

Title: Zero-Carbon Energy for the Asia-Pacific

Criteria 1: What is your Grand Challenge (numbering corresponds to Criteria dot points)

1. The ANU Energy Change Institute (ECI) Grand Challenge (GC) – [Zero-Carbon Energy for the Asia-Pacific](#) – recognizes that Australia is a renewable-energy, 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. Decarbonizing that additional energy use and cutting existing emissions from the region are essential if the world is to have any chance of meeting its goals for limiting climate change. In a rapidly decarbonizing world, Australia's carbon-based exports will soon have to be replaced by zero-carbon embedded energy exports in order to maintain our role as an energy superpower.

Our GC will undertake the research needed to transform the way that Australia trades with the world. We will do this by engaging with the Asia-Pacific to develop zero-carbon technologies and social frameworks founded on an understanding of the geo-political and socio-economic context. We will develop the research under two key themes:

(a) Export of Australian renewable electricity, and the creation of renewable electricity capability, in the Asia-Pacific;
(b) Development of zero-carbon embedded energy products made using Australian renewable energy.

2. Theme (a) will undertake a transdisciplinary study of the technological, economic, regulatory, social and environmental considerations for the proposed export of gigawatts of renewable electricity (solar PV, wind, solar thermal) from north-western Australia, via a high voltage, direct current (HVDC) undersea cable to East Timor, Indonesia, Singapore and thence mainland Asia. We will partner with the global renewable energy company CWP Renewables to understand the challenges and opportunities presented by their Asian Renewable Energy Hub (AREH) project. This includes research into the legal, political, social and economic settings needed to create sustainable development with renewables in NW Australia, particularly for indigenous peoples. The outcome will be an understanding of the challenges and opportunities arising from geopolitical and social acceptance barriers, from technology advances enhancing energy security, and from structural economic, regulatory and governance practices.

Theme (b) will develop research to create new value-added, renewable-energy-rich products to meet the massive demand growth projected for the Asia-Pacific. We will undertake research into improved hydrogen fuel production – through electrolysis energised by solar PV and wind, and through solar thermal production, advanced chemistry and artificial photosynthesis. Further, we will investigate the use of renewables to create carbon-free metal exports e.g. by using hydrogen to replace coking coal, as well as complex hydrogen-rich chemical products including synthetic fuels and biofuels for export. The key economic, social and regulatory issues that will influence these new trading opportunities will form part of a comprehensive study of the techno-economic pathways for such exports. The outcomes will be the creation of new technological processes for the manufacture of embedded energy products and fuels, and an understanding of the economic drivers for such products in the respective countries.

3. Our research into decarbonising energy for the Asia-Pacific will contribute to the ANU Strategic Plan excellence in “research, education and contributions to public policy making [that] will change Australia and change the world. It will have impact.” Our GC will inherently deliver on our “national responsibilities to policy, indigenous Australia and the Asia-Pacific”, will demonstrate “equity and collegiality” across every College through our focus on equity, and will create an “unrivalled [low-carbon energy] campus environment” through our research for the Energy Master Plan.

Criteria 2: Transformative Aspect of research – 20% of overall score

1. The world is undergoing a revolution in the adoption of renewable energy technology that creates enormous opportunities as well as risks for an Australian domestic and export economy dominated by fossil fuels. The outcomes of this GC research will transform the way that Australia does business with the world, by shifting our export industries away from fossil fuels towards products based on renewable energy. We will push the frontiers in the development and export of zero-carbon electricity and electricity capability, as well as in the creation of embedded energy products. This transformative approach to technological development will be complemented by integrating - at every stage - social and environmental transformations on an equal footing with technological and economic ones.

2. We will develop new concepts for economic, policy and governance frameworks that will enable the rapid and effective adoption of these technological advances. Formulating new methodologies for the creation of renewable fuels and products, and for the integration of new technologies with electricity generation by vast renewable energy farms coupled with storage in remote NW Australia, will drive innovative technological advances.

Further, we will create new smart-grid methodologies to optimise network resilience and cost efficiency that will enhance both micro-grids and more complex electricity networks in the Asia-Pacific. We will also investigate new governance and economic policy paradigms to accelerate the transition to zero-carbon energy economies, as well as to transition indigenous communities off costly fossil fuels and create new economic opportunities for them.

3. Through our research linkages with CWP Renewables our team has already demonstrated the ability to establish partnerships with major industry consortia. Similarly, our engagement with EvoEnergy has created a productive partnership with local industry. We will expand these partnerships to include research programs that will be applied by our enduser community who have interests in renewable fuels and renewable energy embedded products, and with whom we have already developed an extensive list of corporate stakeholders.

Criteria 3: Approach – 20% of overall score

1. As grand finalists in last year's Grand Challenge, we have been granted Interim GC funding in 2018, and have already developed a strongly interdisciplinary and inter-sectoral approach to our research program. We have created a multi-disciplinary team of 15 GC Fellows working within the existing, highly successful, collaborative ECI model. These integrative postdoctoral and postgraduate positions - working as a unit in a common location across economic, legal, social, engineering and science disciplines - will drive the inter-sectoral collaboration. Under the Interim GC they are creating a series of position papers that will directly inform the research program for our two GC themes.
2. Through its existing MOUs with organisations like the US National Renewable Energy Laboratory (NREL), and its Spanish and Taiwanese equivalents, the ECI has the demonstrated capacity to deliver our GC goals in cooperation with our external partners. We will engage closely with the NREL Clean Energy Solutions Centre (with an Asia-Pacific focus) soon to be established in Canberra. Our existing links with researchers in the Australia-Indonesia Centre (AIC – where we chair the Energy Cluster) will also enhance our research capability, as will our complementary linkages with the Australian-German Energy Transition Hub. Further, we have established strong links with ACT and Federal Departments such as Environment and Energy (DEE), Foreign Affairs and Trade (DFAT) and the Australian Renewable Energy Agency (ARENA), who are part of our governance structures and with whom we engage in research and conduct professional short courses. We already have linkages with industry partners such as CWP Renewables and EvoEnergy, and with endusers across a range of mining and manufacturing industries with a direct interest in renewable energy products and fuels.
3. We have a range of high-risk, high-reward research spread over a number of disciplines and technological areas which will help ensure a high probability of success. The outcomes we propose from research into the systems needed to export gigawatts of zero-carbon electricity to an Asian super-grid represent an extremely high-risk, but extremely high-reward endeavour. The same is true for our research on zero-carbon embedded energy export products, and for the legal, social, geopolitical and economic frameworks needed to make zero-carbon trade a reality. There is no opportunity for such a broad-reaching program to be fully-funded by a single agency (e.g. ARENA, which is focused on Australia) but there are opportunities to engage them in particular aspects of our program.
4. The linkages outlined in points 2 and 3 above will provide us with significant opportunities to leverage the GC funding for our research programs with our external stakeholders. Already our industry partners have committed \$190K to our interim GC projects in 2018, with considerable prospects for extending this to our 5-year GC program.

Criteria 5: ANU's Competitive Advantage – 20% of overall score

1. We are the only research institution with a comprehensive program targeting the transformation of Australian export industries, through engagement with the Asia-Pacific to ensure a zero-carbon future for our region. We are perfectly placed to exploit this by partnering with the only renewable electricity export consortium (AREH) into Asia.
2. The ANU, with the leading expertise in the College of Asia and the Pacific, and with the frontier energy research capability in the Energy Change Institute, is in a prime position to exploit a first-mover research advantage in this field.
3. We will engage with the DEE Mission Innovation program to accelerate global clean energy innovation, and will complement this technology-led program with key social science research. With our links to DFAT, Austrade and the APEC Energy Working Group, we will address open trade-related questions that can potentially transform the future of renewable energy in Australia's economic future. Partnering with companies like CWP Renewables, we will investigate the key barriers to investment in renewables, both in-country and throughout the wider Asia-Pacific. With partners ARENA, the ACT Government and local energy provider EvoEnergy we will trial the potential of the ANU and the Canberra region as a test-bed for micro-grids, and for hydrogen storage, distribution and conversion.

Criteria 6 Team – 15% of overall score

1. The ECI GC team has members from across 5 Colleges. One third are women, and the team covers a broad spectrum of disciplines, from science, engineering and technology, to expertise in economics, sociology, regulation, policy, indigenous Australia and the Asia-Pacific. The academic team has a balanced career representation with half being ECR/MCRs up to level C, providing a blend of experience and new ideas. Our external partners also bring a wealth of experience, particularly CWP Renewables with a multi-billion-dollar record in renewable energy development. EvoEnergy provides the GC with local expertise in the energy retail and infrastructure business, and the AIC experience will be invaluable for our work in Indonesia. In addition to the named Participants List, there are a further 50 researchers across all Colleges interested in contributing expertise as the research program develops.
2. We will add to our interdisciplinary team of part-time Interim GC Fellow employees (15 ECRs and students – 9 of them women) by creating more opportunities for ECRs to join the university through advertised positions. We aim to enhance the gender balance of our team through new appointments that reflect our balanced governance structure. The Investigators, Steering Committee and Governance Board all have gender balance, as well as the leadership capacity and experience to enhance the career development of our ECR team members.
3. The leadership model for our Interim GC will provide the foundation for strong governance and leadership of our full 2019 – 2023 GC proposal, informed by the existing structure and networks of the ECI. The GC will be led by ECI Director Professor Ken Baldwin who has demonstrated his leadership capabilities since the formation of the Institute. Our existing GC Steering Committee will be augmented by appointments that reflect our participant and stakeholder interests. Our ECR GC Fellows team will be expanded and led by Transdisciplinary Research Leader Emma Aisbett. The Interim GC Governance Board will also evolve to provide key advice to the development of our GC program.

Executive Leadership Team or Grand Challenge Facilitation Team

[Prof Ken Baldwin](#), [Dr Emma Aisbett](#) (MCR), [Prof Kylie Catchpole](#) (MCR)