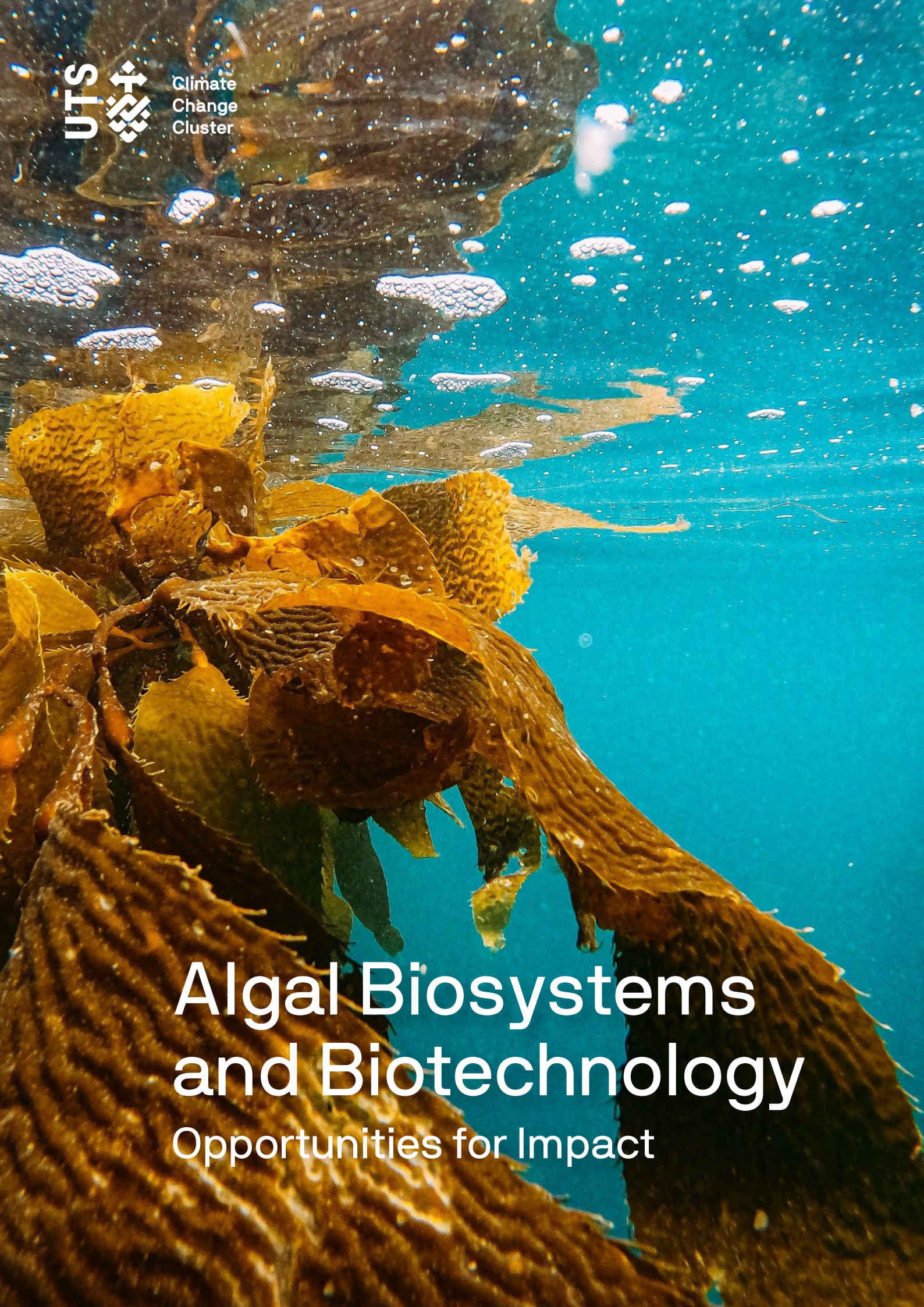

UTS Climate Change Cluster

Algal Biosystems and Biotechnology

Opportunities for Impact

Our Team

We are a multi-disciplinary group of scientists and engineers accelerating the use of algae and algal-based bioproducts for industrial applications. Our work supports the transition to a sustainable bio-economy by developing and fostering collaborative research between industry, government, and academia.

Our team in comprised of experts in wastewater, algal physiology, microfluidics, artificial intelligence, robotics, natural-product chemistry, polymer chemistry, mutagenesis, genetic and metabolic engineering.

The Algal Biosystems and Biotechnology team is passionate about promoting both ecological and economic sustainability. Our research values align with the values articulated in the UTS 2027 strategy, which supports the establishment of partnerships to drive economic, social and cultural prosperity of our community. UTS's Sustainability Policy affirms the principles of the United Nations' Sustainable Development Goals (SDG), which constitute 'the blueprint to achieve a better and more sustainable future for all'. Our work aligns with goals 11, 12, and 13.

Our Impact

The climate emergency has inspired us to develop innovative biotechnology and biosystems, to create sustainable bio-economies. Our research addresses some of the biggest environmental and societal issues facing Australia and other countries in a changing climate, including food and energy security, sustainability and ecological resilience; and global health.

The key to our research is the incorporation of algae and their derivatives in innovative green and clean technologies.

We drive innovation in areas including microalgae and seaweed cultivation, production of algae-based foods, bio-stimulants and fertilisers for agriculture applications, algae-based biodegradable plastics, and wastewater remediation.

By utilising a multi-disciplinary approach, we are accelerating the use of algae and algal based bioproducts in commercial applications, supporting the transition of industries to sustainable bio-economies.

Team Leaders

Distinguished Professor Peter Ralph

ORCID ID: 0000-0002-3103-7346

I am the Executive Director of the Climate Change Cluster and the co-leader of the Algae bio-systems and biotechnology team. I am also the founder of the NSW Deep Green Biotech Hub, connecting NSW-based businesses and community members with cutting-edge algae biotechnologies and innovation support.

As a professor of marine biology, over my career, I have made significant advances in the understanding of photosynthetic processes in seagrass, coral, plankton and algae growing at their environmental extremes. I am currently applying my knowledge of photosynthesis to develop the algae-biotechnology sector, and to mitigate the impact of climate change using carbon capture and use technology. I am passionate about establishing functioning examples of the circular bio-economy using algae, such as bioplastics, alternate protein sources for food and feed and waste (water) remediation.

As recognition of my outstanding contribution to research, I was awarded the 2012 UTS Vice-Chancellor's Award for Research Excellence (Research Leadership), and the 2018 UTS Vice-Chancellor's Award for Research Excellence (Researcher Development, including Supervision). Over my career I've successfully established research partners with international collaborators within the education, research, NGO and industry sectors, and have attracted over $22 million in research funding.

Associate Professor Mathieu Pernice

ORCID ID: 0000-0002-3431-2104

I am the co-leader of the Algal Biosystems and Biotechnology team, and drive world leading research on algal biotechnology.

With expertise in climate change and sustainability, my approach to research is multi-disciplinary and industry-focused, with over 15 years of experience in technology transfer from University to Industry, more particularly in Environmental Impact assessment, Aquaculture, Food and Biotechnology.

The ultimate aim of my research is to transform fossil-based systems into sustainable biomanufacturing, using algae to progress the Australian Bioeconomy.

UTS2027

UTS 2027 has set UTS's vision for the next decade: to be a leading public university of technology recognised for delivering global impact.

UTS will establish partnerships in climate mitigation and adaptation to drive the economic, social and cultural prosperity of our communities. C3 will drive with UTS as a world-leading university by advancing knowledge and learning through research-inspired teaching, research with impact and partnerships with industry, the professions and the community.

C3 has a strong track record of forming industry links and using technology to develop innovative climate mitigation strategies, as well as delivering research excellence in the fundamental sciences relevant/linked to human and environmental health.

Facilities

We bridge the gap between industry and innovative research with access to state-of-the-art facilities and equipment that include:

Algal Phenomics Facility

Australia's and the world's first Phenomics facility designed for high throughput screening of algal strains, mutants and transformants in a dynamic environment.

Advanced Algal Cultivation Facilities

Walk-in incubators for the cultivation of microalgae under specific conditions, with temperature and light control. Along with facilities for large-scale algae production to bridge the gap between lab and industrial scale.

Bioplastics Facility

Capacity to transform the concept of finding alternatives to petrochemical based plastics into reality. The Collins Plastic Extruder can transform extracts from plants like seaweed into bioplastic, for use as feedstock in plastic production.

Examples of Our Research Impact

Young Henrys

Pints That Save The Planet

Thanks to the successful installation of two 400-litre bioreactors at Young Henrys Brewery in Newtown, we are continuing to absorb carbon dioxide produced from the fermentation process of brewing beer, resulting in the production of nutrient rich microalgae.

We have now extended the partnership to include Meat and Livestock Australia, investigating the incorporation of microalgae grown into livestock feed to reduce methane produced by cattle and sheep during the fermentation of feed.

Young Henrys already sends brewers spent grain, a by-product of beer brewing, to farmers as livestock feed. Adding algae to this grain could reduce the methane produced by livestock and help improve productivity: A win-win for all.

Piping Hot

Fashion Meets Sustainability

Our team, in partnership with the Australian surf brand Piping Hot, have embarked on a research journey to develop a sustainable fibre and transform the global polyester industry. Honouring Piping Hot's vital investment in protecting and cleaning the oceans, our team are developing innovative biomaterials, involving the development of fibres from seaweeds.

Our innovation of the first prototype is underway. We are creating a bio-based solution, that simultaneously sequesters carbon from the ocean and reduces the environmental impact of synthetic fibres.

v2food

Transforming The Way We Eat

We established a partnership with v2food to develop and produce sustainable plant-based meats. Our team and v2 shares a mutual goal; to minimise the ever-increasing challenge of climate change, creating more sustainable choices for future generations.

The meat and dairy industry combined contribute nearly 15% to the global total of greenhouse gas emissions. To combat this, we tampered with algal based proteins, carbohydrates, oils, flavouring and colourants to use in food.

Our research and partnership with v2food offers consumers the ability to make more sustainable choices, in response to the ever-increasing challenges of climate change.

Harnessing the power of algae, robotics and artificial intelligence to modernise key sectors of the economy the global move away from fossil fuels.

Responding to Change

Our current linear economy is unidirectional, failing to utilise waste outputs, and exploits non-renewable resources, resulting in a major sustainability crisis.

Algae hold great promise for tackling the global need for sustainability. They are photosynthetic organisms that are critical for the planet's wellbeing: they produce half the oxygen we breathe and contribute to climate stability.

Our research group, work with macroalgae such as seaweed and kelp, and microalgae, which are unicellular photosynthetic organisms. We are one of the world's largest groups of integrated algae specialists, with a team of collective expertise in microfluidics and bio-optics, algal physiology, robotics, natural-product chemistry, polymer chemistry, phenomics, mutagenesis, and genetic and metabolic engineering.

In response to major climate issues such as pollution, food security and energy security, we are developing technologies, products and services that enable the industrialisation of photosynthetic algae in areas such as environmental bioremediation, cosmetics, plastics, nutraceuticals, agricultural feedstock, and pharmaceuticals.

Our Approach

The Algal Biosystems and Biotechnology team is harnessing the power of algae, robotics and artificial intelligence to modernise key sectors of the economy and hasten the global move away from fossil fuels as an energy and materials source.

Our mission is to deliver sustainable climate change mitigation solutions in the areas of food security, energy security, environment, and healthcare by replacing fossil-based raw materials with solar-based and sustainable algal products, whilst simultaneously removing CO_2 from the atmosphere.

Achieving our mission of sustainable change requires genuine connections across all levels of industry. We bring together academia, industry, and government, allowing our team to fast track the commercialisation and adoption of algae-based technologies and bioproducts, pioneering a greener future for Australia.

Opportunities for Impact

1 Seaweed Cultivation and Farming

$500,000
over 2 years

Rethinking Aquaculture, and Seaweed Farming Scalability

In Australia we have seen the emergence of the seaweed farming industry. Seaweed has the ability to capture carbon, making the farming process eco-friendly. This emerging industry has immense potential to address current sustainability issues such as improving water quality through wastewater remediation, developing new sources of nutrient rich foods, and development of new biomaterials.

Currently, there are a lack of tools to support large scale seaweed farming systems in Australia. This project would help to solve some of the biggest bottlenecks in Australian seaweed farming – cultivation and breeding of Australian native seaweeds for scaled use in seaweed farming. The impacts of this project include better outcomes and accessibility for Australian seaweed farmers, better understanding of native Australian seaweed breeding, and better accessibility of seaweed for use in future products.

2 Advanced Bioprospecting

$650,000
over 2 years

Finding the One in 200,000

There are estimated between 200,000-800,000 different microalgae species on the planet, all with different qualities, compounds and benefits that could be used for a variety of applications. So how can we identify the species to best suit specific applications such as for human foods, animal feedstock, cosmetics, nutraceuticals, pharmaceuticals, bioplastics, textiles, and more?

This project aims to develop advanced bioprospecting (the ability to search and identify microalgae species for certain qualities) to better understand the capability of microalgae to solve our planets biggest problem. Thanks to our innovative 24/7 Algae Phenomics Facility, our team has the ability to rapidly investigate 100's of species. This project aims to map and identify microalgae species from the UTS Microalgae Collection and affiliate collections, and better develop our scientific tools to identify prospective species for addressing some of our planet's biggest problems.

3 Super Strains for Climate Change

$900,000
over 2 years/
application

Developing carbon capture and sustainable bioproduct tools with microalgae

This project seeks to develop "elite" algae strains with traits that are preferable for specific applications. One of our main priorities is developing elite strains of algae for carbon capture applications. Algae are capable of capturing carbon dioxide, hence there is the potential to exploit this capability to capture industrial and atmospheric emissions. This captured carbon can be transformed into food production, animal feed and cosmetics applications.

Our unique machine learning capabilities allow us to rapidly grow algae strains. Our equipment is fully automated and can run 24/7, to conduct high-throughput liquid handling, cutting the time to perform experiments by a thousand times over. By utilising machine learning we can develop elite strains with higher carbon capture capacity or concentrations of desirable compounds. The development of "elite' strains will pioneer a way for industries to transition to utilising sustainable alternatives and achieving carbon neutrality.

Opportunities for Impact

4

$1.5 million
over 2 years

Algal Protein Production for Island Nations

Enhancing Protein Availability and the Sustainability of Food Provisions.

Island nations face limited access to quality protein sources due to their remoteness from export nations. To enhance protein availability and promote sustainable food provision within these communities, we are developing a comprehensive cost-effective strategy.

We aim to create a biobank comprised of a diverse array of wild-type and selected superior algae strains, and then develop cost-effective photobioreactors that can produce these selected strains. We aim to collect native strains of both macro and microalgae and house them at the UTS quarantine culture facility. By using chemical fingerprinting, we will identify elite strains that possess desirable traits for increased protein production. This algal biobank can significantly improve Island Nations protein self-sufficiency, as algae-based protein offers a sustainable and nutritious alternative, reducing their reliance on limited local resources such as fish and plants.

This algal biobank can significantly improve Island Nations protein self-sufficiency, as algae-based protein is a sustainable and nutritious alternative to fish and plants.

Further information

If your passion aligns with the Algal Biosystems and Biotechnology team's there is opportunity to be involved via partial, full or similar themed funding.

For more detail about the content of this proposal, please contact: Dr Alex Thomson, C3 Industry Engagement Manager, **Alexandra.Thomson@uts.edu.au**

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