Project 3:
Developing a Future Energy Research Plan for Tasmania

Introduction

Tasmania's energy system is likely to experience a significant change over the next two decades amid the global push to decarbonise energy systems, combined with the Tasmanian Government's legislated target to double Tasmania's renewable energy production by 2040 (150% by 2030) and plans to legislate a net-zero emissions target to be achieved by 2030.

However, the scale and pace of this transformation is not assured. Several major energy projects in Tasmania require financial support, regulatory changes, and approvals to proceed; and Australia's mainland state and territory governments and industries are yet to settle on an energy mix and trajectory with any great certainty, the outcome of which will impact on Tasmania's energy future.

Despite the uncertainty, it is inevitable that a transition of some degree will, and needs to, occur for Tasmania's industries to remain competitive, to attract new industries, and secure on-island jobs in what will be a carbon constrained world.

Energy research is a key component towards realising a transformed Tasmanian energy system and economy. Tasmania is an important test case in terms of the energy transition given the very high penetration of renewables.

Project 3, jointly designed and commissioned by UTAS Future Energy and Tasmanian state-owned energy businesses in late 2019, provides analysis and discussion that shows that there is a need to accelerate the development of on-island interdisciplinary energy research capabilities in collaboration with industry, and provides recommendations that identifies a possible pathway forward, which includes, as a priority task, to establish an interdisciplinary coordinating body or centre for energy research at UTAS that prioritises the three key research themes important to industry out to 2030:

Theme 1: Maintaining our energy independence
Theme 2: Attracting major clean energy projects
Theme 3: Understanding the public benefit of clean energy visions

This project is a result of collaboration between University of Tasmania researchers Ben Parr, Richard Eccleston, Heather Lovell, Evan Franklin; industry stakeholders, Stephen Jarvis (TasNetworks), Tony Field (Hydro Tasmania), and Hayden Moore (Aurora Energy); and input from independent consultant, Rhys Edwards, who has been commissioned by the Tasmanian Government to conduct a scoping study for a possible Tasmanian Renewable Energy Centre of Excellence.

Project 3 had three agreed upon aims:

- Mapping and making visible current energy research activities across the Tasmanian energy research landscape, with a focus on the University of Tasmania and industry
- Taking a broad view on future opportunities and charting a course to prioritise those future efforts.
- Developing a 5-10 year research plan for Tasmania incorporating input from industry, government and the University of Tasmania.

This brief write-up unfolds in the following way:

- Scope and method
- Results and discussion
- Conclusions and recommendations

Scope and method

Scope

The Tasmanian energy research landscape is characterised by a relatively high density of research activity and expertise given the state's small population size relative to mainland and foreign jurisdictions. Given this density, we have sought to define what this Project includes and excludes in terms of 'energy research'. To achieve this, we have provided definitions around three key variables: what constitutes 'energy', 'research', and 'geography'.

Energy for this Project is defined in accordance with a typology we adapted from Stanford University's energy research program to reflect the specific characteristics of the Tasmanian industry, which covers both techno-engineering research (1-4) and human-centred research (5 and 6) (Table 1). In other words, if research could not be categorised under these Research Areas or Subcategories it was not included in the Project. Climate change adaptation and mitigation, despite is clear relevance to energy, was deemed to be beyond the scope of this Project.

Table 1: Energy Research Areas and Subcategories

(1) Renewable Generation: • Hydro • Wind • Solar • Wave and tidal • Bioenergy	(2) Energy Storage and Grid Modernisation: • Batteries • Pumped hydro • Micro grids • Transmission (inc Marinus)
(3) Hydrogen: • Ammonia • Transport and storage • Fuel cells • Industrial applications and oil and gas substitute • Specialist application	(4) End Use and Energy Efficiency: • Buildings • Transport • Agriculture
(5) Policy and Markets: • Energy markets • Governance and certification • Law • Energy planning	(6) Community Partnerships and Engagement: • Community attitudes • Energy justice • Engagement • Training and employment

Source: https://energy.stanford.edu/research/research-areas

The definition of Research outputs for this project encompasses both broadly defined 'grey literature' (ie policy briefs/ submissions/ public and internal research and analysis, consultants reports etc) and peer-reviewed academic literature; as well as things material in nature such as testing equipment or building technologies. To be included in this Project, research was generally required to be accessible and in the public domain, which was combined with insights from one-on-one meetings. Indeed, the main limitation on developing a full and complete understanding of energy research capabilities and plans was that most research undertaken by industry is proprietary in nature.

Geography was our final consideration. For this project, we define 'Tasmanian' energy research as research conducted on-island and off-island for use in Tasmanian as well as nationally and internationally. This broad approach we believe is preferable to better develop our understanding about what UTAS researchers could be involved with in the future.

Method

In terms of understanding UTAS's existing energy research capabilities. First, a desktop analysis was undertaken that identified general energy researcher 'capability'.[1] This information was then combined with several internally generated databases identifying researcher publications, funding and industry collaborations. The final step was to triangulate this information with semi-structured interviews with the key UTAS energy researchers. The in-person discussions were particularly important to develop an understanding about the future energy research directions of UTAS's energy researchers.

Industry engagement involved a desktop analysis of the energy capabilities of key entities that are government funded, public-private funded, consultancies, and civil society actors; combined with discussions with the Project's industry's leads from TasNetworks, Aurora and Hydro Tasmania; and input from Rhys Edwards who has been commissioned by the Tasmanian Government to conduct a scoping study for a possible Tasmanian Renewable Energy Centre of Excellence, and with whom we collaborated. For his study, Rhys conducted interviews with 30 energy industry actors in Tasmania (see appendix). We draw on information and insights from this draft study below, which we clearly identify.

Results and discussion

Understanding UTAS and Industry's existing energy research capabilities

UTAS

This analysis revealed that UTAS has approximately 90 energy-related researchers (Table 2), with research capability (expertise based on projects, publications and personnel) across all six Research Areas and Subcategories (see Table 1) with the exception of energy Training and Employment (however, UTAS's broad and deep energy-related teaching capacity clearly covers off on this area).

It is important to note that the figure of 90 was generated by combining the information found in the 5 spreadsheets with a broader desktop analysis, and refers to UTAS's energy research 'capability', not energy researchers per se, as in not exclusively energy scholars. This means that each person in an energy research team was included in the count, whether they be energy scholars, project managers, institute Directors, or generalists seconded into a project.

---

[1] "Capability" for this Project refers to "expertise defined by projects, publications - grey and peer review - and personnel"

As we shall see below, the distribution of UTAS research capability follows a similar pattern to industry, with a concentration of energy research focused on techno-engineering in Renewable Generation; and Energy Storage and Grid Modernisation (Research Areas 1 and 2 in the typology), most of which relate to marine activities in some way, particularly wind, wave and tidal energy research. On-and-offshore Mirco Grid research also features prominently. Second most prominent was oil and gas related research, which has been interpreted for this Project as presenting an opportunity for hydrogen research and industrial applications (Research Area 3). Third most prominent was End Users (Research Area 4), with an overwhelming focus on marine transport. Human-centred social science energy research featured least prominently in the data, categorised under Policy and Markets; and Communities (Research Areas 5 and 6).

Consistent with these results, the data also shows that the College of Science and Engineering (COSE) produces the vast majority of UTAS energy research, suffice to say that that is where bulk of UTAS's energy research capability (personnel, equipment) is located. The College of Arts, Law and Education (CALE) produced energy research on Policy and Community, and has significantly fewer energy-focused researchers in its ranks compared to COSE (approximate numbers show 62 to 28 respectively - see Table 2).

UTAS's College of Business and Economic (COBE) may have contributed to some of the research output identified in Table 2 below (eg. Energy Markets), but the internal data sheets show the clear distinction was between COSE and CALE energy research capability, and correspondingly between technical-engineering and human-centred social science energy research capability, which, as we see below, is the same distinction industry actors make internally.

The triangulated method of analysis also found that UTAS has world leading energy research capability in three key areas, mostly spanning Research Areas 1, 2, 3 and 4 (all techno-engineering), which may be the result of superior competitive grant funding and Excellence in Research Australia rankings:

1. technical isolated power systems with high renewable energy penetration and staff operating under the Centre for Renewable Energy and Power Systems (CREPS) program;
2. technical marine equipment testing facilities (located onshore and offshore) and staff operating under the Australian Maritime College (AMC) program;
3. technical offshore renewable energy activities and staff operating under the AMC (now integrated into the Blue Economy CRC).

UTAS researchers collaborate with range of industry stakeholders and government agencies in Tasmania, nationally and internationally. For example, Hydro Tasmania, TasNetworks, INCAT, defense and energy departments in Australia and the US, various Tasmanian government departments, ARENA and CSIRO, oil and gas entities, Waveswell, Carnegie Clean Energy, Brookvale energy, British Maritime Technology. The data shows that there is vastly more collaboration between COSE (techno-engineering) and industry compared to CALE (human-centred) and industry.

The data shows that key outputs include technical products such as physically building and testing new equipment for industrial use; results generated through large-scale field-based experiments such as microgrids and offshore green hydrogen; spatial surveying for example to better understand concerns around fishing and marine traffic; a variety of modelling exercises such as power system modelling and scenario development through to economic modelling for infrastructure and grid connection. And to a lesser extent, consumer survey data and analysis; community and household engagement on energy related issues; and knowledge generation to inform government and business standards, regulation, and laws.

Table 2: The Distribution of UTAS's Existing Energy Research Capabilities

Total approximate number of energy-related researchers	90	
Number of researchers identified with capabilities in (Researchers can have multiple capabilities. These are approximate numbers):		
Wave and tidal	25	COSE
Oil and Gas with possible hydrogen application	16	COSE
Micro grids	12	COSE
Governance	*11*	*CALE*
Transport application (marine)	10	COSE
bioenergy	7	COSE
Solar	6	COSE
Wind	6	COSE
Industrial applications of energy	6	COSE
Energy markets	*6*	*CALE(COBE)*
Batteries	5	COSE
Transmission	4	COSE
Community attitudes	*4*	*CALE*
Hydro	3	COSE
Buildings application	2	COSE
Transport application (gen)	2	COSE
Energy justice	*2*	*CALE*
Community engagement	*2*	*CALE*
Law	*2*	*CALE*
Energy planning	*1*	*CALE*
Agricultural application	1	COSE

Industry

The method of analysis used to understand industry's energy research capabilities revealed 22 "industry" actors (which includes our stakeholders) that can be organised under four key categories: government funded entities, multi-funded entities, private consultancies, and civil society/advocacy groups.

Government funded and multi-funded entities energy research capabilities center around wind, wave and tidal, batteries, pumped hydro, transmission, grid management (Research Areas 1 and 2); and to a lesser extent, oil and gas with hydrogen application, and transport (Research Areas 3 and 4); and to a lesser extent again, policy and markets, and community partnerships and engagement (Research Areas 5 and 6). This is a similar distribution of capability as at UTAS.

As one might expect, consumer-facing government entities such as energy retailers placed much greater emphasis on research that leads to an enhanced understanding of customer's attitudes compared to, for example, network operators that focused on engineering-based research.

Yet, both conducted research and analysis on better understanding supply-side dynamics to provide insights into the future of the Tasmanian and national energy market. Also, in both cases, internal research teams were small, requiring the regular use of third parties such as consultancies and partnering with universities and other external research entities on-island, and beyond, including internationally - particularly when it comes to services that require highly technical engineering capability.

Consultancies tended to produce energy research and commercial analysis on Tasmanian energy policy, energy markets, and employment (Research Areas 5 and 6). While civil society and advocacy groups produce a range of quasi-research outputs – some focusing on production of technical research and analysis on issues such as solar, wind, transmission lines, while others display capability on human-centered issues such as energy justice and engagement.

Comparing UTAS and Industry's existing energy research capability

Comparing UTAS energy research capability with those of industry reveals two key general insights. First, there is significant alignment in energy research capability between UTAS's College of Science and Engineering (CoSE), and government and private-public funded entities. Second, there is some overlap in energy research capability between UTAS's College of Arts, Law and Education (CALE), consumer-facing industry actors, large consultancies, and to a lesser extent civil society actors. This is not to say that COSE does not conduct human-centered social research to some degree. For example, research on retail markets, consumer preferences and welfare should and does involve COBE such as through their behaviour economics lab.

Despite this, a broad-brush general insight shining through is that COSE researchers compete for energy research projects with researchers from government funded and public-private funded entities such as CSIRO, AEMO, Hydro, Entura, TasNetworks; while CALE researchers compete for projects with researchers from large consultancy firms.

UTAS-Industry collaboration

In terms of UTAS-Industry collaboration, a review of several internal databases shows that UTAS researchers have provided energy research mainly on the topic of wave and tidal for government agencies as well as for a multitude of smaller engineering and other entities. Second, on the topics of energy-related industrial applications and oil/gas (which may have hydrogen application) for several multi-funded entities. Third, on the topics of batteries and microgrids. Fourth and rarely, on the topic of governance.

UTAS and industry's emerging and future research directions and needs

UTAS energy research directions and needs

In person discussions with 9 key UTAS energy researchers were conducted to verify the analysis of existing capabilities and to gain an understanding of future energy research directions and needs. The key insights from these discussions are as follows:

1. Major research plans are of a technical nature and based in COSE (science and engineering). These future endeavors largely mirror past research in the three key areas of capability noted above.
2. COSE-based research plans involve a range of industry partners and funding streams from national to international government agencies, and businesses of all sizes from small and local to multinational.
3. There are only a handful of human-centered CALE-based (social science) future energy research projects, on the topics of energy governance and regulation.

In terms of UTAS needs, the central message from the in-person discussions was the critical need for UTAS to establish a centre or coordinating body for energy and emissions research. Existing research and programs are fragmented (with the exception of the recently established Blue Economy CRC) and lack the scale to meet industry needs or attract funding. The desktop and internal analyses of historical research projects pointed very strongly to this need as well.

UTAS's ability to secure funding for and contribute to future renewable energy projects – in what is a crowded field of private, government, and hybrid energy research entities located on-Island, nationally and internationally – could be enhanced though the establishment of a Centre which would work with partners to establish clearly defined energy research priorities as well as sustained investment into growing priority capabilities. Rhys Edwards's draft report points to the need to define the focuses and activities of an energy research centre (Table 3).

Table 3: possible focuses and activities of an energy research centre.

A research hub	A demonstrator
A training hub	A narrative creator
A networking place	A policy adviser
An advocate	A showcase
An educator	An incubator
A planner for the future	

Source: Rhys Edwards, Tasmanian Renewable Energy Centre of Excellence, Milestone 3 Report 2021, p 5.

Industry energy research directions and needs

Tasmania has an unusual industry structure, which includes 3 major state-owned entities, 10 large energy users that account for around 60% of consumption, high levels of electrical energy use, no Original Equipment Manufacturer in key sectors (eg wind and hydrogen) but a range of significant developers, and a small but growing band of local industry players (eg hydrostar, BBAMZ).[2]

It is inherently difficult to assess future industry energy research plans and needs due to a lack of disclosure for commercial reasons; and the fact that the very nature of and scale of Tasmania's future energy system is highly uncertain, with, for example, the future of major energy projects such as a hydrogen facility and Marinus Link still unclear.

However, we can extrapolate that industry will need a range of research inputs across the technical engineering and the social science energy research space if Tasmania is to successfully *double* its renewable energy production over the next twenty years. This hypothesis was largely confirmed though conversations with industry actors.

From conversations, it appears that industry's energy research needs fall into the same two broad categories as UTAS capabilities: technical-engineering and human-centred. The first category includes research needs answering all kinds of technical-engineering questions including those related to electrical, power, and construction; as well as IT, modelling, and power system and simulations. The latter category includes research involving energy market analysis, consumer preference, public good analysis, broader economic analysis (cost-benefit), government regulation and policy analysis, community benefits and engagement, social licence research, environmental impact assessments (which can require a strong technical science understanding), and future workforce analysis.

[2] Rhys Edwards, Tasmanian Renewable Energy Centre of Excellence, Milestone 3 Report, 2021, p 9

Consistent with these conversations, Rhys Edwards's draft report, which is the outcome of conversations with 30 industry players, identifies several 'niche' opportunities for future research, all of which are technical-engineering based. These include: renewable energy remote power systems, maritime micro-grids, system security and grid integration, and floating off-shore wind platforms.[3]

The method of analysis suggests that the energy research capability of most Tasmanian industry actors tends to be geared toward technical-engineering projects, which suggests that there may be a strong opportunity for interdisciplinary research that brings together both engineering and social science research within industry itself and in partnership with external knowledge generators with these capabilities.

An important area of research that brings together the technical-engineering and human-centred research agendas – and could provide insights or even a model of how conduct interdisciplinary energy research – is the issue of public benefit. For example, developing a stronger understanding of the energy future that would maximise the public good to Tasmanians could help inform the investment decisions and directions that energy policy encourages. Some projects may deliver greater public goods and customer returns compared to others. An additional advantage is that public goods research compared to proprietary research (which is what most industrial players undertake) would avoid commercial in confidence complications.

A second key interdisciplinary research opportunity involves addressing questions around how Tasmanian industry would operate a power system with large increases in power. To ensure Tasmania keeps a renewable and brand advantage, clearly, we should avoid drawing on mainland fossil fuel supply to support hydrogen and or large data centres, and or the electrification of transport and strong population growth. An accompanying point to this discussion however involves Tasmania's role in supporting the national energy system. Therefore, it could be said that interdisciplinary research around the appropriate mix between independence and interdependence is considered a priority concern for industry.

A third key area of interdisciplinary research could involve analysis of major projects, and well as minor projects. For example, to build and operate Tasmania's green hydrogen facility, should one come online, will require cutting edge technical-engineering energy research capacity as well as leading social science-based research and analysis such as that related to green hydrogen certification, safety standards, social licence, and other regulatory and legislative input. Alternative energy futures should also be a high priority. For example, should Marinus not proceed, it would be highly advantageous to have a raft of Plan B research and analysis into small scale energy systems and microgrids ready to go.

[3] Rhys Edwards, Tasmanian Renewable Energy Centre of Excellence, Milestone 3 Report, 2021, p 8

Conclusion and recommendations

Towards a Tasmanian Energy Research Strategy 2020-2030

Tasmania's energy future is highly uncertain for a variety of reasons.

- First, while the Tasmanian Government has legislated a 200% renewable energy target to be achieve by 2040 (150% by 2030), the governance and policy framework to achieve this target is underdeveloped.
- Second, there are a range of major projects in Tasmania including Marinus Link and a hydrogen facility that are yet to proceed for various reasons such as cost allocation.
- Third, uncertainty surrounds the extent to which the Tasmanian Government will use Land Use and Land-Use Change and Forestry removals to maintain net-zero by 2030 rather than decarbonise transport and industry.
- Fourth, Australia's mainland state and territories energy mix and trajectories are uncertain, and Tasmania's emissions reduction target is significantly weaker than a range of mainland targets (eg Vic, SA, NSW and ACT).

Should Tasmania's energy policy framework remain underdeveloped, major on-island projects fail to materialise, and mainland states continue to outperform Tasmania on energy and climate policy and investment, the opportunities for on-island energy transition, and energy research therefore, may be quite limited.

By contrast, should a rapid and ambitious on-island energy transition scenario emerge, the opportunities for energy research are bright. Both technical-engineering and human-centred social science-based energy research will be important under a rapid transformation scenario. The key is to develop interdisciplinary research projects out to 2030. Social science energy research that could accompany major technical-engineering development and research agendas could include:

- certification and safety standards,
- legal and regulatory issues,
- economic analysis and forecasts,
- consumer and market research,
- social licence,
- community engagement and benefit sharing,
- workforce needs and training (however, Rhys Edwards's report finds that 'training issues in the industry are in reasonable shape').

On-island energy research entities are well placed to undertake this type of interdisciplinary energy research because they understand the local context and the output can confer greater legitimacy on the client.

Recommendations

There is clear need for UTAS to coordinate energy and emissions research and engagement through a university-wide centre or coordinating structure to facilitate collaboration and maximise impact. Such as decarbonisation-focused energy centre could focus on the following themes and questions in collaboration with key industry players out to 2030.

Theme 1: Maintaining our energy independence

- How does Tasmania remain energy independent under a rapid energy transformation?

Theme 2: Attracting major clean energy projects

- How does Tasmania attract major clean energy projects, with an emphasis on green hydrogen operations?

Theme 3: Understanding the public benefit of clean energy visions

- What vision (or scenario) of Tasmania's energy future would maximise public benefit to Tasmanians?

The three key research themes and questions identified are of an interdisciplinary nature and therefore working collaboratively across UTAS and with industry to plan and implement them would be essential.

The overarching aim of an interdisciplinary UTAS energy research centre, or coordinating structure, involving close industry engagement, should be to grow on-island renewable energy-based industries and jobs, and contribute to the decarbonisation of the Tasmanian economy.

Appendix

This table shows the industry contacts included in Rhys Edwards's draft report on the potential design of a Renewable Energy Centre of Excellence.

First Name	Last Name	Title	Company
Tim	Finnigan	Head of School, Engineering	UTAS
Michael	Negnevitsky	Director of the Centre for Renewable Energy and Power Systems	UTAS
Kym	Goodes	Consultant	3P Consulting
John	Wimmer	Principal Policy Analyst	State Government
Lance	Balcombe	Consultant	
Phaedra	Deckart	CEO	TasGas
Colin	Patterson		Fortescue Future Industries
John	Bishop	Director	Kula Energy
Ewa	Ginal-Cumbridge	Business Development consultant	Eavor Energy
Alex	Beckett	Head of Strategic Policy	Hydro Tasmania
Ben	Parr	Project manager	UTAS
Xiolin	Wang	Deputy Director CREPS	UTAS
Fred	Gale	Professor of Energy & Society	UTAS
Wayne	Tucker	General Manager	Tas Networks
Michael	VanBaarle	CEO	Abel Energy
Ray	Mostogl	Chair	TWEIC, TMEC
Peta	Sugden	Director	Office of the Coordinator-General
Shane	Bartel	CEO	Climate Capital
Neil	Grose	Bell Bay Hydrogen Cluster Manager	BBAMZ
Chavelli	Sulikowski	Principal Policy Advisor	State Government
Andrew	Catchpole	Consultant	
Sarah	Tincknell	Stakeholder and Regulatory manager	Origin Energy
Josh	Bradshaw	Leader, Government Relations and Communications	Tas Networks
Heather	Lovell	Professor of Energy & Society	University of Tasmania - UTas
Corinna	Wooldford	Manager, Strategy & Policy	Aurora Energy
Hayden	Moore	General Manager	Tas Networks
Mike	Connarty	Manager, Strategy & Stakeholder Engagement	UPC Renewables Australia
John	Titchen	CEO	Goldwind Australia
Greg	Johannes	Chair	Blue Economy CRC
Irene	Penesis	Research Director	Blue Economy CRC
Martin	Moroni	Director, Bioenergy	State Government
Alexis	Wadsley	Acting Director, Workforce Development	Skills Tasmania
David	Harriss	Head of Energy Program	CSIRO
Roger	Gill	Non Executive Director	Tas Networks
Sue	Morrisson	Manager energy security & regulation	State Government
Matthew	Bowditch	Manger Policy and Projects	State Government
Jenny	Cosgrove	Policy and Regulations Specialist	Tas Networks
Simon	Troman	Manager Hydrogen Development Team	State Government
Alice	Johnson	A-D Major Renewable Energy Projects	State Government
Leigh	Darcy	Principal Adviser	Bell Bay Aluminium
Kim	Enkelaar	Director, Energy Policy and Regulation	State Government
Richard	Eccleston	Director, Tasmanian Policy Exchange	University of Tasmania - UTas