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29 September 2022

Department of Industry, Science and Resources  
GPO Box 2013  
CANBERRA ACT 2601

**RE: University of Technology Sydney's submission on the 2022 List of Critical Technologies in the National Interest**

The University of Technology Sydney (UTS) welcomes the opportunity to provide feedback on the 2022 List of Critical Technologies in the National Interest (the List). We support the Government's intent to back critical and emerging technologies in order to build strategic capability in Australia, secure supply chains and drive growth in well-paying jobs.

For UTS, a technology university whose key research and teaching foci map broadly onto the current List, the investment of \$1 billion through the Critical Technology Fund (the Fund) represents an extremely important opportunity. Given our demonstrated track record in teaching, research and research commercialisation across areas including AI, quantum, robotics, and space-related technologies, we are keen to be involved in discussions around the design of the fund and its priorities.

UTS is pleased the consultation paper makes clear that the List does not signal an intention to prevent or limit collaboration with international research partners. As an Australian university seeking excellence in research, UTS actively embraces the opportunities for global collaboration, both with academic institutions and with industry. It is imperative we do so, given the relatively small role Australia plays in the world innovation system and the need to ensure that we secure inbound technological capability to support our own sovereign capability.

That being said we are also very attuned to an increasingly volatile geo-political context and welcome the Australian Government's focus on ensuring secure, critical technologies supply chains. UTS is a member of the Australian Technology Network (ATN) and supports the points made in ATN's submission. In particular we agree with ATN's contention that given the large scope of the List, there is a need for some over-arching understanding of where the current capabilities lie. Without such an understanding being clearly articulated there is the possibility that Australia may constrain its capacity to develop sovereign capability in key areas.

We support the suggestion that there is a need to overlay a capability map on the key technology areas to understand current gaps, consider strategic partnerships already in place – then focus on investment in those technologies which are both critical and where there is an untenable dependency on external sources. Additionally, the Australian Government may choose to invest further in acquiring key technology through international partnerships where there is a clear need to do so or little prospect of local development in the absence of international linkages. There is a clear link here to the framework for investment from the Critical Technology Fund. UTS supports the development of an over-arching framework to guide investment under the Fund, one that also offers guidance on the split between foundational research and research commercialisation.

It may also be useful to consider various categorisations to aid investment decisions, based on the capability map described above. The categorisations may include:

- a. Enabling technologies with wide application
- b. Technologies that can be developed within Australia for specific applications including those sovereign capabilities of strategic interest

- c. Technologies that require international collaborations in order to achieve the depth or scale necessary to support specific applications.

Recognising the nature of each critical technology and the best way in which to support Australia's access to them is critical for determining an optimal investment profile.

UTS also agrees with the ATN that a risk-based and proportionate approach (both in terms of sovereign capability and security risk) that makes use of existing assessments and evaluations and creates some ground rules/principles for trusted international collaboration would be useful.

I would also like to invite representatives from the Department of Industry, Science and Resources to visit UTS Tech Lab, <https://techlab.uts.edu.au/>, a model for technology capability development. Tech Lab is a multidisciplinary research facility that supports bespoke industry-led partnerships. Partners gain access to cutting-edge equipment, funding opportunities, world-class research talent and the ability to commercialise foreground IP. A new Australian Satellite Manufacturing Hub for larger Earth Observation satellites has just been established in Tech Lab, bringing a range of industry partners and government funding which will help fill gaps in Australia's current space manufacturing landscape by enabling the local development of large, high-quality, reliable spacecraft and optical payloads that are capable of fulfilling complex missions which deliver national economic benefit.

Specific feedback on the five consultation questions is attached. Should you have any questions or would like further information, please contact my office.

Yours sincerely,

[Signature removed]

Professor Andrew Parfitt  
**Vice-Chancellor and President**

## Attachment 1 – Responses to Consultation Questions

### **1. Should we add or remove any technologies from the List (including reasons)?**

- i. The category 'Advanced Materials and Manufacturing' could be usefully re-organised a specific focus on 'Advanced Manufacturing' which encompasses a number of manufacturing technologies deemed critical, such as:
  - a. Additive manufacturing
  - b. High specification machining processes
  - c. Nanoscale manufacturing
  - d. Digital manufacturing
  - e. Collaborative robots
- ii. In the category of 'AI, Computing and Communications' UTS has several suggestions for consideration. These areas could also reasonably be categorised as enabling technologies.
  - a. Artificial intelligence is an umbrella term that often implicitly includes machine learning. However, we recommend that 'Machine Learning' be explicitly included.
  - b. Further to 1 ii. a., inclusion of the metaverse, virtual reality and augmented/mixed reality as a stand-alone category. These are currently linked into machine learning but in and of themselves they are not necessarily reliant on machine learning.
  - c. Separate out 'artificial intelligence algorithms' (a broad term) and 'hardware accelerators' (a platform that helps enable AI).
  - d. Due to the often black-box nature of AI and machine learning techniques, AI ethics and trustworthy AI play a key role in the responsible use of AI in different areas, especially in high-stakes decision making. This is becoming increasingly important for modern, democratic societies. UTS recommends the inclusion of 'AI ethics and trustworthy AI' on the List.
  - e. The need for data to be made readily available in ways that aid decision making and understanding is on the rise and hence UTS recommends that "Data Visualisation" be added.
- iii. For 'Energy and Environment', UTS has several points for consideration.
  - a. The deployment of energy is increasingly critical for Australia so UTS recommends including electricity network-microgrids and integration technologies, along with electric machines and relevant material designs.
  - b. Under the 'biofuels' category, UTS recommends including following addition in bold: "Examples include biogas and biodiesel derived from plant biomass (**including algae**), and bioethanol from crops such as corn and sugar cane." This acknowledges the increasing importance of algae to our decarbonisation efforts.
  - c. With the increasing need to explore a range of ways to reduce the national and global carbon burden we recommend that 'Decarbonisation' be added.

According to the recently published US Decarbonisation Roadmap (<https://www.energy.gov/sites/default/files/2022-09/Industrial%20Decarbonization%20Roadmap.pdf>), the pillars include:

- improvements in the energy efficiency of industrial processes;
- industrial electrification approaches to leverage electricity generated from clean sources;
- expanded use of low-carbon fuels, feedstocks, and energy sources (LCFFES); and
- the deployment of carbon capture, utilization, and storage (CCUS) technologies and alternate approaches to mitigate remaining emissions."

## **2. Should we change how we describe technologies?**

UTS recommends the adoption of universal descriptions wherever possible, otherwise individual interpretations will factor in highly when the list is used. It would also be beneficial to identify the technologies based on the proposed categorisation for investment decisions, as described above:

- a. Enabling technologies with wide application
- b. Technologies that can be developed within Australia for specific applications including those sovereign capabilities of strategic interest
- c. Technologies that require international collaborations in order to achieve the depth or scale necessary to support specific applications.

Further, in general UTS recommends that Indigenous people and communities should be considered in finalising the definitions.

Specific considerations for the current descriptions of the following technologies:

- I. **Advanced composite materials** - these advanced composites could be biogenic and therefore contribute to carbon removal technology.
- II. **Critical minerals extraction and processing** - biomining of rare earth minerals from tailings dams - enhanced extraction and reduce environmental pollution.
- III. **Distributive ledger** - verifying carbon provenance, carbon sink monitoring and reporting, tracking from emission to inclusion into a biogenic product where it can be allocated a carbon token - Estainium (EU-based) is developing this technology.
- IV. **Biomaterials** - biogenic carbon can be used to decarbonize existing construction materials as well as providing short term carbon sinks.
- V. **Synthetic biology** - replace fossil-derived raw materials with biogenic (removing atmospheric carbon).
- VI. **Biofuels** - waste-to-methane (anaerobic digestion) and direct air capture technology hard-to-abate carbon emissions.
- VII. **Quantum communications (incl. quantum key distribution)** – consider replacing the words “between distant people” with “within current telecommunications infrastructure”.
- VIII. **Miniature sensors** – also carbon sensors - for tracking sink efficiency and enable a wider range of sinks to attract offset funding.
- IX. **Advanced robotics** - industry 5.0 technology and advanced biomanufacturing applications

## **3. How often we should update the List?**

Given the timescales needed to acquire, develop and commercialise critical technologies there is a need for stability in the list for investment and planning purposes. UTS recommends a five year review cycle with annual updates or additions to signal prospective changes within a reasonable timeframe. Within that revaluation should be the need to re-assess the sensitivity of technology within the life cycle, as technology evolves and may no longer be critical (has it become public domain) and therefore should they be re-classified (removed from the list).

## **4. Feedback on the Critical Technologies Profiles (previously known as Tech Cards)**

UTS notes several potential issues with these profiles. For example, there are currently specific mentions of companies that seem ill placed and that in general, it is unclear how rankings have been built and if there is a need to rank universities in these areas – especially without a methodology for this ranking being provided. This results in the occurrence of the top-ranked universities not being listed, see e.g., in ‘Advanced Composite Materials’. Generally, research and work on critical technologies should not be done by just one provider/group but rather as part of a robust ecosystem where a degree of redundancy and competition is seen as a good thing.

Currently there is no profile for the following:

- i. 'Quantum Computing'
- ii. Robotics in construction, infrastructure and space applications which are of significance.

**5. If the List has influenced decisions in your organisation about technology investment or adoption?**

As mentioned above, many of the critical technologies are areas of current strength and/or future interest for UTS. Our focus is on ensuring our work delivers public benefit including the creation of new jobs in high value industries. In areas such as AI, we are Australian leaders when it comes to the ethical use of AI, and will soon launch a new Human Technology Institute which has a specific remit to work with governments, civil society and industry to build a future that applies human values to new technology.

Finally, we are aware of some anxiety from researchers that the List will be used to curtail potential collaboration opportunities, including international cooperation. UTS supports the very clear statement in the consultation paper that this is not the intention and will reinforce that message internally. It would be useful if the Government similarly stressed the importance of ongoing work, both domestically and internationally, in these areas, with the appropriate safeguards in place where necessary. However, it is critical to recognise that Australia will be the beneficiary of strong international collaboration under the right circumstances and with a clear view to ensuring we have access to all of the necessary critical technologies we need for future economic, social and environmental success.