

2020 Annual Report

Powering Australia's battery revolution

Minister Karen Andrews (second from right) at the launch of the FBICRC with Board members (from left) Mark Woffenden, Graeme Hunt, Sarah Ryan and FBICRC Board Chair Tim Shanahan.

Chair's Report

In our first year of operations, we have mapped out a substantial - and achievable – program of research and development for Australia's future battery industries.

Despite the significant world-wide challenges of establishing our projects during the global Covid-19 pandemic, we have laid the foundations for a program of great significance to Australia's industry and environment.

I am delighted with the Board we have established to oversee this CRC and equally impressed with the management team and scientific support set up to drive these critical projects.

We are all confident that this initiative - to create the energy storage needed for the transformation of future industries – will be a game changer for our economy and communities.

In designing this program, we focused on four principal strategic objectives

- 1. To leverage Australia's minerals and mining advantages into battery materials innovation and production.
- 2. To accelerate the uptake of battery technologies in Australia.
- 3. To advance our research and capability in battery materials and precursor manufacturing.
- 4. To facilitate battery industry development.

The key indicator of success will be industry development, measured against a baseline established by the CSIRO report – State of Play: Australia's Battery Industries. The landmark study by CSIRO's Dr Chris Vernon and Dr Adam Best measures the impact of the CRC's activities at the start of its six-year research and development journey. The report notes that Australia is on the cusp of developing significant capability and capacity to move further along the battery value chain. This is currently limited to battery grade chemicals but with clear aspirations to move to precursor manufacturer and production of bespoke batteries.

Australia is currently one of the world's principal producers of battery materials from traditional – and expanding - mining industries. In this context, one of the principal elements of the CRC program will be to create further value by downstream processing.



At the same time, we will be looking to reuse, repurpose and recycle battery materials.

In working to accelerate the uptake of battery technologies in Australia, we will be aiming to create new solutions for mass energy storage that enable market penetration.

In doing this, we will seek to establish the FBICRC as a national battery industry authority and help inform a competitive policy framework for industry growth.

Despite the major challenges of 2020, we have good reason to be encouraged by our progress to date. We have a positive response from State and Federal governments and valuable support from international science and industry.

Looking ahead, I believe my role will be to make sure the CRC delivers on the targets expected by our industry participants, giving them the opportunity to have a real impact on industry growth.

Mr Tim Shanahan Chair, FBICRC

Our purpose is to accelerate growth in investment and employment in battery industries in Australia.

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This report provides a summary of activities from the establishment of the FBICRC to the end of 2020. The full Statutory Annual Report is available on request, please email admin@fbicrc.com.au to request a copy.

CEO's Report

The past 12 months have been challenging for many of us. Despite this, FBICRC has had a highly successful first full year of operations.

This is due to the strength of our collaboration and our shared commitment to the role that battery industries can play in boosting Australia's economic growth and improving the sustainability and resilience of its energy systems.

In 2020, the CRC completed a range of establishment tasks. A key focus was engaging the CRC community of participants, and maintaining momentum with its project development and approvals – despite the impact of the circumstances surrounding COVID-19.

The CRC experienced a short-term drop in revenues from some participants and an inability to meet some milestones due to limitations in industry capacity and access to research staff, students and facilities in the first half of calendar year 2020.

It successfully adapted to new ways of getting things done, fostering collaboration and supporting participants. A registration of interest process to establish an initial research and development portfolio was completed. The first of a series of scene setting reports to build interest and support in the work of the CRC were released and the first major projects were approved. Education, advocacy and business incubator activities have been embedded in the design of these projects.

The start-up of the CRC has been timely. Australia is on the cusp of developing significant capability and capacity to move further along the battery value chain based on a world class minerals resource and strong technical competence.

While some of our participants have been under pressure during an unexpected year, all remain profoundly of the view that there is a large economic opportunity for Australia to leverage downstream and become better integrated in the clean energy and battery storage space.

Achievements

We have achieved some significant milestones since the Commonwealth Government's commitment of support for the establishment of the FBICRC announced in April 2019. These include:

- A successful second face to face summit of nearly 100 participants held in Perth in March 2020 just before COVID restrictions limited these options and our office closed for a period.
- The virtual meetings with many members which followed to understand how best to support them



and keep moving forward despite the evolving crisis.

- The release of five initial scene setting reports which have helped inform the direction of our activities, and established a positive profile for the CRC – with three more to be released early in 2021.
- These reports and webinars for Australian and international audiences have been important stepping stones in shaping the direction and industry interest in the process of approving and contracting our initial research portfolio.
- We have developed a portfolio of 15 key projects with participants across the battery industry value chain – with 12 initiated by the end of the year and three more under development.
- We worked with the Board to develop a strategic plan which has highlighted the importance of our investment in research as a foundation for broader battery industry development.
- We finished the year as a growing CRC with several new participants joining the program and increased contributions from existing participants.
- The Commonwealth confirmed a variation to our grant agreement in November confirming the CRC's funding and milestones through to 2025.
- The Centre established its national office within Curtin University in Perth, Australia and operates with a

team of 9 (6 full time staff located at Curtin University and 3 part time research program leads located at Curtin, QUT and University of Melbourne) and a highly experienced and credentialled board, and an expert international Board advisor on battery industries, Christina Lampe-Onnerud.

An education, training and entrepreneurship program is an essential part of growing and building new battery industries. At the end of 2020, we had three PhDs attached to approved research projects - and expect this number to ramp up in 2021. We also have a vocational education stream and have begun to develop entrepreneurship programs. South Metro TAFE has completed phase 1 of a Vocational Workforce Development project, to identify industry skills needed across the battery value chain. The next phase of this project will assess the skills gaps by mapping new and existing skill needs against existing curriculum, training delivery and workforce supply. We also partnered with ClimateKIC in the Climate Launchpad competition, sponsoring a number of battery specific teams in the competition, with a team from Deakin University, Elevenstor, making it through to the Global finals and winning the sustainable mobility category overall.

Operating landscape

There is a confluence of events in Australia and internationally which provides new opportunities for the CRC to promote a bigger role for Australia's battery industries.

The Federal Government's new energy plan has a focus on hydrogen, batteries, green steel and aluminium and carbon capture with plans to invest in these technologies. Its Modern Manufacturing Initiative also has a focus on sectors which will be enabled by the growth of battery industries: resources technology & critical minerals processing, recycling and clean energy, defence and space. These are new multi billion dollar programs.

It is also appropriate to acknowledge that the early and strong support we had from the WA Government is continuing. MRIWA is working closely with the CRC in stewarding the State's \$6M investment in our activities. and a proactive approach to new initiatives such as an incentives to attract cathode active materials manufacture to the State.

There have been some important international signposts for the development of battery industries.

Pleasingly, this includes signs that the weakness in pricing for lithium carbonate and hydroxide may improve. Long-term forecasts showing strong growth as Europe catches up with China in terms of automotive Li-ion battery demand which is driving a focus on sustainable supply chains. Deployment of batteries is also growing rapidly off grid and in grid in Australia.

Tesla Battery Day 2020 put a spotlight on some ambitious stakes in ground for the industry. Scale is everything according to Tesla which plans to transition from gigawatt to terawatt scale production within a decade. This would increase its production 80-fold. The focus on lithium-ion and nickel for higher capacity and on the raw material supply chain including its

sustainability credentials aligns well with the CRC's research projects.

The growing interest in the growth of battery industries in Australia has seen the CRC attract new participants Anteo Technologies, Talga Group, Lycopodium and Mineral Carbonation International join as key participants, and Solvionic and Feline join as associates. Additionally, DLG Batteries and Cherratta Lodge have joined as third parties in individual projects. We represent a nearly \$130 million cash and in kind collaboration. We are also seeking to strengthen our partnerships with some key international research organisations such as Franhoffer and Helmholtz in Germany, and KIGAM in South Korea.

I also particularly want to acknowledge the additional funding to the CRC provided by BASF, a core participant. BASF has provided additional funds towards purchasing four fully automated, continuous manufacturing units for the CRC's cathode precursor pilot plant which is being repurposed from BHP's original nickel sulphate pilot plant at CSIRO's Waterford facilities. We will be using a model that BASF has used successfully elsewhere to demonstrate technically and economically feasible manufacture of PCAM and quality verification via lithiated high nickel based cathode active material (CAM).

BASF has also supported additional post-doctoral researchers for the pilot plant project and the purchase of a FBICRC branded EV and a charging station at the company's offices. It is an incredible contribution and for that we thank them.

As a six year CRC, we remain focused on completing the project initiation phase of our activities, to begin to deliver the projects and solutions for which participants have committed their time and money. By the end of the calendar year 2020 we had initiated 12 of 15 projects. These have been designed as part of an integrated approach to growing a battery industry, and informed by strong engagement from our industry, research partners and advisors in ensuring the projects understand the competitive landscape for the commercialisation of their outputs, and have clear and measurable targets.

In the year ahead, we are focused on the transition from project initiation to delivery, our engagement with participants and being an effective voice for the development of battery industries in Australia leveraging the announcements planned for several major projects.

I sincerely thank all of our participants, our staff for their dedication and determination, particularly in delivering despite COVID-19 restrictions, our Board, and our International Advisor, for their guidance and support.

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Mr Stedman Ellis CEO, FBICRC

2020 Highlights

\$128m total cash and in-kind contributions

\$58m cash

\$35m staff in-kind

Established FBICRC Governance

- Full board and special advisor to the board appointed
- Fstablished Advisory Committees
- Appointed key staff

57 Participants Participant 21 Core & Key Agreements 36 Associates

Education & Training

- 3PhDs of 40 higher degrees by research
- & professional

\$35m non staff in-kind

commenced of a potential total

 Vocational skills, entrepreneurship development

Projects across the battery value chain

- 50+ FOIs
- · 3 Program themes
- 15 Projects
- · 8 Scene Setting reports

Research Projects

From over 50 expressions of interest, the FBICRC's selected an initial 15 projects.

The initial pipeline of projects were selected and designed to cover key areas in the battery value chain where Australia can make a global impact:

- Extraction and refining to produce battery grade chemicals from battery mineral resources
- Conversion to high quality battery component
 materials
- Testing at cell and pack level

- Pack manufacturing and deployment with associated battery management systems
- Applying circular economy principles to all wastes along the value chain, up to end-of-life batteries
- · Certification, Provenance & Traceability

These projects position Australia as a globally competitive provider for the future battery industries value chain, transform the energy sector, and leveraging Australia's natural resources and internationally recognised research capability.

A key focus of the CRC is building a collaborative culture to deliver highly impactful projects.

Three research programs were identified to deliver these projects.

Battery Industry Development, is contributing evidence-based advice to inform competitive government policies and regulations for the development of battery industries within the context of a circular economy.

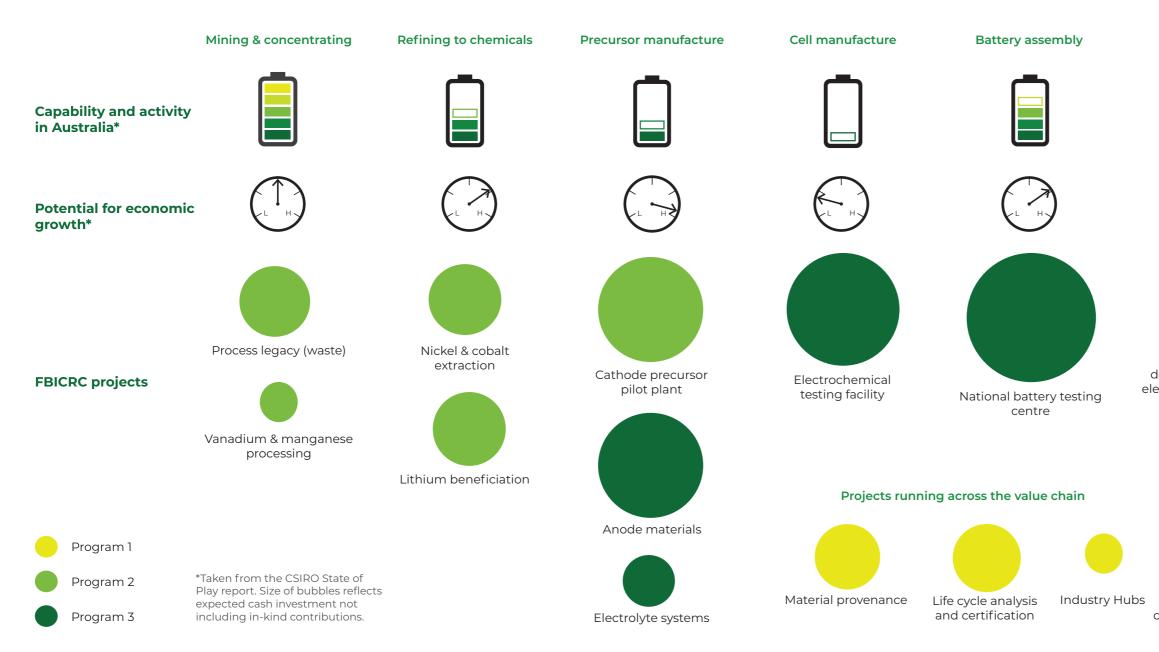
Battery Resources, Processing and Recycling,

provides optimised pathways to mine, extract, refine and recycle battery minerals, metals and materials to produce quality Australian battery grade products.

Battery Materials, Components, Manufacturing,

Testing and Deployment, completes the value chain including battery manufacture, deployment and optimising use of energy storage systems in the economy.

Australia's current capability & potential for economic development from CSIRO's "State of Play: Australia's Battery Industry", mapped against the FBICRC's suite of projects



Projects are aligned to the key national challenges and opportunities identified by industry participants with investment focused on achieving impact for Australia.









Microgrid battery deployment (inc mine electrification stationary)



Mine electrification (mobile)



Value Chain competitive analysis

Recycling







Recycling, reuse and repurposing of batteries

Research Projects

FBICRC Projects across the battery value chain

Production Stage	Capability and Activity in Australia	Potential for economic growth	FBICRC Projects		
Mining and concentrating Mining and concentrating for domestic processing markets and to support the global battery supply-chain. While maintaining exports of battery metals, also ensuring secure domestic supply for our processing industry to grow from.			Process Legacy:Vanadium and MangaMaximising economically viable co-products and minimising waste, within an acceptable regulatory framework.Developing new and in for vanadium and man and purification, and the of vanadium bearing end Vanadium Redox Flow		
Refining to Chemicals Manufacturing battery-grade chemicals e.g. Lithium hydroxide, cobalt sulphate, nickel sulphate, manganese sulphate, refined graphite etc. Australia can compete in the international market for supplying these products as well as used to feed into domestic supply chains.			Innovative Nickel and Cobalt Extraction: Unlocking the extraction of nic and cobalt from material previo classified as waste, for the prod of battery precursor chemicals.	ously refining of b luction to support a	
Precursor Manufacture Manufacturing precursor products and active materials (cathode, anode, electrolytes and separators) that can be exported as well as used in domestic supply chains.		ull	Cathode Precursor Pilot Plant Establishing the technical and processing capabilities to manufacture nickel-rich cathor active material precursors in W increasing the value chain of battery manufacturing in Aust	Developing Aus across the anod de chain to produc /A, anodes, capitalis natural graphite	
Cell Manufacture Manufacturing and testing of battery cells with properties that meet the demands of a range of speciality domestic applications.			Electrochemical Testing Facili Fabrication and testing facility for Australian lithium battery materials to provide data to validate performance and qual of these materials.		
Battery Assembly Small-scale assembly and testing of high-value battery packs that are specifically designed for domestic deployment needs in niche industry applications (i.e. defence/mining).			National Battery Testing Cent A facility to test batteries both from the battery cell, providing feedback on resource develope downstream. It will also provide for nationally accepted standar deployment of these systems in national electricity grids.	upstream 9 ment, and e the basis rds for	

nese Processing:

mproved processes nganese extraction he optimiation electrolytes in Batteries (VRFBs).

Lithium extraction:

technology for the of lithium minerals, and f battery grade lithium an emerging battery uring industry in Australia.

ustralian capability ode material value uce high power alising on Australia's ite reserves and chnologies.

Future Electrolyte Systems:

New electrolyte systems to improve Lithium ion battery performance in niche applications.

Production Stage

Capability and Activity in Australia

Potential for economic growth FBICRC Projects

		Microgrid (residential): Developing new technologies that maximise the benefits of battery energy storage systems.	Mine electrification (stationary): Assessment, design and operation of battery-supported mining vehicles and machinery.
	ıIII	Recycling, Reuse and Re Optimised pathways to r and recycle battery mine materials to produce bat that will pass strict quali	mine, extract, refine erals, metals and ttery grade products
		Value Chain Analysis: Use a contemporary and consistent fact- base to establish a credible estimate of the economic opportunities for Australia to diversify downstream.	Trusted Supply Chain: Connect customers to the source of battery minerals and products by developing tools, systems and platforms that provide transparency within the supply chain that enables supply chain stakeholders to manage risks associated with unethical and unsustainable
-			Image: Second system Image: Second system Image: Second

Mine electrification (mobile):

Providing the Australian mining industry with the tools and information needed to help transition their operations to using battery-supported electric vehicles (BEVs) and associated stationary machinery on mine sites.

Life Cycle Analysis & Certification:

Establishing a quantified environmental basis to ensure traceable, sustainable production of Australian battery minerals, metals and materials.

Battery Industry Hubs:

Facilitating regional synergy and investment around downstream, battery industry development.

Scene Setting Reports

Eight foundational scene-setting projects were commissioned in 2020, five of which have been released. These have set a comprehensive baseline for the industry at 2020, providing a foundation for the projects that build on them. They have also been instrumental in attracting further interest into our project portfolio.

Three additional Scene Setting Reports will be released in 2021 on battery materials provenance, recycling, and battery industry hubs.



Launched in May 2020, we released the first scene-setting project report in collaboration with the Perth USAsia Centre, UWA and the Minerals Research Institute of WA.

The geography of global supply chains is a complex and important issue for Australian businesses seeking to move downstream in battery industries. This report investigates existing battery value chain governance, security and sustainability, and identifies economic opportunities for Australia within that framework.

View report

https://fbicrc.com.au/wp-content/uploads/2020/10/PU-141-Energy-Report-WFB.pdf



The second scene setting report was funded by the Minerals Research Institute of WA and undertaken by QUT, with support from Hatch Engineering and Curtin University. Launched by WA Minister for Mines and Petroleum Minister Bill Johnston, the report shows WA is well placed to develop battery precursor production capability central to downstream processing of battery minerals, a critical gap in the Australian supply chain. This will bring significant social, environmental and economic benefits to WA and the nation, placing Australia as an exporter of value-added products, rather than just raw materials.

View report

https://fbicrc.com.au/wp-content/uploads/2020/07/Li-ion-Battery-Cathode-Manufacturing-in-Aust-1.pdf



This CSIRO report illustrates Australia's potential to capitalise on the value add from moving further along the battery value chain. This benchmark study assessed the widely recognised once in a generation opportunity for Australia to create new battery industries, forming an important benchmark for the impact of the FBICRCs investment in research, development and education.

View report

https://fbicrc.com.au/wp-content/uploads/2020/10/20-00191_MR_ REPORT_FBICRC-StateOfPlayBattery_WEB_201002.pdf



Certification and LCA of Australian Battery Materials – Drivers and Options SCENE SETTING PROJECT PR INDUSTRIES CRC

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This report highlights how Australia could benefit from sustainability certification of battery materials and developing demonstrably sustainable supply chains. The report underpins a collaborative project on establishing Australian industries as socially and environmentally responsible suppliers of battery minerals and materials for a circular economy.

View report

Heightened social pressure and a need for economically efficient mining practices will see Australia's mining industry shift towards a future of automation, electrification and the ultimate goal of zero emissions on site.

According to this report, led by VCI, the majority (89%) of the globe's leading mining executives expect mine sites across the world to electrify within the next 20 years. Electrification is a game changer for the mining industry as it allows the complete removal of diesel from mines and, when combined with renewable energy, results in a decarbonised mine site.

View report

Electricity_Web_v2.pdf

State of Play: Electrification

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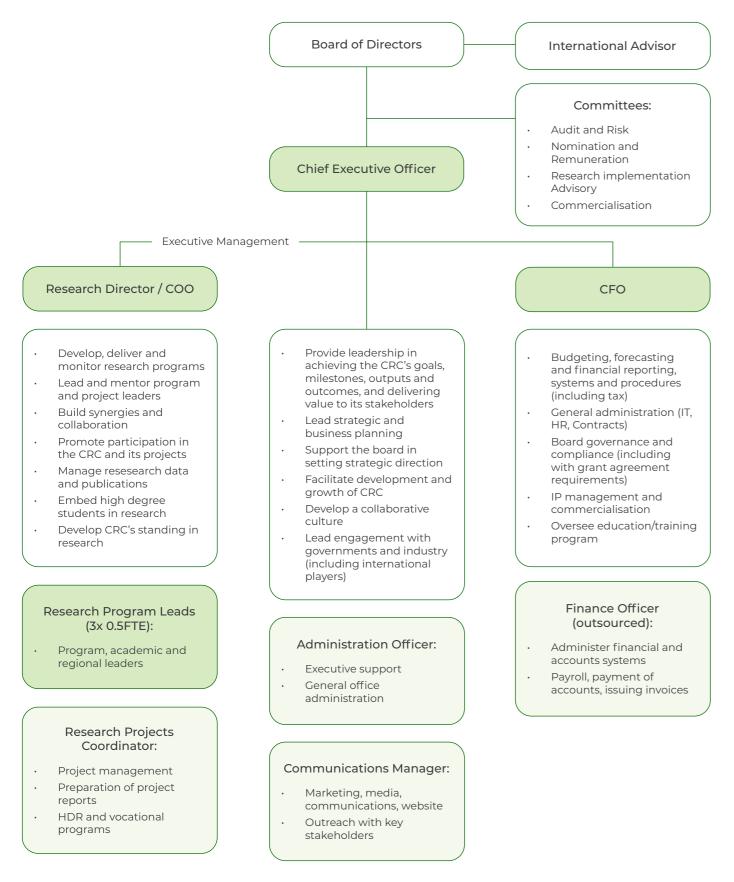
The report was led by the Institute of Sustainable Futures at the University of Technology Sydney and The University of Melbourne.

https://fbicrc.com.au/wp-content/uploads/2020/10/Certification-of-Au-Battery-Materials-WEB-INTERACTIVE-SEPT-2020.pdf

https://fbicrc.com.au/wp-content/uploads/2020/10/StateofPlay_Report_

Governance

The governance and management structure of the CRC has been designed to deliver the outputs needed to grow Australia's battery industries. During 2020, the CRC was structured this way:



Meet the Team

Cooperative Research Centres are jointly funded by the Federal Government, industry participants and research organisations to support Australian industries to solve critical issues, develop new technologies, products and services and compete on the world stage.

The CRC program is a proven model that has delivered significant economic, environmental and social benefits to Australia across a diverse range of industries.

The FBICRC team is based in Perth, with Program Leads in Perth, Victoria and Queensland.

Chief Executive Officer Stedman Ellis

Chief Operation Officer Jacques Eksteen

Chief Financial Officer Derek Hall

Communications Manager Jenny Shewan

Project Coordinator Stacy Osenbaugh



Executive Assistant Kelsee Sewell

Research Program Lead: Battery Industry Development

Jo Staines

Research Program Lead: Resources, Processing and Recycling

Mark Aylmore

Research Program Lead: Materials, Components, Manufacturing and Deployment

Peter Talbot

Meet the Board

The full Board of the FBICRC was established in February 2020. The Board members bring a diverse and complementary skill set across a range of critical talent areas and sectors.

Mr Tim Shanahan



Independent Nonexecutive Chairman

BJuris LLB, FAICD, PSM, RG146

Special responsibilities: Member of the Nomination and Renumeration Committee

Tim is a renowned and highly respected leader, who has made significant contributions to WA during a decorated corporate and civic career, including as CEO of WA Chamber of Minerals and Energy founding Director of the UWA Energy and Minerals Institute (EMI), Chair of the Western Australian Regional Development Trust and Principal Advisor to the UWA Vice Chancellor. Currently. Tim also serves as chair for the Zetta Group, WA Super and WA SuperNet, and is a Director of RAC Holdings and the Committee for Perth.

Ms Lisa Paul AO PSM



Independent Nonexecutive Director BA (Hons), FAICD, FACEL, FAIM, FIPAA, FANZSOG

Special responsibilities: Member of the Nomination and Renumeration Committee

Lisa is a leader with extensive senior executive experience in both the public and private sectors, including as Secretary for the Commonwealth Department of Education, Science and Training and later Department of Education, Employment and Workplace Relations. Lisa has joined three company boards, both listed and private, several not-for profits, and served on the Federal Government's Naval Shipbuilding Advisory Board.

Mr Graeme Hunt



Independent Nonexecutive Director

MBA, BMET, FAus IMM

Special responsibilities: Chair of the Nomination and Renumeration Committee

Graeme is a respected international executive, with a professional career spanning more than 40 years. He holds a Bachelor of Metallurgy and served as President of the iron ore, uranium, aluminium and manganese divisions of BHP Billiton Ltd. He subsequently was the CEO and Managing Director of Lihir Gold Ltd and Broadspectrum Ltd (formerly Transfield Services Ltd) and is currently Chairman of AGL Energy and Bis Industries Ltd.

Mr Mark Woffenden



Independent Nonexecutive Chairman

BSc (Geology)(Hons), BEng (Mining), MAusIMM, AICD

Special responsibilities: Chair of the Research Implementation Advisory Committee, Member of Audit and Risk Committee

Dr Sarah Ryan



Independent Nonexecutive Director

BSc (Geology), BSc (Geophysics) (Hons 1), PhD (Petroleum and Geophysics), FTSE

Special responsibilities: Chair of the Audit and **Risk Committee, Member** of the Commercialisation Committee

Dr Bruce Godfrey



Independent Nonexecutive Director **BEng** (Electrical and

Electronics) (Hons IIA), PhD (Photovoltaics), FTSE

Special responsibilities: Chair of the Commercialisation Committee

Special Advisor to the Board



Christina Lampe-Onnerud

PhD in Inorganic Chemistry from the University of Uppsala Mark has more than 40 years' experience as a senior executive in the minerals industry, including serving in senior management positions with Rio Tinto subsidiaries, including Hamersley Iron and Comalco. He is a former Director for the Centre for Mining Technology and Equipment, Member of the CSIRO Minerals Exploration and Mining Sector Advisory Committee and Non-Executive Director of the METS Ignited Industry Growth Centre.

Sarah is a respected non-executive director of ASX20-ASX50 companies, with more than 30 years of domestic and international executive experience. She spent 15 years with Schlumberger, the leading oilfield technology company. Sarah currently serves on the boards of ASX-listed Woodside Petroleum, Aurizon Holdings and Viva Energy. She is also a Non-Executive Director on Oslo-listed Akastor ASA, an oilfield services and technology company.

Bruce is an experienced, commercial executive with a proven ability dealing with commercialising new technology. He serves as Director for Wyld Group Pty Ltd and Director and Vice-President of the Australian Academy of Technology and Engineering and Director of Science in Australia Gender Equity Limited. He concurrently serves as the Chair of the Advisory Board for the Australian National University's Battery Storage and Grid Integration Program and as a Member of the Australian Renewable Energy Agency's Advisory Panel.

Based in the greater New York area, Christina is a world leading battery expert. She has extensive C-suite experience growing and transforming businesses and has worked in the field of global energy transformation in the United States, European and Asian markets.

She is a proven business strategist and executive leader, with international experience in the commercialisation of Intellectual Property. She has worked in the fields of global energy transformation involving grid, transport, industrial and electronics markets.

Participants

The Future Battery Industries Cooperative Research Centre brings together over 50 partners, including industry participants, Federal and State Government stakeholders, academics and researchers and broader participants and supporters from across related sectors.

Our tiered partnership model allows participants of all sizes to join us in this once in a generation opportunity to develop new technologies.

National participants have each made a cash or inkind contribution to the work of the Future Battery Industries Cooperative Research Centre and provide direct input into our focus research areas. The work will be critical in harnessing the research skills and industry expertise required for solving common challenges.

The CRC unites the expertise of its eight founding university partners, the CSIRO and the ChemCentre of Western Australia.

If everyone is moving forward together, then success takes care of itself - Henry Ford

Associates













Australian Governmen Department of Defence Defence Science and Technology Group

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GALAXY

JOSH BYRNE

& ASSOCIATES

magellanpower



D - BASF

We create chemistry

Core Partners



BHP



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Department of Natural Resources, Mines and Energy





LAVA BLUE LTD





















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