goals, the strategies necessary to build the workforce, build the skills, create the infrastructure, set the conditions for a successful nuclear eco system.
- Commitment to the long term, recognizing the multi-generational facets of nuclear technology that require detailed planning now, and long-term investment and commitment well into the future.

4.1.1. DEFENCE STRATEGIC REVIEW 2023

Given the significant role that nuclear powered submarines will play in Australia’s strategic future, it is appropriate that the Defence Strategic Review 2023 (Department of Defence, 2023) underscores the sentiment of our interview subjects, and specifically points to the need for a national nuclear vision when identifying three foundation elements essential to successful adoption and sustainment of a nuclear capability: an informed public, unity, and democratic integrity. Here’s how a nuclear vision can achieve these goals.

Informed Public

A nuclear vision involves clear, accessible communication on the role of nuclear technology in defence, outlining safety measures, strategic benefits, and long-term objectives. By educating the public on the specifics of nuclear submarines, such as their capabilities, operational advantages, and safety protocols, the government can build a well-informed public that understands the technology’s purpose and its place in national security. Transparency in safety measures, environmental impact, and operational protocols also helps address public concerns, fostering trust. These themes will be specifically addressed in in Section 4.2 *Education: Normalising nuclear* and Section 4.3 *Social Licence: Break It down, Build it up*.

National Unity and Cohesion

By framing the nuclear vision around shared national security goals, such as regional stability and national defence, the vision can help unify the Australian public around common objectives. An inclusive approach that addresses public concerns, including indigenous and environmental impacts, can contribute to social cohesion, ensuring that diverse voices are acknowledged. This inclusive, consultative process makes the initiative feel like a collective national endeavour, not merely a top-down decision, helping to build broad-based support across various communities. These themes will be further discussed in Section 4.2 *Education: Normalising nuclear* and Section 4.3 *Social Licence: Break It down, Build it up*.

Democratic Assuredness

In a democracy, public buy-in and accountability are essential, especially for strategic defence programs like nuclear submarines. A nuclear vision with mechanisms for public oversight—such as regular reports, open forums, and parliamentary scrutiny—reinforces democratic processes. Furthermore, engaging in open discussions about nuclear policy, particularly in Australia where we have limited public exposure or understanding of nuclear technologies strengthens democratic processes by encouraging public debate and informed decision-making.

Through these components—creating an informed public, building unity, and transparent governance—a nuclear vision can foster an environment where nuclear initiatives are not only strategically sound but also democratically supported, creating a foundation for long-term national security.

4.1.2. CORE COMPONENTS OF A NUCLEAR VISION

In order to achieve these outcomes, a nuclear vision should aim to establish a sustainable, safe, and publicly trusted nuclear management system. The core components of that vision, essential to achieve that outcome, are as stated below.

Ownership

The nuclear vision would establish ownership and accountability for Australia’s adoption of nuclear technology. It would commit to, and recognise, the need for long term commitment to the support of the nuclear propulsion technology; and in so doing provide the impetus for broader nuclear enterprise stakeholders to plan, invest and participate in the support system.

Clarity

The nuclear vision will provide the Australian public with clarity regarding the breadth of Australia’s nuclear commitment. It would be clear in communicating to the public that this is a commitment to the investment in technology and support systems driven by submarine nuclear technology. It would be equally clear that this is not a commitment to the establishment of a civil nuclear power industry. These issues have become deeply intertwined throughout the debate, deliberately so in many cases, and as such it is imperative that a nuclear vision is fit for purpose for the now.

Full Nuclear Life Cycle

The vision would comprehensively address the entire nuclear life cycle—facility construction, operation and storage of propulsion systems, decommissioning, waste storage, and final disposal. This would involve establishing secure and safe storage solutions for spent fuel, ensuring efficient decommissioning processes, and developing strategies for waste minimisation and environmental protection and preservation. Again, it would provide the commitment and certainty necessary to progress public consultation given the defined boundary of the technology being discussed and would provide certainty for organisations who wish to be a part of that support environment.

Public Transparency and Accountability

Public trust is crucial for nuclear energy to be widely accepted. A nuclear vision would include mechanisms for transparency, such as public reporting on safety, environmental impact, and incidents. Accountability would mean that companies or agencies would face clear consequences for violations or mismanagement. It would also include opportunities for public engagement in decision-making, especially on matters that could affect public health or safety. Further discussion on implementing this is addressed in Section 4.3 *Social Licence: Break It down, Build it up*. A method for disseminating and accessing related information is discussed in Section 5.1 *A Technology Platform*.

Strategies and Funding

The nuclear vision would identify funding strategies to support initial development, operation, decommissioning, and long-term waste storage. Investment could be secured through a mix of public funds, private investment, and potentially international cooperation on larger technology initiatives such as waste disposal.

Bi-Partisan Support

A successful nuclear vision would ideally secure support across political parties to ensure longevity and stability beyond electoral cycles. Bi-partisan support would help prevent abrupt policy shifts and would underscore the vision's commitment to national security, economic growth, and environmental goals as non-partisan priorities that serve national interests.

4.2. EDUCATION: NORMALISING NUCLEAR

4.2.1. BACKGROUND

Nuclear technology is not new, but the Australian public understanding of nuclear technology is limited due to Australia’s low involvement with the technology, with only one medical use research reactor (Nerio, 2024). Public opinion on nuclear energy in Australia is mixed, and Australia has historically maintained a strong anti-nuclear stance due to concerns about safety and waste management. The absence of a civil nuclear industry in Australia is not an indicator of Australia’s defence capability to adopt a nuclear-powered submarine because the technology and skill sets required are different (Erickson, 2021). The AUKUS partnership presents a significant opportunity and has brought the issue of nuclear technology into clearer focus in Australia. The addition of nuclear-powered submarines to the RAN’s fleet marks a significant leap in technological progress, benefiting both the Australian defence and the broader Australian public (Nerio, 2024). Normalising nuclear will allow the public to understand the technology, and therefore, allow the public to make informed discussions and decisions about its use in society.

4.2.2. UNDERSTAND THE WHY

There may be public apprehensions about nuclear technology but understanding “why” can help address this concern. The Essential poll, shown in Figure 4, conducted in 2023 and published in The Guardian (Lewis, 2023), shows that over 28% of Australians are of the opinion that Australia does not need nuclear-powered submarines, and 19% of the public is unsure. Furthermore, an analysis of surveys conducted in 2017 indicates that, in general, individuals who vote for right-wing political parties are more inclined to support the use of nuclear, fossil fuels carbon capture and storage, whereas those who vote for left-wing parties are typically more of renewable energy sources (Clulow, et al., 2021).

Which of the following is closer to your view on Australia’s need for nuclear-powered submarines?

	Total	Labor	Coalition	Greens	Independent or other party
Australia does not need nuclear-powered submarines	28%	28%	20%	45%	34%
Australia needs nuclear-powered submarines but it’s not worth paying that amount to get them	27%	29%	27%	22%	26%
Australia needs nuclear-powered submarines and it’s worth paying that amount to get them	26%	26%	41%	13%	18%
Unsure	19%	17%	13%	20%	22%

Figure 4: Public opinion poll on Australia's need for nuclear-powered submarines conducted in 2023.

“A lot of people who do follow politics will have that, you know, one way or the other ideology and you won't change their mindset. They'll either be pro or against it due to long embedded or ingrained beliefs.”

Participant #9 – Director, Nuclear Specialist

If Australia is to aim to build greater support for nuclear-powered submarines across the population, one crucial part is to educate the public on the rationale behind their use. The following information aims to help foster a deeper understanding to cultivate the necessary mindset for embracing nuclear technology.

Securing Stability in the Indo-Pacific Region

Australia with its limited stockpiles of critical goods and its concentrated sources of supply relies heavily on various trade and supply routes. The 2023 Defence Strategic Review noted that an adversary could implement military threats against our trade and supply routes especially in the Indo Pacific region (Department of Defence, 2023). With Australia's being global supplier of minerals and energy, and Australia's reliance on imports of consumer goods – defending trade routes has become a much higher priority (Uren, 2024). With 99% of Australia's trade coming from sea, the Australian Government, specifically though Defence Minister Richard Marles, has stated that nuclear-powered submarines will help deter a foreign adversary from launching a shipping blockade (Galloway, 2023).

Essential for Long-term, Long-range, High-performance Operations

The need for a nuclear-powered submarine was first identified in the Australia's Future Submarine mission requirements outlined in the 2009 White Paper. The 2016 Defence White paper further identified the need to have a more capable submarine fleet. Australia has one of the world's largest maritime areas; this means we require the ability to protect Australia's interests from the Pacific to the Indian Oceans, and from the Northern to the Southern Oceans. Submarines are key for deterring conflict and are a strong weapon if conflict happens (Idris, et al., 2022).

In addition, as described in the AUKUS Nuclear Powered Submarine Pathway, nuclear-powered submarines provide superior stealth, speed and operational capabilities compared to conventionally powered submarines (Commonwealth of Australia, 2023). Specifically, they can maintain high speeds over longer distances and remain submerged for extended periods without needing to surface (Behm, 2022). Increasing public awareness of the operational advantages of nuclear-powered submarines, such as through the poster seen in Figure 5, could help foster greater acceptance of this capability.

Economic Benefits

The AUKUS partnership in Australia will be whole-of-nation undertaking. If there is greater public acceptance of the technology, the SSN AUKUS program could be framed not just as a defence initiative, but as a strategic infrastructure project. This shift in perspective could highlight the broader national benefits, including long-term technological advancements, skilled job creation, and economic growth either directly or indirectly over its lifetime (Commonwealth of Australia, 2023).

By positioning the nuclear-powered submarine program as part of Australia's broader infrastructure and technological development, it may be easier to garner public support, while ensuring that the safety and sustainability of nuclear technology remains central to the conversation.

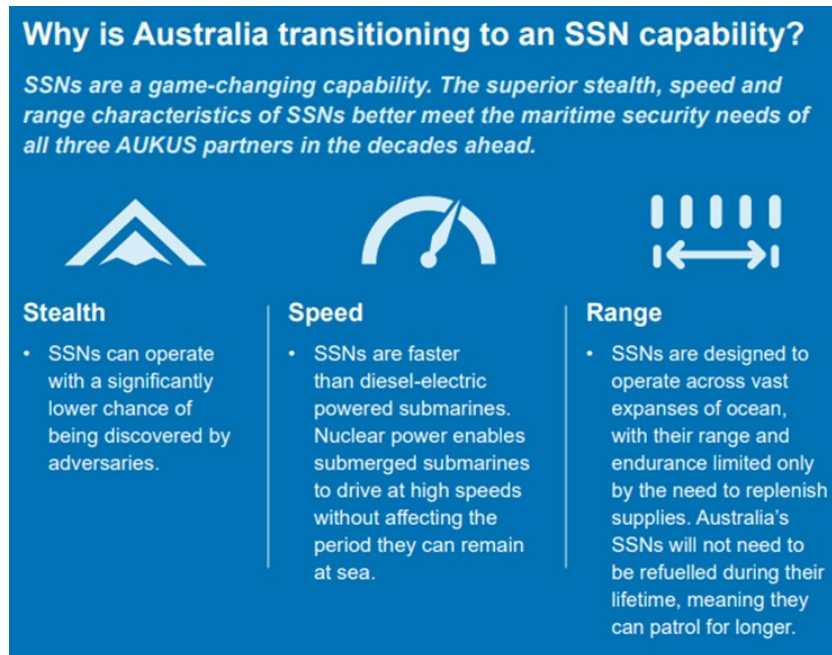


Figure 5: Example of an information graphic that explains why Australia is transitioning to an SSN capability.

Separating the Science

As mentioned previously, nuclear technology in Australia is relatively new. Therefore, it is essential to clearly communicate the technology and science involved to foster understanding and acceptance. Public debate on nuclear power, nuclear submarines and defence capability have grown, highlighting questions around its strategic merits, political commitments, industrial/workforce capacity, and the high costs involved. Public apprehension surrounding nuclear power, particularly in the context of defence applications, is natural. One way of ensuring public acceptance is separating the discussions of nuclear technology from broader debates on defence or politics.

*“If someone turns up in a grey camouflage uniform to talk to you about nuclear safety, you’re challenging the person thoughts on defence.
If you have an engineer who is experience in the nuclear radiological world turn up to talk to you about nuclear works and safety.... The conversation is going to be on nuclear and separate to do you agree with Defence or not.”*

Participant #5 – GM, Defence SME

By focusing initially on the science, safety measures, and the benefits of nuclear-powered submarines, it becomes easier to tackle specific concerns about the technology itself without the added complexity of wider defence debates.

4.3. SOCIAL LICENCE: BREAK IT DOWN, BUILD IT UP

4.3.1. BACKGROUND

The social license to operate (SLO) is the acceptance granted by a community to an organisation or company to conduct operations. The SLO is also enduring as defined by Thompson and Boutilier as “the ongoing acceptance and approval from local communities and other stakeholders” (Thomson & Boutilier, 2011). To embed the nuclear mindset and provide acceptance to the nuclear submarine program within the wider public, trust must be cultivated between the organisation(s) and the public. Trust is a central component to achieving and maintaining a social license (Stronge, et al., 2024). A starting point of negative trust was a common thread in the interview participant feedback, relating to the termination of the previous submarine program.

“The government has lost people's trust already as we haven't started from the most transparent point. AUKUS was developed as a dark project behind the scenes of the Attack Program. How do you come back from this? People will always have doubt about the amount of trust we can put into the government.”

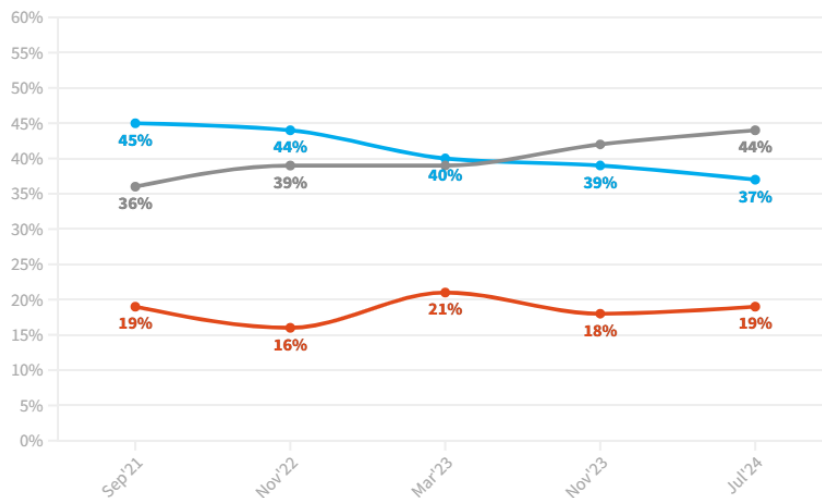
Participant #8 – Director, Academic

Referring to the recent polls in the Lowy Institute shown in Figure 6 and Figure 7, public support for nuclear powered submarines is slowly starting to ebb away. As communication dries up, organisations are unsure about how and when to engage with the wider public. The state government interviews that were conducted, indicated they were in a planning phase coordinating with the federal agency and local governments to try to align the message.

National security and AUKUS partnership (trend)

Q. Thinking about the AUKUS nuclear-powered submarine partnership, which is closer to your view?

- The AUKUS nuclear-powered submarine partnership will make Australia more secure
- The AUKUS nuclear-powered submarine partnership will not affect Australia's security
- The AUKUS nuclear-powered submarine partnership will make Australia less secure



Base: All participants (min. n=1,000)

Figure 6: Public perception on nuclear powered submarine security (Essential Report, July 2024).

Acquiring nuclear-powered submarines

LOWY INSTITUTE
Poll 2024

Now a question about submarines that are powered by nuclear energy, but do not have nuclear weapons. Are you in favour of or against Australia acquiring nuclear-powered submarines?

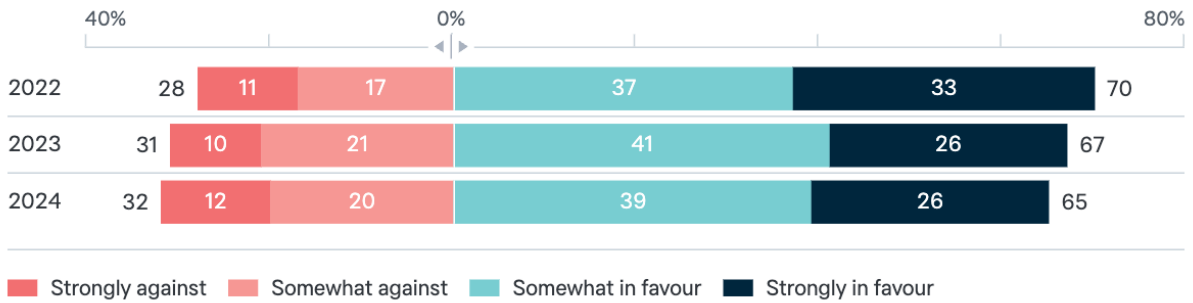


Figure 7: Lowy Institute Poll 2024 (The Lowy Institute, 2024).

The government representatives the Project Team interviewed were conscious to the perception of losing trust and developing consultation fatigue if the public was engaged too early. They did indicate they were comfortable with the current level of engagement at this time. Our team reached out to local governments, but they declined to be interviewed.

“If you go too early, and the timeframe is not met then this upsets people. It’s easy to lose the trust. Some ways your better off to say little until you can get some runs on the board.”

“I think the drumbeat is good, we need to crawl before we walk, before we run. That strategic patience concept is still valid. Its early.”

Participant #3 – Director, State Government Agency

“We are planning. The ASA is all things the optimal pathway.”

“We are coordinating when to go out to the wider public. What we are very much concerned about is having the nuclear conversation the whole way through and creating consultation fatigue. [The infrastructure] will ramp up over the next few months. [Our position is] Not going out when you don’t have things to say.”

Participant #4 – Director, State Government

However, the Project Team’s research outside of government overwhelmingly suggested there was a need to do more around social license. This was in direct contradiction with the strategic patience concept displayed in state government. Messaging and clarity of message was also a key theme within the research. Interviewees felt that the messaging needed to be right to ensure wider mindset adoption and social acceptance.

“The government needs to do more on the social licence piece.”

Participant #1 – Chief Nuclear Specialist

“Greater effort into social licence. Social acceptance is key - we need to convey to the masses that we are doing the right thing and we’re thinking long term through generations; we don’t have a short-term mindset.”

Participant #8 – Director, Academic

4.3.2. ESTABLISHING A SOCIAL LICENCE

The concept of social license was born from extractive industries such as mining and logging in the mid 1990’s. Since then, it has become more widespread and generalised to include many different industries and their impacts to the wider public. Wood and Thistlethwaite (2018) present a brief history and development of the term “Social license”. Focussing on the model from Thompson and Boutilier, the stages of achieving a social license can be presented as a hierarchy shown by Figure 8. The stages of a social license move from public rejection through to co-ownership. At the co-ownership level a high degree of trust is present, and stakeholders feel they are part of the decision-making process within the project. To get to this transformative relationship (rather than transactional), a series of boundaries must be crossed. These are the legitimacy, credibility and trust boundaries.

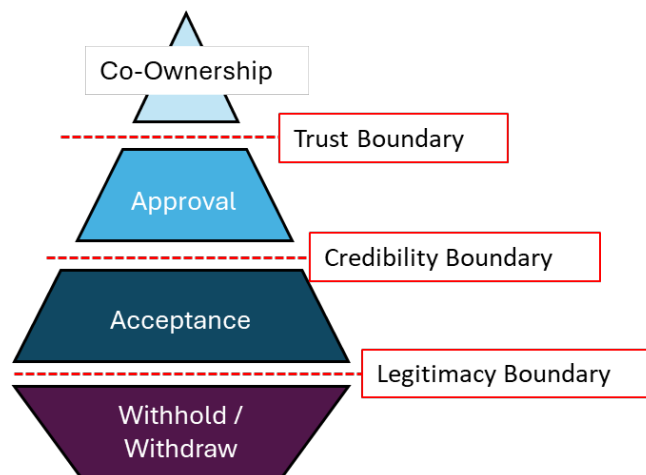


Figure 8: Stages of a Social License (adapted from Thompson & Boutilier).

Stakeholder identification has traditionally been participants within the local area to a project (Gould, et al., 1996), but for a project of the size and scope of AUKUS Pillar I, it may be the case that there are many different stakeholder groups (local proximity, first nations, regional). This would go right up to the wider public due to the large public spend and focus of the project. Establishing a social license to operate may have to be considered with an amount of tailoring depending on which stakeholder group is being targeted. For many participants interviewed, it was clear that public education was a key component of achieving the social license. Developing both the awareness around nuclear technology and the need for nuclear powered submarines.

“Nuclear literacy. For the majority of people, that’s what we really need to target.”

Participant #4 - Director, State Government

Legitimacy

The project can be seen as accepted with stakeholders when the project is seen as legitimate. Legitimacy is defined as “a generalised perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions” (Suchman, 1995). This is then split into four categories comprising of:

PRAGMATIC LEGITIMACY (SELF INTEREST)

What’s in it for me?

MORAL LEGITIMACY

Does the organisation respect us, and have they approached us in the right way?

COGNITIVE LEGITIMACY

Does this project make sense? Is what they are saying confusing? Are we in uncharted waters?

LEGAL LEGITIMACY

Do they have the required permits or permission to do what they want to?

By communicating project scope and benefits, the government at all levels can start to build some pragmatic legitimacy. This can be done easily and does not require careful community engagement as with the other categories. The team’s research indicated that embedding the mindset into the public may be easier if they thought there was a benefit to the country.

“In order to embed the mindset of nuclear or nuclear mindset into people, I think we have to change the narrative around what nuclear does for us as a country.”

Participant #9 – Director, Nuclear Specialist

“The government also needs to better explain the why and tell people what’s in it for them to get them on side. Explain to people why we’re doing this, why do we need nuclear submarines? Make that very clear to people.”

Participant #13 – A/Executive Director, State Gov. Agency

Moral legitimacy refers to the kind of engagement between the organisations and stakeholders. Previously in Australia using a decide and defend (DAD) model ultimately led to failure to achieve social license and projects being abandoned. The low-intermediate nuclear waste storage facility originally planned for Kimba, South Australia was cancelled due to the traditional owners being excluded from voting (Ruble, 2023). This failure of moral legitimacy must not happen again for a successful adoption of a nuclear mindset and broader acceptance of the submarine program.

“The main challenge is clear, far-reaching communication. There needs to be an overall coordinator, and the federal government needs to choose who that coordinator is to control a consistent narrative. We need to take care in the security of the information we provide to the public, to try to limit the amount of disinformation out there through information warfare tactics trying to cause civil unrest. How do we mitigate the misinformation piece and stop the term “nuclear” be an emotive word. We need to differentiate between nuclear bombs and nuclear as a power source.”

Participant #13– A/Exec Director, State Govt Agency

By enacting in proper consultation with the various stakeholder groups, the organisation can seek to gain moral legitimacy. Proper consultation is about moving away from the DAD model of communication and engaging with the stakeholders more personally. This can be best achieved through face to face and interactive engagement. Stakeholders can learn the scope and benefits of a project (building pragmatic legitimacy) and it gives the opportunity for the stakeholders to ask questions and raise concerns (Wood & Thistlethwaite, 2018). Using a model of respect is key. Respect for the health of the local community, their prospects, their safety, their security, the land and the local environment (Kemp & Vanclay, 2013). By engaging in the community in this interactive more personal way, organisations can learn the informal norms (cultural, social and political) that can be used to engage the community on their terms and build moral legitimacy. Consultations must include participation from traditional owners from the start to ensure they are not sidelined or excluded. This is particularly important in South Australia where nuclear weapons testing in Maralinga caused harm to the Aboriginal community in the 1950's (Ruble, 2023).

Cognitive and legal legitimacy can be built through clear transparent communication. This communication must be unambiguous and consistent across the nuclear ecosystem. Therefore, a central national nuclear vision is key to coordinate this message and ensure that it remains positive and factual. Our research found that there was a significant amount of emotive language used in the media to promote fear and discourse amongst the public. It is our opinion that this is likely an artefact of the patience strategy employed by the government who seem to be waiting for the right time to engage the wider public on the program on any large scale.

Communication of risk and safety is key to building cognitive legitimacy. The public need to understand the risks to safety in a clear way and be able to access free public safety information on what to do in an emergency. For the project of this size and scale to make sense to the wider public, a timescale or roadmap is required to detail out when key decisions on engagement and legislation will be enacted. This will enable the public to see progression, building cognitive legitimacy. The team's research showed that the greatest cognitive legitimacy can be built by separating out the nuclear-powered submarines into two parts: the nuclear technology introduction and the importance of nuclear submarines. For most of the population, nuclear technology will be a new concept, so the aspects surrounding the science and safety must be well communicated to ensure its acceptance. Separating out the nuclear technology from defence spending will enable people's concerns to be tackled in the right way. Concerns can be addressed separately and if acceptance can be achieved of the technology, the SSN AUKUS program becomes an infrastructure project.

"[The public] might not agree with the defence nature of the asset, or if the money could be spent elsewhere, but at least the nuclear reactor is shown to be safe."

"Separate out the defence spending from the nuclear component."

"The federal government needs to set the direction, appoint and resource an agency to talk about nuclear safety. Not in uniform since it links back to defence. Use ANSTO etc. Separate out [nuclear] from do you agree with defence or not."

Participant #5 – GM, Defence Industry

"[We] need to spread greater awareness of the "why" and the vision and get people to internalise this. Cultural change is something you need to do collaboratively, not to someone."

Participant #1 – Chief Nuclear Specialist

With a project of this complexity and scale, the communication of this legitimacy will undoubtedly take time and require multiple and continued engaging with the various stakeholder groups; however, we have achieved a social license to operate a nuclear facility before. Sandy Ridge, a low-level radioactive waste storage facility operated by Tellus Holdings Ltd opened in March 2021. This is a good example of how to engage the various stakeholder groups and achieve acceptance. The first stakeholder engagements began in April 2015 (Tellus Holdings Pty Ltd, August, 2017), approximately 6 years prior to opening. As the community migrates in and out of an area, it is important to keep delivering a consistent message now and for the life of the project to ensure that all aspects of legitimacy are demonstrated.

Credibility

Approval for a project can be gained once the organisation is seen as credible. Credibility relates, not to the technical competency of the organisation, but its social interactions (Wood & Thistlethwaite, 2018). By engaging in repeated transparent honest communication, organisations can build credibility. The important aspect of this is the repeated engagement. By being seen as being available, organisations can give the community multiple chances to voice concerns and have questions answered. In the Sandy Ridge consultation process, stakeholders were engaged repeatedly, 20 stakeholder groups were engaged a total of 50 times over the consultation period (Ruble, 2023). By doing what the organisation says it will, following through on commitments builds credibility. Typically, organisations set up agreements with the community to hold themselves to account. This builds credibility by setting out roles and responsibilities to avoid disconnects between the organisation and community expectation (Wood & Thistlethwaite, 2018). At Sandy Ridge, a community commitment register was set up to document these agreements made (Ruble, 2023). Therefore, the Project Team's recommendation is to follow this example of community engagement used to obtain the SLO for the Sandy Ridge facility and apply it to gaining acceptance for nuclear-powered submarines.

Trust

Trust is the final barrier to cross in the social license model. This takes the longest to cross as it is built up of repeated demonstrations of credibility. Trust is hard to build and easy to lose so it must be built gradually. An important factor in earning trust is the perceived fairness of decision making. This is where participants feel they are part of the decision-making process. This is referred to as the procedural fairness (Besley, 2010). Trust is central to the concept of social license and organisations must demonstrate trustworthiness by demonstrating responsible practices that are reinforced by the organisation (Stronge, et al., 2024). Having a mindset that embraces transparent communication is key to building trustworthiness as it demands honesty, a quality of trustworthiness.

Politicians globally and in Australia are seen as the most untrustworthy according to a recent poll (Ipsos, 2024), whereas scientists are seen as amongst the most trustworthy (presented in Figure 9 below). Therefore, the Project Team’s recommendation is, to maximise mindset adoption, the nuclear technological aspects are de-politicised and owned by the scientific community.

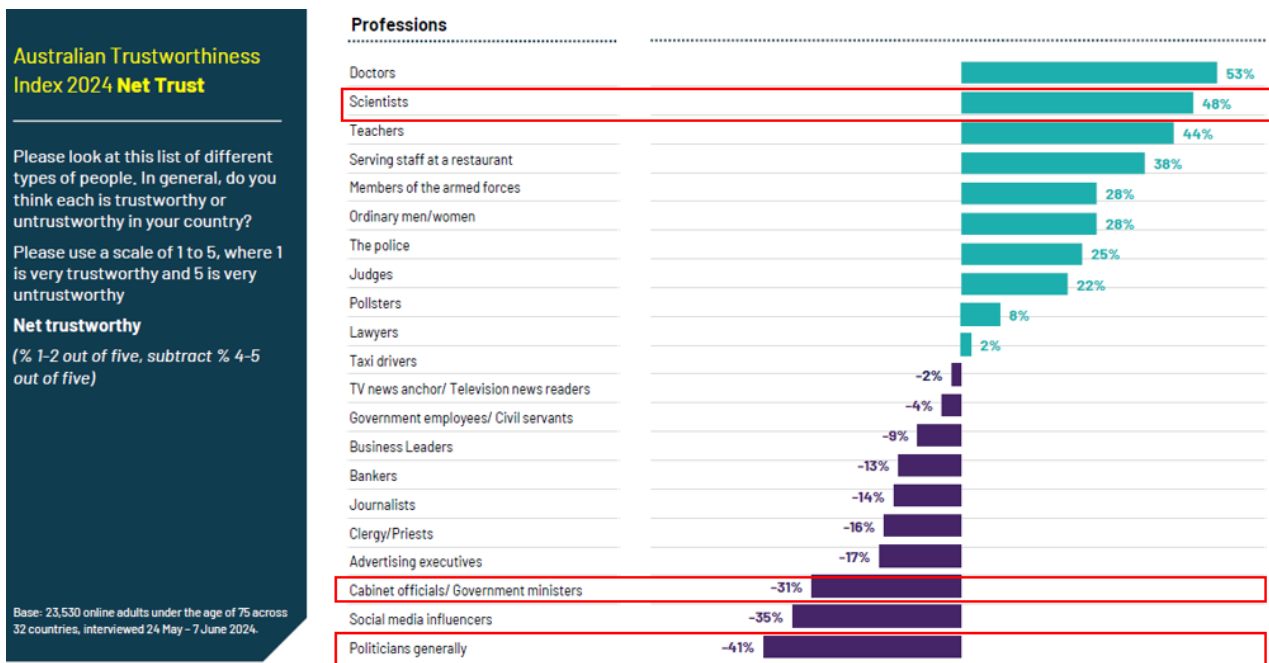


Figure 9: Australian Trustworthiness Index 2024 (Ipsos, 2024).

To feel trust, the wider community must have the trust in the preparedness of the organisation in every eventuality. Emergency plans must be in place. These emergency plans must also be shared with the community to ensure that firstly, they can be seen to be in place and secondly, that the community can practice them to be prepared themselves.

"[On the previous project cancellation] there is a lot of ill will out there. If you talk to the Australian Industry Defence Network, there's a lot of upset. The government bailed out the French government and gave them billions of dollars in compensation. Nothing went to Australian industry and the two problems of that is that one, people are out of pocket and two, they are less likely to trust the government in the future."

Participant #14 – Director, Nuclear Specialist

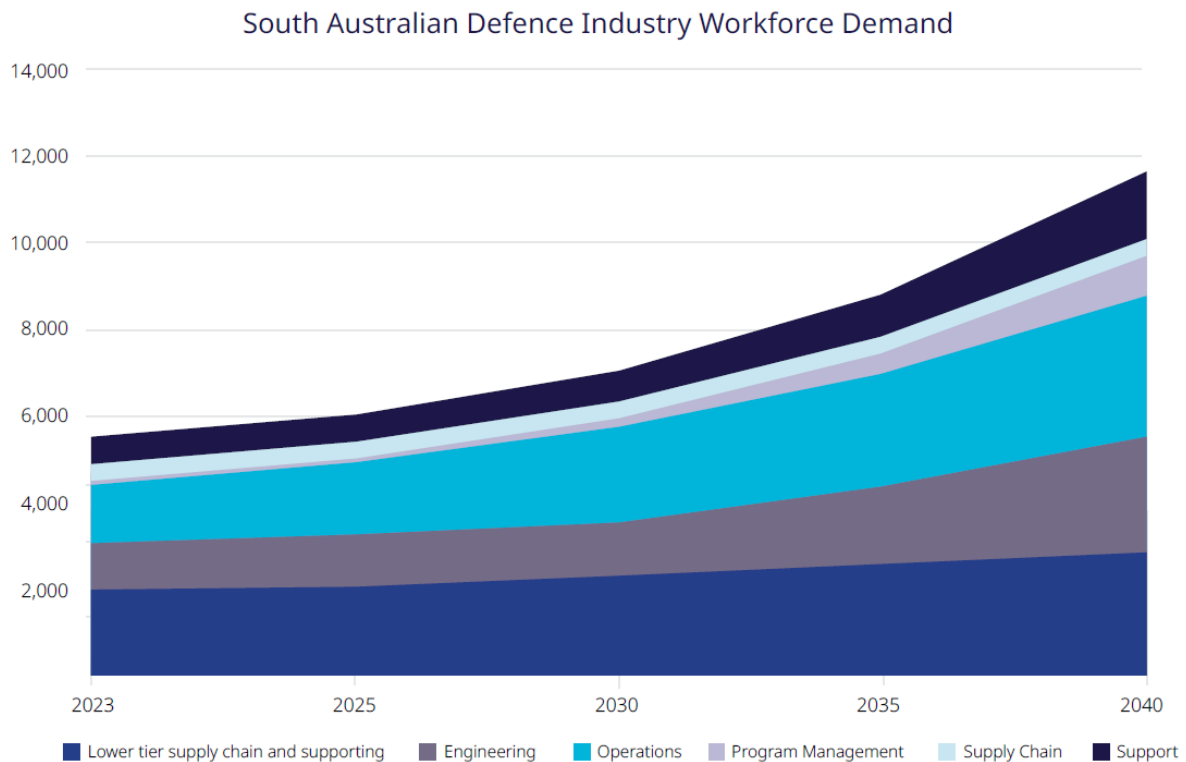
Australia is starting from a position of negative trust with the cancellation of the previous program, both in industry and the wider public. During the Project Team's research, there was a theme of animosity towards the way that this was handled, and it has left a mark on future program. The government cannot let this happen again, they must demonstrate leadership by communicating up front and transparently so that the public and industry can build confidence and feel they are part of the process. Moving away from the DAD model of communication is key.

4.4. WORKFORCE: SUSTAINABLE EXPERIENCE

4.4.1. BACKGROUND

The integration of nuclear-powered submarines into Australia's defence strategy marks a significant evolution in military capability, necessitating a workforce well-versed in the nuclear domain. Essential to this transition is cultivating a "nuclear mindset" within the various professional and trade training initiatives. This chapter examines the nuclear mindset and its implications for workforce development, upskilling, and training. It draws on recent research and first-person interviews to describe the requirements to establish and maintain this mindset within the Australian industry.

The Department of Defence has assessed the workforce demand for the South Australian defence industry, projecting growth from approximately 3,500 direct jobs today to over 8,500 by the 2040s, as shown in Figure 10. Key drivers of this demand include naval shipbuilding and sustainment, with the nuclear-powered submarine program alone expected to create 4,000 to 5,500 direct jobs at its peak in 20 to 30 years. Additionally, the South Australian Government has identified a need for around 2,000 jobs in lower-tier supply chains and supporting activities by 2023, growing to approximately 2,900 by 2040. These jobs will encompass businesses supplying parts, consumables, services, and associated research and technology (Commonwealth and the Government of South Australia, 2024).



Data Sources: Department of Defence and South Australian Department for Industry, Innovation and Science.

Figure 10: Estimated South Australian workforce demand 2023 to 2040 (Commonwealth and the Government of South Australia, 2024).

The workforce demand analysis highlights two key trends: steady growth in demand for engineering and operations skill sets starting in 2025, and a sustained need for skills within the operations job family, particularly in trade and technician roles. In addition to the graph, up to 4,000 workers will be

required for the Submarine Construction Yard design and construction at Osborne, South Australia. The combination of these factors underscores the significant and long-term workforce requirements necessary to specifically support the growth and development of AUKUS Pillar I.

4.4.2. ACHIEVEING A CRITICAL MASS

Building a skilled workforce for Australia’s defence and nuclear submarine programs requires a multi-faceted approach, guided by research and interviews with key stakeholders. Key themes from this analysis, documented below, highlight the need for early engagement through education, diversity in the workforce, and strong collaboration across industry, education, and government. By addressing these priorities with a nuclear mindset focus, we can create a sustainable, adaptable workforce capable of meeting Australia’s strategic needs.

Engaging Early

Engaging early with future talent is crucial for the success of nuclear programs, as it not only fosters acceptance and encourages change through early adopters, but also helps alleviate the fear and uncertainty surrounding new technologies. By incorporating knowledge of nuclear technology and submarine building into the school curriculum, Australia can introduce students to these fields as legitimate, exciting career pathways. This initiative should be led at the Commonwealth level, with significant investment in educational programs that focus on foundational nuclear principles and engineering concepts from an early age. One interview participant highlighted that a comparable initiative has been established by Prime Contractor General Dynamics Electric Boat in the United States. The company has designed a comprehensive K-12 curriculum, which is delivered to local schools in proximity to their shipbuilding training centres and shipyards. This program seeks to educate and motivate school-aged children to pursue careers in shipbuilding, thereby fostering a future workforce for the industry.

“The Commonwealth is the lead – they really do set the demand signals. They have a big responsibility here.”

Participant #11 – Executive Director, State Gov. Agency

Such programs would play a vital role in building public awareness and support for nuclear initiatives, thereby contributing to broader acceptance of nuclear programs (Commonwealth of Australia, 2023). Additionally, tailoring these educational initiatives to align with Australian values, cultural norms, and existing practices will ensure they are relevant and engaging. This approach will not only enhance understanding but also foster a sense of ownership among young people, leading to long-term buy-in and participation in the nuclear workforce as they mature.

Building the Ecosystem

Creating a comprehensive ecosystem for workforce development is essential. According to the United States Studies Centre (USSC), building a comprehensive ecosystem for workforce development involves creating synergies between industry, education, and government. This includes establishing partnerships to develop specialised training programs, ensuring alignment between educational outcomes and industry needs (United States Studies Centre, 2024). Similar insights were found in the South Australian Defence Industry Workforce Skills Report

(Commonwealth and the Government of South Australia, 2024), which emphasises the importance of engaging industry stakeholders in developing and implementing training programs to ensure relevance and industry buy-in. To be able to achieve this in an Australian context, collaboration across state lines is essential to foster a unified approach.

“We need to talk more – but how do you do it in a way that doesn’t look like you’re stealing people? This is where the interstate rivalry is not helpful. We need to rub out the borders and be flexible to work across sites.”

Participant #13 – A/Executive Director, State Gov. Agency

Additionally, research identified the need to better define the mid-career transition pathways for personnel who wish to upskill into the nuclear workforce. Both USSC (2024) and Werber et. al. (2022) referenced the need to facilitate mid-career transition through short courses, micro-credentials and dedicated training. Werber et. al. (2022) specifically found this to be a shortcoming in the American nuclear sector, where a significant gap exists between retirement-eligible personnel and younger, less experienced employees. The paper referenced industries such as electrical power generation, transmission, and distribution and commercial equipment repair and maintenance as sources of midcareer talent for sustainment efforts. These industries, which already embrace similar mindset principles, could seamlessly transition into a workforce that is consistent, adaptable, and able to move between different organisations and projects.

Planning to Retain

As the Defence industry attracts new talent, our focus must shift toward retention. Our research highlights the need to better understand and engage younger generations, who may hold different expectations from previous cohorts due to their distinct societal priorities. To retain the next generation, it is crucial to articulate how their roles fit into the larger picture, emphasising the interconnectedness of their contributions and the broader mission.

“A good leader can articulate in their vision and their leadership style to show how everything fits together; how they’re interconnected and how the impact of what you do in one place can positively or negatively impact another.”

Participant #13 – A/Executive Director, State Gov. Agency

To achieve this in the Australian context, we must address the fundamental “why” and “what’s in it for me” questions that will keep younger generations motivated. For example, one source suggests incorporating real-world examples like the Fukushima disaster helps trainees grasp the severe implications of safety failures. These case studies can offer practical insights into the necessity of stringent nuclear safety measures, a key part of the nuclear mindset (The Guardian, 2023). However, Australia's limited civilian nuclear sector currently restricts practical training opportunities that illustrate the strategic need and insistence of the nuclear mindset. Therefore, to fill this gap, simulations and interactive discussions embedded into our training programs can be used to build a more motivated and long-term committed workforce equipped with the skills necessary for success.

4.4.3. CONTINUOUS IMPROVEMENT

Embedding a nuclear mindset within Australia’s workforce is fundamental to the success of our nuclear submarine programs and broader defence objectives. This mindset goes beyond initial training, requiring continuous engagement and practice to ensure skills remain current and effective. By fostering a culture of continuous learning and leveraging both local and international expertise, Australia can ensure a workforce that is both highly skilled and capable of meeting the evolving demands of nuclear technologies. The following sub-sections expand on these key strategies.

Embedding the Mindset

To truly embed a nuclear mindset, practice is essential; training alone is insufficient if it isn’t followed by regular application. Therefore, we must ensure that those who undergo training continue to engage with operational tasks to maintain both their skills and confidence. If engagement levels are insufficient, Australia risks losing valuable talent to overseas markets. To combat this, Australia should consider establishing a qualification renewal process and continuous development opportunities to keep our workforce occupied and motivated. Regular certification renewals help maintain the validity of qualifications and ensure personnel are updated on current standards and technologies. This process encourages continuous learning and adherence to best practices, key parts of the nuclear mindset.

“If you train people, and they don’t practice within one or two years, it’s all gone. In the current time frames, we’re sending people to Pearl Harbour for 24 months then we’ve got the Submarine Rotation Force – West from 2026. The question is, will these people do enough domestically to remain sharp? [...] Do we need to implement a qualification that we have to renew? How can we keep them engaged on assets that are not too far away? How do we build instead on managing attrition?”

Participant #8 – Director, Academic

The Project Team’s research show that nuclear engineering academic specialists also agree that programs providing refresher courses and advanced training to ensure personnel continuously enhance their skills should be part of career development plans (UNSW, 2023). Furthermore, practical training should include the demonstration of nuclear mindset principles. An example of this is the inclusion of simulations where errors are analysed in a non-punitive context, which encourage trainees to report and learn from mistakes. This approach reinforces the no-blame culture and promotes transparency. Ultimately, these strategies ensure that the nuclear mindset becomes ingrained in everyday practice, helping to sustain a skilled, capable workforce over the long term.

Learning From Others

While this may be Australia’s first attempt at such an ambitious endeavour, it’s important to recognise that similar successes have already been achieved globally. To accelerate our progress, we must leverage the expertise of our AUKUS partners and domestic institutions like ANSTO and ARPANSA, continuously learning from international best practices. While the ASA nuclear mindset has established implicit knowledge management, it is crucial to implement formalised processes for knowledge transfer that extend beyond individual tenures, ensuring critical expertise is retained and shared.

“We need to take a leaf out of the book of ANSTO and how they’ve been able to integrate into their neighbourhood, who have an actual nuclear reactor sitting there.”

Participant #11 – Executive Director, State Gov. Agency

The Australian Strategic Policy Institute (ASPI) underscores the importance of drawing lessons from existing submarine programs to inform Australia’s approach, emphasising the need for early adoption of best practices and addressing workforce challenges proactively (Australian Strategic Policy Institute, 2024). A key example is the AUKUS Workforce Alliance (AWA), a tri-lateral initiative involving Australia, the US, and the UK, designed to build sovereign capability, capacity, and resilience in Australia’s defence sector (Adelaide University, 2023). In addition, leadership development is vital—mentorship programs that guide emerging leaders, facilitate knowledge transfer, and provide insights into effective practices will strengthen Australia’s defence capabilities and ensure long-term workforce resilience. By embedding these lessons into workforce training and continuous improvement initiatives, Australia can build a highly capable nuclear workforce and drive progress with the right mindset.

Establishing and maintaining a nuclear mindset within Australia’s workforce is essential for the successful implementation of nuclear-powered submarines. By defining the nuclear mindset, integrating it into training and upskilling programs, and addressing workforce development challenges, Australia can build a skilled and effective workforce. Collaborative engagement, public and government support, and cultural adaptation are key to achieving these goals. Insights from recent research further underscore the importance of a comprehensive approach to workforce development, ensuring that Australia is well-prepared to meet the demands of its nuclear capabilities.

4.5. SAFETY: SHE'LL BE RIGHT

4.5.1. BACKGROUND

Safety is paramount – this is one of the key pillars in the ASA's Nuclear Mindset, mentioned first in the overarching nuclear mindset document (Australian Submarine Agency, 2024). As Australia embarks on establishing a nuclear-powered submarine program under the AUKUS partnership, developing the appropriate safety frameworks and culture are key to the program's success. The nuclear industry requires a holistic safety approach, that integrates technical standards, risk management processes, and a strong safety culture. Building this culture at the federal level is crucial, ensuring consistent safety practices across government, defence, and industry sectors. Legal and regulatory frameworks must be established and reinforced to ensure compliance with both national and international safety standards. This must include clear guidelines for handling nuclear materials, environmental protection, and incident response, fostering public trust and safeguarding personnel, infrastructure, and the broader community.

Holistic Safety

As shown in Figure 11, the holistic approach to safety focuses on managing the safety of technological, human, and organisational aspect "*making sure the technology (plant, equipment, tools, apparatus, machinery, etc) is safe to use; people perform tasks safely at work; and the organisation overall is managed safely*" (Australian Radiation Protection and Nuclear Safety Agency, n.d.). Importantly, holistic safety extends to address the complex interactions between these elements. For example, how people safely use technology, or how the organisation provides training to people and ensures the technology is safe to use.

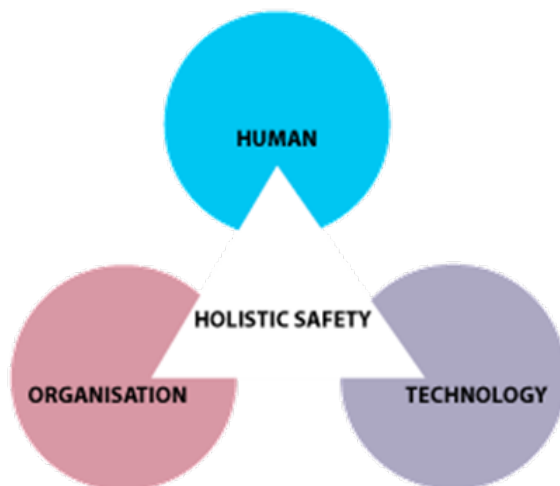


Figure 11: Holistic safety involves human, organisation and technology integration (Australian Government, 2020).

4.5.2. SAFETY CULTURE

Safety culture refers to the collective values, attitudes, beliefs, and behaviours that shape how people within an organisation approach safety. There are two core elements to safety culture:

VALUES AND BEHAVIOURS FOCUSED ON SAFETY

A strong safety culture ensures that safety is prioritised at all levels of the organisation—from leadership to operations.

SPREAD ACROSS THE ORGANISATION

A positive safety culture is widespread across the organisation, meaning that everyone, regardless of role or position, consistently demonstrates and upholds safety practices.

In essence, safety culture is "what people expect around here" in terms of safety practices. It is fundamental for reducing operational risks and preventing accidents, particularly in high-risk fields like nuclear energy and defence. A strong safety culture is crucial for maintaining safe operations. If safety is prioritised and integrated into the daily practices of the workforce—whether from operators or managers—incidents and accidents are less likely to occur. A positive safety culture promotes:

- Vigilance and accountability;
- A culture of reporting near misses and incidents; and
- Proper following of safety procedures.

In contrast, poor safety culture can lead to complacency, failure to report safety concerns, and a lack of accountability. This ultimately increases the risk of accidents and poses undue risks to both workers and the public. A poor safety culture also means lessons are not learned from past incidents, perpetuating unsafe practices.

During interviews, several subject matter experts noted the challenge of combating the casual confidence of the "she'll be right" culture in Australia. It is, however, important to note that Australia currently successfully operates other safety-centric industries such as aviation, mining, and oil & gas. These industries already have ingrained safety culture, as well as a culture for continuous improvement, flowing from the Federal Government level, with initiatives such as the Australian National Aviation Safety Plan 2024–2027, which serves 'to ensure continued confidence in our aviation industry' (Department of Infrastructure, Transport, Regional Development, Communications and the Arts, 2024). Further, when it comes to work-related injuries, Australia is well below the global rate of 12.1% at just 3.5% (SafeWork Australia, 2024).

4.5.3. SAFETY CULTURE AS PART OF THE NUCLEAR VISION

Safety in nuclear industries is paramount, and as such, safety culture must be part of a national nuclear vision to support shaping the way Australia approaches nuclear safety. This aspect of the nuclear vision should focus on:

LEADERSHIP COMMITMENT

Leaders at all levels must understand and prioritise safety above all else. They must be competent and must lead by example.

INDUSTRY COLLABORATION

Defence and defence industry must work together to ensure safety standards are consistently applied and maintained across projects.

PUBLIC ENGAGEMENT

As Australia navigates its nuclear future, public engagement and social license will be key, demonstrating a commitment to safety, transparency, and accountability will be key.

A national safety culture framework can help foster the right attitudes and behaviours, ensuring that nuclear safety becomes deeply embedded in the operational practices of Australian Defence, industry, and the broader public. By focusing on safety as a shared value and priority, Australia can reduce risks, prevent accidents, and ensure the safe and secure use of nuclear technologies for defence and energy needs.

4.5.4. LEGAL AND REGULATORY

Australia's adoption of nuclear-powered submarine technology under the AUKUS partnership represents a significant challenge across its existing legal and regulatory frameworks. Historically, Australia has been a non-nuclear state, committed to nuclear disarmament and non-proliferation, having ratified the Nuclear Non-Proliferation Treaty (NPT) in 1973, and further having implemented the Australian Nuclear Non-Proliferation (Safeguards) Act 1987 (Department of Foreign Affairs and Trade, 2021).

This stance on nuclear technology has extended into Australia's refraining from adopting civil nuclear power generation technology. The Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) is a key piece of legislation that has played a role in maintaining this position. Under the EPBC Act, nuclear power generation facilities are subject to rigorous environmental assessment processes, and any proposed nuclear facility must undergo extensive scrutiny to evaluate potential risks. In addition, the Australian Radiation Protection and Nuclear Safety Act 1998 (ARPANS Act) governs the regulation of radiation and nuclear safety, including the management of radioactive waste, but it does not provide a legal framework for the establishment of civil nuclear power plants.

In preparation for the AUKUS Program, Australia introduced the Australian Nuclear Naval Power Safety (ANNPS) Bill which provides the necessary framework for safe operation of nuclear-powered submarine technology to allow for the import, handling, and operation of nuclear technology. This includes updating provisions related to safeguards, environmental assessments, and safety standards. Additionally, Australia must navigate international obligations under the NPT to ensure compliance with its commitment to non-proliferation. These legal adjustments are crucial for enabling the country to integrate nuclear-powered submarines into its defence capabilities without violating its long-standing non-nuclear policies. The ANNPS bill is critical in establishing the following:

**ENSURES
SAFETY**

Sets legal standards for the safe operation of nuclear-powered submarines and the handling of nuclear materials.

**REGULATES
NUCLEAR
MATERIALS**

Establishes controls for the use, transport, and storage of nuclear materials in compliance with safety and non-proliferation standards.

**CREATES A
REGULATORY
AUTHORITY**

Establishes a body to oversee nuclear safety and submarine compliance.

**ALIGNS WITH
INTERNATIONAL
OBLIGATIONS**

Ensures submarines comply with the NPT, supporting non-proliferation while enabling military nuclear propulsion.

The International Atomic Energy Agency (IAEA) stresses the importance of a sound governmental, legal and regulatory framework to support safety throughout the lifetime of a nuclear facility. That framework is best achieved and maintained through transparency and public consultation.

To achieve this, there must be frameworks and channels for appropriate public consultation and incorporating public concerns into regulatory decisions. The Australian government must avoid the previously discussed DAD model and instead must embrace a consultation process with all key stakeholders. This should be aimed at gathering feedback for the purposes of informing decision making around the establishment of legal and regulatory frameworks to ensure broader public trust and acceptance in nuclear technologies and the supporting safety practices.

As such, the Australian Government's messaging must remain clear around what is in scope under the AUKUS Agreement to not confuse the broader public. As Australia has historically been a non-nuclear state there is a need to be clear with the public that the focus is on Naval nuclear propulsion only. The Non-proliferation commitment remains and the debate around civil nuclear power generation is a separate one. Finally, the implementation of an independent naval nuclear regulator is in progress and will be key to providing and adapting the key regulatory frameworks around naval nuclear safety and security. As one of the interview subjects voiced, they must be independent, their people must be competent, and they must be firm.

5 . R E C O M M E N D A T I O N S

5.1.A TECHNOLOGY PLATFORM

A novel recommendation from the Project Team’s research is to set up an online nuclear technology portal that would aim to demonstrate nuclear leadership at a national level and help to embed the mindsets within the wider public and nuclear eco-system.

www.nuclear.gov.au

A CENTRAL FEDERAL NUCLEAR TECHNOLOGY PORTAL

This platform would be federally owned but not directly defence related. Its purpose would be to provide a single source of truth for Australia’s nuclear projects. This platform could later be expanded to become sector agnostic, helping to build the nuclear ecosystem (waste, civil power) for the future.

5.1.1. PORTAL KEY COMPONENTS

The key components of this platform would seek to address the themes outlined in this report.

Vision and Leadership

The main finding of this report is that a central nuclear vision is required to boost industry confidence and build public trust. This vision would be present front and centre to this platform. Underpinning this would be the overarching strategy and mindsets developed for visibility. Key roadmaps featuring investigations, decisions and consultation would be laid out to further build on the public mindset and build cognitive and legal legitimacy. This approach would help mitigate the risk of consultation fatigue and provide the public with greater transparency regarding the plan for key activities, such as legislative decisions and community consultation periods. Roadmaps like this are demonstrations of an organisation’s credibility.

To demonstrate leadership around nuclear technology, the government must be seen to be on the front foot. Therefore, a section of the platform could be dedicated to countering the misinformation that would likely spread from bad actors targeting this platform. Such strategies that could be adopted are outlined Bateman and Jackson (2024).

Education

To normalise the word nuclear and make it less emotive, the basic nuclear literacy of the population must be increased. To do this the government must provide free tailored education at various levels (basic, intermediate, advanced) in a variety of languages. This must be clear and provide the necessary materials to demystify the science and relinquish the fear of the unknown. Whilst educating the wider audience the government must also not divulge any classified information.

To mitigate this the separation of nuclear technology from the nuclear submarine, will allow basic nuclear education whilst not compromising national security information. This will help to build legitimacy of the project from a pragmatic and cognitive standpoint.

Safety

It is essential for the Australian population to have confidence in the government’s ability to ensure their safety and act as a responsible steward of nuclear technology. As such, a strong emphasis on safety is paramount. This can be achieved culturally through creating a no blame culture. To further reinforce this commitment, incident reports from nuclear facilities should be made publicly available in real time, alongside a comprehensive repository of nuclear safety information and emergency procedures, to ensure transparency and preparedness, should the rare happen. An example of this is given in Plymouth City Council (2023) and shown in Figure 12.



Figure 12: Devonport Emergency Procedure Booklet (Plymouth City Council, 2023).

Social Licence

To build legitimacy of the project, the various stakeholder groups must be engaged meaningfully by identification and conformance to community norms. The nuclear technology platform would be the conduit to receive engagement feedback on projects after face-to-face consultations and publish any community agreements or engagement reports for reference. By having a feedback channel, participants can provide feedback in their own time and have questions answered. Links to various projects could be provided so that scope and benefits to the community could be communicated.

Consultation sessions and engagements for specific projects would also be published as part of the roadmaps. The platform would also be the single source of the truth, enabling control of the message to provide positive, confident communications surrounding the aspects of the mindset.

Workforce

Links to specific nuclear based career opportunities would be provided to make it easy to transition into the required fields. There could also be state government-based involvement, promoting specific skill shortages and offering incentives for successful transitions into required roles. Ultimately, this platform could be the launchpad for anyone interested in starting or transitioning into a career in the nuclear sector.

5.2.A NUCLEAR DISCOVERY TECHNOLOGY CENTRE

Establishing a Nuclear Discovery Technology Centre modelled after the structure of a Space Centre at Lot 14 in Adelaide will offer an opportunity for people of all ages to engage with and learn about the technology in an engaging environment, fostering greater public understanding. Ongoing public engagement with the local community is essential for fostering informed discussions about the strategic, economic, and societal implications of nuclear-powered submarines. This can be a highly effective tool for educating public about the safety and benefits of nuclear. A well-designed Nuclear Technology Discovery Centre can help promote:

TRANSPARENCY AND TRUST

Where the public can learn about nuclear in an objective and informative manner by demystifying the myths and reduce fear associated with nuclear.

ACTIVE COMMUNITY ENGAGEMENT

Provide a platform to encourage open public dialogue. Experts in the field can host workshops, lectures, Q&A sessions to have a constructive discussion with the wider public. When the public is well-informed, they are better equipped to contribute meaningful feedback that can help guide the adoption of nuclear technology.

INTERACTIVE LEARNING

The inclusion of virtual simulations allowing the public to easily understand complex concepts. For example, the operation of nuclear reactor in a nuclear-powered submarine.

CENTRE FOR COLLABORATION

Beyond public education, the Centre could also be a hub for collaboration between academia and industry as potentially international nuclear technology Centre.

In addition, to maintain a lasting awareness and understanding of nuclear technology, it is crucial to acknowledge the need for long-term commitment. The public engagement strategy and its messaging should be regularly reviewed and updated to ensure they remain relevant, impactful, and effective over time. A Nuclear Discovery Technology Centre can act as a powerful educational resource that not only informs the public about nuclear and safety but also addresses misconceptions and fosters a deeper understanding of the many benefits nuclear technology can offer. By engaging visitors in a meaningful way and providing factual, accessible information, such a centre can help build public support, reduce fear, and ensure that the community is better prepared to engage in discussions about nuclear technology and its future role in Australia.

“Importance to not only educate the sailors but you need to educate their families to show that you’re not putting them quite literally into harm’s way because they are working with a nuclear propulsion system. Everybody needs to know a bit about nuclear and let’s teach it at the right age at school. And let’s not teach the nastiest. Let’s teach the benefits.”

Participant #14 – Director, Nuclear Specialist

5.3. THE PUBLIC MINDSET

When comparing the ASA mindset with the findings of the Project Team's research and the model of a social license, the team recommends tailoring the mindset approach to optimise public acceptance. The proposed public mindset is shown in Figure 13, with each element explained below.

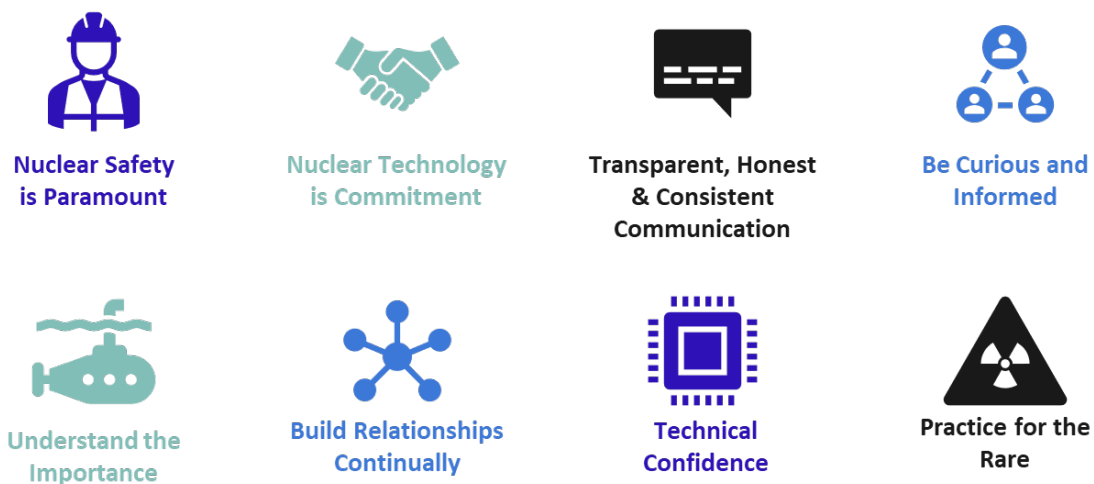


Figure 13: The proposed public mindset.

NUCLEAR SAFETY IS PARAMOUNT

Safety must be in focus as a top priority in the public mindset. Accidents although rare are far reaching, both environmentally and socio-politically. To build trust the stakeholders must feel safe. This also relates to the creation of a no blame culture.

**NUCLEAR
TECHNOLOGY IS
COMMITMENT**

The nuclear lifecycle extends well beyond the political cycle and the wider public need to be shown that the commitment is there from the organisation to manage it over its life. Conversely the public must commit to the project and both sides must work towards a building a partnership.

**TRANSPARENT
HONEST &
CONSISTENT
COMMUNICATION**

To build cognitive legitimacy and thereafter credibility, the communication between the public and organisation must be transparent, honest and consistent. Feedback must be listened to and concerns addressed with respect. Communication must be delivered by the right people to maximise impact.

**BE CURIOUS AND
INFORMED**

This relates to the transparency and availability of information surrounding project scope, timescales and benefits. A public that seeks knowledge and receives it appropriately can feel that they are being listened to building moral legitimacy.

**UNDERSTAND THE
IMPORTANCE**

The team's research showed that separating out the nuclear technology from the submarine strategic need was key to mindset adoption. The public must still be mindful of the world we live in today and understanding the strategic need for nuclear submarines is still required within the scope of the nuclear submarine program.

**BUILD
RELATIONSHIPS
CONTINUALLY**

By working together and engaging in meaningful consultation with stakeholders, relationships can be developed helping with the organisation, helping to build trust. This must be done throughout the life of the project as trust is hard to win and easy to lose.

**TECHNICAL
CONFIDENCE**

The knowledge base of the public surrounding nuclear needs to be increased so that the science is demystified, and the fear of the unknown is reduced. It is also important to demonstrate the technology is safe to ensure public perception of stewardship is sound.

**PRACTICE FOR
THE RARE**

Public emergency information must be made widely available through a variety of means to foster trust between the public and organisation. These drills must be practiced regularly to build familiarity and normalise them into everyday life.

5.3.1. ENGAGEMENT STRATEGY: THE OWNERS

A theme that emerged from the conducted research was the need to separate out the debate between nuclear technology and nuclear submarines. Doing so will enable the program to address specific concerns more efficiently. This would enable the nuclear mindset to be based around nuclear technology more holistically, and achieve wider acceptance due to the publicised resistance around defence spending and the AUKUS project.

“The ASA should not be leading the social licensing aspect of nuclear safety because the connotations of that is that it is only to do with submarines, and therefore the debate from a public perception point of view is tied to whether you agree with Defence spending or not. Separate the reactor part out of it.”

Participant #9– Director Nuclear Specialist

The ASA currently own the social license for the nuclear submarine program. The team’s research showed this as limiting, as it associates defence spending with nuclear technology. Therefore, the team recommends splitting the social license up into several owners each coordinated by a national nuclear vision and underpinning strategy. This would enable areas of expertise to tackle specifics and get a whole of nation thrust to the adoption of the public nuclear mindset. This proposal is shown in Figure 14.

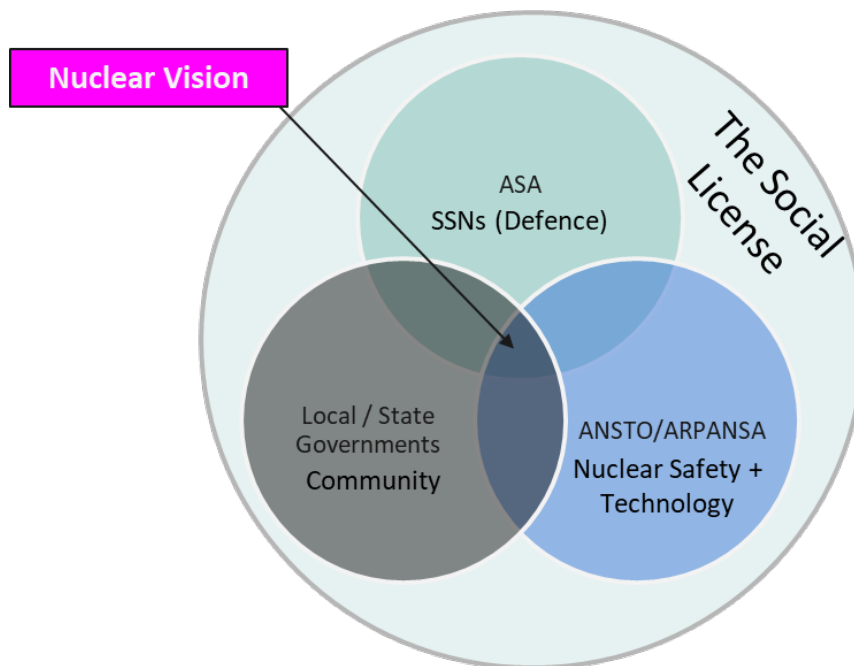


Figure 14: Proposal for a shared social license.

Under the proposal, the ASA will be accountable for developing the public awareness around the strategic need for submarines. They would also be responsible for communicating details surrounding the infrastructure and project benefits. The local and state governments are key in determining the stakeholder norms and identifying these drivers within the affected stakeholder groups. They would be responsible for local engagement and facilitating the feedback channels to ensure they were appropriate, drawing up community commitment contracts where required. The currently existing nuclear technology organisations in Australia (ANSTO and ARPANSA) could be

expanded to be tasked with the nuclear technology side of the social license. This would leverage on the perceived trust of science professions, existing nuclear knowledge and safety expertise. Splitting out the nuclear technology would achieve the necessary the separation from defence. Basic technology information could be shared without compromising security details, and interactive tours of facilities could be offered to key stakeholder groups.

"We've got a federal regulator already for the radiation industry through ARPANSA. [The Federal Government is] going to stand up a new regulator for the nuclear subs.

I'm not really sure why they've taken that approach, because ARPANSA is actually the appropriate regulatory body to do that...So you know the government, they need to have the vision and they need to fund it.

But the scientists and the engineers will be the ones who need to say how it happens, because they're the best place to do it."

Participant #9– Director, Nuclear Specialist

Central to all is the nuclear vision and underpinning engagement strategy. The engagement strategy would have to encompass many means of communication to become far reaching. Organisations such as IAP2 offer such materials and have been engaged successfully at a local level in South Australia to develop similar engagement strategies.

5.4. BUILD NUCLEAR MINDSET INTO THE WORKFORCE

The future workforce demand driven by AUKUS Pillar I will need to be built in stages, considering the full spectrum from early education through to opportunities for mid-career entry. Ensuring Australia has ample skilled people to deliver the government's strategic objectives requires a coordinated approach across government, industry, education and training providers. As quoted from the South Australian Defence Industry Workforce and Skills Report (Commonwealth and the Government of South Australia, 2024), *"Building SSN-AUKUS will be the leading contributor to the workforce growth of the defence industry in South Australia."* Recommendations around workforce in this report do not only focus on building a critical mass of suitably qualified personnel, but also the ways in which we can integrate a 'nuclear mindset' into training across the ecosystem.

5.4.1. EXPAND EARLY, ACTIVE INDUSTRY ENGAGEMENT WITH SCHOOLS

The first key recommendation around workforce is to expand early, active industry engagement with schools. This initiative should extend beyond South Australia to encompass a nationwide strategy led by the Federal Government in collaboration with the submarine prime contractors. A strong example of this approach is the existing "Subs in Schools" program run by Re-Engineering Australia, which has successfully engaged students in South Australia and can serve as a model for broader implementation across all States and Territories. Engaging students at the grassroots level will help demystify the complexities and secrecy surrounding nuclear-powered submarines, start to embed the recognition of a nuclear mindset, as well as clearly communicate the purpose and the benefits for future generations. Special attention must be given to addressing diversity challenges, particularly

the underrepresentation of women in STEM fields—currently only 16% of Australia's STEM workforce are women, with even fewer qualifying for the stringent security measures required for a nuclear submarine workforce (Australian Academy of Science, 2019). Therefore, fostering a supportive and transparent culture from the grassroots level, with a focus on accountability and inclusivity, will be essential. By engaging students early, we can build their confidence in the career opportunities available within the nuclear-focused Defence industry, especially for women and other underrepresented groups.

5.4.2. EXPAND TECHNICAL COLLEGES AND DEGREE APPRENTICESHIPS WITH A NUCLEAR FOCUS

To support both the Submarine Construction Yard and the AUKUS initiative long-term, it is essential to develop a workforce with specialised trade and engineering skills. A key recommendation is to integrate nuclear-specific training pathways into existing vocational and higher education initiatives, such as South Australian technical colleges and degree apprenticeship schemes. This integration should be coordinated at the national level, aligned with a comprehensive nuclear strategy, to ensure we build the right skills in the right people for the right jobs. Additionally, the training curriculum should incorporate nuclear-specific mindset principles, such as understanding high security and safety practices, instilling a no-blame culture, and learning accountability. By embedding these principles, we will foster a workforce that is not only technically skilled but also equipped with a strong nuclear mindset. The development of this curriculum should be led by education sectors with the relevant expertise, while the Federal government provides clear direction on needs. Further, leveraging best practice examples from international partners, such as the UK and the US, will facilitate knowledge transfer and ensure the most effective and efficient training programs. This approach will position Australia's workforce for success in the nuclear sector, providing clear development opportunities for promising individuals and ensuring long-term sustainability.

5.4.3. CREATE A CLEAR PATH TO TALENT AND SKILL RETENTION

The Project Team recommend prioritising the development of a comprehensive strategy for workforce retention and ongoing skills development within the nuclear sector, especially as it relates to the nuclear submarine program and the broader AUKUS roadmap. This strategy must focus not only on ensuring long-term generational continuity but also on enabling today's workforce-in-training to confidently leverage their skills when the AUKUS submarines become operational into the 2030s and 2040s. A proactive plan is necessary to keep personnel engaged and continually skilled during this interim period, aligning with the core nuclear mindset principles of continuous improvement and a commitment to excellence. To achieve this, it is essential to align efforts with a bipartisan national nuclear vision, offering workforce opportunities across all states and exploring purpose-driven international placements. Additionally, fostering exchanges and secondments with clear incentives for return will be key to upskilling. Looking ahead, creating pathways for personnel to transition into other nuclear fields—such as civil nuclear power and waste management—will provide ongoing career opportunities and ensure that submarine-trained experts remain integral to the nation's nuclear capabilities throughout their careers.

6 . C O N C L U S I O N

In conclusion, by adopting the recommendations derived from our thematic analysis, Australia will be strategically positioned to realise its long-term goals under the AUKUS Pillar I trilateral security partnership. These recommendations provide a comprehensive framework that fosters unity, alignment, and focus—critical elements that can only be achieved through the establishment of a clear, national policy and a cohesive vision for the nuclear sector. By uniting stakeholders around a shared nuclear vision, Australia can create the public trust and industry confidence necessary to secure widespread acceptance of nuclear technologies. This trust is essential not only for the successful implementation of current nuclear initiatives, but also for ensuring their sustainability in the long run.

Furthermore, embracing a unified nuclear vision will provide a strong foundation for a productive national conversation on the role of nuclear energy and technology in Australia's future. It will help to address public concerns, clarify the strategic value of nuclear programs, and foster a more informed and open debate. This proactive approach will be essential in ensuring that the nuclear sector evolves in a way that reflects both national interests and global best practices. Ultimately, the steps outlined in this report will support the development of a robust, educated, and resilient nuclear workforce, preparing Australia to meet future challenges and seize the opportunities that come with advancing nuclear capabilities in defence and energy sectors

REFERENCES

1. Adelaide University, 2023. *Tri-lateral Alliance Set to Address Critical AUKUS Workforce and Skilling*. [Online]
Available at: <https://www.adelaide.edu.au/newsroom/news/list/2023/11/06/tri-lateral-alliance-set-to-address-critical-aukus-workforce-and-skilling>
2. Australian Academy of Science, 2019. *Women in STEM Decadal Plan*, s.l.: Australian Academy of Science.
3. Australian Conservation Foundation, 2021. *Kimba Nuclear Waste Facility: A Failure in Consultation*. [Online]
Available at: <https://www.acf.org.au>
4. Australian Government, 2020. *National Radioactive Waste Management Facility - Public Consultation and Engagement*. [Online]
Available at: <https://www.industry.gov.au>
5. Australian Radiation Protection and Nuclear Safety Agency, n.d. *What is holistic safety?*. [Online]
Available at: <https://www.arpansa.gov.au/regulation-and-licensing/safety-security-transport/holistic-safety/learn-about-holistic-safety>
6. Australian Strategic Policy Institute, 2024. *Astute Lessons for Australia's AUKUS Submarine Workforce*. [Online]
Available at: <https://www.aspistrategist.org.au/astute-lessons-for-australias-aukus-submarine-workforce/>
7. Australian Strategic Policy Institute, 2024. War Risks to Australian Maritime Trade. *The Strategist*, 28 March.
8. Australian Submarine Agency, 2024. *Nuclear Mindset Interactive*. [Online]
Available at: https://www.asa.gov.au/sites/default/files/2024-02/Nuclear_mindset_interactive_PDF_3.pdf
9. Bateman, J. & Jackson, D., 2024. *Countering Disinformation Effectively: An Evidence-Based Policy Guide*. [Online]
Available at: <https://carnegieendowment.org/research/2024/01/countering-disinformation-effectively-an-evidence-based-policy-guide?lang=en>
10. Behm, A., 2022. *Australia's Future Submarines*. [Online]
Available at: <https://australiainstitute.org.au/report/australias-future-submarines/>
11. Besley, J. C., 2010. *Public Engagement and the Impact of Fairness Perceptions on Decision Favorability and Acceptance*. s.l.:Sage publications.

12. Braun, V. & Clarke, V., 2022. *Thematic Analysis – A Practical Guide*. s.l.: Sage publications.
13. Clulow, Z., Ferguson, M., Ashworth, P. & Reiner, D., 2021. Comparing public attitudes towards energy technologies in Australia and the UK: The role of political ideology. *Global Environmental Change*, Volume 70.
14. Commonwealth and the Government of South Australia, 2024. *South Australian Defence Industry Workforce Skills Report*, s.l.: Department of Defence.
15. Commonwealth of Australia, 2023. *The AUKUS Nuclear-Powered Submarine Pathway: A Partnership for the Future*, s.l.: s.n.
16. Defence Australia, 2024. *Sovereign Defence Industrial Priorities*. [Online]
Available at: <https://www.defence.gov.au/about/strategic-planning/defence-industry-development-strategy>
17. Department of Defence, 2023. *National Defence: Defence Strategic Review*, s.l.: Commonwealth of Australia.
18. Department of Industry, Science, Energy and Resources, 2020. *Sandy Ridge Facility: Community and Stakeholder Engagement*. [Online]
Available at: <https://www.industry.gov.au>
19. Department of Infrastructure, Transport, Regional Development, Communications and the Arts , 2024. *The Australian National Aviation Safety Plan 2024–2027*. [Online]
Available at:
<https://www.infrastructure.gov.au/department/media/publications/australian-national-aviation-safety-plan-2024-2027>
[Accessed 14 October 2024].
20. Dept. of the Prime Minister and Cabinet, 2024. *2024 ASEAN-Australia Special Summit - Resources*. [Online]
Available at:
<https://aseanaustralia.pmc.gov.au/sites/default/files/resource/download/2024%20ASEAN-Australia-Special-Summit-Outcomes-Summary-Factsheet.pdf>
[Accessed 10 November 2024].
21. Erickson, A., 2021. *Australia Badly Needs Nuclear Powered Submarines*, s.l.: Foreign Policy.
22. Essential Report, July 2024. *Essential Report*. [Online]
Available at: <https://essentialreport.com.au/questions/national-security-and-aukus-partnership-4>
[Accessed 20 October 2024].

23. Galloway, A., 2023. *New submarines will deter blockades that cut us off from the world: Marles*. [Online]
Available at: <https://www.smh.com.au/politics/federal/new-submarines-will-deter-blockades-that-cut-us-off-from-the-world-marles-20230316-p5css4.html>
24. Gould, K. A., Gould, K., Schnaiberg, A. & Weinberg, A. S., 1996. *Local Environmental Struggles: Citizen Activism in the Treadmill of Production*. Cambridge, UK: Cambridge University Press.
25. Government of South Australia, 2022. *Community Engagement Handbook*. [Online]
Available at: https://www.lga.sa.gov.au/data/assets/pdf_file/0027/551295/2022_LGA-Community-Engagement-Handbook-Revised_6thEdition.pdf
26. Idris, A. M., Sasongko, N. A. & Kuntjoro, Y. D., 2022. AUKUS Cooperation in the Form of Australian Nuclear Submarine Technology for Stability in Indo Pacific Region. *International Journal of Research and Innovation in Social Science (IJRISS)*, 6(2).
27. Ipsos, 2024. *Global Trustworthiness Index*. [Online]
Available at: <https://www.ipsos.com/en-au/Trustworthiness2024>
[Accessed 6 November 2024].
28. Kemp, D. & Vanclay, F., 2013. Human rights and impact assessment: Clarifying the connections in practice. *Impact Assessment and Project Appraisal*, 31(2), pp. 86-96.
29. Lewis, P., 2023. *Selling the Aukus deal to the public presents clear challenges for the Labor government*. [Online]
Available at: <https://www.theguardian.com/australia-news/commentisfree/2023/mar/21/selling-the-aukus-deal-to-the-public-presents-clear-challenges-for-the-labor-government>
30. Nerio, S. J., 2024. *Australian Nuclear Stewardship and Nuclear Powered Submarines*, s.l.: The Pennsylvania State University.
31. Plymouth City Council, 2023. *WHAT YOU SHOULD DO IF THERE IS A RADIATION EMERGENCY AT THE DEVONPORT SITE*. [Online]
Available at: <https://www.plymouth.gov.uk/sites/default/files/2023-11/Easy-Read-Devonport-Radiation-Emergency-Booklet-2023.pdf>
[Accessed 6 November 2024].
32. Rublee, M. R., 2023. *AUKUS: What to do with nuclear waste?*. [Online]
Available at: <https://www.lowyinstitute.org/the-interpreter/aukus-what-do-nuclear-waste>
[Accessed 2 November 2024].
33. SafeWork Australia, 2024. *Key Work Health and Safety Statistics Australia 2024*. [Online]
Available at: <https://data.safeworkaustralia.gov.au/insights/key-whs-stats-2024>
[Accessed 14 November 2024].

34. Scarce, K., 2016. *Nuclear Fuel Cycle Royal Commission report*, s.l.: Government of South Australia.
35. South Australian Government, 2021. *Kimba Facility Consultation and Community Response*. [Online]
Available at: <https://www.sa.gov.au>
36. Stronge, D. C., Kannemeyer, R. L. & Edwards, P., 2024. Building social licence to operate: A framework for gaining and maintaining meaningful, trustworthy relationships. *Resources Policy*, Volume 89.
37. Suchman, M. C., 1995. Managing legitimacy: Strategic and institutional approaches. *Acad. Manage.*, 20(3), pp. 571-610.
38. Tellus Holdings Pty Ltd, August, 2017. *The Proposed Sandy Ridge Facility Response to Submissions Report, Final Report*, s.l.: s.n.
39. The Guardian, 2023. *Australia Faces Looming Nuclear Skills Challenge to Support AUKUS Submarines*. [Online]
Available at: <https://www.theguardian.com/world/2023/mar/13/australia-faces-looming-nuclear-skills-challenge-to-support-aukus-submarines>
40. The Lowy Institute, 2024. *Lowy Institute Poll: Acquiring Nuclear Powered Submarines*. [Online]
Available at: <https://poll.lowyinstitute.org/charts/acquiring-nuclear-powered-submarines/>
[Accessed 20 October 2024].
41. Thomson, I. & Boutilier, R., 2011. Social License to Operate. In: *SME Mining Engineering Handbook*. 3 ed. s.l.:Littleton: Society for Mining Metallurgy and Exploration., pp. 1779-1796.
42. United States Studies Centre, 2024. *AUKUS Inflection Point: Building the Ecosystem for Workforce Development*. [Online]
Available at: <https://www.usssc.edu.au/aukus-inflection-point-building-the-ecosystem-for-workforce-development>
43. UNSW, 2023. *AUKUS Workforce and Skills Development Strategy*. [Online]
Available at: <https://www.unsw.edu.au/newsroom/news/2023/03/three-tiers-and-more-than-8000-new-engineers--what-it-will-take->
44. Uren, D., 2024. The trade routes vital to Australia's economic security. *The Strategist*.
45. Werber, L. et al., 2022. *Is the National Nuclear Enterprise Workforce Postured to Modernize the Triad? Insights and Options from a Quick-turn Assessment*, s.l.: RAND Corporation.
46. Wood, M. & Thistlethwaite, J., 2018. Social License to Operate (SLO). Case Review of Enbridge and the Northern Gateway Pipeline. In: *Handbook of Engaged Sustainability*. s.l.:Springer, pp. 579-597.

APPENDIX A

INTERVIEW QUESTIONS

DILP 2024 RESEARCH PROJECT: NUCLEAR MINDSET AND NUCLEAR LEADERSHIP

As part of undertaking the Defence Industry Leadership Program (DILP) run through the Defence Teaming Centre (DTC), participants have been divided into groups and assigned a research question to write and present on. Our group has been given the research topic of nuclear leadership and nuclear mindset. The overarching theme of the question is about exploring what “nuclear leadership” and “building a nuclear mindset” means within the context of Australian industry, and how nuclear knowledge can be built across all aspects of the Enterprise (physics, engineering, legal, policy, security, education etc.) to achieve the goals of AUKUS Pillar 1. To research our topic, we are interviewing subject matter experts to understand their thoughts on nuclear leadership and nuclear mindset in the Defence Industry.

The ASA has defined what it sees as the key principles of a nuclear mindset. These are:



In the interview, we would like to hear your feedback on the following questions:

1. Do you think the ASA has created a comprehensive and accurate definition of the nuclear mindset? Is there anything that you think has been omitted?
2. What is it about nuclear powered submarines that require a mindset that is different to other complex and potentially high-risk technologies?
3. From your perspective, what will present the main challenges to creating the right mindset and leadership qualities to deliver on AUKUS pillar 1?
4. What do you think would be effective strategies or activities to address these challenges? Have you implemented any of these within your organisation?
5. How can we not simply establish the nuclear mindset, but ensure that it is enduring?
 - a. Who do you see as the key change leaders?
 - b. What do you see as the actions on them to establish, and then maintain?
6. What impact, if any, do you think the parallel debate about civil nuclear power generation will have on the introduction of these submarines?
7. What would you like to see federal government do specifically to support the establishment of this nuclear mindset?

