Survey on energy research and innovation centres in Australia

Ben L Parr and Richard Eccleston

Tasmanian Policy Exchange
University of Tasmania
September 2020

Summary

This brief survey of energy-related research and innovation centres has been prepared as a resource for the scoping study for the proposed Tasmanian Renewable Energy Centre of Excellence. The broad aim of the TRECoE is to foster broad-based collaboration to provide independent advice, research and analysis drive innovation, productivity and employment growth as the Tasmanian Government as it develops and implements policies under the auspices of the Tasmanian Renewable Energy Action Plan. The survey provides both a thematic survey of key features of existing Australian energy centres, a summary of their activities and a list of relevant international examples. The key findings include:

- There are more than 20 significant energy-focused research and innovation centres in Australia highlighting the importance of promoting research and innovation in the sector as we transition to a low carbon economy
- All centres are collaborative and include partnerships between research institutions, government and industry. Most are university-based and many non-university-based centres are more concerned with advocacy rather than applied research and innovation. The most established and effective non-university led models are C4net (Victoria) and The Climate Exchange (Scotland)
- Governance arrangements vary widely but if the preference is to establish an independent entity it should be governed by an independent board
- Resourcing models and the scale of funding varies. Core funding is usually provided by a combination of university, government and industry funding (the latter of which is the greatest) with specific projects being commissioned and funded. In-kind support and secondments should be encouraged and options for leveraging investments through CRC, NERA, ARC funding should be explored.
- No centres have a place-based focus and none focus on some of the distinctive features that occur in the Tasmanian energy system (eg. Pumped hydro)

1. University-based collaborations involving industry

Most Australian universities have an energy centre reflecting the importance of energy system (broadly defined) research and innovation. This survey presents a thematic analysis of six key elements of 13 energy centres hosted at different universities in Victoria, NSW, Queensland, South Australia, Western Australia, ACT and Tasmania. The appendix provides more information.

1. Mission

Most energy centres in Australian universities described themselves as providing 'leading' and/or 'impactful' research. To produce this research, most emphasise the 'interdisciplinary' nature of their work. Many emphasise their extensive industry and government partners and/or world-class facilities. The aim of this research, most explain, is to 'transition to a clean energy system'. Research that drives a 'change' and 'transition' in energy is key to the mission of all energy centres. Variations on 'clean energy system' include 'lower emissions energy sector', 'reduced carbon footprint', 'clean, healthy, and sustainable environment', 'clean future', 'sustainable future'.

2. Programs

The Energy centres surveyed all have a number of distinct research programs. Most have between four and eight. Most are technical in nature. For example, an energy system program may identify a range of capabilities of the centre such as risk analysis or modelling and the researchers who can do this work and how it has been applied by government and industry. A hydrogen program may include technical production research, financial modelling as well as scholars that research the legal issues involved in developing the hydrogen industry. Other programs include those focussing on energy networks, low-pollution transport, chemical processes, power generation, wind and wave, advanced battery storage; to specific research programs such as drive chains for electric vehicles. There are many more.

3. Partners and collaboration

Most energy centres partner with three main entities: industry, government (state and federal – and agencies such as the CSIRO or Department of Defence), and tertiary institutions (both in Australia and overseas). Some also partner with prominent think-tanks (eg Grattan Institute) and international organisations (eg Asian Development Bank). Industry partners dominate the partnerships. Industry partners can range from technical specialists (eg. an engineering company working on a specific feature of carbon capture and storage), through to grid managers (eg. AEMO, AusGrid) and national and multinational end users (eg. Woodside, AGL, Chevron, Ford, BHP, GE). All centres, regardless of whether they are university-based, acknowledge the importance of collaboration with industry and government.

4. Governance

In most cases, energy centre governance is configured into four tiers:

1. *Executive Committee (EC)*. The EC, sometimes described as a Cross Faculty Steering Committee, usually comprises about 10 people. These people are Faculty/School/College Deans and senior faculty staff; and the Deputy VC of research and their staff.
2. *Centre Director and Staff* (CDS). The CDS comprise about 7-10 people inclusive of a director, deputy director, administrative staff, and several fellows. In addition, some centres boast access to a compliment of 300 academic staff inclusive of post-graduate research students.
3. *Advisory Council (*AC). The AC, regularly described as an Industry Advisory Board, usually comprises about 10 people. Members of the AC are sourced from official industry partners, which include representatives from state and federal governments as well as corporate partners.
4. *External Board (EB).* While university-based centres include an external advisory board, independent centres, such as C4net, have an independent board of management which includes representative of funding partners. In this case the EC will report to the EB.

In most university models the EC is ultimately responsible for the strategic direction of the centre. The CDS is responsible for the operation of the centre. The EC and CDS meet regularly throughout the year to discuss the strategic direction and operation of the centre. The AC meets with the EC and CDS (senior staff only) periodically to provide advice and guidance on centres' focus and strategy.

5. Funding

The funding arrangements for most energy centres is not transparent. However, it appears from annual reports and discussions that most energy centres have three major funding streams: 1. via the host universities' deputy VC (Research); 2. industry funding, and 3. government funding. In all cases this core funding is leveraged with additional research and project-specific funding secured through competitive grants (ARC, CRC, NERA) although, in many cases, it takes a number of years to build the critical mass and capability to attract significant external funding. In most instances it seems that industry provides the bulk of the funding. For example, the Melbourne Energy Institute has an annual budget of approximately $10 million with the University and Victorian Government each contributing 1.5 million per annum, industry 3 million per annum with the remainder from competitive grants and commissioned analysis.

6. Outputs, outcomes and impacts

In most cases, the centres' deliverables involve academic publications, engagement events, short courses, modelling, and policy analysis although some have a clearer focus on solutions-based analysis rather than traditional academic outputs. Few seem to be focusing on the cutting edge of policy and industry engagement.

Publications involve policy reports and analysis, short energy briefs, regular media contributions (print and social media mostly, but also broadcast), and a monthly newsletter highlighting centre activities (events, publications, employment/research opportunities and grants etc); and submissions to government policymaking processes; and peer-reviewed articles and books. While not always obvious, many seem to provide informal advice to industry and government.

Engagement events include an annual day-length symposium in which industry leaders and university experts hold panel discussions with audience participation; and a range of presentations and exhibits are held and showcased. An annual oration is often held with a speaker of international significance. Centres also host and organise book launches and regular smaller-scale seminars, lectures, workshops and webinars involving industry, government, civil society and academics.

Short courses usually geared toward professional and applied employment opportunities, with accompanied industry experience and placements, are offered. Centre and industry internships are occasionally on offer for undergraduates and postgraduates.

Facilities are also developed and made available to industry partners. For example, 'hard' laboratories to test solar fuels, hydrogen cells, energy storage, and geothermal activities as well as wind tunnels and marine-based activities; but also access to 'soft' forums to test ideas about social licence (eg community engagement, benefit sharing, energy poverty and justice); and collaborative forums that merge hard and soft disciplines (eg social and environmental impacts and their rehabilitation).

2. Industry-led collaborations involving universities

Thus far, the survey has provided a synthesis of university-based, research orientated centres. Perhaps a more appropriate option for the Tasmanian context is an 'innovation hub' or 'policy exchange' model in which participating government, industry and university partners engage on an equal basis under the direction of an independent board. Innovation hubs are closer to and more responsive to industry and government needs while also being able to draw on and mobilise the research expertise of member universities and their partners. When successful this model can improve coordination and collaboration between government, business and industry. Two successful energy-focused innovation hubs are C4net (Victoria) and Manufacturing USA.

C4Net

C4Net appears to have two functions. On the one hand, it connects energy researchers in most Victorian-based universities (eg Monash, University of Melbourne, Swinburne etc) with energy companies (eg Powercore) and government (eg City of Melbourne, Victorian Government). Through C4Net university researchers can pitch innovative ideas directly to industry. Ideas can be of a technical nature and/or data-modelling based. On the other hand, C4Net helps connect industry with university researchers, to provide research-based energy solutions to industry problems.

Industry-university partnerships can develop pilot projects to test innovative ideas and solutions to transition Australia's energy system. In short, C4Net, it seems, seeks to provide opportunities for industry and universities to convert whiteboard ideas into real-world projects. Governance involves a Board of Directors with extensive high-level experience in energy markets, engineering and technical skills, and climate and energy policy. It has a very small operational staff of two. Funding seems to include seed funding from the Victorian Government, and one would presume funding from universities and industry.

https://c4net.com.au/

Manufacturing USA

Manufacturing USA convenes and enables industry-led, public-private partnerships (which includes universities) focused on manufacturing innovative products, including on clean energy. It explains that it 'seats all players at the one table': small, medium and large manufacturers, researchers from university and government labs, educators from trade and tech schools, non-governmental organisations as well as local, state and federal government partners. They share facilities and equipment, train tomorrow's workforce and bridge gaps 'to propel new products into the market'.

https://www.manufacturingusa.com/

3. Leverage

A final dividend of established collaborations between research organisations and industry in strategically important sectors such as energy is that they are well positioned to secure Commonwealth funding via programs such as the NERA Oil, Gas and Energy Resources Growth Centre (https://www.nera.org.au/), ARENA, CRC programs and the ARC.

4. Leading Overseas Climate and Energy Centres

Potsdam Institute for Climate Impact Research, Germany

https://www.pik-potsdam.de/members/Ueckerdt

Grantham Research Institute on Climate Change and the Environment, LSE

https://www.lse.ac.uk/granthaminstitute/profile-type/00-staff/

The Earth Institute, Columbia University

https://www.earth.columbia.edu/

The Environmental Change Institute, University of Oxford

https://www.eci.ox.ac.uk/

Energy Initiative, MIT

http://energy.mit.edu/

The Scottish Climate Exchange

https://www.climatexchange.org.uk/

Appendix: Models of Energy Centres

Australian Energy Institutes/ Centres

Melbourne Energy Institute, University of Melbourne

https://energy.unimelb.edu.au/

Mission	Programs	Partners	Governance	Funding	Deliverables
The Melbourne Energy Institute (MEI) delivers influential, interdisciplinary research on the transition to a clean energy system. We work with the community, industry and government on some of the world's most pressing energy challenges.	MEI researchers work together in *four programs*: • Energy Systems • Environment and Resources • Hydrogen and Clean Fuels • Power Generation and Transport	• Australian Energy Market Commission • Australian Energy Regulator • Arup Group Limited (Engineering) • Asian Development Bank • AusNet • Australian Energy Market Operator • Australian Gas Infrastructure Group • Department of Defence (Australian Government) • BHP • Co2 CRC (Carbon Capture)	The Institute reports to the Deputy Vice Chancellor (Research) for research matters and the Faculty of Science Dean for operational matters. The Institute Staff and the Executive Committee operate the Institute, and the Advisory Board and Fellows provide strategic advice. A small team of professional staff	Internal Income: Core funding from Deputy Vice-Chancellor (Research) $1 157 000 Other income $156 000 Balance carry forward 2017 $1000 Total Internal Income $1 314 000 External Income: ARC $1 944 000 Industry – direct contract and leveraged $5 585 000 Government $1 922 000 Total External Income $9 451 000	• Research programs (see 'four programs' in scope. A range of various outputs, particularly modelling and advice it seems, for partners) • Offers short-courses for professionals • Annual Symposium • Seminars, Lectures and Workshops - various • Government submissions • Communications and Media (monthly Institute newsletter. TV, Print, Radio – various)

		• CSIRO • Ford • Future Fuel CRC • Grattan Institute • IBM • Meridian Energy Australia • Mitsubishi • Powershop Siemens • Victorian Government	support the Director in all Institute activities.		

Monash Energy Institute, Monash University

https://www.monash.edu/energy-institute

Mission	Programs	Partners	Governance	Funding	Deliverables
To accelerate the transition towards a sustainable energy future through impactful interdisciplinary research and education programs for Monash University and its trusted partners. The Institute has connected leading educators and		Industry Partners: • Woodside • Honeywell • C4Net • AEMO • Indra • AusNet Services • AusGrid • Advisian • AGL • DATA61 • United Energy	• Leadership and Management Team • Industry Advisory Council (10 people - eg AGL, Clean Energy Council, Deloitte) • Monash Executive Committee (eg Deans Engineering, Technology ProVC research etc)		• research publications • reports • submissions • featured articles • webinars • newsletters • events Facilities: • Renewable energy Laboratory • Solar Fuels Laboratory

researchers with industry to facilitate problem-solving, innovation and commercialisation in the energy sector. We have also linked educators to members of industry, to help align educational goals with the current and future needs of the energy sector, and to offer joint PhD scholarships.		• Energy Consumers Australia • GE • ANT Energy Solutions			• Deep Earth Energy Research Laboratory • Low Emissions Coal Laboratory • Monash Wind Tunnel Facility • Monash Centre for Electron Microscopy

Energy Change Institute, Australian National University

https://energy.anu.edu.au/

Mission	Programs	Partners	Governance	Funding	Deliverables
The 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		We have memoranda of understanding with the US National Renewable Energy Laboratory (NREL), the Italian Agency for New Technologies, Energy and Sustainable Economic Development	The ECI comprises more than 150 academic staff and their postgraduate research students, bringing the total complement close to 300 researchers. The wider ECI membership meets every year at the		• Professional short courses • Government submissions (quite a few of these) • Newsletters monthly • Media contributions • Events

efficiency, to energy economics, regulation, security, sociology, policy and security. A defining feature of the ECI is that we are both technology and policy neutral. That is, we undertake research and education in key areas of energy technology and energy policy without favouring one particular area over another. This can and should create an open forum for good ideas leading to energy change.		(ENEA), CIEMAT (the Spanish renewable energy agency), the Industrial Technology Research Institute of Taiwan (ITRI) and Ecole Polytechnique (Orsay) in France. The ECI is also a member of the Australia-Indonesia Centre (AIC) and the Australia-Germany Energy Transition Hub. As well as the ACT Renewables Hub. The Energy Research Institute Council for Australia. South East Region of Renewable Energy Excellence.	Annual Business Meeting, which establishes the activity for the coming year. Operationally, the ECI is governed by an Executive comprising representatives from ANU Colleges (8 senior staff) The Executive meets regularly throughout the year as required. The strategic directions of the ECI are reviewed each year when the Executive meets with the ECI Advisory Board. Board members AEMO, Climate Change Authority and DFAT reps, ACT gov rep, Evoenergy, Solar group, Other ANU climate/energy directors.		

Energy Institute, University of NSW

https://www.energy.unsw.edu.au/

Mission	Programs	Partners	Governance	Funding	Deliverables
Our vision is for Australia's global university to be a global leader for energy transition.	1. Energy that is affordable, reliable and sustainable 2. Energy underpinning a growing economy, and prosperity for all Australians 3. Energy contributing to solving many of the United Nations Sustainable Development Goals		• Ms Justine Jarvinen CEO has worked in operational, investment analyst, strategy and advisory roles in Australia and the UK for organisations such as Exxon, Shell, Caltex, JBWere and AGL Energy • Cross Faculty steering committee: The Energy Institute takes a multi-disciplinary approach to energy challenges and opportunities, across a range of faculties and schools at UNSW, which participate in the Institute's Steering Committee. • Industry Advisory Board: We are grateful to a range of companies and		

			individuals for their partnership and guidance. Members of the Industry Advisory Board (BCA, Origin, Energy Australia, Macquarie).		

Energy, Resources and Environment (Has several relevant centres under this heading), University of Sydney

https://www.sydney.edu.au/engineering/our-research/energy-resources-and-the-environment/centre-for-sustainable-energy-development.html

Mission	Programs	Partners	Governance	Funding	Deliverables
From renewable energy to waste transformation, our researchers are designing the technology to drive us towards a clean and sustainable future.	• Centre for Future Energy Networks • Centre for Sustainable Energy Development • Centre for Wind, Waves and Water • Carbon neutral futures • Chemical process and innovation • Fuels and clean combustion • Thermodynamics and fluids • Waste Transformation				

Centre for Clean Energy Technology, University of Technology Sydney

https://www.uts.edu.au/research-and-teaching/our-research/centre-clean-energy-technology

Mission	Programs	Partners	Governance	Funding	Deliverables
Vision: to be a world-leading University of Technology through developing cutting-edge renewable energy technologies for a green future, through educating and training a new generation of engineers and scientists, through partnering with industries, through world-wide collaborations, and through engaging with general communities.	Our ultimate goal is to support the reduction of carbon footprint and realisation of sustainable development from both fundamental and applied research. Research areas: • Advanced battery technologies for automotive and smart electricity grid applications. • Supercapacitor technology for high power applications. • Hydrogen production and hydrogen storage • Hydrogen fed fuel-cell technologies • Bio-fuel cell technology for biomedical application	Identifies approx. 40 universities across the world as 'research partners'			

	• Powertrain for electric car and hybrid electric car • Fundamental research on graphene • Chemical and bio-sensor technologies				

Energy Initiative, University of Queensland

https://energy.uq.edu.au/about

Mission	Programs	Partners	Governance	Funding	Deliverables
A key focus of the UQ Energy Initiative is to facilitate engagement between the university's best researchers and leaders in industry and government. The priorities of industry and policy makers need to inform and drive UQ energy research programs to make them as effective as possible. Energy researchers at UQ are guiding our energy future through	• Scoping study for material carbon abatement via carbon capture and storage • Energy and Poverty Research Group • Water-Energy-Carbon Research Group • Sustainable Power Economy • Monitoring social impacts of the mining industry • Mine Rehabilitation • Clean Coal Technology UQ Solar Array				

scientific discovery and technological innovation.					

Centre for Clean Environment and Energy, Griffith University

https://www.griffith.edu.au/centre-clean-environment-energy

Mission	Programs	Partners	Governance	Funding	Deliverables
The Centre for Clean Environment and Energy is a strategic platform for multidisciplinary research and innovation in the area of environmental sustainability. Our overarching goal is to deliver positive research outcomes that help drive healthy, clean and sustainable environments, both now and in the future.	We focus on innovative chemical, microbiological and nano-technological approaches to better understand the effects of pollutants within aquatic environments and soils, and renewable green energy sources.			ARC GRANTS Low Cost Smart Windows, ARC Linkage Project, 2017–2020, $813,210. ARC Discovery Project, 2017–2019, $300,000. A New Integrated Photo-electrochemical Device Fabrication, ARC Linkage - Infrastructure (LIEF), 2015. Management Tool for Effective Wastewater, ARC Linkage Project grant, 2012–2016, $1.95m.	Our work at CCEE leads to publications in international refereed journals or with international academic publishers. Recent publications are included below and provide further insight into our world-class research.

Centre for Energy Technology, University of Adelaide

https://www.adelaide.edu.au/cet/

Mission	Programs	Partners	Governance	Funding	Deliverables
We collaborate with leading industry, government agencies and other research organisations to move us closer to this goal, drawing on our research capacity in sustainable power, fuels, networks and minerals. CET works with industry to reduce emissions now, by retro-fitting innovative technologies to existing systems, and is also developing new carbon neutral and carbon negative technologies to replace existing heat, power and fuel production systems. In this way, CET's research has an immediate impact on CO2 emissions while we			• Industry Advisory Board • Steering Committee • Management Committee		• Seminars • Peer review • Data • Advice • Facilities • Seminars and events

transition to sustainable, affordable clean energy solutions.					

Centre for Energy, University of Western Australia

https://www.cfe.uwa.edu.au/

Mission	Programs	Partners	Governance	Funding	Deliverables
UWA's Centre for Energy is dedicated to improving gas-to-liquid, clean-coal and biofuel technology, and to developing efficient and effective ways to minimise greenhouse gas (CO2) and other emissions. The Centre's work is critical to address Australia's increasing reliance on imported oil and the associated energy security implications and supports energy production and services		• Chevron Energy Technology • BHP Billiton • Anergy • ENN (China) • South Coast NRM • Synfuels China • Wesfarmers • Woodside • Fuel Technology Pty Ltd • Pearl Global Ltd And a range of domestic and foreign universities			Research Areas: • Natural gas • Petroleum • Biogas and biomass • Marine and subsea • Future energy • Geothermal Energy Seems to be peer-review publications. And 'industry-driven' project outputs

in regional communities. We also offer a range of courses, including postgraduate research that shapes future industry leaders.					

Fuels and Energy Technology Institute, Curtin University

http://energy.curtin.edu.au/

Mission	Programs	Partners	Governance	Funding	Deliverables
	Research: 1. Bioenergy science and engineering 2. Fuel cells 3. Energy storage 4. Coal science and technology Gasification. 5. Natural gas conversion and CO2 utilisation 6. Environmental impacts of energy processes				

Centre for Renewable Energy and Power Systems, University of Tasmania

https://www.utas.edu.au/centre-for-renewable-energy-and-power-systems

Mission	Programs	Partners	Governance	Funding	Deliverables
To advance research in the area of renewable energy and power engineering in Australia To promote strategic cooperation between the University of Tasmania and Tasmanian Power Industries in the area of renewable energy and power engineering research To establish the University of Tasmania as a world class research institution in the area of renewable energy and power engineering.				*Program 1: Electrical Power* Variable-Speed Diesel Retro-Fit for Remote Area Energy Resilience, Office of Naval Research Global, U.S.A. (2019 - 2020), $687,096 Optimal Scheduling of Distributed Energy Resources for power system frequency stability provision, ARENA, TasNetworks (2019 - 2021), $821,582 Synthetic Storage for Improving Flexibility and Security of Micro-Grids, Australian Research Council; GO	

				Solar (2018 - 2021), $380,000 Variable Speed Diesel Application for Improved Energy Resilience and Power Security, Office of Naval Research Global, U.S.A. (2018 - 2020), $570,300 No Load Diesel Application in Remote Power Systems, Australian Research Council; Hydro Tasmania (2018 - 2021), $451,000 Low Load Diesel Technology Demonstration, Office of Naval Research Global, U.S.A.; Hydro Tasmania (2015 - 2018), $749,150	

				Program 2: Energy Systems Dam spillway hydraulics, Hydro Tasmania (2017 - 2018), $110,666 *Program 3: Sustainable and Emerging Technologies* Variable-Speed Diesel Retro-Fit for Remote Area Energy Resilience, Office of Naval Research Global, U.S.A. (2019 - 2020), $687,096 Synthetic Storage for Improving Flexibility and Security of Micro-Grids, Australian Research Council; GO Solar (2018 - 2021), $380,000 Variable Speed Diesel Application for Improved Energy	

				Resilience and Power Security, Office of Naval Research Global, U.S.A. (2018 - 2020), $570,300 No Load Diesel Application in Remote Power Systems, Australian Research Council; Hydro Tasmania (2018 - 2021), $451,000 Low Load Diesel Technology Demonstration, Office of Naval Research Global, U.S.A.; Hydro Tasmania (2015 - 2018), $749,150 Program 4: Renewable Energy, Enabling and Storage Technologies Optimal Scheduling of Distributed Energy Resources for power system frequency	

				stability provision, ARENA, TasNetworks (2019 – 2021), $821,582 CONSORT: Consumer Energy Systems Providing Cost-Effective Grid Support, ARENA, Reposit Power, TasNetworks (2016 - 2019), $3,965,701	