BIOPLATFORMS AUSTRALIA
ANNUAL REPORT 2021

SCIENCE IN PRACTICE

BIOPLATFORMS
AUSTRALIA

PHOTOGRAPH CREDITS:

P8: CC BY-SA 4.0 - Wikipedia, main entrance of the AIBN

P13: Shark Bay bandicoot release, Dirk Hartog,
Photograph: Saul Cowen - DBCA

P14: Themeda Triandra 'Kangaroo Grass' in Para Wirra Conservation Park,
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P18: Photograph provided by the Australian Wine Research Institute (AWRI)

P24: GADI computer, the National Computational Infrastructure (NCI)

LEADERSHIP

Bioplatforms Australia is committed to maintaining a high standard of governance and leadership. Strategic direction and operational oversight is provided by an independent Board of Directors and supported by an Executive Management Committee who advise on platform technologies and organisational initiatives.

Board Members and Responsibilities

Bioplatforms Australia's Directors offer a wealth of experience across scientific, business and government domains. Each Director has responsibility for particular aspects of organisational strategy in addition to their fiduciary duties.

Dr Leslie Trudzik – Chairman
Les is a founding Board Member of Bioplatforms Australia and became Chairman in 2013. He is responsible for developing the organisation's performance and impact framework.

Dr Sue Meek – Director
Sue joined the Board in 2012 and is responsible for organisational communications and liaison with the Commonwealth government.

Dr Katherine Woodthorpe – Director
Katherine joined the Board in 2014 and is responsible for industry engagement, advising on the innovation pipeline, and providing experience to support challenging decision-making processes.

Professor Peter Gray - Director
Peter was appointed to the Board to provide scientific insight and expertise to all platforms. He supports academic and industry engagement, and integration with aligned NCRIS capabilities.

Executive Management Committee

The Executive Management Committee manages and advises on platform issues and operations. It is also responsible for implementing strategic initiatives, including Commonwealth funding agreements established with network partners..

Committee members are:

Chair
Andrew Gilbert, Chief Executive, Bioplatforms Australia

Genomics Convenor
Professor Marc Wilkins

Proteomics Convenor
Professor Ian Smith, retired 2020

Metabolomics Convenor
Professor Malcolm McConville

Bioinformatics Convenor
Associate Professor Andrew Lonie

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Dr Les Trudzik
Chairman

BIOPLATFORMS: SCIENCE IN PRACTICE

As Australia, indeed the global community, works through the COVID-19 pandemic, it is clear that research and science will be critical to address all manner of challenges, whether addressing the health challenge itself through better diagnostics, improving treatment regimes, vaccinating the world's population, or monitoring long term effects from those infected by the disease.

The pandemic has both emphasised existing issues as well as created a range of new challenges, from rebuilding economies, re-engineering supply chains, to addressing labour shortages as consequence of sudden international immobility. These challenges of course compound with the ongoing impacts of climate change and clean energy, other health issues across cancer and cardiovascular diseases, food quality and security, bushfire responses and biodiversity collapse. Science and innovation represent both an opportunity and necessity to address these pressing priorities.

With the current 5-year review and reset of the National Research Infrastructure Roadmap, 2021 is an important year in the development of Australia's science and research policy. This is an important consultative process that will provide the nation with the settings to both meet our science responsibilities and identify opportunities across government science programs, including ARC, NHMRC, MRFF, CSIRO. It will also establish the underpinning national capabilities to support a vibrant industrial and commercial sector.

Australia's capacity to maintain the world-class research outputs essential for innovation largely rests upon the availability of a highly skilled workforce and access to cutting-edge research infrastructure platforms. The success of future research and its translation will increasingly be complex and multidisciplinary, beyond the singular involvement of any one institution or program, and deliberate partnership strategies will be required.

As a prime example, Life Science is increasingly underpinned by Genomics together with functional assessments, and the Zero Childhood Cancer initiative represents a practical adoption of applied functional genomics. Bioplatforms facilities are DNA sequencing the 1,000 children per annum afflicted by cancer and enabling global data sharing and interoperability thereby acting as an end-to-end strategic and integrated partner in this flagship program.

Furthermore, Bioplatforms has partnered on the National Environmental Science Program hubs in support of conserving Australia's unique biodiversity to build an understanding of the diversity and evolution of life through a foundational genetic assessment of Australia's unique biodiversity. Likewise, Bioplatforms deploys capability to Agricultural themes supporting global food security while improving quality through function and nutrition, ultimately contributing to Australia's health, environmental, economic and social wellbeing.

Bioplatforms is committed to supporting the Australian life sciences community through a diverse access program, provision of targeted infrastructure requirements, and making integrated capability available to initiatives of breadth, scale and complexity in a way that is not readily achievable through other mechanisms. In 2020/21, the Bioplatforms network undertook 18,459 contracts for 3,130 discrete collaborators, of which 18% were focused on industrial and commercial research communities.

Bioplatforms purposefully seeks to support the discovery-to-impact cycle within the innovation system through advanced partnership strategies that require contributions by more than one scientific discipline. Towards this end, Bioplatforms partners extensively as a driver of convergence with other researchers, scientific capabilities, partnering and purchasing businesses, and financial investors, thereby providing a vibrant ecosystem for innovation and application.

In reporting the above achievements, I would like to acknowledge the support of my fellow Directors, Professor Sue Meek, Dr Katherine Woodthorpe and Professor Peter Gray, all of whom have provided sound counsel, creativity and positivism throughout the year.

The Bioplatforms team, led by our Chief Executive Andrew Gilbert, also continue to deliver high quality ideas, services and outcomes, supporting the critical scientific leadership of our network convened by Professor Marc Wilkins (Genomics), Professor Ian Smith (Proteomics, retired), Professor Malcolm McConville (Metabolomics) and Associate Professor Andrew Lonie (Bioinformatics). Despite the challenges associated with COVID-19, all have led the growth and development of our national networks with great energy, spirit and direction.

I look forward to ongoing interaction with the Bioplatforms Australia network in the coming year, and to ensure that NCRIS investment in research infrastructure continues to best meet both the immediate and longer-term needs of the Life Science community.

CAPABILITY

- **17** world-class facilities in genomics, transcriptomics, proteomics and metabolomics
- **$19** million invested in best of breed technology and leading expertise
- **273** funded staff (245 full time employees)

DIGITAL INFRASTRUCTURE (BIOCOMMONS)

- **23** Bioinformatics training events (BioCommons, face-to-face and webinar)
- **4,555** training attendees (32% live, 68% YouTube channel)
- Galaxy Australia activities (online bioinformatics platform)
  - **768** active users per quarter (average)
  - **1323** analytical tools available

INITIATIVES AND COLLABORATIONS

- **12** active National initiatives
- Partner Organisation to **5** ARC Centres of Excellence
- **4929** registered users (**221** new) to the data portal across 13 framework datasets

SCIENTIFIC OUTCOMES OF TECHNOLOGY PLATFORM NODES

- **1071** research papers published in peer-reviewed journals
- **47%** of the papers published in top 10% journals including Nature, Science and Proceedings of the National Academy of Sciences (PNAS)
- **216** ARC and NHMRC grants Chief Investigator, partner investigator or organisation

CAPABILITIES NETWORK

Effective results driven research requires a critical mass of expertise and state-of-the-art infrastructure for the Australian life sciences sector.

Through Bioplatforms' infrastructure and personnel investment, we ensure highly skilled researchers have access to world-class technology platforms in Genomics, Proteomics and Metabolomics with integrated Bioinformatics capabilities.

The life sciences sector is transforming with increased focus on data-enabled approaches to modern day complex biological challenges. To ensure an ongoing state-of-the-art capability across the research sector, Bioplatforms has consolidated our diverse platforms and technology capabilities into 'critical mass' centres, each with specialised functions. Our 'omics capabilities are in high demand, despite the continued impact from COVID-19 on research. The completed contracts have led to impacts across all four capabilities in Genomics, Proteomics, Metabolomics, and Bioinformatics

We support the breadth of the Australian research community through our diverse client base. Research contracts completed were distributed proportionally across clients and sectors, with an average of six submissions per client, indicative of the value of Bioplatforms facilities to researchers.

3,130
CLIENTS

72% CLIENTS EXTERNAL TO FACILITY HOST ORGANISATION

18,459
CONTRACTS

1,071
PEER REVIEWED PUBLICATIONS

ENABLING LABORATORY ACCESS

CLIENTS

18% Government and industry

24% Medical research institutes and PFRA

58% University

RESEARCH FOCUS

18% Agri-food

21% Environmental

61% Biomedical and diagnostics

SYNTHETIC BIOLOGY

BIOFOUNDRY

$8.3m towards a national synthetic biology infrastructure capability

ARC CENTRE OF EXCELLENCE

$35m ARC investment

32 partner organisations

HYDGENE RENEWABLES

Spin-off

BIO INFORMATICS

GALAXY AUSTRALIA

1,323 tools available (408 added in 2020-21)

768 active users per yearly quarter (average)

BIOCOMMONS

23 training events held

4,555 attendees

NATIONAL DATA INITIATIVES

12 active National initiatives

1,683 datasets generated

57 reference genomes of native Australian species to date

>10,000 environmental samples with microbial genomic resource

>1,500 specimens studied to support the bushfire response

PARTNERSHIP DEVELOPMENT

2 Cooperative Research Centres

2 National Environmental Science Program hubs

6 ARC Centres of Excellence

6 Industry transformation research hubs and training centres

72 ARC projects

144 NHMRC projects

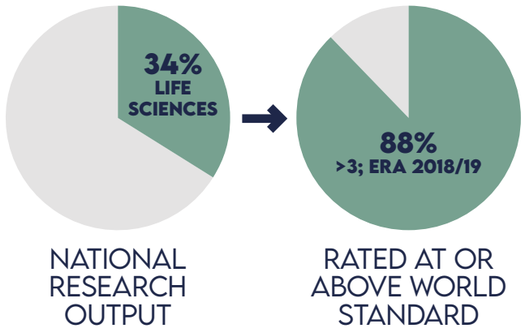
51 Commercially-linked activities (patents, clinical trials, startups)

BIOPLATFORMS AUSTRALIA

Australia's capacity to maintain world-class research outputs essential for innovation largely depends upon the availability of a highly skilled workforce and access to cutting-edge research infrastructure platforms. Future research success and application will increasingly be complex and multidisciplinary, beyond the singular involvement of any one party and deliberate partnership strategies will be required.

DEMAND

The Life Sciences sector, incorporating Technology, Biological Sciences, Agri-food and Veterinary Sciences, Biotechnology and Medical and Health sciences collectively, represent approximately 34% of the national research output with approximately 88% rated at or above world standard (>3; ERA 2018/19).



In support of this evidence, 3 of the 10 ARC Centres of Excellence awarded in 2020 included Bioplatforms as a partner organisation. Furthermore, approximately 30% of ARC Discovery projects awarded in 2020 were in support of research requiring 'omics capability.

DEPLOYMENT

Bioplatforms has a successful history of prioritising key national research agendas and deploying the national asset of genomics, proteomics and metabolomics through deep collaboration to energise research, build re-usable data resources and enable open science of scale and diversity. Combined with support of peak peer-reviewed research collaborations through the ARC Centre of Excellence program and MRFF Missions, Bioplatforms has proactively deployed NCRIS capabilities and fostered persevering collaborations across biomedicine, agriculture and environmental research communities.

DIGITISATION OF DISCIPLINE

The 'omics have become data-centric digital sciences demanding of investment in computing power, data storage and management, software development and deployment and a differential expertise not traditionally identified with the biological sciences.

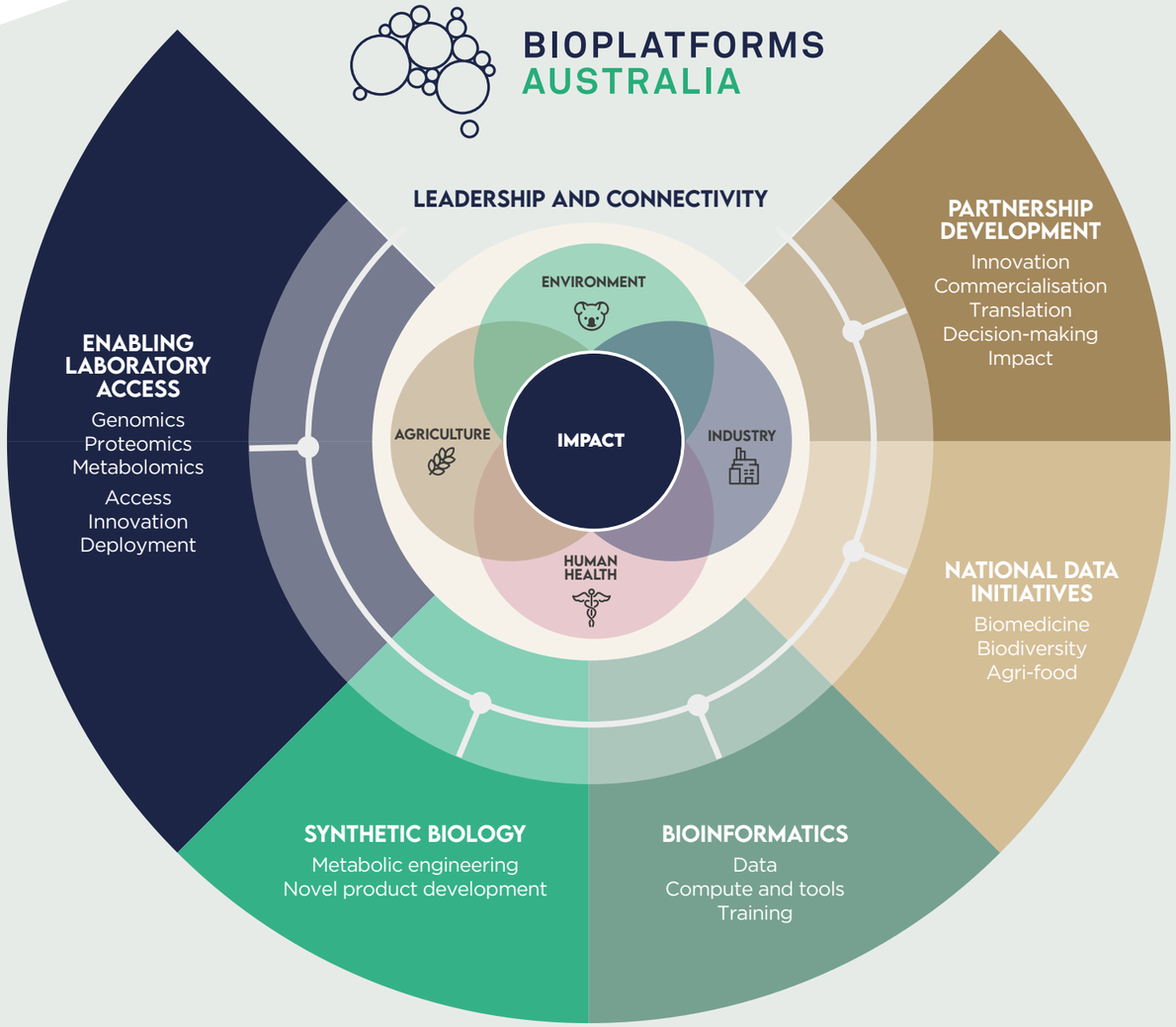
The Australian BioCommons represents Bioplatforms' response to this digital transition and addresses a number of pressing infrastructure needs, including supporting naïve adoption of bioinformatics through the Galaxy Australia cloud offering, leading a national consortium in human genomics attempting to harmonise approaches and promote data sharing locally and globally, and the synthesis of that aggregate data for new science; and coordinating Australia's national digital providers (NCI, Pawsey, AaRNET, AAF, ARDC) in their support for increasingly complex Life Sciences requirements.

EVOLVING STRATEGY

Bioplatforms is committed to supporting the Australian Life Sciences community through provision of targeted infrastructure requirements and making integrated capabilities available to initiatives of breadth, scale and complexity in a way that is not readily achievable through other mechanisms.

Bioplatforms supports the current research life cycle through deep sector engagement with research communities, and is aligned with national strategic research initiatives such as future gene and cell therapies, precision medicine, food security and quality. Existing capabilities in data production, informatics, as well as human capital in the form of skills and training, and research communities, have ensured Bioplatforms can deeply support many touch points in a researcher's impact journey.

We deliberately seek to support the discovery to impact cycle within the innovation system through an advanced partnership strategy. The innovation cycle typically involves a myriad of inputs including contributions by more than one scientific discipline. We recognise that extensive partnership and convergence of capabilities with our NCRIS peers is critical to enabling a vibrant national innovation ecosystem.



SYNTHETIC BIOLOGY PROGRAM

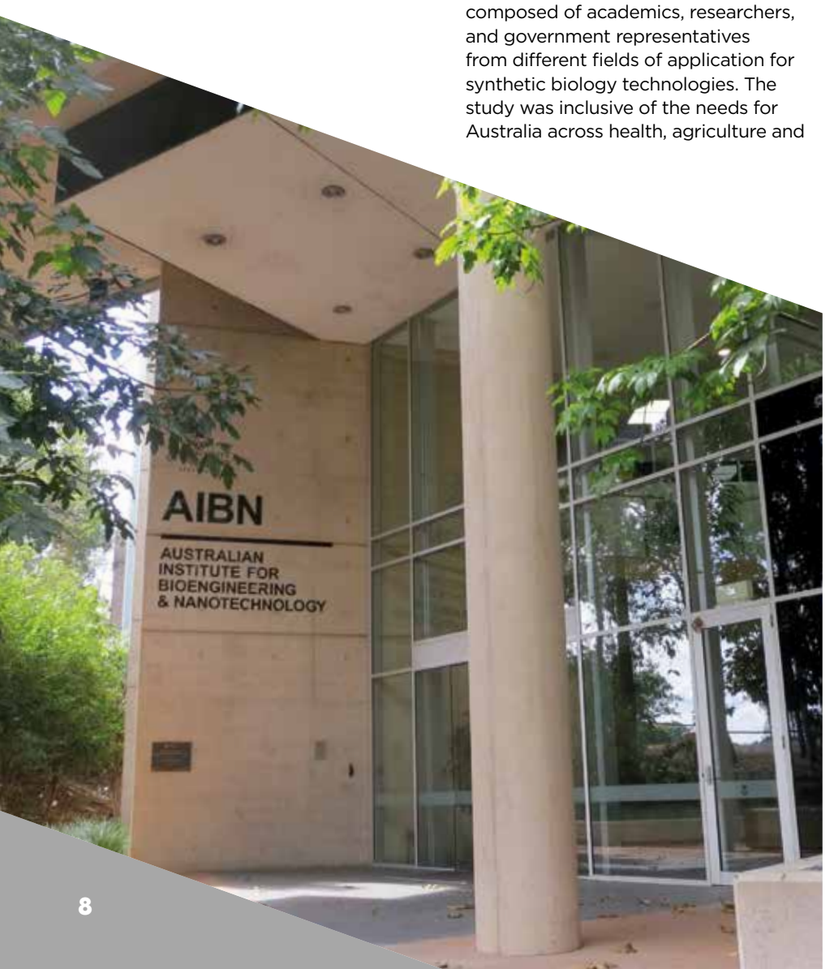
Synthetic Biology is a new way of engineering biology. It is a multi-disciplinary approach which has adopted the iterative engineering principles of Design-Build-Test-Learn and incorporates robotics and computational biology for high-throughput development and analysis. This pipeline of technical capability is carried out a facility called Biofoundry.

Synthetic biology is a foundational platform technology which underpins innovations requiring the customised performance of cells and biological components. It has far reaching applications in pharmaceuticals and cell therapies, fuels, agricultural productivity and sustainability, and the chemical industry and new materials. Synthetic Biology utilises specialty disciplines in genomics, proteomics and metabolomics and Bioplatforms Australia is well positioned for expansion of capability into this field.

In 2018, NCRIS commissioned Bioplatforms Australia to lead a scoping study into Australia's infrastructure requirements to instil capacity for globally competitive activities. The scoping study working group was composed of academics, researchers, and government representatives from different fields of application for synthetic biology technologies. The study was inclusive of the needs for Australia across health, agriculture and industrial biotechnology. The resulting infrastructure implementation plan made allowance for the adoption of these modern strategies across major sectors of the life sciences from idea conception to proof-of-concept scale up capability or field trials and clinical application.

Bioplatforms Australia was allocated $8.3m from NCRIS over three years to establish a new synthetic biology research infrastructure. This infrastructure will facilitate synthetic biology, rapid responses to emerging disease and biosecurity, and address critical gaps in technological platforms and informatics. Bioplatforms Australia has a well-established track record in providing research infrastructure across the life sciences and is well positioned to establish this very exciting capability.

The NCRIS investment will bring the capability of the Bioplatforms portfolio in step with the rapid evolution of complexity and dependency upon biological analytics and advancements in biotechnology. The new investment will boost staff and instrumentation to offer services across strain development and screening and will increase fermentation capacity and analytics for increased characterisation and optimisation of engineered strains. These new capabilities will integrate and augment the expertise of the existing NCRIS supported facilities.



THE AUSTRALIAN RESEARCH COUNCIL CENTRE OF EXCELLENCE FOR SYNTHETIC BIOLOGY

The ARC CoESB was launched in December 2020 and will focus on engineering proteins and pathways, organelles and whole microbial cells to a desired functionality.

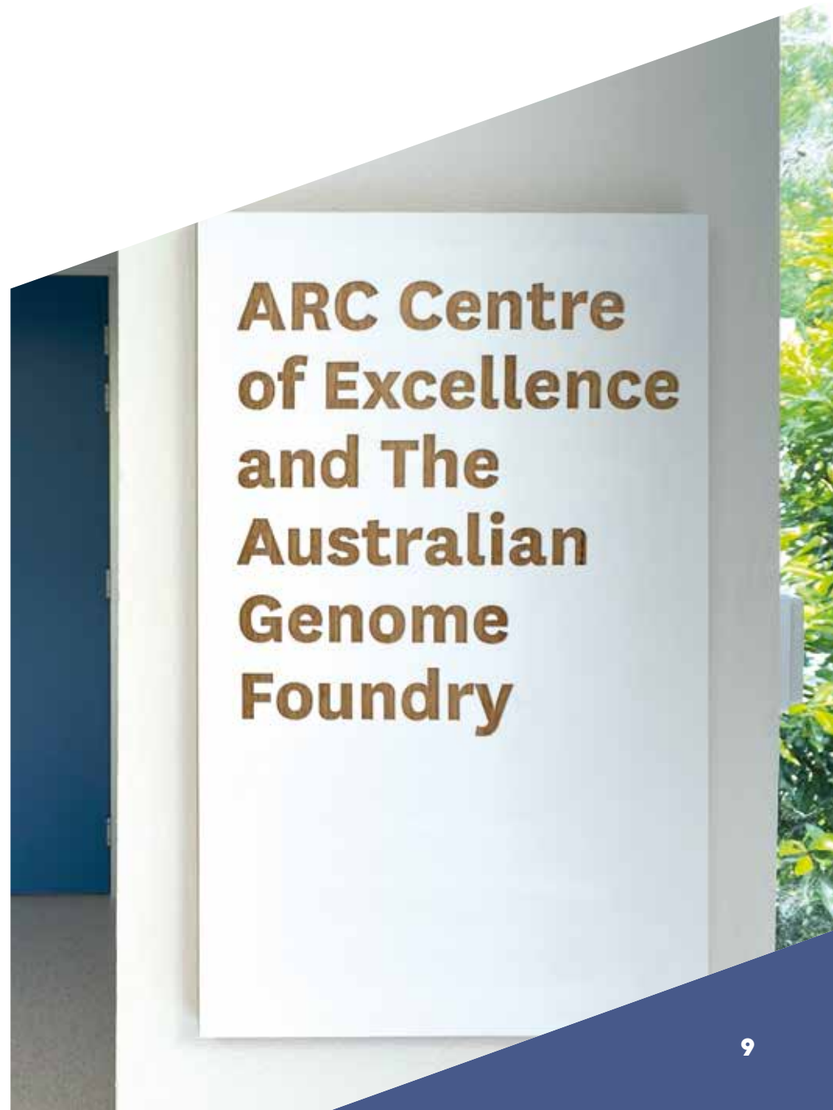
The centre brings together 9 Australian universities and a range of partners, including Bioplatforms Australia, government departments, international university and research facilities as well as a number of companies from start-ups to industry incumbents.

The vision of the CoESB is to build on Australia's historic strengths in agriculture by designing and constructing synthetic microbes that can take agricultural biomass or waste streams from industry and turn them into high-value products such as pharmaceuticals, industrial biochemicals, fuels or plastics. Centre Director, Professor Ian Paulsen of Macquarie University described synthetic biology as a relatively new science that combines an engineering mindset with molecular biology approaches, using the idea that we can treat genes and DNA as modular, standardised parts that can be constructed into biological machines or circuits from which we can build entirely new-to-nature circuits or synthetic microbes.

The centre hopes to translate research into impactful elements of the bio-based economy and includes research streams within the economic and societal dimensions of this highly promising deep tech. Professor Paulsen hopes the long-term legacy of the Centre will be the emergence of a new bio-manufacturing industry in Australia and lead to new synthetic bio start-up companies. Bioplatforms is very excited to partner with this Centre which aligns well to our current infrastructure offering.

"We hope the long-term legacy will be the emergence of a new bio-manufacturing industry in Australia and lead to new synthetic bio start-up companies that can form an ecosystem of nimble companies able to address the broader, myriad problems that face Australia."

Professor Ian Paulsen



SUPPORTING AUSTRALIAN AGRICULTURE

Bioplatforms has been conducting an inclusive dialogue to define the need for critical data resources to support Australian agriculture and primary industries. Two new programs have been launched that will generate data assets to enhance crop health, protection and improvement.

Plant Pathogen 'Omics Initiative

Plant diseases cost Australia millions of dollars each year as they reduce productivity, increase the cost of production, impact on our ability to trade both locally and internationally and adversely affect our environment and biodiversity. As such, preparedness and awareness are a national priority, and enabling data-driven decision making is essential to this. The Plant Pathogen 'Omics Initiative is working across research, industry and government to create a significant multi-omics data resource, alongside standardised methods, to support enhanced decision-making within Australia's agricultural and biosecurity system.

This initiative is anticipated to provide the building blocks for knowledge across two main sectors:

1. **Fundamental research and development in plant protection**
   For example, understanding the emergence and evolution of pathogens in crop systems, enabling the development of sustainable plant protection strategies (e.g. biocides), and providing a foundational information source for breeding programs.
2. **Supporting an effective biosecurity system**
   For example, enabling reliable and timely detection and diagnostics of plant pathogens to ensure they are contained, suppressed or managed.

OzBarley

Crop improvement relies on connecting trait variation to underlying genes. With recent advances in phenomics, genomics and transcriptomics, we can generate multi-'omic data at scale. However, the current challenge is to curate, integrate and analyse this data for gene discovery and ultimately provide information that leads to genetic gain in crops. Bioplatforms, in collaboration with two other NCRIS capabilities, the Australian Research Data Commons (ARDC) and the Australian Plant Phenomics Facility (APPF), is demonstrating how a data-driven genome-to-phenome platform can drive future crop improvement.

In partnership with Australian breeding companies (InterGrain and Australian Grain Technologies), the OzBarley project is building an open-access resource that unravels the genes and pathways that contribute to grain quality features, particularly those that are desired by export partners. This database will form the basis for faster, accurate prediction of desirable traits earlier in breeding programs, and provide opportunities to develop barley varieties that might be better suited to the animal feed or human food industries.

ZERO CHILDHOOD CANCER

"Cancer kills more children than any other disease in Australia and every week three children and adolescents in Australia die because of it" said Associate Professor Mark Cowley from the Children's Cancer Institute.

"Every child is different, every cancer is unique, so treatment has to be tailored for each individual. Through an international data collaboration on paediatric cancer subtypes, we hope to better understand how to treat the cancers we find in Australia, based on information that was previously inaccessible." ZERO Childhood Cancer is led in partnership with the Children's Cancer Institute and Kids Cancer Centre, Sydney Children's Hospital, Randwick.

Bioplatforms' largest genomics investment, the Australian Genome Research Facility, is partnering with the Zero initiative, to deliver a comprehensive range of genomics services, including:

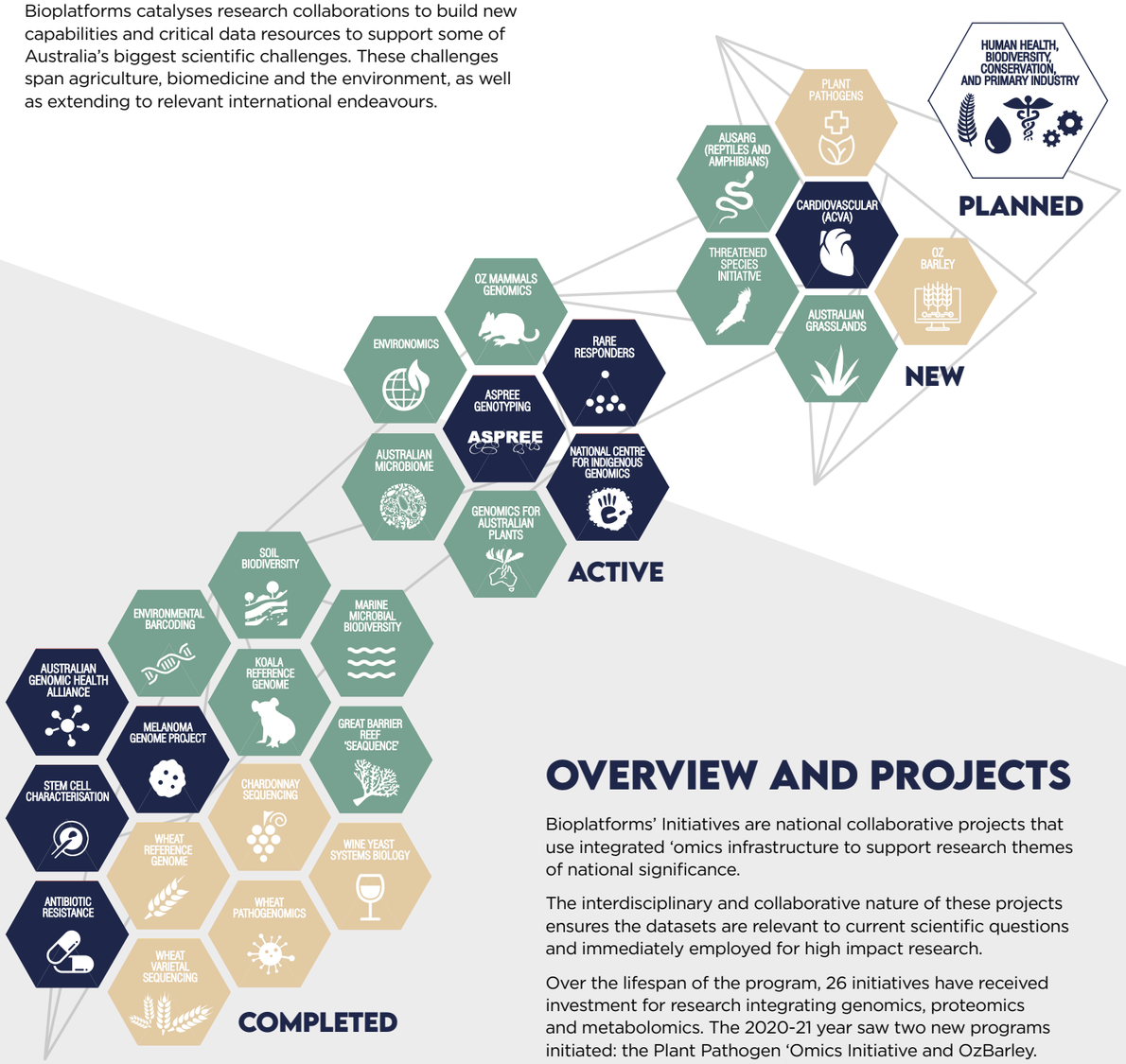
- Whole genome sequencing for healthy cells (control) and tumour
- RNA Seq data for each tumour
- Epigenetic (methylation) data for each tumour
- Cancer panel data for each tumour

Data analysis will be performed on the CAVATICA Platform, a cloud-based system for collaboratively accessing, sharing and analysing childhood cancer data. The CAVATICA Platform allows clinicians and scientists worldwide to rapidly access large amounts of genomic data and workflows within a computation and storage environment where they can share, process, integrate and analyse data. The Australian BioCommons led the implementation in collaboration with the Children's Hospital of Philadelphia who host the NIH reference data for childhood cancer.

RESEARCH PROGRAMS

MISSION

Bioplatforms catalyses research collaborations to build new capabilities and critical data resources to support some of Australia's biggest scientific challenges. These challenges span agriculture, biomedicine and the environment, as well as extending to relevant international endeavours.



OVERVIEW AND PROJECTS

Bioplatforms' Initiatives are national collaborative projects that use integrated 'omics infrastructure to support research themes of national significance.

The interdisciplinary and collaborative nature of these projects ensures the datasets are relevant to current scientific questions and immediately employed for high impact research.

Over the lifespan of the program, 26 initiatives have received investment for research integrating genomics, proteomics and metabolomics. The 2020-21 year saw two new programs initiated: the Plant Pathogen 'Omics Initiative and OzBarley. The new initiatives launched last year have made substantial progress in their activities.

Additional programs are being scoped for future Framework Initiative investment, with continued focus on primary industry and the completion of genetic resources for all Australian flora and fauna taxonomic groups.

THE BENEFITS OF DATASET PROGRAMS

Build large-scale data resources

Maximise impact of national research infrastructure

Build scientific capabilities

Catalyse scientific collaboration and international linkages

Research acceleration and translation into industry

THREATENED SPECIES INITIATIVE

NATIONAL INITIATIVES

THE THREATENED SPECIES INITIATIVE

The Threatened Species Initiative (TSI) consortium continues to work closely with the conservation managers delivering on the ground actions to save our global species, to ensure that they have access to genetic data when they are undertaking activities such as translocations and captive breeding.

61 species are currently supported by the TSI program from across Australia, representing species that are listed as Extinct in the Wild (3), Critically Endangered (16), Endangered (17), Vulnerable (15) and Data Deficient (9). Of the 61 species' projects, there are over 130 project team members representing government (46%), academia (35%) and non-government conservation agencies (19%). These projects are generating genomics resources that provide tangible on-the-ground conservation outcomes.

USE CASE:
Enhancing management and monitoring of the endangered Shark Bay bandicoot

TSI members (University of Sydney, WA Department of Biodiversity and Conservation Attractions, and the Australian Wildlife Conservancy) have been working closely with the Recovery Team for the Shark Bay bandicoot (previously named Western barred bandicoot) to inform ongoing translocations of individuals.

The TSI-supported data is also being used in population viability models so managers can predict the impact of these translocation decisions.

PHOTOGRAPH: Saul Cowen - DBCA.
Shark Bay bandicoot release, Dirk Hartog.

NATIONAL INITIATIVES

AUSTRALIAN GRASSLANDS INITIATIVE

The Genomics for Australian Plants (GAP) Initiative was set up to develop genomic resources to enhance our understanding of the evolution and conservation of the unique Australian flora. The program is also aligned with, and will help deliver on strategic actions identified in the "Discovering biodiversity: a decadal plan for taxonomy and biosystematics in Australia and New Zealand 2018–2027".

The outcomes and learnings from the GAP Initiative including the operational and analytical workflows established have helped to build the Australian Grasslands initiative, which connects heavily with the network for the ARC Centre of Excellence for Plant Success. Australian native grasses dominate much of the Australian landmass, with some species spreading over vast ranges while others demonstrate more localised adaptations. As the only grass species that is found across the entire Australian landmass, Kangaroo grass is a good model to understand how its unique phenotypic traits enable the plant to adapt and thrive in different environments.

The initiative will look at several native grasses including spinifex, Mitchell grass and weeping grass, which have more localised ranges compared to Kangaroo grass. Phenomic characteristics variation (interaction between genes and their environment) in these rangeland grass species, and ecotypes within each species (genetically distinct variety, population, or race within a species, which is adapted to specific environmental conditions), will be revealed by applying the principles and technologies of biogeography, phenotyping, biochemistry, population biology, molecular genetics and evolutionary biology. We will develop new insights into the nature of adaptation to extreme environments and those traits and networks that can be applied for the benefit of knowledge, agriculture and society such as improving seed quality for better yield and nutrition. The initiative will utilise a combination of genomics, proteomics and transcriptomics technologies.

PHOTOGRAPH: Jordan Comley. Themeda Triandra
'Kangaroo Grass' in Para Wirra Conservation Park, South Australia.

SUPPORTED PROGRAMS

CONTINUED SUPPORT TO THE COVID-19 RESPONSE WITH AUSTRALIAN NATIONAL INFRASTRUCTURE

For the second year of this global pandemic, the Bioplatforms network of research facilities have remained heavily involved in response to the COVID-19 disease.

The SARS-CoV-2 virus has continued its worldwide disruption of activities, and also impacted Bioplatforms and the supported network of facilities. It was unfortunately not possible to have in-person meetings which is an integral part in building our initiative consortia, however, we have all adapted by necessity to videoconferencing and shown remarkable resilience with not only great advances in our young initiatives as well as the creation of Australia-wide consultations and establishment and scoping of new program such as the Ag-Pathogen initiative.

The Bioplatforms network of facilities have provided ongoing support to the research community, as well as providing continued crucial services in support of the response to last year's Bushfire recovery efforts and the ongoing battle with the COVID19 pandemic, including:

- Characterisation of various B cell types and their roles in response to vaccinations and infection control in humans, including COVID-19 [BRF-ANU, genomics]
- Investigation of the rationale for persiting symptoms for COVID-19 infections (long COVID) [SAGC, genomics]
- Investigations of the rationale for absence of symptoms and acute illness in children [APAF, proteomics]
- Understanding of the metabolic impacts of SARS-CoV-2 infection to better disease management [AGRF, genomics]
- Development of virome capture sequencing technique to better identify co-infection rate and clinical impact in SARS-CoV-2 patients, and improve therapeutic intervention [Ramaciotti Centre for Genomics]

PHOTOGRAPH:
Dimitris Barletis.

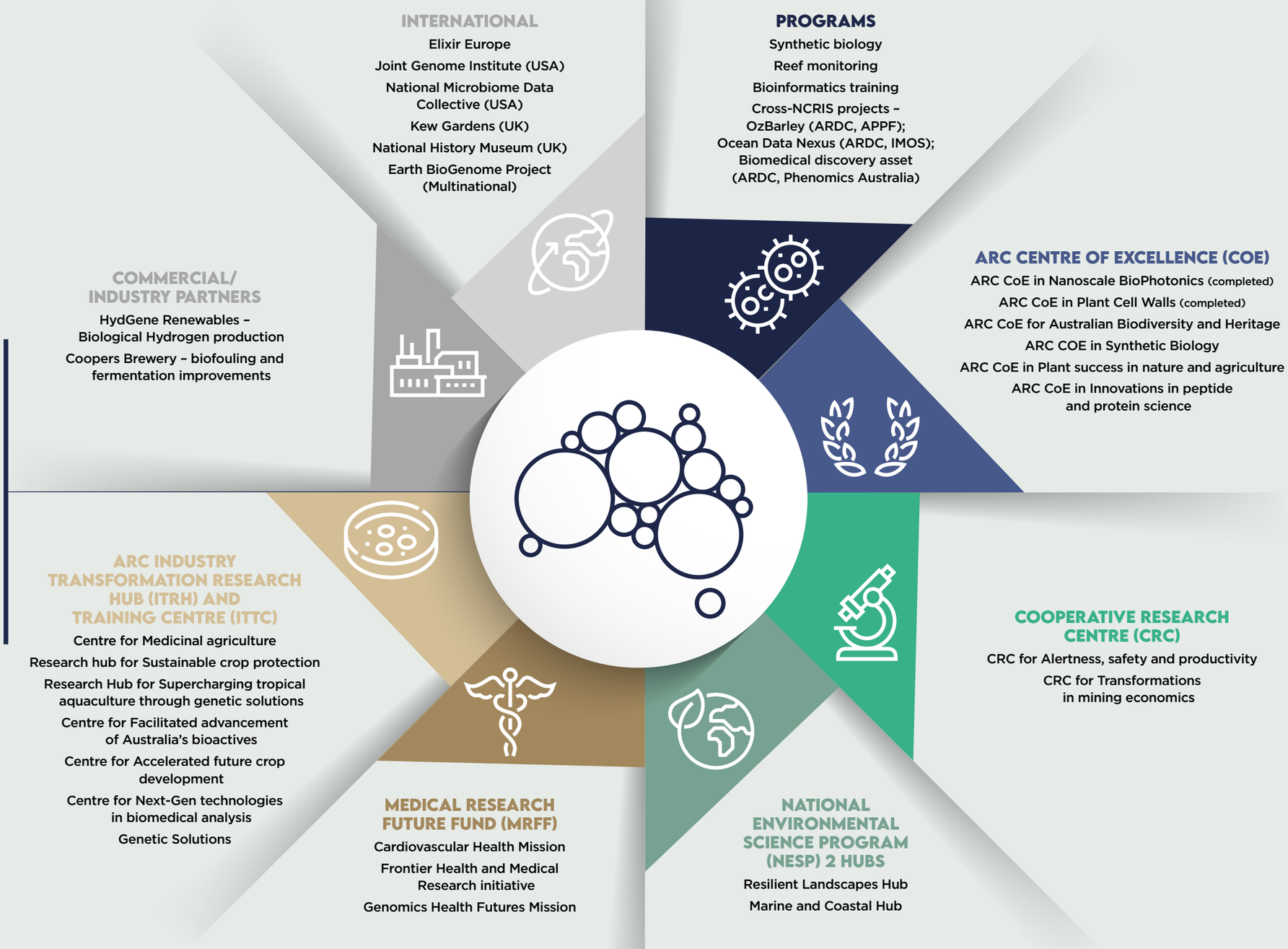
COLLABORATIONS AND PARTNERSHIPS

Our collaborations and partnerships for 2020/21:

IMPACT THROUGH COLLABORATION

Bioplatforms has ongoing partnerships with Cooperative Research Centres, Australian Research Council (ARC) Centres of Excellence, and ARC Industry Transformation Research Hubs. We also collaborate closely on national programs and have strong links with international partners.

These national and international partnerships are central to delivering on our core values and beliefs – building impact, quality, collaboration and trust



INTERNATIONAL

Elixir Europe

Joint Genome Institute (USA)

National Microbiome Data Collective (USA)

Kew Gardens (UK)

National History Museum (UK)

Earth BioGenome Project (Multinational)

PROGRAMS

Synthetic biology

Reef monitoring

Bioinformatics training

Cross-NCRIS projects – OzBarley (ARDC, APPF); Ocean Data Nexus (ARDC, IMOS); Biomedical discovery asset (ARDC, Phenomics Australia)

COMMERCIAL/ INDUSTRY PARTNERS

HydGene Renewables – Biological Hydrogen production

Coopers Brewery – biofouling and fermentation improvements

ARC CENTRE OF EXCELLENCE (COE)

ARC CoE in Nanoscale BioPhotonics (completed)

ARC CoE in Plant Cell Walls (completed)

ARC CoE for Australian Biodiversity and Heritage

ARC COE in Synthetic Biology

ARC CoE in Plant success in nature and agriculture

ARC CoE in Innovations in peptide and protein science

ARC INDUSTRY TRANSFORMATION RESEARCH HUB (ITRH) AND TRAINING CENTRE (ITTC)

Centre for Medicinal agriculture

Research hub for Sustainable crop protection

Research Hub for Supercharging tropical aquaculture through genetic solutions

Centre for Facilitated advancement of Australia's bioactives

Centre for Accelerated future crop development

Centre for Next-Gen technologies in biomedical analysis

Genetic Solutions

MEDICAL RESEARCH FUTURE FUND (MRFF)

Cardiovascular Health Mission

Frontier Health and Medical Research initiative

Genomics Health Futures Mission

NATIONAL ENVIRONMENTAL SCIENCE PROGRAM (NESP) 2 HUBS

Resilient Landscapes Hub

Marine and Coastal Hub

COOPERATIVE RESEARCH CENTRE (CRC)

CRC for Alertness, safety and productivity

CRC for Transformations in mining economics

COMMERCIAL AND INDUSTRY ENGAGEMENT

The Bioplatforms infrastructure network is a resource for Australian business and industry. Expertise in life sciences research and development is relevant across the sectors of health and medicine, agriculture and food, biotechnology and waste. Our facilities are available for outsourced product development and for more collaborative research and development. We commonly perform industry led projects, partner on grant opportunities and broker relationships for constructive collaborations with the research community.

Bioplatforms also provides project management for solutions to industry-identified problems. This approach ensures we are able to maximise commercial outcomes, deliver targeted research to end user needs, and ensure links with current national scientific and innovation priorities. Industry engagement is a key component of the programs and initiatives that Bioplatforms supports.

OUTLOOK

Bioplatforms is exposed to the intersection between academic and applied scientific discovery and believe this is the foundation for emerging knowledge-based economy. Our federally funded network is crucial for enabling technologically-heavy start-ups and SMEs to become the Australian bio-industries of the future. We offer various levels of assistance and support to enable innovative ideas to attract further investment.

PHOTOGRAPH: Australian Wine Research Institute (AWRI).

COMMERCIALISATION: HYDGENE RENEWABLES

A long partnership which is a success story in the making. Bioplatforms commenced support for the Macquarie University prize winning 2017 student team of the International Genetically Engineered Machine competition (iGEM) turned into a multi-million-dollar company.

Bioplatforms has sponsored the travel for the Macquarie University iGEM team for several successful years. The 2017 iGEM was outstanding with the team bringing home the competition's Energy Award and formed the basis for the development of HydGene Renewables. The biological engineering of a common microbe to produce Hydrogen gas is a breakthrough technology which won the research team at Macquarie University a $2.8m ARENA grant in 2018.

Bioplatforms was instrumental in brokering the early partnership with BOC, and both companies have continued to follow the ongoing success of HydGene. A further $100K was awarded in 2021 from the Business, Research and Innovation Initiative (BRII) funds for turning farm waste into Hydrogen. With applications from fertiliser, remote power generation and the chemical industry, Bioplatforms will continue to identify strategic partnerships, capital and technical resources for the team.

HydGENE renewables

BUSINESS BREAKFASTS

The greatest growth of the bio-based economy and cutting-edge innovations translated into our everyday lives will come from new companies. These young companies are founded on a passionate belief that their technology will have positive impacts on society and climate change, as much as the desire to build a successful business. Bioplatforms has a great desire to lift and support these entrepreneurs on their translational journey. Partnerships Manager, Natalie Curach has been hosting monthly business breakfasts for startup founders. The minutiae of science is off the table during these meetings, and the focus is turned to collegial conversations and constructive discussions on issues affecting these companies such as IP arrangements with universities, laboratory rental agreements or recommendations to professional services. There are regular invited speakers from industry, government and venture capital including FIAL, ANFF, AB Mauri and Antler, providing invaluable insights to theses start-up founders.

CAPABILITIES NETWORK

SCIENTIFIC RESEARCH CHANGES LIVES THROUGH INNOVATION

Bioplatforms Australia encourages innovation by investing in scientific infrastructure and biomolecular research capabilities through our Capabilities Network. This network which spans 17 leading universities and research facilities across Australia, employs 273 staff annually.

GENE DISCOVERY AND GENOME FUNCTION

- Australian Genome Research Facility
- The Ramaciotti Centre for Genomics, UNSW, NSW
- Biomolecular Resource facility, ANU, ACT
- Garvan-Weizmann Centre for Cellular Genomics, NSW
- Genomics Western Australia, WA
- South Australian Genomics Centre, SA

PROTEIN STRUCTURE AND FUNCTION

- Australian Proteome Analysis Facility, NSW
- Monash Proteomics & Metabolomics Facility and Monash Antibody Technologies Facility, VIC
- University of South Australia, SA
- Proteomics International and UWA, WA

DATA ACQUISITION, INTEGRATION, ANALYSIS AND MODELLING

- Australian BioCommons led out of the University of Melbourne
- The Queensland Cyber Infrastructure Foundation (QCIF)

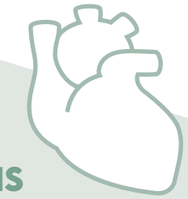
SMALL MOLECULE ANALYSIS

- Bio21 Institute, University of Melbourne, VIC
- Australian Wine Research Institute, SA
- Centre of Metabolomics, UWA, WA
- Australian Institute of Bioengineering and Nanotechnology, UQ, QLD

GENOMICS

The genomics platform is important to every field of life sciences research and provides cutting-edge genome research services via our state-of-the-art infrastructure and world class specialists with expertise in high throughput genomics, transcriptomics, epigenomics and associated bioinformatics.

- Australian Genome Research Facility
- Ramaciotti Centre for Genomics
- Biomolecular Resource Facility
- Kinghorn Centre for Clinical Genomics
- Genomics Western Australia
- South Australian Genomics Centre



CLEARING UP ATHEROSCLEROSIS

Characterisation of heart and aorta cells advances atherosclerosis research

Atherosclerosis is a complex vascular condition associated with aging and is a major cause of mortality worldwide. In atherosclerosis, plaques consisting of fats, cholesterol and other substances build up on, and within, the artery walls, resulting in restricted blood flow and an increased risk of blood clots and heart attacks.

At the cellular level, atherosclerosis involves a diverse range of cell types interacting in complex ways and resulting in inflammation. The mechanisms causing inflammation are poorly understood. Current therapeutic approaches treat symptoms such as high-cholesterol and high blood pressure, without addressing the underlying causes of cellular dysfunction. The specific environmental and genetic factors in different individuals are also not taken into consideration.

A deeper understanding of the cell types involved and their activities is therefore required in order to develop more targeted therapeutic strategies for atherosclerosis. Single cell RNA-sequencing technology has been gaining traction for understanding complex diseases and a possible precision medicine tool to treat underlying cellular causes specific to individual patients.

Bioplatforms facilities:
South Australian Genomics Centre (SAGC)

Partners: Associate Professor Peter Psaltis - Co-Leader of the Lifelong Health Theme and Leader of the Vascular Program at SAHMRI

Outcome: Different cell-types present in the heart and the aorta were characterised in unprecedented detail, including the inflammatory progenitor cells of interest using the single cell RNA-sequencing technology. The findings have contributed to an improved understanding of the cellular mechanisms underpinning inflammation during atherosclerosis.

Impact: The detailed map of the cellular mechanisms underpinning inflammation during atherosclerosis are providing a blueprint for potential therapeutic targets.

DRONES AND WHALE SNOT

Development of a novel humpback whale health monitoring system

Humpback whales play an essential role in their marine ecosystem. They also represent an important economic resource with whale watching being a booming industry in many Australian cities and around the world. From May to November each year, East Australian humpback whales complete an arduous 8000-kilometre round trip between Antarctica and Queensland, fasting for most of their journey.

To continue assisting the recovery of whales' population around the world, researchers are trying to understanding how the physical strains of the migration affect the whales' immune systems. Airway mucus samples from whales were collected several months into their migration from Antarctica and were compared to samples collected at the start of migration. The whale blow was collected using drones or long telescopic poles with a collecting dish at the end, making it non-invasive and non-intrusive.

Bioplatforms facilities:
Ramaciotti Centre for Genomics – UNSW

Partners: Evolution and Ecology Research Centre UNSW, Stats Central MWAC UNSW, Griffith University, BABS UNSW, Centre for Marine Bio-Innovation UNSW

Outcome: The study found the whales' respiratory microbiota (community of microorganisms) was severely lacking in diversity and richness the longer they fasted during their migration.

It was concluded that the physical strains of the migration, in addition to exposure to marine pollutants, compromised the immune system of whales and was a potential indicator of the overall health of the animals.

Impact: The findings are key to further developing the analysis of airway microbiota as a non-invasive method for monitoring the immune function and overall health of whales and dolphins, supporting ongoing efforts for recovery of these previously endangered species.

PROTEOMICS

Proteomics is concerned with protein structure and function. Bioplatforms' supported facilities offer a broad range of services including high throughput proteomics, protein biochemistry, monoclonal antibody production, along with drug discovery and screening.

- Australian Proteome Analysis Facility
- Monash University - Monash Proteomics and Metabolomics Facility, Monash Antibody Technologies Facility
- Mass Spectrometry and Proteomics, UniSA
- Proteomics International

CARBON CONVERSION TARGETS GLOBAL WARMING

Carbon Capture and Utilisation – one step closer to reducing greenhouse gas emissions

Since the mid-20th century, scientists have attributed the global warming trend to human activities through the release of heat-trapping greenhouse gasses. The rise in global temperature has melted glaciers and ice sheets increasing sea level and ocean temperatures. Climate extremes such as floods, droughts and extreme temperatures threaten our agricultural production, food security and our natural ecosystems.

One response to the global challenge of reducing greenhouse gas emissions is Carbon Capture and Utilisation (CCU). A possible step in CCU is the electroreduction of carbon dioxide to carbon monoxide (CO_2ERR) which makes use of very specialised materials, known as organometallic CO_2ERR electrocatalysts. The electrocatalysts need to be active and ideally maintain the activity for as long as possible. However, even the best organometallic CO_2ERR electrocatalysts show clear drops in activity over time.

A detailed investigation into the factors that contribute to the degradation of the organometallic CO_2ERR electrocatalyst activity over time was conducted through high-resolution mass spectrometry experiments performed at APAF.

Bioplatforms facilities:
Australian Proteome Analysis Facility

Partners: Yijiao Jiang Lab, School of Engineering, Macquarie University

Outcome: The work conducted allowed a better understanding of how degradation occurs in organometallic CO_2ERR electrocatalysts.

Impact: A clear pathway towards the design of industrially viable organometallic CO_2ERR electrocatalysts was uncovered. This will allow improvements in CO_2ERR technology and CCU more generally, and support its use to combat climate change in the near future.

ZERO METHANE AGRICULTURE

Reducing emissions from livestock through seaweed feed supplementation

Globally livestock are responsible for 15% of global greenhouse gases such as methane. This poses a significant environmental concern as greenhouse gasses contribute to a warming planet and climate change.

Compounds present in seaweed such as bromoform can disrupt gut microbial enzymes that produce methane during digestion, thus presenting feed complemented with seaweed as a potential solution to reducing methane emission.

In collaboration with an industry partner, the Mass Spectrometry and Proteomics facility at UniSA, has developed a mass spectrometry assay for routine bromoform testing for a native Australian species, *Asparagopsis armata*, a marine red algae.

Bioplatforms facilities:
Mass Spectrometry and Proteomics, UniSA

Partners: CH4 Global Pty Ltd

Outcome: The assay that was developed helped to quantify the bromoform levels in the harvested seaweed, allowing the industry partner to assess the suitability of each harvest and its potential effectiveness in reducing methane production. Seaweed was also sampled from different locations, helping to identify optimal growing conditions. The facility is now able to offer an end-to-end service from sample receipt to analysis.

Impact: The assay allows for rapid quantification of bromoform levels in seaweed, accelerating the development of harvested seaweed as a livestock feed to reduce methane production and subsequently reduce greenhouse emissions.

METABOLOMICS

Metabolomics involves large-scale analysis of cell metabolites. Metabolomics is integral to the suite of 'omics technologies required for systems analysis and is often described as the 'glue' that brings multiple 'omics efforts together.

Through our network of metabolomics partner facilities we provide state-of-the-art metabolomics capabilities and customised services, from specific detection and quantification services, through to complex investigations and systems wide analyses in biological systems.

- University of Western Australia
- Australian Wine Research Institute
- The University of Melbourne
- University of Queensland

'MADE IN AUSTRALIA' YEAST

Development of new fermentation solutions for the global market

The wine sector contributes $45.5 billion to the Australian economy. In 2019-20 alone, Australia exported 729 million litres of wine valued at $2.8 billion. Yeast is a critical component in wine making as it converts the sugars of wine grapes into alcohol and carbon dioxide through the process of fermentation.

In this collaboration, AB Biotek worked closely with researchers at the Australian Wine Research Institute (AWRI), from product conception to final product evaluation for their 'Made in Australia' Maurivin™ Active Dry Yeast products to upscale their operations for global export. AB Biotek (Mauri Yeast Australia) is the only Australian active dry wine yeast locally manufactured in Toowoomba.

This industry collaboration is built on prior research where wine grape industry levy payers and the Australian Government had jointly funded several yeast discovery and strain development projects at the AWRI, through their investment agency, Wine Australia.

The Metabolomics Australia facility at AWRI supported the commercialisation and performance testing during upscaling by establishing flavour and aroma profiles of wines made throughout the development phase using mass spectrometric analysis.

Bioplatforms facilities:
Metabolomics Australia – Australian Wine Research Institute (AWRI)

Partners: AB Biotek

Outcome: This project led to the development and commercialisation of the new and lucrative 'Made in Australia' yeast strains for export.

Impact: These new yeast products are now being used by winemakers as tools for improving wine quality and creating novel and distinctive flavour profiles for product differentiation.

IMPROVING FERTILITY OUTCOMES

Biomarker development for improving in vitro fertilisation success rate

Historically, transferring multiple embryos in an in-vitro fertilisation (IVF) cycle was performed to improve success rates. However, transferring two or more embryos may result in multiple gestations, which carries significantly greater medical risks to both mother and child.

In IVF, the selection of the embryo is based on morphological and morphokinetic analyses but these do not provide a measure of embryo physiology, metabolism, or post-transplant viability.

Researchers from the University of Melbourne and Melbourne IVF worked with Metabolomics Australia to determine if small molecule changes can be detected and if these can be used as biomarkers to improve IVF outcomes.

Bioplatforms facilities:
Metabolomics Australia – University of Melbourne

Partners: University of Melbourne and Melbourne IVF. This work was supported by Virtus Health Limited and the Australian Government Research Training Program Scholarship, University of Melbourne

Outcome: The study showed that detection of higher levels of glucose consumption and a distinct amino acid profile correlated with blastocysts (fertilised egg) with higher developmental and viable pregnancy potential.

Impact: Small molecule (metabolites) technology can be used to detect biomarkers of embryo viability and can be used in combination with other approaches to improve healthy embryo selection to improve IVF outcomes and reduce medical risks for both mother and child.

BIOINFORMATICS

Australian BioCommons is building digital capability in Australian life sciences.

By collaborating with strategic partners in 2020-21 BioCommons enabled:

- The establishment of the Australian BioCommons Human Genome Informatics Initiative and commencement of projects in partnership with ZERO, Australian Genomics, Garvan, QIMR-Berghofer, UMCCR, AAF, Seven Bridges, Kids First, CHoP, NCI, ARDC, and AARNet.
- Galaxy Australia's rapid growth to 14,000 users, and the provisioning of new critical national computational resources suitable for large bioinformatics projects through new infrastructure partners
- The expansion of a national training program featuring high levels of collaboration with training partners and the flexibility to deliver quality events despite lockdowns
- An increase in the frequency and quality of multifaceted and mutually beneficial engagements with ELIXIR Europe around activities such as training, tools, workflows and Galaxy.
- The delivery of game-changing practical capabilities for researchers, such as the Australian Apollo Service, which had been identified in community road-mapping activities
- New modes of access to high-end computational resources for research collaborations to increase the availability of computational systems to members of consortia.

HUMAN GENOMICS DATA

The Australian BioCommons Human Genome Informatics Initiative is working with multiple partners to establish infrastructure across Australia that will enable the power of human genomics data to be more easily harnessed to inform better disease diagnosis, earlier disease detection and tailored treatment options. Full participation in the rapidly expanding global ecosystem of responsible human genomics data analysis requires the establishment of infrastructure for human genome data warehousing that enables ethical, secure and safe sharing and analysis in Australia and beyond, while adhering to global best practice standards.

Activity areas of the Human Genome Informatics initiative include:

- establishing systems to enable data findability and support virtual cohort assembly covering multiple data repositories across the country
- expediting safe and secure access to genomics data for research
- connecting secure and scalable Cloud analysis platform(s)
- streamlining data submission to the International EGA Human Genome Data Repository,
- undertaking community engagement and workforce transition

Two new programs of work commenced with a range of research partners (including ZERO, AGHA, UMCCR, Garvan, QIMR-Berghofer) infrastructure partners (including AAF, NCI, AARNet, ARDC), and expert national and international groups (including the global GA4GH Organisation, Australian Genomics, the ELIXIR Federated Human Data Community in Europe, the Children's Hospital of Philadelphia D3b and Seven Bridges Genomics in the USA).

The Gadi supercomputer at the National Computational Infrastructure in Canberra.

ACCELERATING THE CREATION OF DATA ASSETS

The Australian BioCommons is pioneering rapid insights into life science community data assets using Australia's peak high-performance computing facilities.

The benefits of generating molecular biology reference datasets such as reference genomes or a continental-scale of environmental microbiome analyses are far-reaching, where research for health, agriculture and the environment all benefit. Bioplatforms Australia and many of its co-funding partners enable the generation of such molecular biology reference datasets to address themes of national significance through Bioplatforms Australia's Framework Initiatives.

To date, these large collaborative efforts have been impeded by challenges they face around access to appropriate high-powered computational and storage infrastructure. The lack of access, available scale and support have limited the ability of research communities to construct shared reference datasets from the raw data, and analyse the reference datasets to generate new scientific insights and knowledge.

The Australian BioCommons is spearheading a solution to this challenge by working closely with research leaders and bioinformaticians associated with the Framework Initiatives as well as Australia's two Tier 1 compute facilities - National Computational Infrastructure (NCI) and the Pawsey Supercomputing Centre. The intention is to explore, develop and operate methods that enable collaborative use of high-powered computational infrastructure by national research communities.

To accelerate the development of significant reference data assets and other derived data products, the Australian BioCommons Leadership Share (ABLeS) has been established. It provides research communities, working within the Framework Initiatives, access to cloud and high-performance computing infrastructure at NCI and Pawsey, as well as commercial cloud resources. Furthermore, it coordinates support and training as well as access to expertise to use that infrastructure effectively. The intention is to create more 'life science-ready' compute resources, and an upskilling of researchers and research communities to be able to benefit from these large but rationed compute facilities.

ABLeS aligns with a variety of other BioCommons platforms, such as the provision of tools and workflows in Galaxy Australia. It also engages the same national and institutional computational resources and network of experts involved in the Bring Your Own Data initiative co-invested by the ARDC. A longer-term goal of ABLeS is to broadly inform compute allocation policies, ensuring they are more attuned to supporting life sciences, and generating maximal impact from major computational investments.

GALAXY AUSTRALIA

The digital analysis service, Galaxy Australia, has grown to become a critical research infrastructure for the Australian life sciences community. Rapid development, including continual code base improvements and new hardware, have provided a combined offer of access to best practice pipelines and tools in genomics, proteomics and metabolomics.

Galaxy's COVID-19 effort was published in Nature Biotechnology with two Galaxy Australia authors: Ready-to-use public infrastructure for global SARS-CoV-2 monitoring: (https://doi.org/10.1038/s41587-021-01069-1)

Galaxy Australia at the end of 2020/2021:

USERS
13,751
↑ 56%

JOBS RUN
2,455,451
↑ 50%

DATASETS CREATED
4,246,743
↑ 54%

PAPER CITATIONS
112
↑ 50%

BIOPLATFORMS AUSTRALIA

Bioplatforms Australia is a non-profit organisation that supports Australian Life science research by investing in state-of-the-art infrastructure and expertise in genomics, proteomics, metabolomics and bioinformatics. Investment funding is provided by the Commonwealth Government National Collaborative Research Infrastructure Strategy.

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