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ANU Energy Change Institute submission:

Inquiry into Jobs for the Future in Regional Areas

Senate Select Committee on Jobs for the Future in Regional Areas

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About the ANU Energy Change Institute

The [ANU Energy Change Institute](#) (ECI) provides authoritative leadership in energy research, education and public policy through a broad portfolio ranging from the science and engineering of energy generation and energy efficiency, to energy economics, regulation, security, sociology and policy. The ECI comprises more than 300 staff and PhD students from all seven Colleges of the University, and over \$100 Million in infrastructure and facilities, supported by a major portfolio of external grant funding.

The ECI leads an ANU strategic initiative - [Zero-Carbon Energy for the Asia-Pacific](#), in which the University is investing \$10m from 2019 to 2023. This program recognises that Australia is a potential renewable-energy powerhouse and a resource-rich nation, whose immediate neighbours in the Asia-Pacific will account for two-thirds of the world's energy demand growth in the coming decades. Decarbonising further energy use and cutting existing emissions in the region are essential if the world is to have any chance of meeting its goals for limiting climate change. In a rapidly decarbonising world, Australia's carbon emitting exports will need to shift to zero-carbon embedded renewable energy exports in order to maintain our role as an energy export powerhouse.

Submitted by:

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Terms of Reference A.

New industries and employment opportunities that can be created in the regions.

Australia has a natural abundance of renewable energy (wind and solar) and mineral resources. Our country is well positioned to become a renewable energy powerhouse and an exporter of zero-carbon energy products by value adding and refining our bountiful metal ores.

With a focus on Northern Australia, opportunities exist and are already underway to develop multi-gigawatt, zero-carbon renewable power plants. For example the [Asian Renewable Energy Hub](#) (AREH) plans to generate up to 15,000 MW of renewable energy in Western Australia. Up to 3,000 MW will be dedicated to large energy users in the Pilbara region, which could include new and expanded mines and downstream mineral processing. The bulk of power will enable large-scale production of green hydrogen and other products for the domestic and export markets. AREH, and similar projects like [Sun Cable](#) in the Northern Territory which is aimed at direct export of electricity via high-voltage DC undersea cables, have the potential to create skilled high-tech jobs through supply chains to manufacture and assemble equipment needed for wind and solar generation and hydrogen production.

The geographic combination of vast, cheap renewable energy and hydrogen generation with massive mineral resources provides a new opportunity for Australia to value-add and refine more of its abundant metal ores for export. Australia is the world's largest exporter of iron ore, and its major iron ore deposits are co-located with some of its best solar and wind resources in the world. Substantial transport-energy wastage could be avoided if the ore was reduced close to where it is extracted. Emissions-free reduction of metals like aluminum is already possible at scale. In contrast, zero-carbon technologies to reduce iron ore using heat from renewable electricity, and potentially with hydrogen as a reducing agent, are currently at laboratory or pilot plant level. It is difficult to predict when – or where - these technologies will be economic at scale.

The economics of renewable energy generation are particularly favourable at large scale, in locations that are windy and/or have a low cloud cover and low population density. These areas have typically been considered by policy makers as “marginal” land in both agricultural and industrial economies. In many countries – including Australia – they are the location of the most intact Indigenous cultures and the highest density of Indigenous populations.

Indigenous populations currently reliant on costly energy sources are likely to benefit from or be disproportionately affected by a rapid transition to zero-carbon energy systems. Experience over recent decades with large-scale land acquisitions for agriculture and mining provide insight into the potential nature of these implications. If public and private governance are done well, the energy transition represents an enormous opportunity for sustainable development on traditionally-owned and managed lands, for example new skills, jobs and income that could provide comprehensive and enduring benefits to local Indigenous communities. Ensuring multi-generational benefit from the development of

renewable energy and associated industries will require strategic collaborations across industry, government and Indigenous groups, informed by best practice internationally.

Terms of Reference D.

The importance of long-term planning to support the diversification of supply chain industries and local economies.

Providing foresight that assists long-term planning is the task of the research community, and in particular the ANU Energy Change Institute's Grand Challenge *Zero-Carbon Energy for the Asia-Pacific* aims to provide the underpinning research to inform long-term planning of future industries in Australia's mineral- and renewable energy-rich regional areas.

Techno-economic research can guide and map the necessary technologies. It can also identify which technologies are likely to have the lowest social and economic cost in the long-run, thereby helping to avoid lock-in to sub-optimal pathways. Identifying likely techno-economic pathways can also support the work of social scientists.

Research in the social sciences and the humanities can identify who will be affected under various transition pathways, and how. Working closely with stakeholders, these fields can also help identify changes to proposed pathways that can ameliorate or even remove negative social outcomes, particularly for vulnerable groups. Political and political-economic insights can help steer the transition pathways clear of potential stakeholder roadblocks.

Informed by experts in other disciplines, legal, regulatory and governance researchers have an important role to play in supporting the evolution of governance systems. These systems will include new or changed institutions, policy and formal regulation; as well as private and community governance and regulation in global supply chains and community organisations.

Terms of Reference F.

The use of renewable resources in Northern Australia to build a clean energy export industry to export into Asia.

The scale of the opportunity for renewable energy exports from Northern Australia is vast. Australia has in abundance the natural resources needed to become a major exporter of renewable energy and zero-carbon embedded-energy products to the Indo-Pacific.

Australia experiences some of the best solar resource in the world – often complemented by high-quality wind resources. Solar photovoltaics and wind are currently the cheapest form of new build electricity generation in the world.

Particularly in northern Australia, wind and solar are often complementary resources yielding capacity factors approaching 70 percent in some cases. With the addition of off-river pumped hydro storage and batteries, firm supply can be guaranteed for the giga-scale projects being proposed for Australia's northern development. We have mapped the off-river pumped hydro resource for Australia and find that the required sites exceed the

capacity needed by more than an order of magnitude, even in such a dry and relatively flat continent such as Australia . This creates the capacity to guarantee low-cost electricity to meet daily (and potentially seasonal) variations in demand.

The technologically most developed pathway is the export of zero-carbon electricity through the establishment of multigigawatt-scale renewable energy power plants. These plants rely on proven, low-cost generation technologies such as solar photovoltaic cells and wind turbines, combined with storage to meet daily and seasonal demand - dominantly via pumped hydro (a mature technology). These power plants could export zero-carbon electricity directly to south-east Asian markets via high voltage direct current (HVDC) sub-sea cables. The main barriers to this form of export will be geopolitical- and governance-related.

The second major zero-carbon energy export opportunity for Australia is likely to be clean hydrogen generated by renewable energy. Off-grid giga-power plants could be used to generate competitively priced green hydrogen for export to Asian and other global markets. Japan and South Korea have announced strategies towards hydrogen-based economies and have named Australia as a preferred provider. In the short term, clean hydrogen is likely to be produced using zero-carbon electricity to split water using proven electrolysis technology. In the medium- and long-term electrolysis may be superseded by technologies currently under development which, for example, could potentially convert sunlight directly into hydrogen.

And thirdly, by combining its renewable energy capabilities with massive co-located mineral deposits, Australia could also produce green (zero-carbon embedded energy) metals – especially iron and steel – for further processing in the Asia-Pacific.

Natural resources alone do not create zero-carbon energy in forms useful to modern economies. Complementary capital investments will be required. Importantly, the investment climate is also sunny in Australia. These advantages notwithstanding, Australia's ability to produce very large amounts of cheap, clean energy will be of limited benefit to the rest of the world unless that energy can reach potential overseas markets.

International regulation and governance will need to evolve to support renewable energy trade. Australia's relative geopolitical stability make it an attractive supplier of energy for a wide range of potential customers. It will need to capitalise on this position by supporting the development of external governance systems suitable for free international trade. These systems range from formal regulation such as agreed technical standards for transport of hydrogen fuel vectors, and bilateral and regional trade and investment agreements; to private governance within global value chains. We are undertaking research in these areas as part of our Grand Challenge, and this understanding will underpin the creation of new clean export industries to the Indo-Pacific.