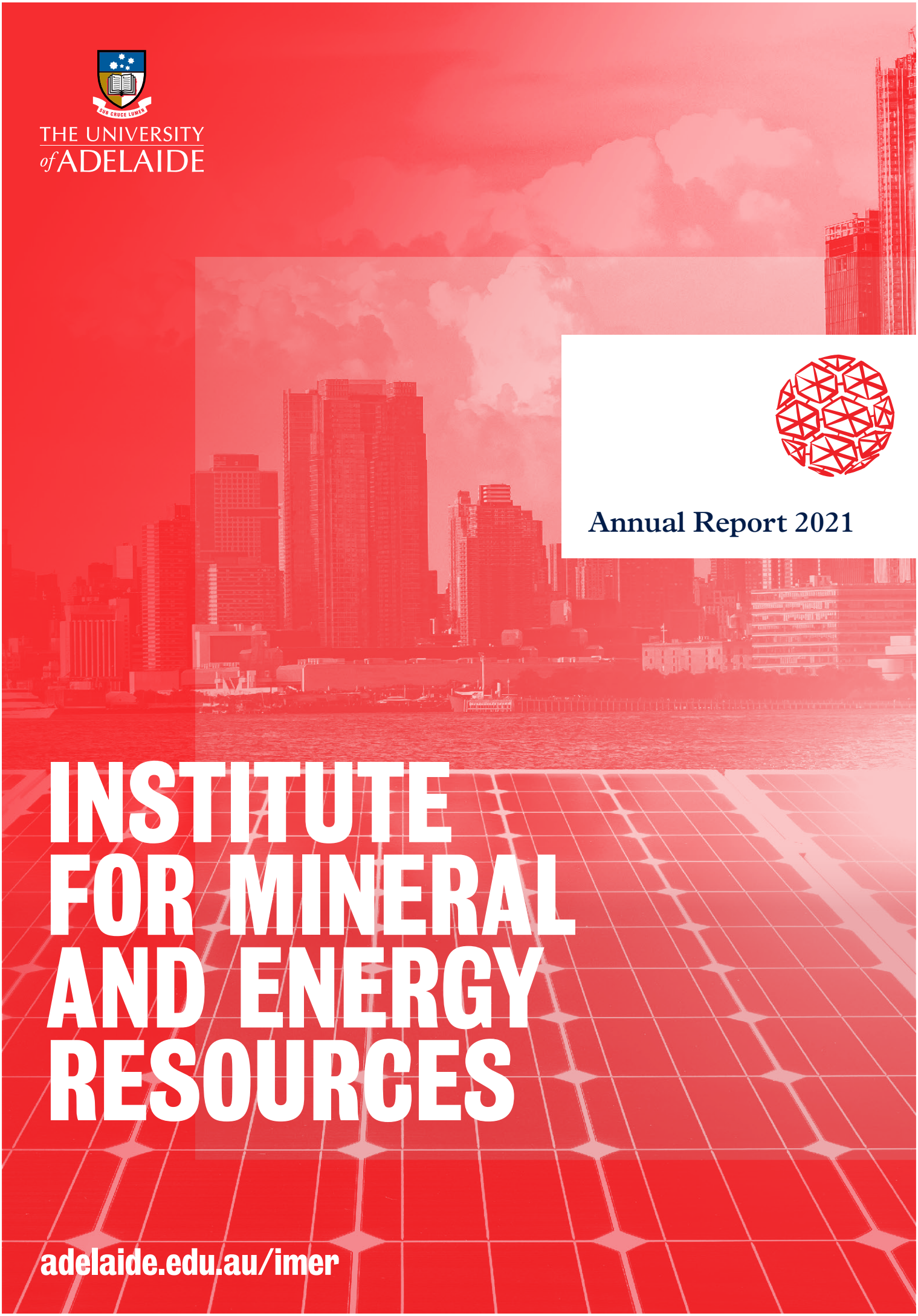


THE UNIVERSITY of ADELAIDE

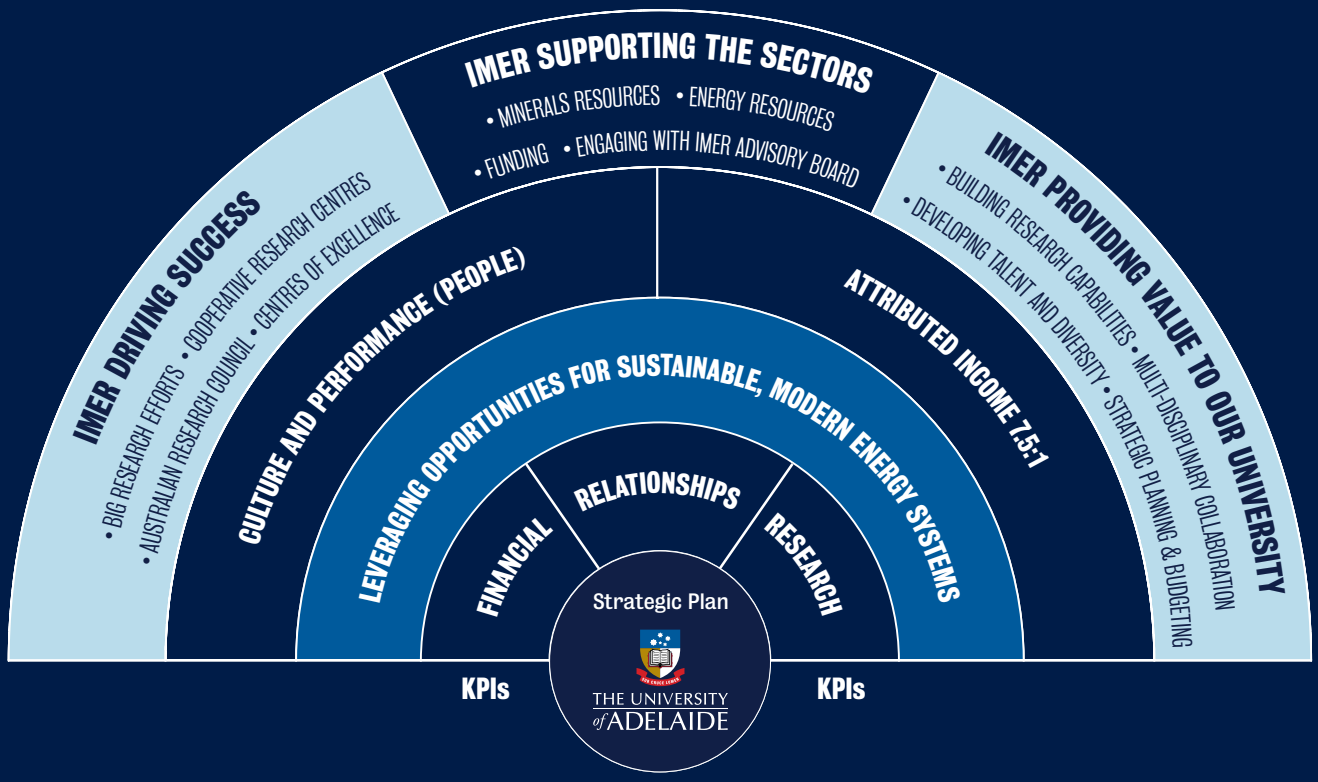
Annual Report 2021

INSTITUTE FOR MINERAL AND ENERGY RESOURCES

adelaide.edu.au/imer

“WE ARE PROUD OF IMER’S EVOLVING FOCUS AND COMMITMENT TO CREATING A POSITIVE IMPACT — FOR OUR PARTNERS, OUR COMMUNITY AND OUR PLANET.”

Professor Anton Middelberg, Deputy Vice-Chancellor (Research)



THE IMER UNIVERSE

IMER operates at the international forefront of the mineral, energy and resource sectors, showcasing our finest talent in large-scale research and innovation outcomes, with the capacity to pursue higher-risk, cutting-edge projects catalysing the modern energy system.

IMER helps create and deliver a vision for a more sustainable world, and reaches out across the globe to collaborate on delivery of this vision.

IMER supports an important component of the University of Adelaide's Strategic Plan and is driven by key performance indicators, influenced by its own culture and that of the University. It illustrates here the critical need for a return on investment and the interconnected nature of our business.

CONTENTS

What was IMER?

IMER was the Institute for Minerals and Energy Resources, one of six institutes in 2021 at the University of Adelaide. In 2022, IMER will evolve to ISER – the Institute for Sustainability, Energy and Resources. It will continue to develop cross-disciplinary programs and teams that transcend University school and faculty boundaries to work collaboratively with industry and government. Like IMER, ISER will focus on opportunities critical to energy and resources sustainability, productivity and global competitiveness.

ISER will catalyse research-driven innovation for modern energy systems. This new institute will also be guided by a fresh industry advisory board. This annual report contains required information and aims to add value for ur stakeholders.

Who are ISER's stakeholders?

- Academics and researchers
- Energy, sustainability and resources sector industry groups
- Energy, resources and minerals companies
- The State Government of South Australia
- The Australian Government and funding bodies.

MISSION

To provide transformative solutions for modern energy systems in a rapidly changing world

VISION

To be the global destination for research and development in modern energy systems

AIM

To win highly competitive funding from government and industry, in the energy, minerals and resources sectors, through:

- national and international research and interdisciplinary initiatives such as cooperative research centres, Australian Research Council Centres of Excellence, training hubs and collaborative research programs with industry for global impact
- strategic cooperative research ventures with state, territory and Australian Government agencies to lever significant social, economic and environmental outcomes
- facilitating smaller-scale pilot programs for longer-term growth.

AT A GLANCE

82 MEMBERS

FUNDING OUTCOMES

$10.4M
Australian Competitive Grant Research Income

$7.8M
Other Public Sector Research Funding

$8.9M
Industry and other Funding for Research

$3.5M
Cooperative Research Centre CRC Funding

PUBLICATIONS

Our research leaders have produced the following publications in 2021:

628
Journal Articles

5
Books

128
Conference Papers

4
Expert reports to external bodies

ARTICLES IN HIGH IMPACT FACTOR JOURNALS

37
15+ JIF* Publications

29
10–14 JIF* Publications

114
6–9 JIF* Publications

*Journal impact factor

HIGHLIGHTS

South Australian Scientist of the Year Professor Shizhang Qiao

STEMM Educator of the Year Finalist - Dr Richard Lilly

HILT CRC awarded to accelerate a low carbon future for heavy industry

Launch of the Australian Critical Minerals Research Centre

Australian School of Petroleum and Energy Resources teams up with Chevron Australia to create a new state-of-the-art facility for carbon storage research.

DEPUTY VICE-CHANCELLOR (RESEARCH) REPORT

Professor Anton Middelberg

We know the critical importance of the energy sector to planetary sustainability, and in IMER – now ISER for 2022 and beyond – the University has developed an institute underpinned by sustainability principles and pioneering energy and resources research.

Clean energy and associated technologies are crucial to overcoming multiple challenges for humanity -- decarbonising energy utilities, transport, heavy industry and mining, reducing air pollution and its health and environmental impacts. There is also the task of expanding access to reliable electricity for developing countries and remote communities.

The University of Adelaide continues to invest significant human, technological and financial resources in helping society to meet the grand challenge of net zero emissions by 2050.

The important work of ISER in this sector covers modern energy systems and networks, mining and energy markets, materials and security, clean energy, storage and materials, data and cyber capability, renewables, economics and social policy for all of these game-changing fields.

ISER will be the industry and governmental conduit to the University of Adelaide's full spectrum of world-class, sustainability, energy and resources-related expertise. We are proud of IMER's evolving focus and commitment to creating a positive impact — for our partners, our community and our planet.

Congratulations to the staff and contributors to IMER's incredible success in 2021, and to its evolution to ISER in 2022 and beyond.

FIVE PILLARS TO EXCELLENCE

Five pillars define our Strategic Plan and will shape the trajectory of the University of Adelaide. These connect our research and teaching capabilities, manifest in our Faculties and Research Institutes, with the key challenges faced by our evolving world.

1. CONNECTED TO THE GLOBAL WORLD OF IDEAS
2. A MAGNET FOR TALENT
3. RESEARCH THAT SHAPES THE FUTURE
4. A 21ST CENTURY EDUCATION FOR A GROWING COMMUNITY OF LEARNERS
5. THE BEATING HEART OF ADELAIDE

DIRECTOR AND ADVISORY BOARD CHAIR REPORT

Professor Michael Goodsite

As part of the Organisational Sustainability Project, ISER replaces IMER as a university research institute. I would like to thank all staff, including deputy directors, who have delivered considerable success through their leadership of IMER, and their engagement with key sectors in Australia. We expect this engagement will deepen and broaden through ISER, building on the IMER legacy.

IMER's evolution has the full backing of the IMER Advisory Board, and we the members collectively thank the University for the opportunity to have served. We wish the incoming ISER Advisory Board, to be appointed in 2022, all success.

Achievement of KPIs despite the odds

IMER again exceeded all key performance indicators, primarily to earn at least $7.5 million in research income attributed to our efforts, over and above our annual budget of just under $1m. This is despite the ongoing disruption and challenges of the pandemic.

Bid wins worth millions

At a time when the University has been pressured to increase revenue and undergo structural change in the wake of border closures and economic disruption, IMER achieved many significant bid successes. These will contribute millions of dollars in research income or funding for the University and South Australia.

IMER demonstrated its ability to bring together collaboration partners in international research and development expertise with their own strategic know-how.

Working with industry partners to best secure research outcomes that benefit these sectors is a cornerstone of the IMER approach. As ISER, the institute will continue to maximise limited resources by applying a portfolio management style of programs to balance risk and reward on value-generating activities and projects.

Mentorship program for early career women

IMER also delivered results in research impact and relevance. We are delighted to have worked with Dr Kathryn Amos as our first female deputy director to create a new mentorship program for early career women.

Outcomes in 2021

This year's annual report continues our practice of delivering meaningful, short and concise information to our stakeholders.

We are excited to have supported the efforts of SA Scientist of the Year, Professor Shizhang Qiao, the STEMM Educator of the Year finalist, Dr Richard Lilly, and contributed to the successful award of the HILT CRC bid to accelerate a low-carbon future for heavy industry.

In 2021, IMER also played an integral part in the creation of the new Australian Critical Minerals Research Centre and the Andy Thomas Centre for Space Resources.

We thank our team of dedicated colleagues within IMER and the advisory board, as well as across the University. We are also grateful for the companies who have supported our ongoing challenge to modernise our energy and sustainability systems.

ACHIEVEMENTS IN 2021

ATTRIBUTED INCOME: $30.60 to $1

(exceeded KPI of 7.5)

Attributed Income – the ratio of IMER's attributed research funding delivered in 2021, to its 2021 budget.

IMER focuses the University's capabilities on large research efforts for best outcomes towards modern energy systems.

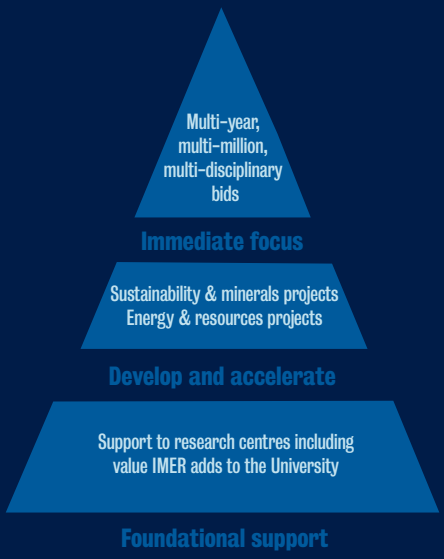
2022 PRIORITIES

Looking ahead, our focus in 2022 will be on creating impact in areas of excellence for the University such as:

- building long-term capability in 'environmental, social and governance' through the development and implementation of the new University FAME Strategy in Sustainability
- creating visibility for the University and generating capability statements that focus on the research needs of the mineral and energy resources sectors as well as other sectors whose focus is on improving sustainable development goals (SDGs)
- translating cutting-edge research into impact through multi-disciplinary collaborations with local and world-leading partners
- generating a long-term pipeline of planned projects, such as two Co-operative Research Centre (CRC) bids (*Copper for Tomorrow* and *Scaling Green Hydrogen*) and one Industrial Transformation Training Centre ITTC (*Battery Recycling*)
- improving gender, equity, diversity and inclusion on boards and in the ISER executive committee
- supporting the career development of women in STEM through mentorship and professional development
- training future leaders who will have sustainability as a beacon guiding their professional endeavours to build an ecosystem of experts, by employing the greatest minds in sustainability research.

DEVELOPING MODERN ENERGY SYSTEMS

2021 ACTIVITY



AWARDS IN 2021

SA Scientist of the Year

Congratulations to Professor Shizhang Qiao who was named as the winner in the SA Science excellence and Innovation Awards in the Scientist of the Year category. Professor Shizhang Qiao's transformative work in materials science for energy conversion and storage technologies successfully brings together materials engineering, physical chemistry, electrochemistry and quantum chemistry. IMER is proud to support Shizhang and congratulates him on this well-deserved recognition.

New SA Chair in Petroleum Geoscience

Associate Professor Simon Holford (ASPER) was appointed to the State Chair in Petroleum Geoscience, thanks to ongoing support for this prestigious position (now for 25 years) from the South Australian State Government's Department for Energy and Mining.

HILT CRC BID & ARC Success

IMER's bid for a 'Heavy Industry Low-carbon Transition (HILT)' CRC, led by Professor Gus Nathan, was successful in 2021. The University was awarded $39M cash over 10 years by the CRC to complement $46M raised from partners including Adbri, Alcoa and Fortescue Metals Group. In October 2021, Ms Felicity Lloyd was appointed as the new CEO of the HiLT CRC.

Two ARC Linkage Projects and one ARC Discovery Project ($1.4M total) were awarded to IMER researchers in November 2021. Congratulations also to Nesimi Ertugrul, Wen Soong and Ali Pourmousavi Kani for being awarded $900k from the Future Battery Industries CRC for a mine electrification project.

STEMM Educator of the Year – Dr Richard Lilly

Finalist (NExUS Educator) Dr Lilly is a University research fellow who teaches, supervises and coordinates minerals industry-related research projects for companies including Mount Isa Mines and OZ Minerals. In 2016, he co-founded the successful National Exploration Undercover School (NExUS), which provides advanced training to the most promising geoscientists in Australia. The NExUS program has an alumni of 161 geoscientists engaged in various geoscience roles to benefit the discovery and use of natural resources.

ACCOLADES

The Australian newspaper's Research Magazine supplement ranked the University's Dr Cristiana Ciobanu as Australia's #1 researcher in geochemistry and mineralogy. Ten University academics in total were highlighted as Rising Stars of Research, Superstars of Research (for lifetime performance), and as leaders in their field.

The Australian's list focused on excellence in research as seen through the lens of influence. It was based on Google Scholar citations data compiled by the League of Scholars.

The University was also named as the nationally leading institution in the fields of high energy and nuclear physics, thermal sciences, dentistry, and chemical kinetics and catalysis, and was named among the top 10 most entrepreneurial universities. See **www.theaustralian.com.au/special-reports/research-magazine-2021**

In April 2021, Prof. Gus Nathan and IMER colleagues' HiTeMP-2 Outlook Report into transitioning heavy industry towards net zero emissions was launched by Minister Dan van Holst Pellekaan and Vice-Chancellor Professor Peter Høj AC.

Professor Alan Collins' cover article in the prestigious publication, *Cosmos*, was one of the most read in 2021. It explored South Australia's Flinders Ranges, based on his research on deep time and the Earth's geological history.

Centre for Energy Technology researchers published an innovative (first ever) particle velocity measurement method important for solar thermal research. See **www.osapublishing.org/oe/fulltext.cfm?uri=oe-29-7-10923&id=449461** for details.

Two IMER PhD students (Darwinaji Subarkah, Department of Earth Sciences, and Monica Lloreda, Australian School of Petroleum and Energy Resources) won prizes from the Petroleum Exploration Society of Australia for published PhD papers:

- The 2021 NTGS/PESA Student Prize for the best NT-focused and energy-related thesis or paper was awarded to Darwinaji Subarkah for his paper published in Geology in 2021, thought to be the first international work exploring deposition age of shales using a novel laser-based reaction cell mass spectrometry technique.
- The 2021 DEM/Cooper Energy/PESA Prize for the best SA-focused and energy-related thesis or paper was awarded to Monica Jimenez-Lloreda for her extended abstract and APPEA presentation, published in the APPEA Journal in 2021. Monica also presented her work at a PESA SA/NT branch technical lunch in late 2021.

Premier's Awards in Energy & Mining 2021

In the Industry and Collaboration (Energy) category 2021 Premier's Awards in Energy and Mining, the University's industry partner EnviroCopper Ltd received top honours for its work in collaboration with IMER, researching in situ recovery at a demonstration site at Kapunda. This is a mining technique that aims to recover valuable resources while minimising its environmental impact. EnviroCopper and partners have has effectively developed environmentally friendly solutions to extract copper, a vital commodity for 'greening' our world.

The 'ARC Hub for Copper Uranium' received a Commendation at the South Australian 2020 Premier's Awards in Energy and Mining for Innovation and Collaboration.

FF-CRC PARTNERSHIP WITH ENERGY, GAS AND PIPELINES SECTOR FOR GREENER FUTURE WITH HYDROGEN AND BIO-DERIVED GAS

The Future Fuels Cooperative Research Centre (FF-CRC), in partnership with Australia's multi-billion-dollar energy, gas and pipelines sector, works towards a low-carbon future through exciting developments with hydrogen and bio-derived gas.

Both 'green hydrogen' and 'biogas' are expected to play a growing role in transforming Australia's natural gas pipeline for a new low-carbon economy.

The University of Adelaide's activities in the FF-CRC, as the leading national research and development entity of the pipelines industry, is guiding this transition while also contributing to the National Hydrogen Strategy.

The CRC's goal is to 'de-risk' the introduction of hydrogen into the existing 120,000-km pipeline network throughout Australia.

According to the University's Professor Gus Nathan, Director of the Centre for Energy Technology (CET) and Deputy Director of IMER, producing green methane from biogas – rather than fossil fuels – will also play an important role in meeting international greenhouse targets, through providing a competitive, low-carbon energy alternative for residential, commercial, industrial and/or transport sectors.

IMER member, Professor Holger Maier from the School of Civil, Environmental and Mining Engineering is leading an investigation seeking to identify cost-effective investments into the supply chain for these systems.

Bio-derived methane has the advantage of requiring no change to either the pipeline or end-use appliances. It can also use commercially available digesters and purification technology. There are also challenges though, associated with the way resources are distributed and the investment needed to harness them, so new analysis aims to unlock the potential.

Using matter commonly either dumped or underutilised, the CRC partners with multiple investors to replace up to 30% of Australia's gas pipeline network with biomethane.

Professor Nathan believes that another option to 'decarbonise' is to convert hydrogen to methane – using 'power to gas' technology that uses 'surplus' renewable electricity. The CRC is evaluating which combination of the available options for 'green' pipeline fuels makes the most sense and is the most viable.

The FF-CRC also leverages a core focus of the University's Centre for Energy Technology, by addressing pathways to decarbonise 'heavy industry' – producers of alumina, iron and cement.

IMER also played an important role in bringing together some of these major players. This expertise has led to the University leading its own cooperative research centre, the HILT-CRC.

There's a strong synergy between green hydrogen and decarbonising the heavy industry sector. Professor Nathan argues that this field of work aligns strongly with IMER's wider focus of driving the transition to sustainable, high-value mineral products. This is one of reasons why IMER led a hydrogen CRC bid as well as a second CRC bid focused on copper, for submission in 2022.

By establishing major new initiatives in the application of hydrogen to minerals processing, in addition to hosting forums and think-tanks, and seeding new ideas, IMER provides critical support. This includes engaging partners and using advisory boards to drive challenges and opportunities.

Prospective low-net-carbon energy sources and mitigation technologies

The chemical nature of industrial commodities means the need for the high-temperature processing will continue, although new research and investment will create pathways to mitigate these risks and carbon-heavy outputs.

New pathways include:

- electrification – assisted by ongoing reductions in the cost of renewable electricity from wind and solar technologies, energy-intensive processes such as steel making are more likely to make greater use of electricity if solutions can be found for current barriers. These are:
  - a lack of commercial availability of technologies suitable for electrifying high-temperature processes, and
  - a need to avoid exposure to large fluctuations in electricity prices
- hydrogen – falling costs of low-net carbon hydrogen (both 'blue' and 'green') together with the growing number of largescale utilisation pilots (such as iron/steel making) are beginning to drive change.

However, there is still a need to overcome significant barriers such as:

- the high cost of low-net-carbon hydrogen relative to natural gas and coal, and additional risks in safety, storage and distribution
- concentrated solar thermal (CST) energy –developments in both increasing the temperature and lowering the cost suggest a growing role for CST energy in decarbonising the high-temperature process industries. CST is likely to be competitive in the mix of low-carbon resources technology to manage periods of poor harvesting, such as cloudy periods in winter
- carbon dioxide management – the chemical nature of producing lime from carbonate ores creates a long-term need to manage CO2 even when energy inputs are fully decarbonised.

There must be further investment in research around lowering the cost of de-risking the pathways for implementation, and better understanding of the full life-cycle costs and opportunities.

Contact ISER to be part of this exciting work.

Power and renewable energy

Today's energy market is evolving at a rapid pace and focused research is critically needed to modernise the ways we generate, distribute, and manage today's energy—both on the electricity grid and as well as in gas pipelines.

The industry expert and award-winning Professor Derek Abbott, says that electrification is a pervasive phenomenon that is driving change – occurring in everything from end-user products, advanced power electronics switching and smart control systems on the grid, to renewable sources of energy with marginal operating costs.

These factors have transformed the grid into a dynamic place. While this presents engineering challenges, it also creates exciting opportunities for Australia. An energy policy vision for Australia is the intentional over-installation of renewables that will not only reduce the need for storage but will create excess electricity at marginal operating cost.

This oversupply can then open up opportunities for economic generation of alternative energy vectors such as hydrogen for both local industry and mass export.

The University of Adelaide has a tailored brochure that explores the considerable engineering expertise we have in the energy sector for both meeting such vision and also assisting with needed transitional solutions as Australia presses towards its energy future.

The Centre for Energy Technology (CET)

Founded in 2010 under directorship of Professor Gus Nathan (also a Deputy Director of IMER), the University of Adelaide's CET has a primary focus of accelerating the transition of Australia's heavy industrial sector to carbon neutrality from its present high CO2 intensity.

CET's focus is synergistic with its leading capability in related fields including:

- hydrogen
- alternative fuels
- energy storage
- solar thermal energy
- mine electrification.

CET's research is highly interdisciplinary, bringing together researchers from multiple University schools and faculties, across engineering, sciences and humanities. Most of these disciplines have won the highest ranking of five in the national Excellence in Research (ERA) system.

One of its exciting projects is the development of a novel water-splitting technology using photo-catalysis.

Another is the investigation of heliostat wind loads and aerodynamics, where the research team is developing methods to lower the cost of heliostats by reducing the aerodynamic loading that they must withstand.

For details on this research, publications, experimental facilities and data, visit **www.adelaide.edu.au/cet/technologies/heliostat-wind-loads**

BEST PRACTICE CENTRE PUTS ADELAIDE ON THE INTERNATIONAL MAP, AGAIN

Launched in March 2021, the Australian Critical Mineral Research Centre is a one-of-a kind national group for multidisciplinary research programs aiming to identify, characterise and extract key minerals to support expanding green energy in Australia and across the world.

Until 2022, IMER was the umbrella institute for the centre, responsible for fostering interdisciplinary collaboration, and acting as a one-stop portal to connect industry and government with university expertise. From 2022, ISER will continue this vital role.

One of only a few worldwide, the Centre focuses on end-to-end critical minerals research and education. This begins with early prospectivity analyses and includes defining resources through to processing minerals. Australia now has a great opportunity to be a global leader in critical minerals production, according to Professor Nigel J Cook, Centre Deputy Director.

The Centre's research aims to increase Australia's sovereign supply of critical minerals, including:

- how they are found, refined and manufactured
- how they occur as by-products in other deposits
- how they can be separated from nontarget elements.

Building on IMER's research bid wins

During 2020, Professor Cook teamed up with South Australia's largest mining operation, BHP Olympic Dam, to win another research grant from the Australian Research Council.

They are now looking at accessing critical minerals in the processing circuit at Olympic Dam. The recruitment of Associate Professor Carl Spandler in early 2020 to the University of Adelaide crystallised the ambition to elevate University research performance where there are tangible outputs of global significance.

Several of the nation's experts in this field are now located here in South Australia.

Associate Professor Spandler and his new team are prioritising collaboration with industry and governments for the medium to long term.

As the Australian Critical Mineral Research Centre's inaugural Director, Associate Professor Spandler sees its specialist capabilities and infrastructure as unique and valuable.

His prior role at Queensland's James Cook University spanned 11 years as an academic working in earth sciences, specialising in studies of ore deposits of rare earth elements and other metals.

According to Associate Professor Spandler, any natural resource can become critical when its supply is at risk, whether it be due to geology, geopolitics, economics, or social and environmental issues.

The Critical Mineral Research Centre is the go-to group for multidisciplinary research programs. It is the only one of its kind in Australia, and one of only a few worldwide. It covers end-to-end critical minerals research and education, from early prospectivity analyses to resource definition to mineral processing.

For further details contact Associate Professor Carl Spandler at **carl.spandler@adelaide.edu.au**.

Lanthanum

La

Praseodymium

Pr

Europium, Terbium, Ytterbium

Eu Tb Yb

Neodymium

Nd

Cerium

Ce

Gadolinium

Gd

Critical minerals in modern technology

Critical minerals are needed for many everyday technologies, such as smart phones and similar devices, and soon more will be required as demand expands for electric cars and renewable energy generation. Although Australia has huge potential as a producer, the supply of many critical minerals is limited, in some cases not enough to meet rapidly expanding demand.

There is a perception that 'mining is environmentally harmful', whereas critical minerals are actually required to save the world's environment, according to Professor Cook.

Wind turbines, solar cell batteries and electric vehicles all need commodities like rare-earth elements and in the near future, we will need a lot more. The new Centre is working towards achieving a sustainable, guaranteed supply from Australia, rather than China, which currently mines most of the world's current supply of many of these valuable resources, notably rare earth elements.

There are also defence applications, which is one reason the United States and other allies are interested in Australia's critical mineral potential.

THE CRITICAL MINERAL RESEARCH CENTRE IS THE GO-TO GROUP FOR MULTIDISCIPLINARY RESEARCH PROGRAMS. IT IS THE ONLY ONE OF ITS KIND IN AUSTRALIA, AND ONE OF ONLY A FEW WORLDWIDE.

Future projects combining areas of expertise

There is already an international shift in demand for copper and lithium, which Australia has in abundant resources. These are examples of resources our country will transition to extracting for a more sustainable future.

The Institute is now collaborating on forthcoming bids for both copper and hydrogen CRCs, to be submitted in 2022.

National challenges include how to transport hydrogen, potentially through repurposing the 120,000 kilometres of gas pipelines across Australia. There also needs to be solutions to the problem of current household appliances not functioning with hydrogen.

Researchers, policymakers and governments are considering the costs and implications of alternative energy sources. A previous logistical transition occurred in the 1950s, when whole suburbs transferred from what was known as 'town gas' to natural gas.

One 'green success' story is electric vehicles, which in five or six years will match conventional cars for whole-of-life costs. There are still questions to be answered about how hydrogen and other 'greener' energies can be used in housing and construction. This means heating, cooling, cooking and water, and what decarbonising could mean for consumers along with the industries that support construction and housing.

Associate Professor Liam Wagner and his University team in Energy and Environmental Economics are also considering the policy mechanisms needed to encourage new technologies, and how this will impact on utilities regulations – charges to the public and pricing structures and net costs of energy.

These are some of the issues that will bring together experts across disciplines.

Contact Associate Professor Liam Wagner at **liam.wagner@adelaide.edu.au**.

Transforming the heavy industrial sector to a low-carbon future – heavy industry, low carbon transition (HILT)

In 2021, IMER led the successful bid, together with bid partners, the University's largest ever bid, stage 2 of the HILT CRC proposal. It was submitted to the Australian Government in January 2021 and announced as a success in July of that year.

After two years of planning, building relationships and engagement with industry, the bid included strong support from industry, government and university partners, who pledged contributions totalling more than $175 million in combined cash and in-kind support.

A further $39 million was requested in grant funding from the Australian Government CRC Program.

HILT CRC is planned to be Australia's leading collaboration transforming heavy industry for the low-carbon economy. University of Adelaide partners will develop and demonstrate the technologies needed to grow Australia's overall economy. They will also address the broader challenges of the policy/regulatory frameworks, market transformation and social licence needed to unlock a potential value of $48.7 billion in annual revenue, and $92 billion in investments to 2050 – while also mitigating the sector's carbon dioxide (CO_2) emissions.

This brings together key stakeholders to build a national hydrogen production capability that will progressively make hydrogen an affordable energy source for Australian industry.

See the HILT CRC website **www.hiltcrc.com.au** for more information or to be involved.

HYDROGEN'S ROLE CRITICAL FOR LOW –OR ZERO– EMISSIONS ENERGY

There's no single answer to a 'greener' energy future, but we know that hydrogen will play a key role.

Scaling Green Hydrogen CRC Bid

Through ISER, the University of Adelaide is sponsoring the Hydrogen CRC bid, which brings together key stakeholders to build a national hydrogen production capability. This will progressively make hydrogen an affordable energy source for Australian industry, including the mining sector.

The CRC will help Australia become a leading global player in the hydrogen industry. It will accelerate hydrogen's commercialisation by growing domestic demand, driving production and building export capabilities.

If successful, through the Hydrogen CRC, ISER will help to expand innovation in hydrogen production, storage, distribution and utilisation.

Our work will also lead workforce upskilling to facilitate the transition to a hydrogen economy. A dedicated education and training program will access 7.5% of the CRC's budget for delivering applied programs, vocational skills development and community education.

Underground hydrogen storage

Integrating our geoscience and engineering expertise, our subsurface hydrogen storage research enables the temporary and large-scale storage of green and blue hydrogen.

Critical capabilities include:

- assessing and characterising potential geological storage sites and systems through desktop, laboratory and numerical modelling studies
- assessing subsurface storage's geochemical and geomechanical impact
- subsurface storage sites' reservoir modelling and engineering
- determining site seal capacity
- assessing well and reservoir injectivity during subsurface gas storage
- hydrogen-water-rock interactions' geochemistry
- modelling and simulating coupled well bore reservoir systems
- multiscale modelling of geochemical and bio-reactive transport in sedimentary rocks.

Blending hydrogen and natural gas

IMER members have contributed to several projects within the Australian Government's Future Fuels Cooperative Research Centre focused on ensuring the safe distribution and use of a 1:9 hydrogen–natural gas blended fuel for domestic and industrial use.

This includes:

- testing in-service and older domestic appliances
- assessing emissions safety issues
- testing a wide range of commercial and industrial appliances and burners, such as package burners
- performance modelling.

We will also be testing the use of more hydrogen-rich fuel in several industrial and commercial appliances, and developing 100% hydrogen cookers and ducted space heaters.

Key areas of focus

The Hydrogen CRC will drive innovation in hydrogen:

- production
- storage
- distribution
- utilisation.

It will also lead workforce upskilling to facilitate the transition to a hydrogen economy.

For information or to join the Hydrogen CRC bid, contact Dr Chris Matthews, Bid Engagement Manager at **chris.matthews@adelaide.edu.au**.

OUTGOING ADVISORY BOARD 2021

Mr John Anderson (Chair)
(Chair) Managing Director,
Austrike Resources Pty Ltd

Mr Joe Cucuzza
Director, *industry*C21

Mr Andrew Freeman
Manager, Business Support, Santos Ltd

Dr Paul Heithersay
Chief Executive, Department for Energy and Mining, Government of South Australia

Professor Richard Hillis
Pro Vice-Chancellor (Research Performance)
University of Adelaide

Ms Katie Hulmes
General Manager Transformation and Readiness, OZ Minerals Ltd

Dr Damien Leclercq
Standing proxy for the Executive Dean, Faculty of Engineering, Computer and Mathematical Sciences, University of Adelaide

Mr Simon Ridgway
Engineering Manager,
Gas & Renewables Division, AGL Torrens

Mr Matthew Reed
Chief Executive, Mining, SIMEC Mining

Adjunct Professor Peter Williams
Centre for Exploration Targeting,
University of Western Australia

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Director

Dr Kathryn Amos
Professor Nigel Cook
Professor Graham Heinson
Professor Gus Nathan
Deputy Directors

Dr Chris Matthews
Manager

Ms Louise Beazley
Senior Administrator

UNIVERSITY ACADEMIC IMER MEMBERS 2021

The Institute supports members from across the University:

- School of Physical Sciences
- School of Mechanical Engineering
- School of Computer Science
- School of Chemical Engineering & Advanced Materials
- School of Civil, Environmental and Mining Engineering
- Australian School of Petroleum and Energy Resources
- Professional staff
- School of Electrical and Electronic Engineering
- School of Biological Sciences
- School of Economics
- School of Mathematical Sciences
- Centre for Global Food and Resources
- Adelaide Business School
- School of Agriculture, Food & Wine
- Adelaide Law School

CENTRES THAT OPERATED WITH IMER IN 2021

- Centre for Energy Technology
- Mawson Centre for Geoscience
- Andy Thomas Centre for Space Resources
- Centre for Materials in Energy and Catalysis
- Centre for Radiation Research, Education and Innovation
- Integrated Mining Consortium
- Centre for Global Food and Resources
- Critical Minerals Research Centre
- ARC Training Centre for Integrated Operations and Complex Resources

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We acknowledge and pay our respects to the Kaurna people, the original custodians of the Adelaide Plains and the land on which the University of Adelaide's campuses at North Terrace, Waite, and Roseworthy are built. We acknowledge the deep feelings of attachment and relationship of the Kaurna people to country and we respect and value their past, present and ongoing connection to the land and cultural beliefs. The University continues to develop respectful and reciprocal relationships with all Indigenous peoples in Australia, and with other Indigenous peoples throughout the world.

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