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15 December 2022

Mr Steve Georganas MP
Chair, Joint Standing Committee on Trade and Investment Growth
PO Box 6021
Parliament House
Canberra ACT 2600

Dear Chair

Re: Inquiry into Australia's transition to a green energy superpower

CSIRO welcomes the opportunity to provide input to the Inquiry into Australia's transition to a green energy superpower. CSIRO is delivering science and technology, in partnership with government and industry, that will enable Australia's transition to a lower emissions energy future.

As Australia's national science agency, CSIRO is well placed to speak on the role of innovation in identifying opportunities and trends to support the transition to renewable energy. Here we provide examples of our energy research investments which illustrate the role of innovation and research. In doing so we have not addressed the Inquiry's Terms of Reference specifically, as we are aware there are other agencies and departments that are better placed to comment on specific outcomes that trade and investment could deliver.

Our Future World report

CSIRO's *Our Future World* report released in July 2022 describes seven global megatrends which underpin the possible challenges and opportunities ahead. With an outlook to 2042, the report explores the geopolitical, economic, social, technological and environmental forces unfolding around the world, predicting their likely impact on Australia's people, businesses and governments. The second megatrend *leaner, cleaner and greener* is of particular relevance to this Inquiry. It suggests there will be an increased focus on potential solutions to Australia's resource constraints through technologies including those to enable a net-zero energy transition.

Energy transition

For more than two decades, CSIRO has undertaken analysis and projections on energy futures to better understand the scientific and technological pathways to achieving net zero. Past reports of interest include:

- *Low Emission Technology Roadmap* (2017) - indicating that Australia's resources position it well to benefit from the energy transition, the transition to low emissions electricity is achievable at moderate cost, and that technology neutral policies are important.
- *Hydrogen Roadmap* (2018) - which found clean hydrogen is a versatile energy carrier and feedstock that can enable deep decarbonisation across the energy and industrial sectors and can help Australia meet its decarbonisation targets.
- *Australian National Outlook* (2019) - Australia's roadmap to 2060: which examines what Australia might look like economically, socially and environmentally over the next forty years. It found under its Outlook Vision Australia can successfully transition its energy system, with high reliability and affordability and

lower emissions; and if the world cooperates to limit climate change to 2°C, Australia can go even further and reach 'net zero' emissions by 2050, driven by significant shifts in land use to carbon plantings.

Most recently, CSIRO's investments in energy research are underpinning innovation through our [Future Science Platforms](https://www.csiro.au/en/about/strategy/Future-Science-Platforms) (<https://www.csiro.au/en/about/strategy/Future-Science-Platforms>); and the [CSIRO Missions Program](https://www.csiro.au/en/about/challenges-missions) (<https://www.csiro.au/en/about/challenges-missions>) focussed on Australia's key challenges, described below.

Future Science Platforms

CSIRO's Future Science Platforms (FSPs) are an investment in boundary-pushing science that will enable future innovation. The FSPs are multi-disciplinary, bringing together different fields of research and are multi-year initiatives, designed to invent the foundations of tomorrow's science breakthroughs. For example, the Revolutionary Energy Storage Systems FSP focuses on the need for energy storage to evolve as technology advances.

CSIRO's Missions Program

Over the past two years, CSIRO's Missions Program has strengthened investment in research to support the energy transition. The program enables CSIRO to accelerate the pace and scale at which we achieve impact by channelling our multidisciplinary teams to focus on Australia's key challenges. Our Missions model is one way CSIRO collaborates with the innovation system, across government, industry, the research sector and communities, to catalyse research investment and participation. CSIRO aims to build Australia's energy and resource security and competitiveness, while lowering emissions, through missions including the Hydrogen Industry Mission, Towards Net Zero Mission, Renewable Energy Powerhouse Mission and Smart Energy Mission.

Hydrogen Industry Mission

The Hydrogen Industry Mission aims to underpin the development of a domestic and export market for hydrogen. Developed to address Australia's energy transition, the mission combines CSIRO's technologies in hydrogen production through hydrogen electrolysis and usage in hydrogen fuel cells. Further, the mission enables third parties to demonstrate their products in the hydrogen value chain at our recently established Victorian Hydrogen Hub (VH2) in collaboration with Swinburne University (<https://research.csiro.au/hyresearch/the-victorian-hydrogen-hub-vh2/>).

Towards Net Zero Mission

The Towards Net Zero Mission seeks to develop transition pathways to embed low-emission technology into Australian industry and agriculture, supporting regional communities in a low emissions future.

Renewable Energy Powerhouse Mission

CSIRO has commenced the development of the Renewable Energy Powerhouse Mission. Its aim is to create Australian capability, technologies, and home-grown supply chains for affordable storage of renewable energy and other power for deployment in grids and microgrids, to secure reliable energy as the nation's power mix is decarbonised.

Smart Energy Mission

CSIRO has commenced the development of the Smart Energy mission. Its goal is to enable reliable, affordable, sustainable and equitable energy for industry and community by building integrated systems intelligence into Australia's energy transformation.

Role of research investment and partnerships

As noted in the above examples, CSIRO aims to work closely with Australian industry in the application of research and development that has a commercial focus, for example:

To accelerate the commercial uptake of CSIRO technologies, Endua (<https://www.endua.com>) an Australian-owned joint venture between CSIRO, Main Sequence Venture and Ampol, was established in 2021. Endua's purpose is to develop electrolyzers and hydrogen-based power generation systems specifically for the diesel replacement market for remote/off-grid and backup power applications. CSIRO, with funding support from the Innovative Manufacturing CRC, has used its years of expertise in battery systems development to design and prototype a cyber secure battery management system, both hardware and software, for Energy Renaissance (<http://www.energyrenaissance.com>). These technologies will begin to deploy in 2023.

We work with the Australian Trade and Investment Commission to attract investment to scale, grow and complement our research and science capability to effectively tackle global challenges. As an example, CSIRO together with Austrade arranged a delegation of industry and academics to visit Osaka, Japan, in December 2018. The visit served to highlight Australia's capabilities in electrochemical energy storage both in R&D and in supply chains and opened doors to key companies in the Osaka region involved in energy storage materials and devices. More recently, Austrade supported the CSIRO-hosted International Meeting on Lithium Batteries (IMLB), from 26 June to 1 July 2022 in Sydney, helping to promote the meeting through their offices overseas.

CSIRO is also building strategic international partnerships to enhance and build our technology to support the energy transition in Australia's national interest. For example, in 2022, CSIRO entered into new partnerships with National Science Foundation and the US Department of Energy labs including National Renewable Energy Laboratory (NREL). Under the agreement, CSIRO and NREL will initially focus on four areas of strategic importance to Australia: hydrogen, global power system transformation (G-PST), plastics, and an accelerator/incubator program for small and medium sized enterprises (SMEs) that has the potential to transform our global energy future (<https://www.csiro.au/en/news/news-releases/2022/energy-partnership-to-strengthen-research-collaboration-between-aust-and-us>)

Future trends and opportunities

CSIRO's role is to ensure that it provides the best possible evidence-based options to government, industry, and the public. CSIRO is therefore considering a broad range of technologies to meet different energy demand settings, including for off-grid and micro-grid solutions for remote industries, and to address energy security for remote communities. This includes the application of stable and integrated renewables to the mining and processing sectors to decarbonise the very production of materials that will decarbonise energy generation and storage. These outcomes will require that more downstream manufacturing is conducted in Australia (with the creation of jobs in cities and regions) and also international partnerships and reciprocal technology trade to develop integrated supply chains.

CSIRO is also exploring how to optimise the digital transformation of the energy system, in circumstances where the system is increasingly interconnected, dynamic and collective. By adopting a whole of systems approach, this work will help to integrate the deployment of digital capability into the energy system, increasing the reliability and coherence of forecasting, and allowing for the integration of small-scale assets into the system, which will improve energy access.

CSIRO is assisting industry in the development of lithium-ion battery supply chains, commencing with unlocking our large reserves of graphite, lithium, nickel and cobalt, nickel through lower cost, lower environmental impact processing innovations, through to simplified refining to battery grade and production of cathode- and anode-active materials (<https://www.csiro.au/en/research/production/materials/Nickel->

west). These are essential first steps in producing high-grade high-value engineered materials for inclusion in batteries whether in Australia, or in partner countries.

We would be pleased to provide more information on the activities referenced in this submission. For more information, please contact Dr Emma Giakoumatos, Senior Advisor, CSIRO Ministerial Liaison, at mplo@csiro.au.

Yours sincerely

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