Cooperative Research Australia

Response to the 2022 List of Critical Technologies in the National Interest

October 2022

Cooperative Research Australia acknowledges the traditional custodians of the land on which we operate, the Ngunnawal people. We also acknowledge the traditional custodians of the various lands across Australia upon which Cooperative Research Centres operate.

We pay our respects to Elders past, present and emerging and celebrate the diversity of Aboriginal peoples and their ongoing cultures and connections to our lands and waters.

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Executive Summary

Cooperative Research Australia (CRA) welcomes the opportunity to provide recommendations for consideration on the 2022 List of Critical Technologies in the National Interest (the List).

CRA is the voice of industry-research collaboration and advocates for the translation of research into commercial, economic, social, and environmental outcomes that benefit all Australians. Our members form a lynchpin in the Australian innovation system and are focused on creating new products, services, industries, and value in our economy. CRA represents Cooperative Research Centres (CRCs), CRC –Projects (CRC-Ps), post-CRC entities, and universities as well as other collaborative research entities, associated businesses, and alumni.

CRA commends the Australian Government on its commitment to science and innovation and appreciates the Department of Industry, Science and Resources' effort to backing critical and emerging technologies to provide the country with a clear competitive advantage, accelerate productivity growth, and create well-paying jobs and secure supply chains.

The consultation on the Critical Technologies List creates an opportunity to give advice to policymakers from the industry-led research cohort, whose operations will have a direct impact from the direction that the List incurs.

There are four primary areas of focus that CRA wants to put forward for consideration based on the analysis of our members' experience:

1. A revision to the format of how critical technologies in the national interest are presented
2. Clarity on how critical technologies are used for a broader national strategy.
3. A review of specific technologies
4. General comments

Cooperative Research Australia is committed to working collaboratively with the Australian Government to build a technological strategy that ensures an innovative and prosperous country for all Australians. We are open to facilitating a platform for further consultation and/or clarification with our members on any of the points.

Recommendations

The presentation format of critical technologies in the national interest

Although depicting critical technologies in the form of a list facilitates a quick reading, a matrix form with consistent variables would provide formality, uniformity, and easy comparison and analysis.

In addition, the List should include a guidance of what purposes it serves and how exactly it should be used to fulfill those purposes. For example, the consultation discusses that the importance of the List lies on its capacity to provide focus and basis around investment and collaboration by identification and understanding of what our critical technologies are, and it links this to some government initiatives such as the Critical Technology Fund and the 1.2 million tech-related jobs by 2030 commitment, however it does not clarify how that link actually works.

The consultation paper points out that the List embeds "technologies with the capacity to significantly enhance or pose risk to Australia's national interest, including our economic prosperity, social cohesion, and national security" and that the List "is intended to serve as a summary of identified critical technologies that stakeholders should be aware of when undertaking their activities". Both statements are too broad for users from the industry-led research ecosystem to fully understand the implications of commenting, adding or removing technologies from the List.

Finally, a clearer definition of *Critical* needs to be included, as well as a description of what sort of effects should the stakeholders be "aware of" when undertaking their activities in relation to the List.

Clarity on how critical technologies are used for a broader national strategy.

As a complementary recommendation to the above, CRA -in representation of users of these technologies- invites the Australian Government to consider a different approach to critical technologies where a plan is easily recognized, as opposed to isolated items on a list.

It has been brought to our attention that the List is focused on standalone technologies rather than integrated solutions involving cross-cutting applications and business models. There is a common view that the interlinking -and even the degree of complexity- of pathways to use these technologies is potentially omitted in the current thinking.

The roles of critical technologies should be considered dynamically through an interplay between sectors and even regions. For example, from a Net Zero perspective, it is evident that the List's topics are viewed in isolation, rather than the real-world challenge of interlinking all the complexity to navigate credible, reliable pathways forward.

A review of specific technologies

Technologies that should be considered for inclusion or removal

- **ADD Advanced materials and manufacturing - Smart drilling**

Systems and devices to significantly speed up and reduce the cost of drilling hard rock, to so to better detect and define minerals, particularly critical minerals. Examples include smart

materials for drill bits, dynamic fluids for sample retrieval and AI for optimal drilling parameters. Applications include mineral exploration, re-use of previously mined tailings, rehabilitation of areas disturbed by previous mining.

- **ADD Energy and Environment – Hydrogen derivatives**

The extent of Hydrogen in this space, is vast enough as to include its derivatives as a separate category, e.g. production of Methanol, which is gaining prominence for example as a preferred and likely route for decarbonisation the worlds Marine/shipping industries.

- **ADD Energy and Environment – Underground Gas Storage**

The use of large-scale underground reservoirs, aquifers or salt caverns are likely to play a major role in inter-seasonal storage of excess energy generation in summer being transferred to winter months, as well as necessary buffer storage for grid stabilisation, and hydrogen supply chain reliably buffering for export, industry, network and transport applications.

- **ADD Energy and Environment – Long duration storage technologies**

Given the critical role that long duration (inter-month up to inter-seasonal) large scale energy storage plays in a net zero transition, mature technologies such as Pumped Hydro Energy Storage (PHES), Compressed Air Energy Storage (CAES), flow batteries, supercapacitors, etc.

- **ADD Energy and Environment - Carbon Capture and Storage (CCS)**

Fundamentally, to achieve our targets under the Paris Agreement we are going to need CCS technology. These are technologies which capture a store carbon released into the atmosphere by burning fossil fuels in electricity generation and industrial processes such as cement production. Carbon capture and storage can capture up to 90% of the released CO2. Applications for retrofitting into existing heavy industry manufacturing machinery to capture process carbon emissions. For example, cement kilns.

- **ADD Energy and Environment - Negative Emissions Technologies – (NET)**

Technologies that remove CO2 from the atmosphere and play a crucial role in the credible achievement of 1.5 deg C / COP21 commitments. There are a range of possible technologies than generally also interface with CCS. Their applications include Direct Air Capture as well as BECCS Bioenergy combined with CCS.

- **ADD Augmented reality / virtual reality as a self-standing topic**
- **ADD Blockchain as a self-standing topic**

Review of individual technology definitions

- **Advanced materials and manufacturing - Advanced magnets and superconductors**

Increasing the magnetic strength of permanent magnets enable a reduction in size and weight of electric motors. This certainly presents an opportunity to Australia for leadership in a globally important technology.

- **Advanced materials and manufacturing – Advanced protection**

Applications should include its use in all natural hazard responses where individual protection is required.

- **Advanced materials and manufacturing - Continuous flow chemical synthesis**

Applications should include chemically neutral retardants for fire, hazmat, etc.

- **Advanced materials and manufacturing - Critical minerals extraction and processing**

Include applications on exploration, mining and processing.

- **Advanced materials and manufacturing – Smart materials**

Include applications in first responder tracking and protective suits during natural hazard events.

- **AI, computing and communications - Advanced data analytics**

The high levels of data analytic capability, required to extract further efficiency from this complex environment, should be acknowledged.

Also, applications should include traffic / movement and mineral exploration.

- **AI, computing and communications - Artificial intelligence (AI) algorithms and hardware accelerators**

Traffic management and automated driving systems (autonomous vehicles) are applications that are heavily dependent on AI.

- **AI, computing and communications - Distributed ledger**

Distributed ledgers are critical for financial assurance and transfer of liabilities in the mine closure process

- **AI, computing and communications - Machine learning (incl. neural networks and deep learning)**

It should include the importance of enabling more rapid upscaling of sub-pilot to pilot to demonstration to commercial scale facilities.

- **Biotechnology, gene technologies and vaccines - Genome and genetic sequencing and analysis (Next Generation Sequencing)**

Genome sequencing-rehab (plant and soil sequencing) is critical in the closure process to achieve post mine value.

- **Quantum - Post-quantum cryptography**

Applications should include techniques that are useful to protect critical infrastructure from cyber-attacks.

- **Energy and Environment – Biofuels**

Given the necessary role of renewable gases in the energy transition, especially for switch of industrial sectors as well as the potential for gas networks decarbonisation, Biomethane should complement the liquid biofuels mentioned. However, there should be an evaluation of their role in the upcoming years with advent of eFuels and EV's.

Also, in terms of applications, they can be useful to minimise the use of petrochemicals and mineral energy sources if created from waste and recycling.

- **Energy and Environment – Electric batteries**

Definition is too narrow. It is important that, whilst keeping technologies specific, they ensure full assessment.

- **Energy and Environment – Hydrogen and ammonia for power**

On the one hand, the definition is found to be too narrow. It is important that, whilst keeping technologies specific, they ensure full assessment.

On the other hand, this topic needs a balanced approach on i) Production, ii) Transmission, Storage and Distribution (i.e. all the infrastructure issues and needs from production to End-Use) and iii) End-Use. It is noted that the only applications listed currently are related to part iii), End-Use, which masks the much wider areas of work necessary in the National Interest also on Parts i) Production and Part ii) Transmission, Storage and Distribution.

Also, for the 'heavy' end of Australia's freight task, great hope is being placed on hydrogen as the energy source. The challenge is the development of fuel cell technology that has sufficient capacity and robustness to reliably operate heavy haul machinery over long

distances and under harsh conditions. Without it, the freight system will struggle to reduce its carbon emissions. This may warrant fuel cell technology being categorised as a critical technology in its own right.

- **Energy and Environment – Photovoltaics**

With reference to Hydrogen Superpower Scenario (AEMO-ISP 2022) or Net Zero Australia Initiative (just publicly released), it is likely that 80-90% of electricity generation in the 2050 future will be to make clean fuels like hydrogen, largely for export. Solar PV is likely to be the core driver of these competitive / low costs and yet this emphasis is not yet recorded in the applications

- **Sensing, timing and navigation – Advanced imaging systems**

Applications should include all hazards mitigation, response and recovery.

- **Sensing, timing and navigation – Inertial navigation systems**

Applications should include hazards recovery efforts where geographic references have been destroyed.

- **Sensing, timing and navigation – Magnetic field sensors**

Applications should include mineral exploration.

- **Sensing, timing and navigation – Miniature sensors**

Applications should include understanding environmental conditions during disasters.

- **Sensing, timing and navigation – Multispectral and hyperspectral imaging sensors AND Scalable and sustainable sensor networks**

Applications should include mineral exploration and mine closures.

- **Sensing, timing and navigation – Scalable and sustainable sensor networks**

Applications should include understanding micro conditions in all hazards events.

General comments

Comments on the frequency of updates to the List

It is broadly agreed that a frequency of 1 year is adequate

Feedback on the content of the Critical Technology Profiles

Our cohort has raised the issue that there needs to be a sense of direction of where Australian limited resources should be allocated: whether they should be allocated into developing technologies in which Australia represents low impact or should we focus on the ones where we have high impact?

Impacts of the List on investment / adoption decisions

It is generally agreed that the List has not influenced decisions about technology investment or adoption within our membership base.