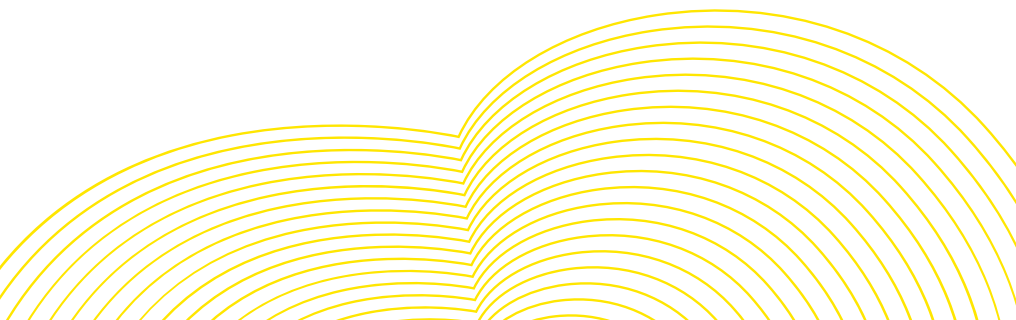


Societal Impact of Science at UNSW





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Acknowledgement of Country

UNSW is located on the unceded territory of the Bidjigal (Kensington campus), Gadigal (City and Paddington Campuses) and Ngunnawal peoples (UNSW Canberra) who are the Traditional Owners of the lands where each campus of UNSW is situated.

The Uluru Statement

Foreword

Sven Rogge, Dean of Science



Science is at its most powerful when its ideas take root in the world around us. At UNSW, this belief has shaped a culture where discovery, collaboration and social purpose move together.

Our researchers work on problems that matter to communities, industry, government and the environment, and they do so with partners who share our commitment to creating positive and lasting change. The Societal Impact of Science at UNSW report reflects this shared effort. It shows how progress emerges through relationships, trust and a deep understanding of the systems in which knowledge is created and applied, and how both discovery and translation are essential to turning knowledge into societal benefit.

As investment in research continues to grow, the challenge facing Australian universities is no longer simply producing excellent research—it is demonstrating the value that research creates for society. In response, UNSW Science launched the Pact for Impact in 2024, our collective commitment to recognise, support and measure the many ways science contributes to society. The Pact acknowledges that impact is rarely linear. It grows from sustained interaction between people and organisations, shaped by cultural context and technological change. It spans outcomes that cannot be captured by traditional measures alone. Crucially, it makes explicit that both discovery research and applied research are essential—and interdependent—in driving long-term societal benefit and productivity.

This philosophy is closely aligned with UNSW's broader strategy – Progress for All. At its core lies the UNSW Societal Impact Framework, a roadmap equipping UNSW to improve society and the environment for current and future generations. Science is a key part of this solution, from fundamental insight to translation and adoption.

Since the launch of the Pact for Impact, more than 150 individuals representing 85 organisations have joined us as Pact Partners. We have piloted a proof-

of-concept impact indicators tool that enables researchers to measure and communicate the real-world value of their work, including the broader gains that flow when new knowledge fuels innovation, capability and social progress across sectors.

In 2024 we published a report into the Economic Contribution of UNSW Science in collaboration with Professor Richard Holden. This demonstrated, with strong economic evidence, that research undertaken in UNSW Science delivers significant value—contributing around \$2.2 billion annually to global GDP and underpinning Australia's capacity for innovation, competitiveness and long-term prosperity. These findings reinforce a key message: investment in research is investment in societal progress—strengthening our economy, improving wellbeing, and enabling Australia to respond to emerging challenges.

I want to acknowledge all those who contributed to this paper, particularly Melissa Edwards and Jack Noone from the UNSW Centre for Social Impact. UNSW Science has collaborated with the Centre on this research to highlight the significant role science plays in creating societal outcomes. The researchers profiled demonstrate the breadth and depth of UNSW's work across the discovery–application spectrum. Their contributions show that impact is a process shaped by curiosity, collaboration and a commitment to improving the world through science. As we continue to advance the Pact for Impact, I look forward to deepening our partnerships and strengthening the role of science—across all stages of research—in building a more sustainable, equitable and productive future for all.

Scientia Professor Sven Rogge
Dean of Science, UNSW Sydney

Foreword

Dr Cathy Foley, former Australian Chief Scientist



Science earns its place in society not only through what it discovers, but through what those discoveries make possible.

Australia is fortunate to have an exceptionally strong university research system, and UNSW is currently at the forefront of it. Its standing as the number one Australian university in the 2027 QS World University Rankings is an achievement worth celebrating. But rankings, citations and international reputation, important as they are, tell only part of the story. The more demanding question is: what difference does research make?

That is why I welcome this report.

Societal Impact of Science at UNSW asks us to look beyond conventional measures of research success and consider the pathways by which knowledge becomes useful to people, communities, governments, industry and the environment. It examines impact across five dimensions: Commercialisation, Scholarly Outputs, Policy and Influence, Lives Changed, and Sustainability and Development. It does this while recognising that impact rarely follows a simple or predictable path.

The stories showcased here are impressive. They range from safer aviation systems and improved healthcare technologies to restoration of urban marine environments and innovations that can make industry more sustainable. They demonstrate the strength we expect of an institution such as UNSW: excellent scholarship, technological innovation, engagement with industry, commercialisation and an increasing focus on sustainability and the great challenges facing society.

But the report does something else that I regard as equally important. It makes the journey visible.

Research impact does not begin when somebody commercialises an invention, changes a regulation or adopts a new clinical treatment. Long before those outcomes become visible, researchers identify problems, build relationships, create new knowledge, train people, engage communities and work with partners. The report shows particularly clearly that research, partnership and understanding of

need reinforce each other, and that the route from discovery to impact is iterative rather than linear.

Universities cannot take their social licence for granted. They must continually earn and renew it by showing that society's investment in knowledge and education delivers value beyond the university itself. At a time when Australians are asking difficult questions about productivity, cost of living, health, environmental sustainability, technological change, and national resilience, our universities need to explain not simply what research they undertake, but why it matters.

Reports such as this are therefore much more than exercises in measurement. They are an important form of accountability, and of connection.

As Australia's former Chief Scientist, and now President of the Australian Academy of Technological Sciences and Engineering, I have repeatedly seen how fundamental science, applied research, engineering and technology combine to create opportunities that could not have been anticipated when the original research began. We need discovery. We need translation. And we need institutions willing to build the bridges between them.

Science and research are among the most important pathways we have for developing the knowledge, capability and confidence Australia needs to become the country we aspire to be: prosperous, sustainable, resilient, fair and able to shape our own future.

UNSW Science is already a major contributor to that endeavour. By producing this report, UNSW is also demonstrating that it is prepared to ask the harder question of itself: not only "Are we excellent?", but "What does our excellence enable?"

That is a question every research institution should be prepared to ask.

Dr Cathy Foley
President, Australian Academy of Technological Sciences and Engineering (ATSE)

A national challenge for Australian research

Australian universities are spending more on research and development than ever before. At the same time, expectations are growing for universities to demonstrate the benefits that research creates beyond academia.

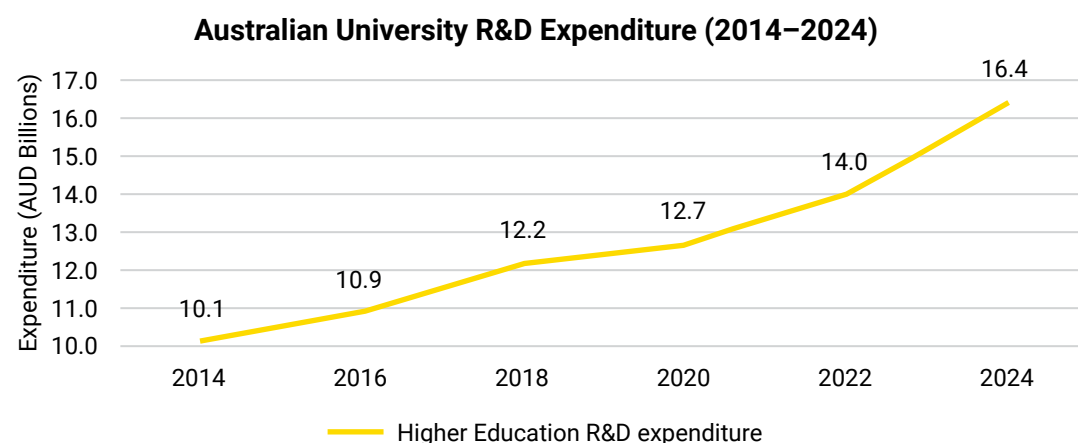


Figure 1. Australian university research and development expenditure, 2014–2024. Source: Australian Bureau of Statistics (2026).

Australian Research at a Glance

\$16.4 billion invested in university R&D (2024)

17% growth in two years

3.4% of global research publications

0.33% of the world's population

≈2/3 of research rated above or well above world standard

In 2024, Australian higher education organisations recorded **\$16.4 billion in research and development expenditure**, the highest level recorded by the Australian Bureau of Statistics. This was a **17 per cent increase from 2022**, the strongest biennial rate of growth since 2012 (Australian Bureau of Statistics, 2026).

Australia also has a highly productive university research system. The Australian Universities Accord notes that universities produce most of Australia's scientific publications, with Australia accounting for approximately **3.4 per cent of the world's published research**. It also reports that **two-thirds of Australian university research output assessed through the national Excellence in Research for Australia system was rated above or well above world standard** (Australian Universities Accord Panel, 2024).

Australia has therefore developed substantial systems and evidence for understanding **how much research is undertaken and the academic quality and influence of that research**. Yet these measures leave a different question much harder to answer:

How does excellent research create value for society?

Publications, citations, grants and patents remain important measures of research activity, quality and influence. But they capture only part of the story. They do not, on their own, reveal the relationships, decisions, collaborations and processes through which scientific knowledge contributes to improved health, public policy, industry capability, environmental outcomes or stronger communities.

These societal contributions can also be difficult to observe. They may emerge over years or decades; involve multiple researchers, organisations and communities; and depend on translation, adoption and adaptation beyond the university. As the case studies in this report demonstrate, impact rarely follows a simple path from discovery to outcome. It develops through interconnected systems of research, partnership, engagement and application.

The challenge, then, is not simply to demonstrate research excellence, but to make visible how that excellence contributes to society.

This challenge is increasingly recognised across Australia's research system. The Australian Research Council has long identified a need to better understand and communicate the environmental, economic and social benefits arising from research, noting that government, industry and the community require better information about the benefits derived from research activity (Australian Research Council, 2024).

More recently, the ARC has begun developing a new national approach to research evaluation through its **Research Insights Capability**, intended to strengthen understanding of Australian research excellence, impact and depth while reducing unnecessary reporting burden (Australian Research Council, 2026a). The ARC has also formalised a commitment to **responsible research assessment**, including fairer and more transparent approaches to evaluating research (Australian Research Council, 2026b).

This focus is particularly important within Australia's broader research and development environment. While higher education R&D expenditure increased between 2022 and 2024—and rose from **0.54 to 0.59 per cent of GDP**—Australia's **total national R&D expenditure across business, government, higher education and the private non-profit sector** has declined over the longer term as a share of the economy. The Australian Universities Accord reported that national R&D expenditure fell from **2.25 per cent of GDP in 2008–09 to 1.68 per cent in 2021–22** (Australian Bureau of Statistics, 2026; Australian Universities Accord Panel, 2024).

Against this backdrop, understanding what research contributes—and the conditions and pathways that enable those contributions—becomes increasingly important.

This report responds to that challenge.

Rather than replacing traditional measures of research excellence, it complements them. Through qualitative narratives, structured impact indicators and pathway mapping, the report examines not only **what** societal impacts emerge from scientific research, but **how** those impacts develop.

In doing so, the report serves two purposes.

- **First, it demonstrates the diverse ways in which UNSW Science research contributes to society** through discoveries that improve lives, inform public policy, strengthen industry, advance sustainability and contribute to Australia's long-term prosperity.
- **Second, it presents a practical approach to making those contributions more visible**, illustrating how qualitative evidence, impact indicators and pathway mapping can help universities recognise and understand societal impact alongside established measures of research activity and excellence.

Australia has developed sophisticated ways of recognising research excellence. **The next challenge is making the societal value of that excellence visible.**

By tracing the pathways from scientific discovery to societal impact, this report seeks not only to demonstrate the contributions of UNSW Science, but to contribute to a broader conversation about how universities can better recognise, understand and communicate the ways research creates lasting benefit for society.



Reframing the societal impact of science

As a leading scientific institution, UNSW scientists are well recognised for founding or contributing to scientific fields of research. As scientists around the world call for appreciation of the process and impacts of scientific discoveries¹, UNSW Science understands that impact is created through many and varied routes. Traditional assessments of science impact commonly measure when the scientific solution or remedy becomes known, at the early-stage translation. Assessment typically includes counts of publication outputs and related citations, patents or frequency of application and translation into products, frameworks and policies.

While significant, traditional assessments offer a partial view of the multifaceted societal benefits and impacts of knowledge generation occurring throughout the entire scientific method, discovery and innovation process.

This report centres on UNSW scientists' stories about how and why they engage in scientific research, to reveal a more nuanced view of societal impact cumulating all throughout the scientific process.

Rather than focus on outputs, we intentionally foregrounded the 'pathways to impact' to map the many and varied interactions, processes and outcomes that shape societal impacts as UNSW scientists explore, partner and collaborate, generate, test, invent and innovate. The pathways are not always alike, can be nonlinear and happen in interactions between scientists, their peers, students and professionals, within communities and societies and those social, cultural, political, economic, technological and environmental influences of the time.

Put simply, it is the cumulative effect of science in the making that shapes ultimate societal impacts.

It is within this context that UNSW Science developed the Pact for Impact and the UNSW Science Impact Indicators framework, to better recognise and demonstrate the diverse ways scientific research contributes to society. Together, they provide a practical framework for understanding societal impact beyond traditional academic measures alone, while making visible the different pathways through which impact occurs across discovery, translation, collaboration, policy, and community engagement.

¹ How does science benefit society? | Creating Our Future Together With Science | Nobel Prize Dialogue, available at: <https://www.youtube.com/watch?v=WtHfzCuACDo>

From scientific discovery to societal impact

Scientific discovery can be viewed as a technical and creative process emerging in a field through the interaction of three elements:

- the individual or individuals (who produce new ideas).
- the domain (a disciplinary field defined as a cultural system such as biology or mathematics).
- and the field (a network of experts and gatekeepers who evaluate and select ideas for preservation).

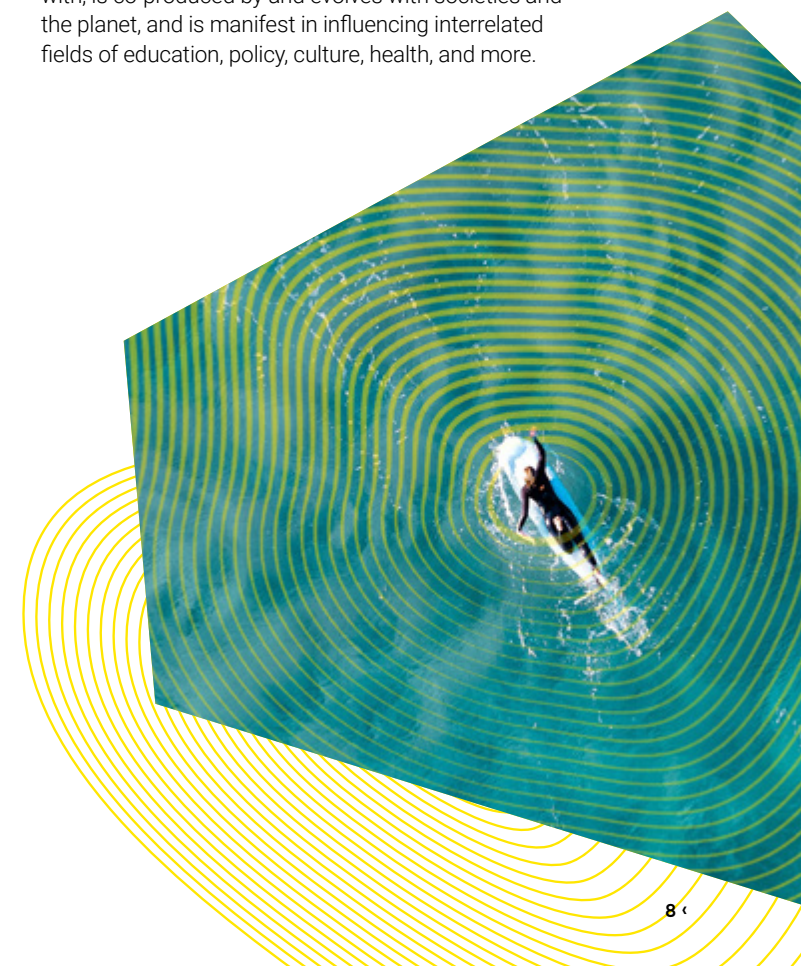
Layered over this is a temporal dimension where discoveries may not have an immediate impact but rise to significance as rules and norms within scientific communities or when recognised societal needs arise. Conventional outputs such as publications, patents, or inventions and their immediate scholarly outcomes have great significance in shaping scientific domains and fields, but as single artefacts, only assessing these risks underrepresenting the societal impact of science. The societal impact of science does not occur in a vacuum, or only within laboratory walls.

Contemporary scholarship on the societal impact of science challenges metric-driven approaches, drawing on various sociological traditions to emphasise uncertainty, temporal dynamics, networks and material and symbolic interactions, and the nonlinear pathways through which scientific impacts emerge. Helga Nowotny (2005) emphasises how current scientific practices operate in increasingly complex, uncertain environments, and argues for a more reflexive approach to scientific governance and impact assessment. She emphasises that scientific progress today is shaped not only by disciplinary expertise but also how it co-evolves with societal expectations, institutional incentives, and evolving technological infrastructures.

Similarly, Sheila Jasanoff (2004) foregrounds "co-production", that science and society are mutually constituted in a multisystemic and polycentric world. Scientific knowledge is shaped by governance and political cultures, economic policies, institutional norms, ethics and laws, and trust in science, and vice versa. These coevolutionary perspectives call us to look beyond traditional metrics of impact and to instead reflect on how scientific knowledge evolves as an inquiry, a negotiated process within innovation systems and regimes.

Jack Spaapen and Leonie van Drooge (2011) encourage interpretations of social impact to value the conditions that allow "productive interactions" between researchers and stakeholders - those are societal actors and networks through which scientific inquiry, knowledge and discovery are co-produced. These approaches focus on the possibility for societal impact contributions to be documented across a broad array of stakeholders and institutions, not only as the direct attribution measured through the impact of a scientific output over time.

While differing in explanation, these theories challenge impact models that look for direct pathways, or causal factors to explain scientific impacts, by suggesting that what counts as scientific knowledge is often negotiated through social, cultural and political processes. Taken together, these perspectives establish a conceptual foundation for understanding why societal impact frameworks should not be reduced to linear models of input-output. Instead, they call for multidimensional evaluations that account for how science interacts with, is co-produced by and evolves with societies and the planet, and is manifest in influencing interrelated fields of education, policy, culture, health, and more.





Toward institutional recognition and assessment of the broader societal impacts of science

Policy initiatives and scientific awards worldwide increasingly recognise the societal impacts of science, such as in addressing societal challenges. UNESCO advocates for inclusive and accessible STI (Science, Technology and Innovation) systems, highlighting science's material contributions to living and working conditions and its intellectual role in shaping human thought. Australia's National Science Statement links science to Australia's future prosperity, security and wellbeing, while highlighting future resilience strategies to address misinformation and promote public trust and responsible technology development. The latest Australian Research Council's science and research priorities position science impact as essential to a net zero future, healthy communities, Aboriginal and Torres Strait Islander knowledge systems, environmental protection and restoration, and national resilience.

Scientific awards are progressively aligning with social impact criteria. While traditional prizes like the Nobel do not explicitly assess social impact, laureates engage in dialogue on the social impact of science. Newer awards such as Australia's Eureka Prize, emphasise transformative outcomes across health, environment, equity, and governance, highlighting how science shapes and generates tangible benefits to society.

The UK's Research Excellence Framework (REF) was the first to assess the broader societal impacts of science through a robust model for evaluating research impact using case studies. These case studies cover a wide array of themes, including health and wellbeing, public engagement, education, policy, innovation, safety, and inclusion. The outputs of the 2014 and 2021 REF assessments show the significant contributions to social change that occur through scientific research. Examples range from improving mental health through cultural programs to advancing accessibility and public safety, underscoring the diversity and depth of research impact.

Despite the worldwide influence of the REF in the societal impact space, it is not without its critics. The REF is argued to:

- Prioritise a retrospective strategic narration of impact, rather than an authentic account of how change actually happened (Watermeyer, 2014).
- Privilege certain types of impact such as policy uptake and easy to evidence outcomes (Chubb & Watermeyer, 2017)
- Privilege certain disciplines that are related to government, industry or professional practice (Chubb & Watermeyer, 2017).
- Carry significant administrative burden (Martin, 2011)
- Reshape academic behaviour towards creating impact that is "REF-able" rather than what may be needed socially (Watermeyer & Lewis, 2018).

While the strong qualitative emphasis of the REF helped to reframe the societal impact of science, there remains general agreement in the use of mixed methodologies for assessing social impact contributions, combining qualitative and quantitative insights. These approaches typically draw on case studies alongside selected metrics and attend to impacts both within scientific fields and beyond, including adoption or adaptation within policy, practice, and institutions.

Currently, Australia has delayed its national Engagement and Impact Assessment process (similar to the REF), creating space to explore how the societal impact of science can be described in ways that capture both outcomes and the processes that enable them.

UNSW Science Impact Indicators

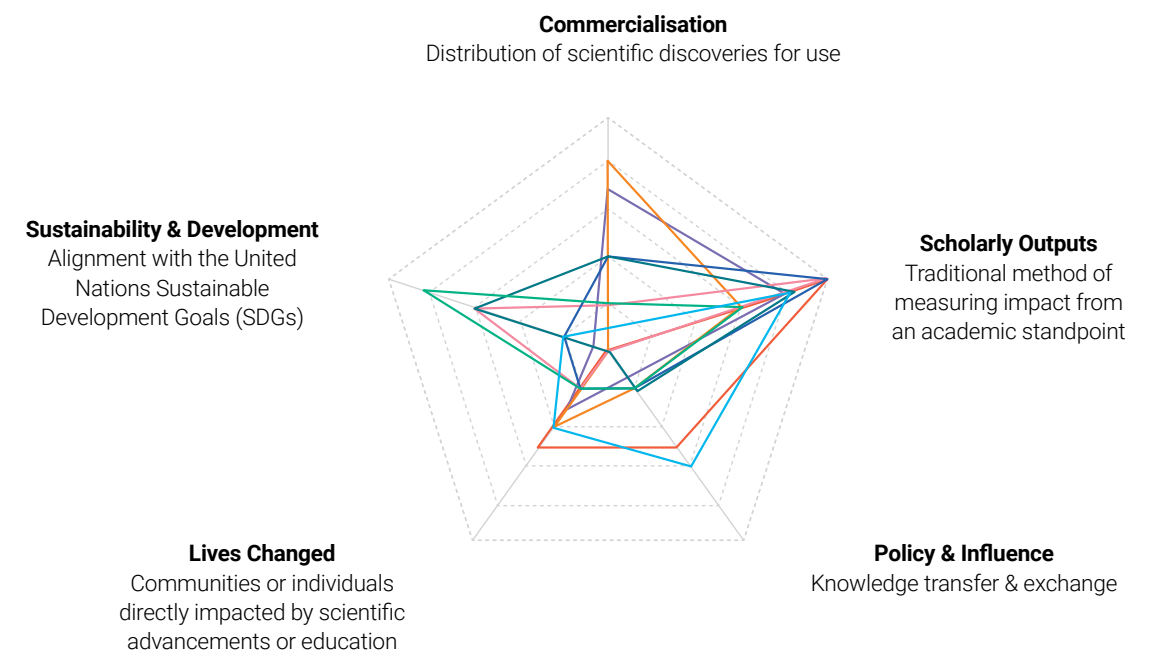


Figure 2. UNSW Science Impact Indicators

Coevolutionary understanding of pathways to impact and progress towards the societal impact of science at UNSW

To explore science and societal impacts as coevolutionary requires an appreciation of the scientific processes and conditions that generate scientific outputs and their reciprocal effects on and with society throughout. Quantitative output metrics only capture one part of the process and while such measures offer advantages for efficiency and comparability, they are limited in capturing complex, context-specific, and long-term forms of impact. An overreliance on quantitative indicators risks obscuring the nuanced processes through which science unfolds which may also generate social change.

For example, as understandings of what constitutes the societal impact of science continue to evolve, UNSW Science developed the Pact for Impact initiative to increase the visibility of how science creates

impact through collaboration with external partners. As a means to visualise the diversity of impact created through science, the UNSW Science Impact Indicators were developed (see Figure 2 above).

Through asking scientists a series of questions, the breadth and diversity of impact can be clearly observed, areas of strength identified and the full gamut of what science achieves can be recognised. As shown in Figure 2, the UNSW Science Impact Indicators framework measures five categories: Commercialisation, Scholarly Outputs, Policy and Influence, Lives Changed, and Sustainability and Development, to demonstrate the diverse ways scientific research contributes to society. Each colour in the figure represents a different UNSW scientist featured in this report. While individual scientists demonstrate different strengths across the five areas, together they reflect the breadth, diversity, and interconnected nature of societal impact across UNSW Science.

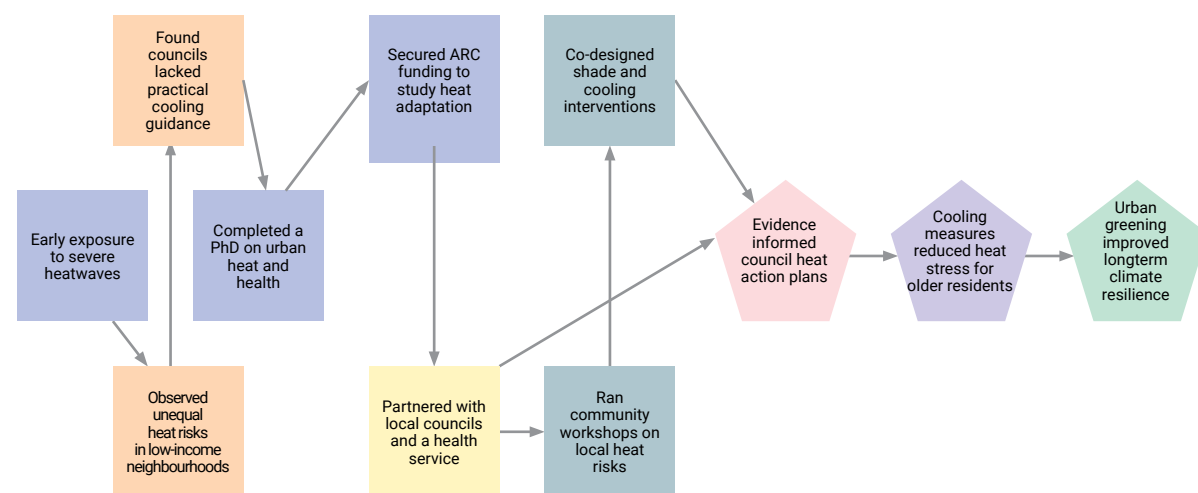


Figure 3. Pathway map example

Report aim 1:

Within this context, this report demonstrates the societal impact of science research at UNSW, in line with the Pact for Impact, and to make visible how this impact has occurred across a range of scientific domains and contexts.

Universities internationally are grappling with how to demonstrate the societal impact of research in ways that are credible, proportionate, and appropriate to complex systems change. The Pact for Impact aligns with the UNSW Progress for All strategy and the UNSW Societal Impact Framework, reflecting this wider shift towards contribution-based approaches that draw on mixed forms of evidence and attend to both outcomes and enabling processes.

Interviews with eight UNSW scientists were guided by the five categories within the UNSW Science Impact Indicators framework and the objectives of the Societal Impact Framework, especially to focus on progress indicators and contributions to broader sustainable development goals.

Report aim 2:

The second aim of this report is to contribute to ongoing debates about how universities can demonstrate societal impact at scale, by illustrating how qualitative case studies and pathway-based analysis can be used alongside existing indicators to make impact visible in practice and inform future approaches to impact reporting and learning.

'Impact narrative' case studies, and Pact for Impact pathway maps were developed for each scientist. By qualitatively coding these narratives, four process domains were identified: understanding need, research process, community engagement, and partnerships. Case study narratives were further coded against either the Pact for Impact themes or one of the four process domains to generate process maps for pathways to impact for each scientist and a generalised map. An example can be seen in figure 3.

A second layer of coding was also applied to identify process and Impact Indicators.

Further details on the methodology can be provided on request.

Taken together, these narratives and analyses provide a foundation for considering how a scaled-up, faculty-wide approach to demonstrating societal impact might be designed, supported, and embedded within UNSW Science.

Meet our scientists



“I’ve always really enjoyed seeing that my research actually has real-world applications.”

Professor Sophie Primig

Materials science and engineering

Reshaping how high-performance metals are designed, processed, and reused across aerospace and industry, this researcher blends fundamental discovery with industry collaborations to deliver safer engineering components with superior properties and more sustainable materials processing routes that support global resilience.

Professor Sophie Primig has built her career on a simple idea: science delivers its greatest value when it helps solve real problems. Trained in Austria in a research culture tightly connected to industry, she began her scientific journey in an environment where companies not only sponsored projects, they co-designed them. That approach, working on real problems with measurable outcomes, has defined her career. “I’ve always really enjoyed seeing that my research actually has real-world applications.” That industrially embedded model, rare in Australia at the time, was common in Europe and it instilled in her the view that science could, and should, solve tangible, high-stakes problems.

Today Professor Primig is an ARC Future Fellow and Alcoa Distinguished Professor in the School of Materials Science and Engineering at UNSW. Her field is physical metallurgy and her work has significant implications for safety, medicine, the environment and sustainability.

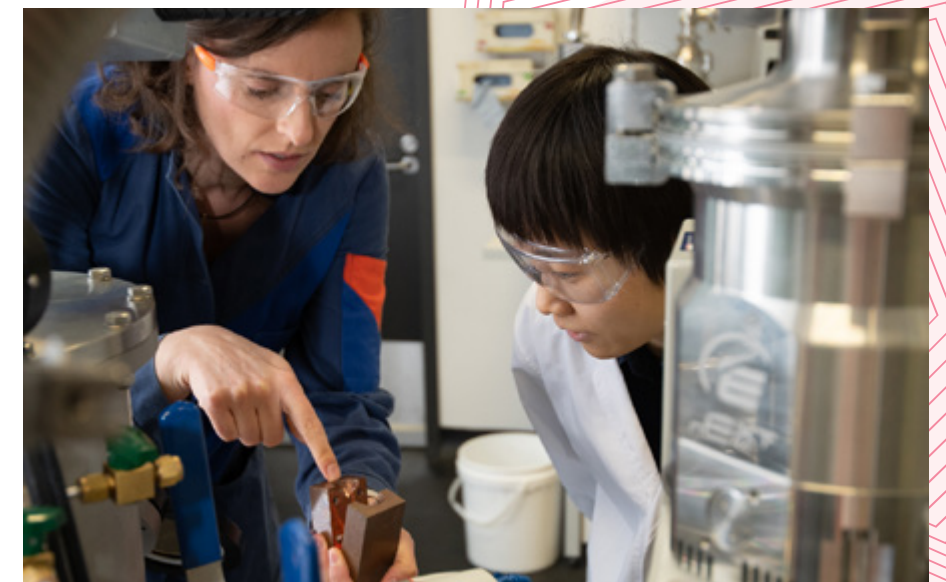
Her first area, superalloys for aerospace, demonstrates how her research directly influences safety, performance, and environmental efficiency. “I work directly with companies that melt and forge alloys into future engine disks or turbine plates. These plates sit inside jet engines that power aircraft built by all major global manufacturers.” She studies how deformation and heat treatments can control the microstructure of the alloys, allowing engines to run hotter, supporting faster travel and better fuel efficiency. This enables companies like Airbus and Boeing to defer costly transitions to new materials while meeting next-generation performance targets. Her work has improved component strength, enhanced safety, and supported cleaner, longer flights.

Understanding how metals can work together has other implications including additive manufacturing of metals, particularly in metal 3D printing. She sees metal 3D printing as a strategic capability for Australia because it allows high value components to be produced without large forges or foundries. Small, flexible systems can fabricate specialised parts using powder or wire feedstock which creates opportunities for more autonomous, localised supply chains. The implications are broad. In defence, on-demand fabrication supports resilience. In biomedicine, tailored implants can be designed to match a patient’s anatomy with far greater precision. “Nowadays you can personalise implants and make one that’s really perfect for your body.” These advances reduce waste, enhance design flexibility, and open pathways for personalised medicine.

The capacity for future impact in Professor Primig’s work is clear, and building – her work in sustainable metallurgy tackles one of the world’s most energy-intensive industries, aluminium production. “Australia has very large deposits of bauxite,” she notes. “Bauxite is refined into alumina and then aluminium. Everyone uses that daily, whether it’s your drinks can, the fuselage of an aircraft, or cooking foil.” As lead investigator of a major collaboration with Alcoa,

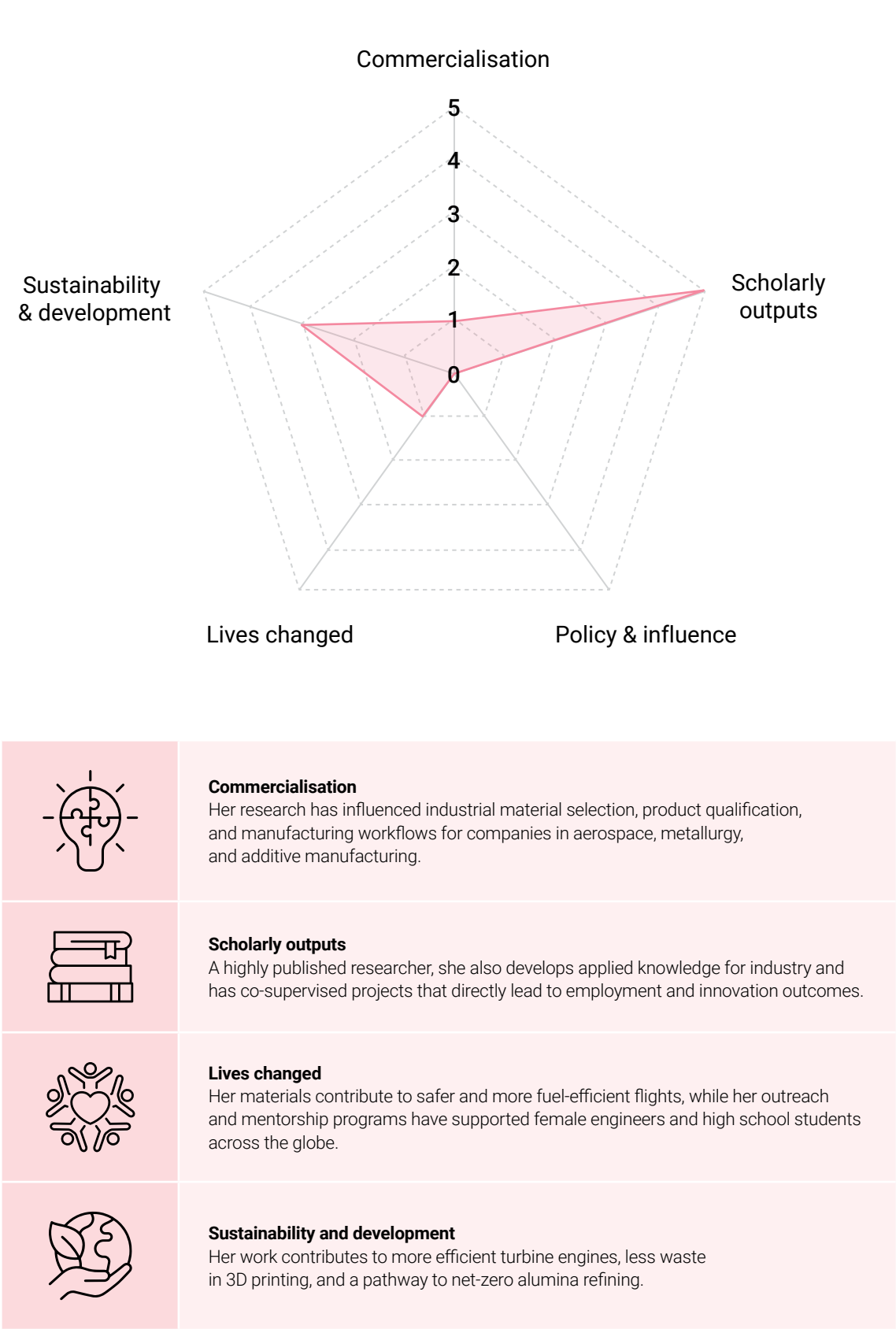
Professor Primig is helping design a future net zero alumina refinery through a multi-university partnership. By applying metallurgical insights to reconfigure how bauxite is processed, Professor Primig and her collaborators aim to reduce energy consumption, cut emissions, and address long-standing waste problems. She describes the initiative as a global challenge because aluminium underpins almost every sector from transport to packaging. A genuine technological shift would deliver benefits well beyond Australia.

Professor Primig’s work demonstrates how materials science can deliver improvements that affect everyday life. Stronger alloys support safer and more efficient aviation. Metal additive manufacturing expands national capability. Sustainable refining offers solutions to global environmental pressures. Through research, partnership, education, and advocacy she shows how metallurgy can drive societal benefit while shaping a cleaner and more resilient future. As she puts it: she’s not just inventing new materials, she’s making existing ones work harder, last longer, and do more. That might not make headlines, but it is changing the way the world flies, builds, and thinks about metals.

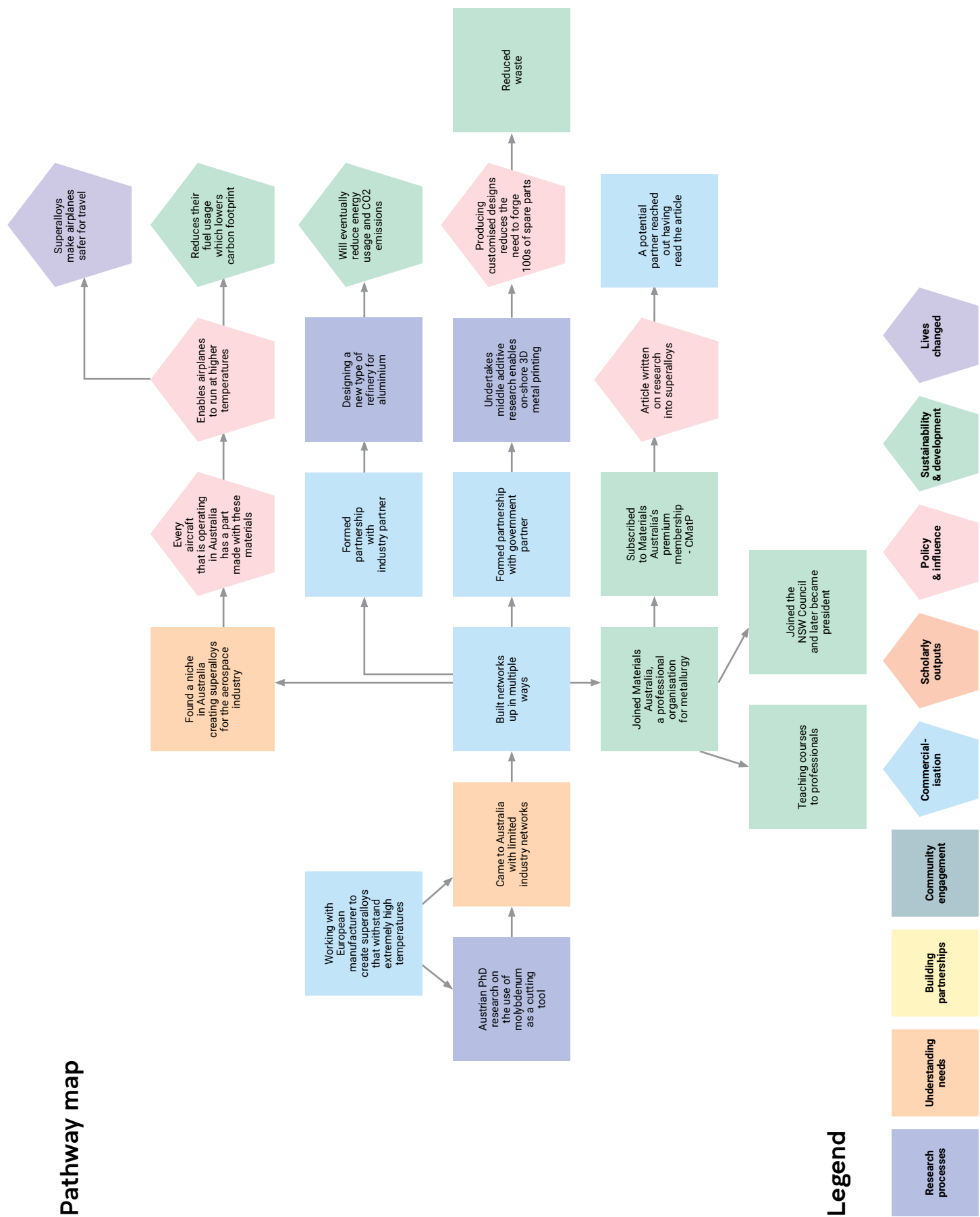


Professor Sophie Primig mentoring an early-career researcher in a UNSW laboratory.

Research Impact Indicators



Pathway map





Scientia Professor Justin Gooding

Chemistry

Breakthroughs in sensing, 3D bioprinting and wearable diagnostics have reshaped global healthcare. Teaching and public leadership connect chemistry, design and medicine to improve how millions of people understand and manage their health.

For Scientia Professor Justin Gooding, science is a moral responsibility as much as an intellectual pursuit. “We are the people that have the opportunity to change the world.” He believes scientific privilege carries an obligation: “You need to be able to tell the bus driver when you get on the bus why their taxes should pay for your research.” That conviction — that science must improve lives — underpins everything he does, from device invention to education and public communication. With over 40 researchers in his multidisciplinary team, the lab has produced globally impactful technologies across diagnostics, 3D bioprinting, drug monitoring, and personalised medicine.

A chemist by training but an entrepreneur by instinct, Scientia Professor Gooding has spent his career at the convergence of sensing, materials science, design and medicine. He is known among colleagues as “the sensor guy,” making technologies that give people knowledge about their own health. One of his earliest contributions became a milestone in global consumer

health. Working with a start-up, he helped develop and commercialise a portable glucose meter that became the first biomedical device integrated with an iPhone and the first sold in an Apple store. This glucose meter, which sold many millions of strips worldwide, has changed daily life for millions of people living with diabetes. It has changed daily life by transforming an invasive, cumbersome process into a simple, portable routine. This experience defined his understanding of scientific impact. For him, the goal is never publication alone but clear benefit for patients, clinicians and communities. “Why wouldn’t you want to make people’s lives better?” he asks. “Isn’t that what we’re here for?”

His next step was to bring automation to cell biology for drug development. Biologically complex 3D structures that mimic human tissues are far better than traditional 2D cell cultures. “Cell biology is completely manual ... everyone knows they have to go to 3D, but 3D is time-consuming hard work. So could you automate that process?” The result was an automated 3D bioprinter that produces artificial cancers at high throughput for drug testing and personalised medicine. The device introduced a level of precision, reproducibility and scale previously impossible, enabling pharmaceutical companies to test drug candidates more efficiently and ethically. Its design was also widely recognised, winning Australia’s Good Design Award. More than 120 printers have since been distributed worldwide, with growing relevance as regulators push for alternatives to animal testing.

“Science is an enormous position of privilege... And with that comes great responsibility.”

The technology is now poised to support personalised medicine by allowing clinicians to test therapies directly on a patient’s tumour model, potentially enabling faster and more tailored cancer treatments.

A third commercial partnership focuses on wearable health monitoring. Working with the start-up Nutromics, he is involved in developing a microneedle patch that continuously measures drug concentrations directly under the skin using DNA-based molecular sensors. The device aims to replace blood draws with a painless, real-time system that enables personalised dosing and ensures safe and effective dosing for complex medications with narrow therapeutic windows. For Scientia Professor Gooding, the potential is profound. “We can monitor the drug level inside a person,” he says. “This could change the world.” Such technology could help prevent adverse drug events, support remote patients and reduce inequities in access to therapeutic monitoring. From glucose meters to rapid-flow tests, these technologies embody accessibility by enabling diagnosis where laboratories are unavailable. “A sensor lets you do a measurement without needing all the analytical instrumentation” he explains. “That means you can do it in a remote community anywhere in the world.”

His leadership also bridges science and policy. As co-founder of the NSW Smart Sensing Network, he helped create a model adopted by the state government to link universities, industry and government laboratories which seeded initiatives such as the UNSW RNA Institute. The network created rare spaces where leaders of competing institutions worked together toward shared objectives, reflecting his belief that scientific progress depends on cooperation rather than insularity.

Education is a core dimension of his impact. He

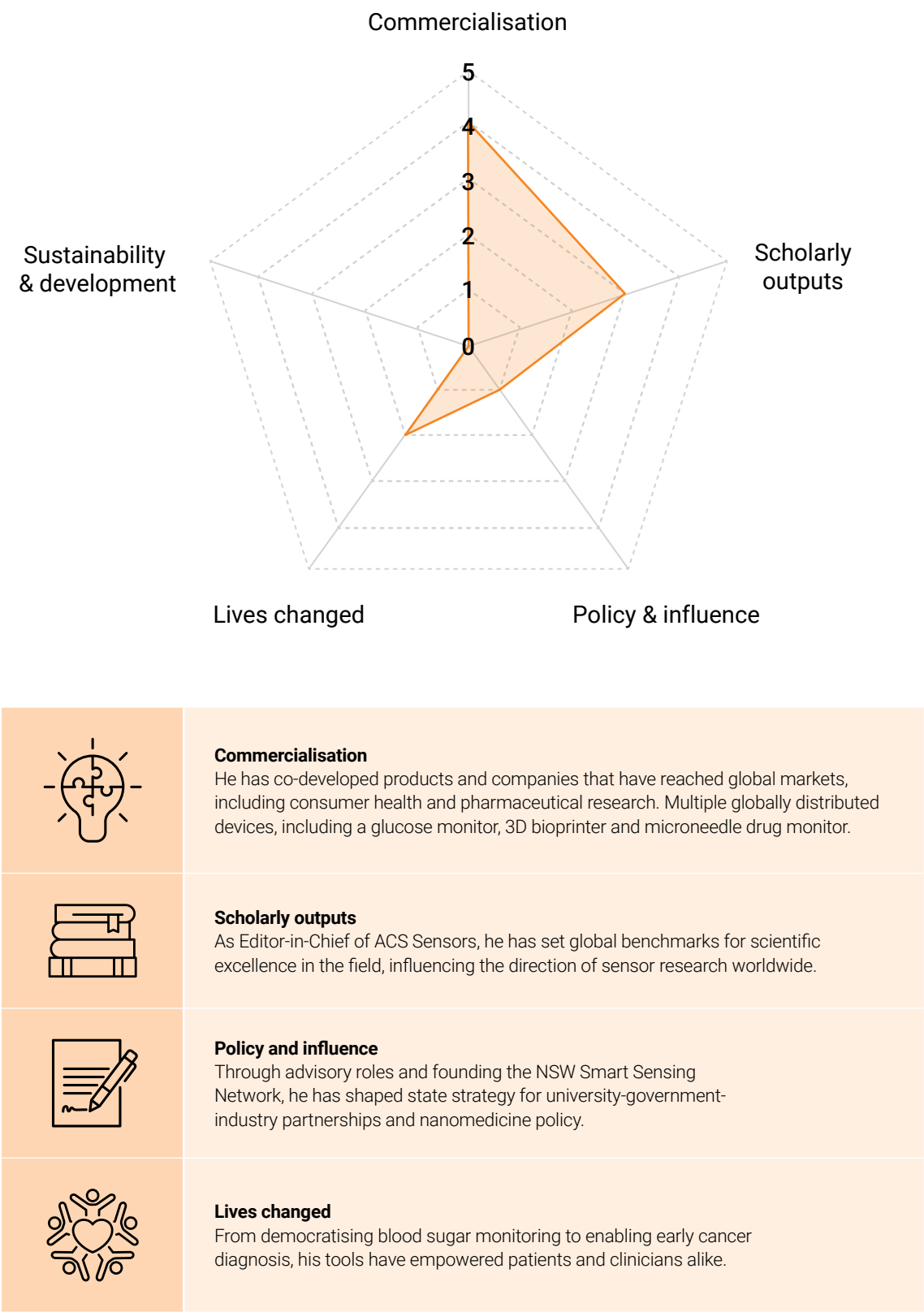
created and taught one of UNSW’s most popular general-education courses, Science and Cinema, which used films such as Jurassic Park, Gattaca, Outbreak and The Day After Tomorrow to explore the role of science in society. The subject became a model for science communication, helping students — many outside science — understand how scientific reasoning shapes culture and ethics. His lab has also trained dozens of PhD students from diverse backgrounds, many now leaders in biotechnology, agriculture and medicine. He describes mentoring as a privilege. “We’ve got such a privileged job as we work with beautiful young people who are full of hopes and dreams. All we’ve got to do is not dash their hopes and point them in the right direction.”

Across these layers of invention, training, policy, public engagement and field leadership, Scientia Professor Gooding demonstrates how scientific curiosity, compassion and practical design can function as one integrated system of impact. “Science is an enormous position of privilege,” he says. “And with that comes great responsibility.”



Scientia Professor Justin Gooding conducting research in a UNSW laboratory.

Research Impact Indicators



Pathway map





Professor Brett Molesworth

Aviation

Redefining training and support for pilots, surgeons, and drivers to enhance risk awareness, decision-making, and communication and improve safety and performance.

For Professor Brett Molesworth, understanding how humans perform under pressure is both a scientific and moral question. “The overriding aim of my research is to understand human performance in complex, high-consequence workplaces.” His focus spans aviation, road safety, and medicine — fields where a single lapse can have profound consequences.

Originally trained in aviation and later drawn into psychology, Professor Molesworth’s career reflects the systems view of science, where individual curiosity, collaboration and translation converge to improve real-world outcomes. Bridging the cockpit, the operating theatre, and the driver’s seat, his work investigates how stress, cognitive load, communication, and risk propensity shape human performance and decisions in complex, high-consequence settings.

In aviation, his team investigates how pilots think, communicate, and make decisions in both normal and abnormal situations. Early studies mapped risk propensity among pilots, distinguishing between impulsive and calculated risk takers. “Risk isn’t always bad,” he notes. “Sometimes you need a bit of it — but it has to be the right kind.” This insight helped redefine training and recruitment approaches across commercial and general aviation, ensuring that flight schools and airlines could recognise and mitigate excessive risk taking while preserving adaptive decision-making skills.

Professor Molesworth’s research on noise, workload, and communication has produced measurable industry change. Collaborating with engineers and aviation authorities, his team demonstrated that cockpit noise levels of around 95 decibels significantly impair communication accuracy and elevate pilot stress. These findings led a major Australian airline to retrofit its entire 737 fleet with certified noise-attenuating headsets — an industry-wide shift now mirrored internationally, from the Royal Flying Doctor Service to Middle Eastern military aviation divisions both adopting noise-reducing technologies to improve crew performance. These outcomes illustrate how commercialisation and translation can align with public benefit.

His research extends to aviation communication, where miscommunication between pilots and air-traffic control remains a persistent safety risk. By analysing transcripts of cockpit exchanges, he revealed that native English-speaking pilots, not their multilingual colleagues, were often the source of error — slipping into colloquial expressions like “heading for the big smoke” that confused non-native speakers trained only in regulated Aviation English. These findings challenged industry assumptions and prompted revised communication protocols now adopted by Asia-Pacific aviation authorities, improving clarity and safety across multilingual flight environments. “They were quite surprised,” he recalls. “But once we showed the data, they couldn’t deny what was happening.”

Beyond the cockpit, Professor Molesworth’s research has reshaped understanding of risk-taking behaviour among young drivers, demonstrating the broad applicability of his human-factors framework to road safety. Through simulator studies and real-world feedback, his team discovered that a widely promoted mobile app “speed advisor”, designed to curb speeding, actually increased risk-taking among young drivers who rebelled against its auditory warnings. The findings prompted the authority to immediately amend the program, directly influencing state-level policy by restricting its use for probationary drivers.

“Risk isn’t always bad... Sometimes you need a bit of it — but it has to be the right kind.”

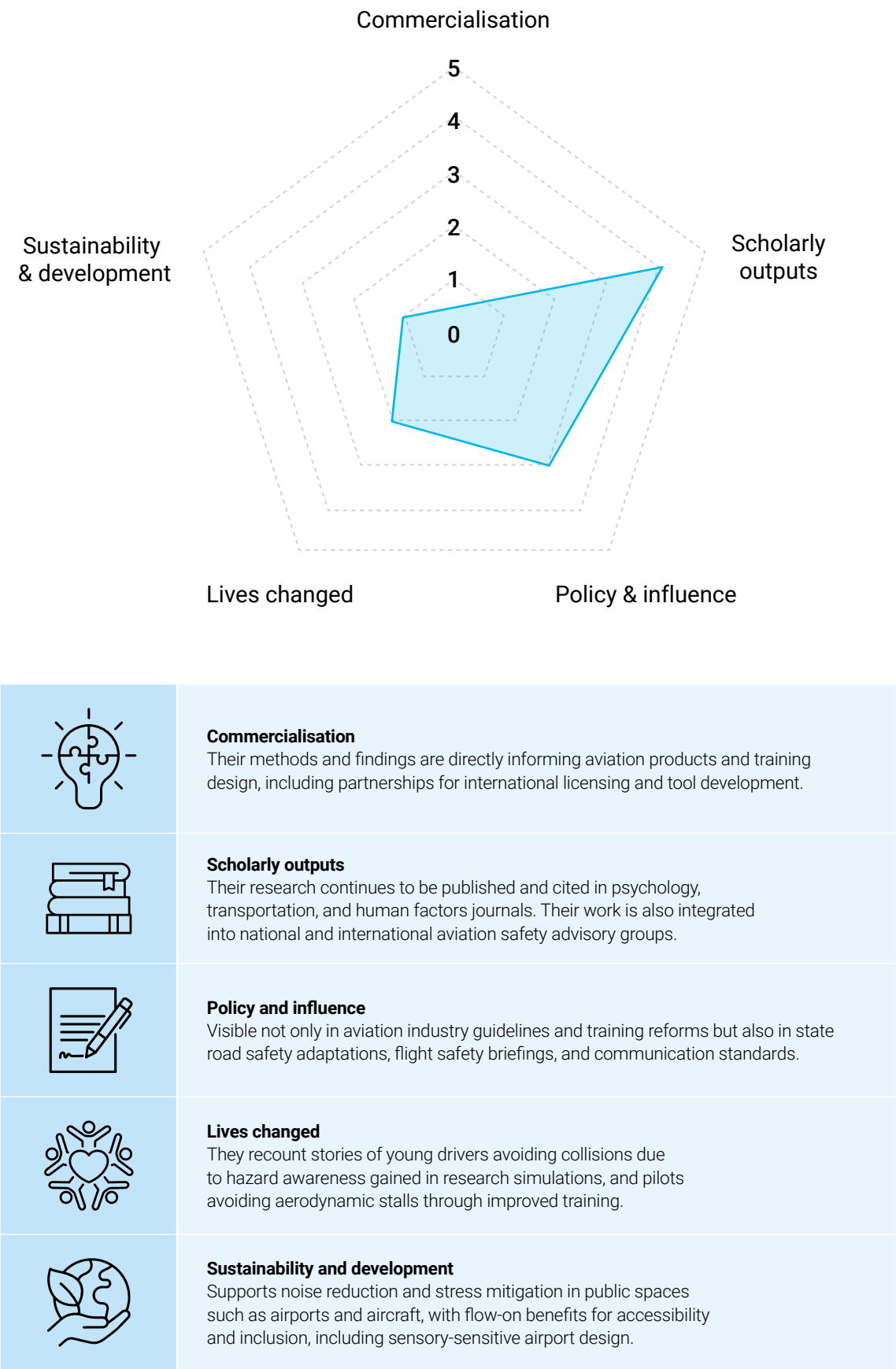
Equity and inclusion are emerging priorities within his portfolio, where women comprise fewer than ten percent of pilots. A new study is exploring why women remain under-represented in aviation, examining perceptions of risk, employment stability, and workplace culture. The findings will inform future recruitment and mentoring initiatives to create a more diverse and resilient aviation workforce.

At its core, his work reflects a conviction that science must engage directly with the complexity of human experience. For Professor Molesworth, these multiple layers of impact are inseparable. “You start by asking how people think and behave,” he reflects, “but before long, that knowledge is reshaping how aircraft are built, how pilots are trained, how surgeons communicate, and how young people learn to drive. That’s what science should do — connect the lab to the world.”

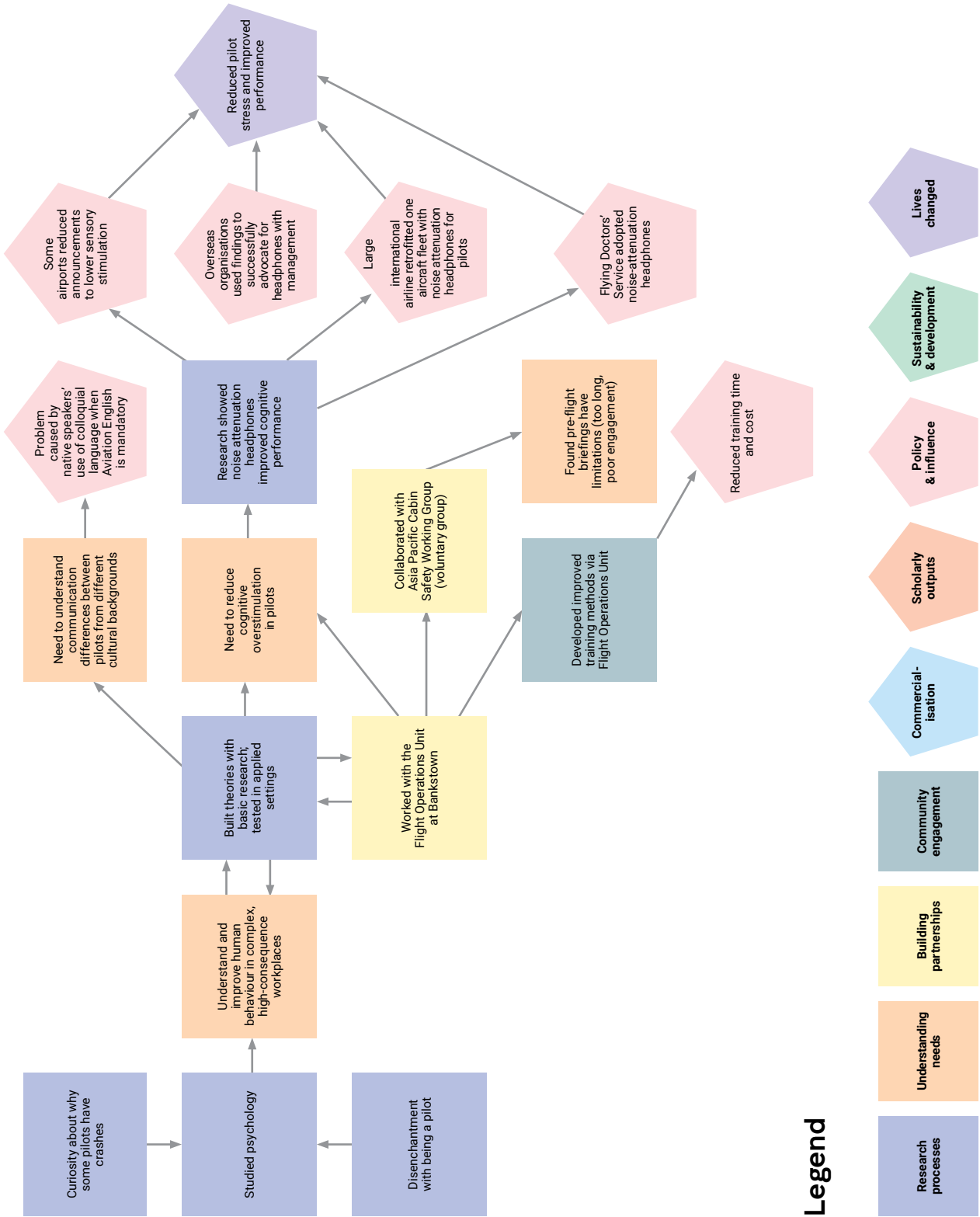


Professor Brett Molesworth guiding a student in the UNSW aviation simulator.

Research Impact Indicators



Pathway map





Associate Professor Mariana Mayer Pinto

Biological, Earth & Environmental Sciences

Through Living Seawalls and new studies on marine light pollution, this research has transformed how science connects discovery, design and society, building an evidence base that now shapes international policy, education, and industry practice.

Associate Professor Mariana Mayer Pinto leads a research team applying marine ecology to shape strategies and actions for coastal cities. What began as documenting the effects of coastal construction and urban pollution gradually shifted into a mission to reimagine the urban ocean. “I started just documenting human impacts,” she recalls, “but it got to a point where I thought—we need to do more than describe the problem.” That pivot has grown into a program of work that now informs international policy, education and industry practice.

Based on early work on the ecological effects of coastal construction and chemical contamination, Associate Professor Mayer Pinto delved into the field of eco-engineering and started considering not only how cities affect the marine environment, but how they can be redesigned to accommodate it. These studies demonstrated that flat seawalls reduce and

support different biodiversity compared to natural rocky shores. In response, the Living Seawalls team, of which she is a co-founder and co-leads, developed a suite of modular panels, made from 3D printed moulds that mimic features often found in natural habitats. Living Seawalls has been highlighted by the IUCN Nature-based Solutions report as a global exemplar of applied science generating both ecological and civic value. “When you look at a seawall covered by these panels,” she says, “you, many times, can see organisms that might not be able to survive (or thrive) on unmodified seawalls – and the panels look pretty!” Through partnerships with Lendlease, Volvo, and coastal councils, Living Seawalls panels have been installed in more than 20 sites globally, from Sydney Harbour to Ireland, Dubai, and soon Brazil.

Within UNSW, her research group has become a hub for interdisciplinary knowledge production. Along with other academics spanning four Sydney universities, she now co-leads Project Restore, a flagship project of SIMS (the Sydney Institute of Marine Science) an initiative integrating marine ecology, coastal engineering and social science research. Engineers study hydrodynamics to refine panel design. Social scientists assessing the economic and human wellbeing potential benefits. Lawyers map pern



Living Seawalls habitat panels, part of a project co-founded by Associate Professor Mariana Mayer Pinto.

pathways to overcome regulatory bottlenecks that slow restoration. The result is a rare ecosystem of expertise that generates science while reshaping how decisions about coastal infrastructure are made.

Associate Professor Mayer Pinto's work on marine light pollution reflects a similar pattern of responding to emerging issues with integrated solutions. Urban light spill into marine areas is largely unregulated, despite evidence that artificial lighting disrupts the behaviour of fish and invertebrates. These findings have contributed to national guidelines on coastal lighting and informed white papers for Australia's State of the Environment report, advocating the inclusion of light and noise as pollution categories. “Protected areas are shielded from fishing,” she says, “but not from light. We need to show that evidence so policy can catch up.” Here, she's not only producing first-of-its-kind data on marine species' responses to artificial light, but also engaging with city planners, lighting engineers, and public stakeholders to shift awareness and guidelines.

Public engagement is woven into every stage of the research. Encounters with curious residents carrying groceries or walking their dogs have become opportunities to explain the science, show the importance and build connection. “You can't achieve much if you don't get people involved,” she

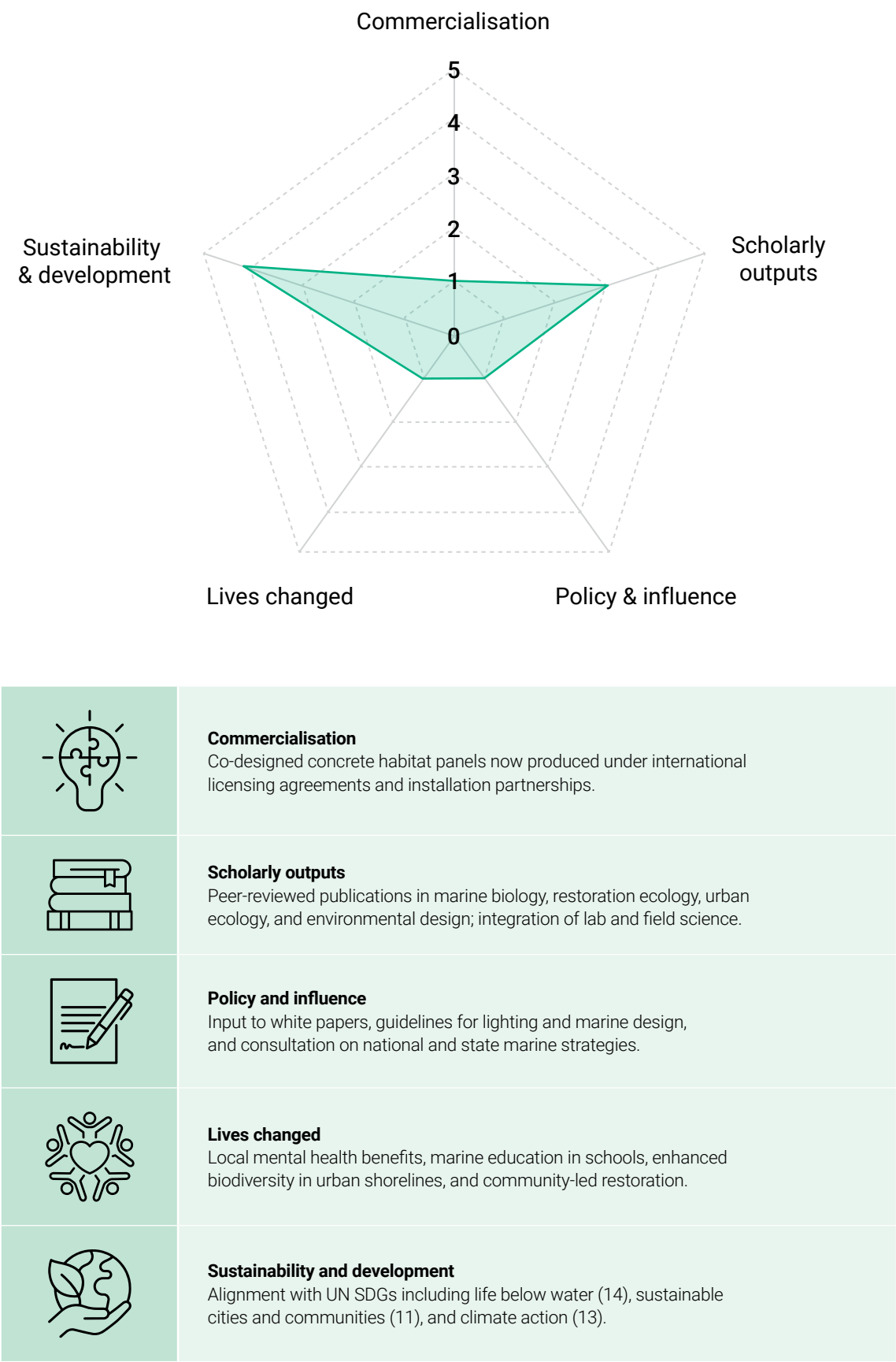
You can't achieve much if you don't get people involved...When they connect with the ocean, they want to protect it.”

says. “When they connect with the ocean, they want to protect it.” Her group's outreach materials have appeared in three children's books, including a Dr Seuss inspired ocean series, demonstrating the cultural diffusion of her science.

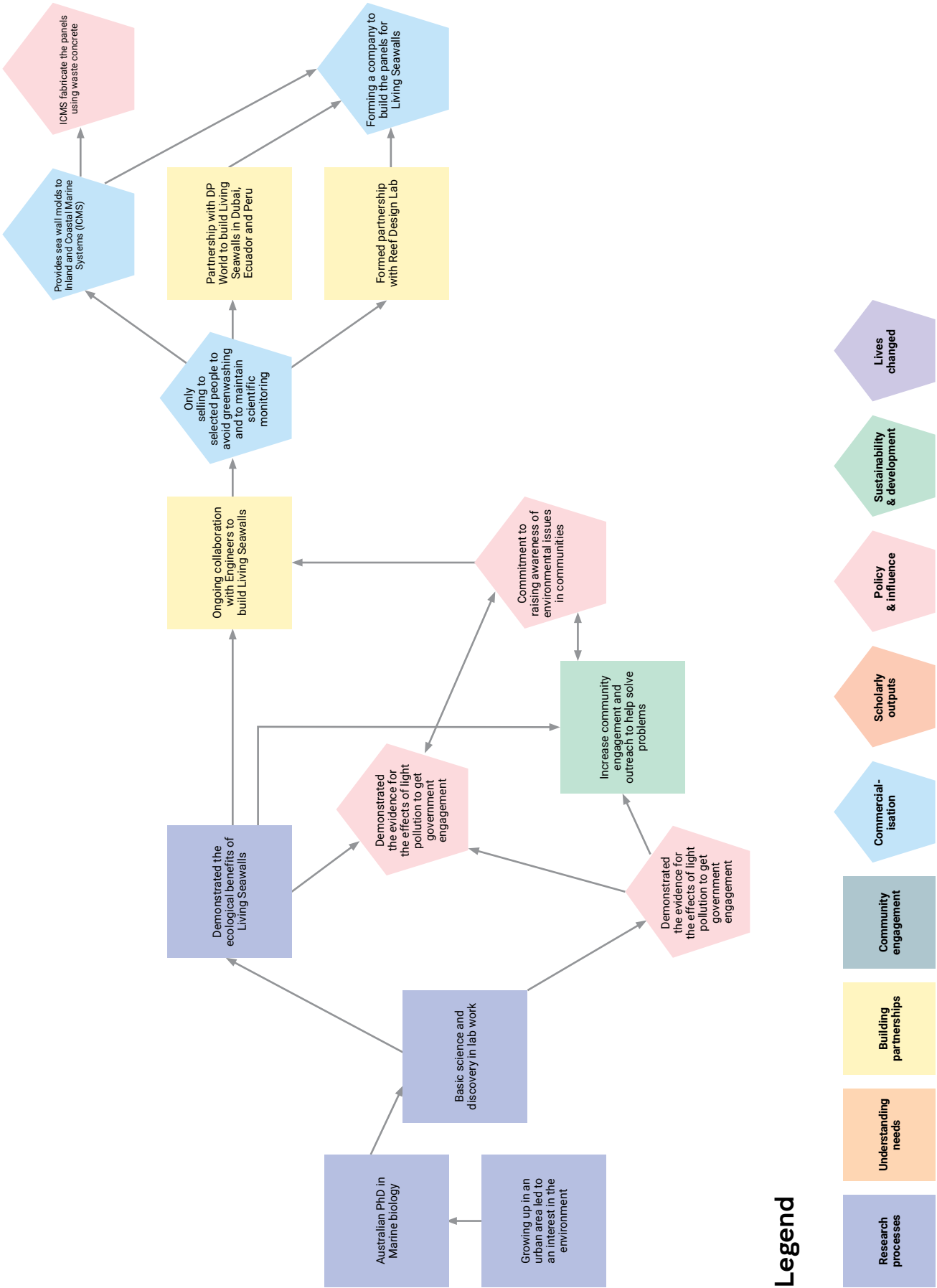
This emphasis on connection extends to partnerships with Indigenous communities. Recent installations, including new Living Boulders habitats, are in partnership with Traditional Owners, Elders, and the Gamay Rangers, who advised on siting, and environmental values. These collaborations help ensure that restoration is place-based, culturally grounded, and guided by local knowledge.

Through this integrated approach, her research transforms not only the built marine environment but also the ways societies understand and value the ocean. It repositions restoration from a niche scientific activity to a civic project, one that connects discovery, design, and community in shaping healthier coastlines for future generations.

Research Impact Indicators



Pathway map





Associate Professor Shane Keating

Mathematics & Statistics

Combining mathematics, oceanography and an entrepreneurial approach to innovation, this research is improving climate forecasting, strengthening global shipping and equipping the next generation of ocean scientists.

From the rugged west coast of Ireland to the bridge of a cargo ship crossing the Pacific, Associate Professor Shane Keating's journey has been as dynamic as the waters he studies. Growing up in a small fishing village, he developed an early and intuitive relationship with the sea. That experience seeded a lifelong curiosity about how oceans work.

Associate Professor Keating joined UNSW because, as he puts it, "there are only about four places in the world that are excellent in both mathematics and oceanography." His initial research was discovery-led science, focused on extracting insights from global satellite measurements of the sea surface. By combining satellite altimetry with in-situ sensors and physical models, he developed tools that produce

more complete representations of how currents evolve. This fundamental research revealed how small-scale ocean eddies influence heat transfer and energy balance, improving understanding of climate dynamics. "It's about using data and physics together," he says. "You can't observe the ocean everywhere, so mathematics fills in the gaps."

As his work advanced, so did his sense of responsibility for how it could be used. He began collaborating with organisations including the Bureau of Meteorology, the Australian Maritime Safety Authority, defence agencies, and research institutions in Europe and the United States. These relationships showed him a persistent problem. Many industries, including defence, meteorology, shipping, and fisheries depended heavily on the ocean yet lacked access to reliable forecasting tools. He realised that "to really create impact, you need to create value for the person who's going to use your science." In some cases, shipping companies were relying on antiquated methods to navigate ocean-going vessels in some of the world's most dynamic waters. The issue was not data scarcity but trust, design, and the needs of decision makers.

"It's about using data and physics together... you can't observe the ocean everywhere, so mathematics fills in the gaps."

That realisation catalysed a shift from academic to entrepreneur. His UNSW spin-out company, CounterCurrent, now delivers real-time hyper-local ocean forecasts for the global shipping industry. CounterCurrent harnesses dynamical ocean models, artificial intelligence, and satellite observations to provide ships with optimal routes through the ocean. "It's like 'Google Maps for the sea'," he explains. "We've shown that ships can get to their destination at the same time, using less fuel, without modifying the vessel." The commercial shipping industry is responsible for three percent of global greenhouse gas emissions, this represents immediate and scalable environmental benefit.

His discoveries also contribute to major international science missions. Associate Professor Keating is part of the team behind the Surface Water and Ocean Topography (SWOT) satellite, a joint US-French satellite mission launched in 2022. "SWOT is measuring ocean currents at ten times higher resolution than before," he says. "That's like going from black-and-white TV to high-definition TV." The data reveal the fine-scale weather systems of the ocean, anticyclones and cyclones that shape heat transport, fishing grounds, and maritime safety. This new generation of satellite observations is revolutionising ocean mapping and forecasting, with direct applications for search-and-rescue operations, fisheries management, climate and naval operations.

Through the medium of storytelling, Associate Professor Keating has reached unexpected audiences far beyond academia. He sees this as more than outreach: it is another way to discover. Each conversation — whether with a fisherman from Port Stephens calling in to a late-night radio show or a reader emailing from overseas — helps him understand how people perceive science, risk, and change. "You get to talk to people you'd never have the opportunity to talk to," he says. "It's not one-way communication. You learn from them." For him, public engagement is an essential feedback loop in science, "a way of testing ideas in the real world."

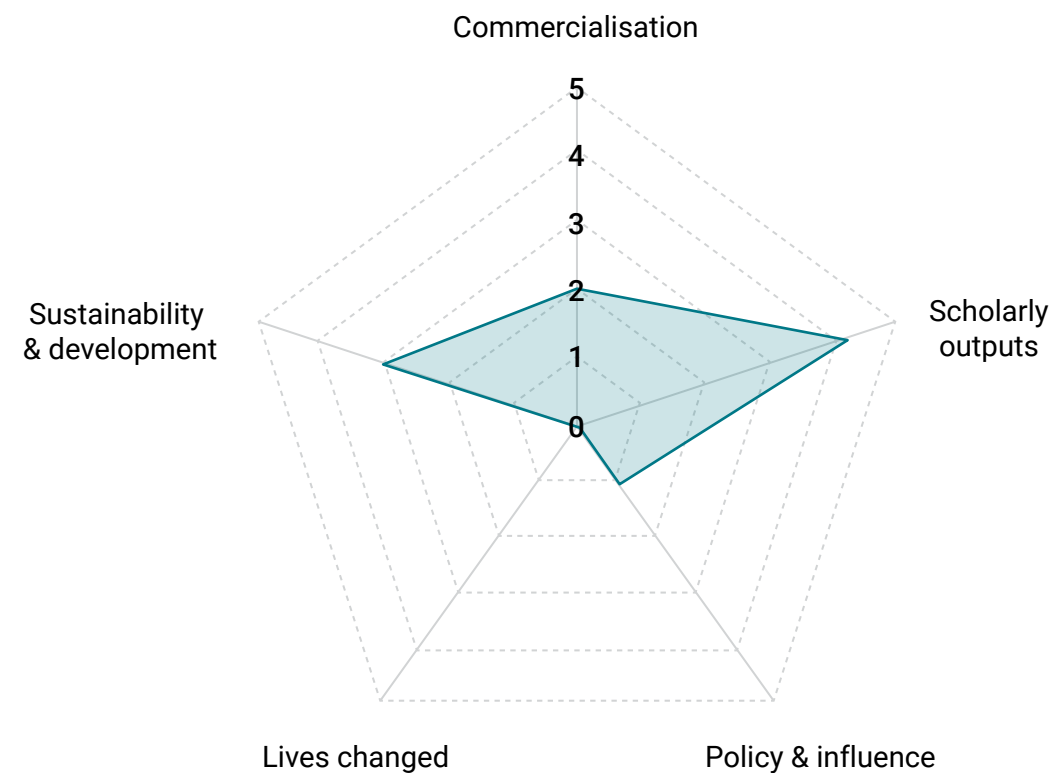
Across all these activities, he represents a growing hybrid model of research, where discovery, translation, and innovation operate as a single continuum. "Working in a start-up or company and being an academic will be totally normal in a few years' time." He believes future scientists will move fluidly between academic and commercial environments. His vision of scientific impact is clear. "My goal is to change the way that ships cross oceans," he says. Every ship, he explains, could one day follow "the most efficient path, reducing emissions immediately, without changing a single engine."

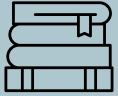
His work demonstrates how discovery drives social impact. By combining rigorous science with storytelling and partnerships, Associate Professor Keating is helping to shape how society adapts to our changing oceans.

Associate Professor Shane Keating collecting ocean data during field research at sea.

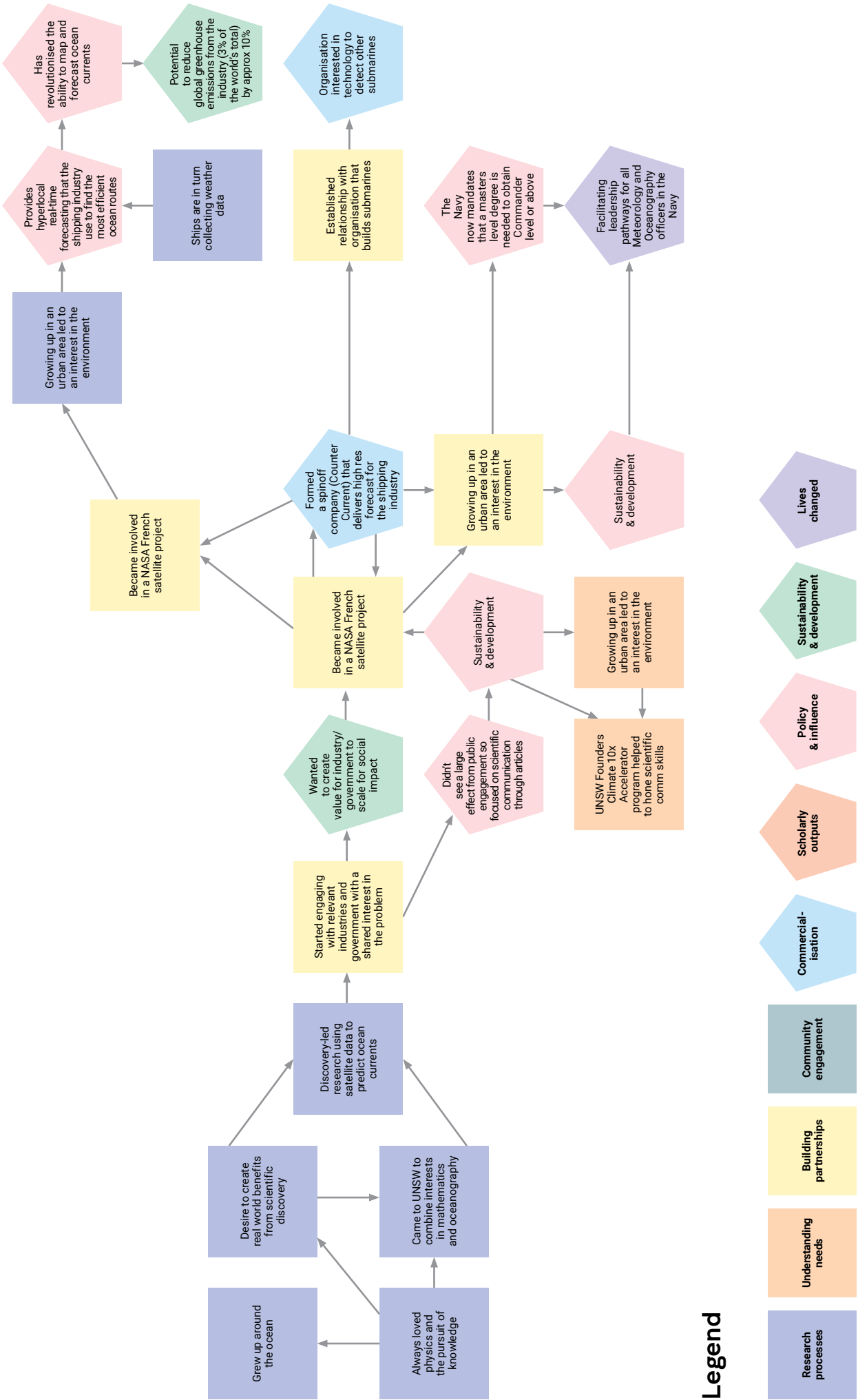


Research Impact Indicators



	Commercialisation CounterCurrent has secured start-up funding, international partnerships, and government support through accelerators and AWS's AI for Climate program.
	Scholarly outputs Beyond traditional academic work, he is actively reshaping science communication, using public writing, radio, and storytelling to bring the science of everyday ocean dynamics to new audiences. His writing on surfing, shipping, and the mathematics of the ocean has reached millions.
	Policy and influence The researcher contributes to international bodies including the UN Ocean Conference and collaborates with the World Meteorological Organization, supporting the development of global ocean observation and data-sharing frameworks.
	Sustainability and development By reducing global shipping emissions and promoting more efficient ocean routing, the work contributes directly to global climate goals and greener logistics.

Pathway map





Professor Rajib Rahman

Physics

By modelling electronic devices atom by atom, Professor Rajib Rahman helps researchers understand and improve quantum technology. His simulations guide experiments, inform the design of more energy-efficient electronics and lay the groundwork for novel computing platforms that can advance science and engineering applications.

The chips in our phones and computers depend on tiny electronic switches called transistors. For decades, making these switches smaller made computers faster and more powerful. But as they approach the scale of individual atoms, they become harder to control and waste more energy as heat. For Professor Rajib Rahman, that challenge led to a larger question: "Ultimately, we reach the size of an atom. Then what new ways of computing can emerge?"

An opportunity to explore quantum computing arose during his PhD at Purdue University. "It was by chance, but it matched well with my interests," he recalls. With a background spanning physics, electrical engineering and computer science, he was drawn to a field that brought all three together.

Quantum computing offers a fundamentally different way to process information. A conventional computer uses bits that are either zero or one—like a coin lying flat as either heads or tails. A quantum computer uses

quantum bits, or qubits, which are more like a spinning coin: until measured, they can hold a combination of both possibilities. By carefully controlling how qubits interact, researchers could tackle certain problems that are difficult for today's computers, such as modelling complex molecules and materials. In time, this could help scientists design new medicines, catalysts, fertilisers and other advanced technologies.

Turning that possibility into useful technology is a challenging task. Qubits are extremely fragile: a material defect, a misplaced atom or a small environmental disturbance can disrupt the information they hold. To build quantum computers capable of solving practical problems, researchers must first understand and control what happens inside each device.

This is where Professor Rahman works. "My lab is the computer," he says. As a computational physicist, he develops simulations showing how electrons behave inside materials and devices, down to the arrangement of individual atoms. His team can model systems containing millions of atoms, bringing simulations close enough to real devices to compare predictions directly with experiments.

An experiment may show that a qubit is behaving unexpectedly without revealing why. Professor Rahman's models can identify what is happening, reveal how an atomic defect, material disorder, or an electromagnetic field, for example, is affecting the device and suggest an improved design to test. In this way, his



Professor Rajib Rahman and a student using atomic models to explore the building blocks of next-generation quantum devices.

work provides a virtual testing ground for quantum technology, allowing researchers to investigate designs before constructing them. By reducing uncertainty and the need for costly, time-consuming trial and error, it makes discovery, development and commercialisation faster, better informed and more targeted.

Partnership has been central to this process. Early in his career, Professor Rahman began collaborating with Professor Michelle Simmons and her UNSW team before Silicon Quantum Computing was established. Her team could construct quantum devices with atomic precision, while his tools could simulate them at the same level of detail. Through regular collaboration over several years, simulations informed experiments and experimental findings generated new questions. "Both parties were exploring things and trying to discover and pave out a new direction," he reflects.

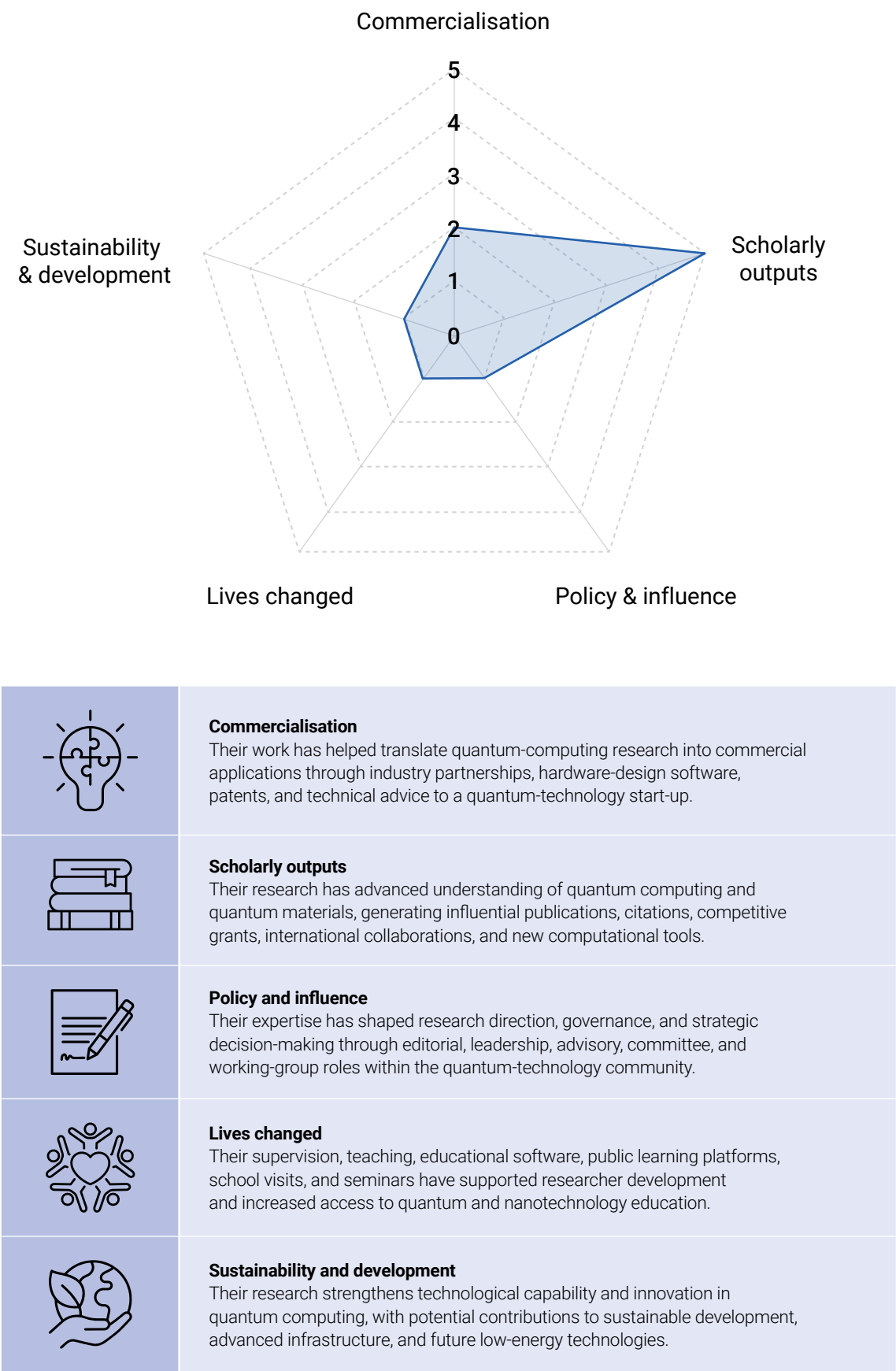
Professor Rahman's computational tools and expertise have since supported academic groups, national laboratories and quantum technology companies, contributing to software, device design, technical advice and intellectual property. The methods also extend beyond quantum computing to next-generation transistors and optoelectronic devices that are extremely small in size but consume less energy as they operate. As artificial intelligence drives growing energy demand, his guiding questions—"Can we have electronic devices that consume less power? Can they process information faster?"—are increasingly important to sustainable digital infrastructure.

Professor Rahman's impact also travels through the people he teaches and trains. Through supervision, educational software, public learning platforms, school visits and seminars, he has helped develop researchers and make quantum and nanotechnology more accessible. Former students have joined international semiconductor companies and Australian quantum start-ups, carrying specialist expertise into a rapidly growing industry.

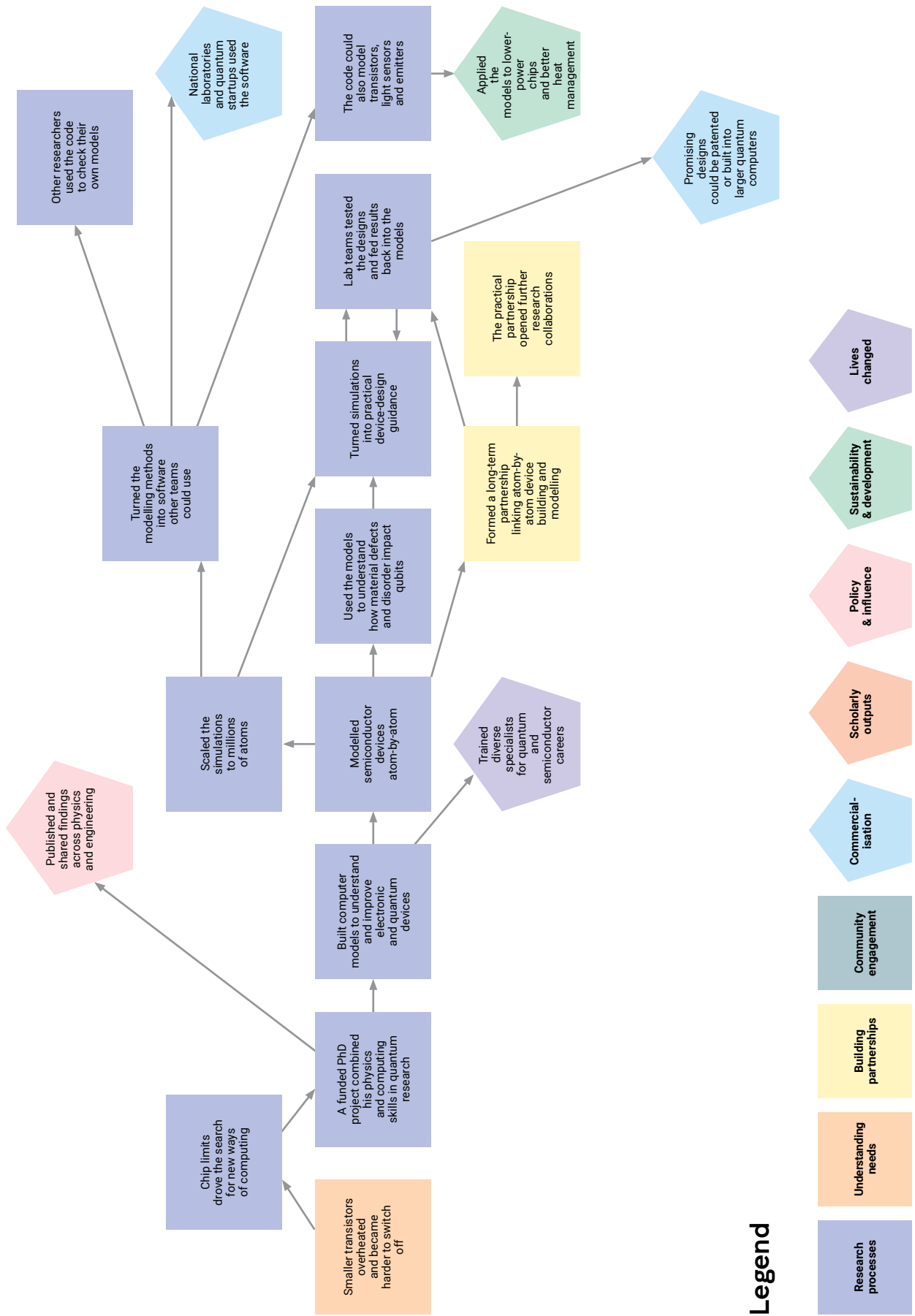
The full societal benefits of quantum computing may take decades to emerge, but they depend on the foundational work happening now. Professor Rahman's research sits at the beginning of the impact pathway, laying the foundation for every advance that follows. By providing the models, methods, partnerships and people that make future breakthroughs possible, he is helping move quantum computing from scientific promise towards practical application.

"Ultimately, we reach the size of an atom. Then what new ways of computing can emerge?"

Research Impact Indicators



Pathway map





Professor Fatemeh Vafaei

Biotechnology & Biomolecular Science

Integrating data science with molecular biology, this research accelerates drug development, enables non-invasive cancer detection, and advances ethical AI in healthcare.

After completing a PhD in Computer Science, Artificial Intelligence, at the University of Illinois at Chicago, Professor Fatemeh Vafaei was building cutting-edge machine learning models but felt something was missing. “I was generating a lot of cool models,” she recalls, “but just developing models and benchmarking them better than the others—what after?” With strong opportunities in industry on the table, she decided to direct her expertise toward biomedicine, where she saw “a lot of problems that I have solutions for.”

Today, as a leader in artificial intelligence and precision medicine at UNSW, Professor Vafaei exemplifies what it means to engineer precision and democratise care. Her work sits at the intersection of data science and molecular biology, transforming biomedical discovery, diagnosis, and the ethics of AI in healthcare. At UNSW, Professor Vafaei has built a multidisciplinary laboratory spanning computational biology, artificial intelligence, and clinical medicine. Her research centres on two interconnected themes: AI-accelerated drug discovery and AI-enabled precision diagnostics.

In drug discovery, Professor Vafaei’s team works with Australian and international pharmaceutical partners to address one of medicine’s most persistent challenges—the time, cost, and high failure rate of developing new therapies. “Traditional de novo drug discovery can take more than 15 years, cost upwards of two billion US dollars, and succeed less than 10 percent of the time,” she explains. By applying advanced AI to integrate complex data on diseases, drugs, and patients, her team rapidly identifies high-value therapeutic targets and predicts synergistic drug combinations. Her work is translated through partnership with Algorae Pharmaceuticals and her UNSW spin-out, OmniTx.ai, which commercialises AI-driven knowledge-graph and reasoning technologies to systematically accelerate drug discovery and precision medicine at scale.

The same computational logic underpins her work in diagnostics. Collaborating with the Australian company BCAL Diagnostics, her lab developed a blood-based “rule-out test” for breast cancer that identifies patterns of lipids predictive of malignancy. The test is already being used in Sydney and Melbourne clinics, reducing the need for unnecessary invasive tissue biopsies and reducing anxiety for patients. Now, with UNSW as lead partner, the team is expanding the test into a multi-analyte platform

“We need to think strategically about how AI is adopted, ensuring we maximise its potential while safeguarding against harm.”

that measures multiple molecular signals—lipids, RNA, and proteins—to improve early detection. “If that rule-out test expands to a diagnostic test,” she says, “it would be a significant impact for breast-cancer detection and a blueprint for diverse cancer types.”

Her vision extends beyond discovery and diagnosis to the social dimensions of health technology. She advocates for equitable, transparent, and responsible AI. “We have seen models based on European samples performing poorly for other ethnicities,” she notes. “It’s a bias inherent in the data.” To address this, her lab designs studies that include diverse populations and develops computational methods to detect and correct algorithmic bias.

Her engagement in public and policy dialogue reflects this commitment. Over nearly a decade, she has contributed to government forums on responsible and equitable AI, including invitations from the New South Wales Parliament and Royal Society of New South Wales & Learned Academies Forum. Through these discussions, she has helped shape how policymakers approach algorithmic fairness, data accessibility, and the ethical integration of AI into clinical decision-making. “We need to think strategically about how AI is adopted, ensuring we maximise its potential while safeguarding against harm,” she explains.

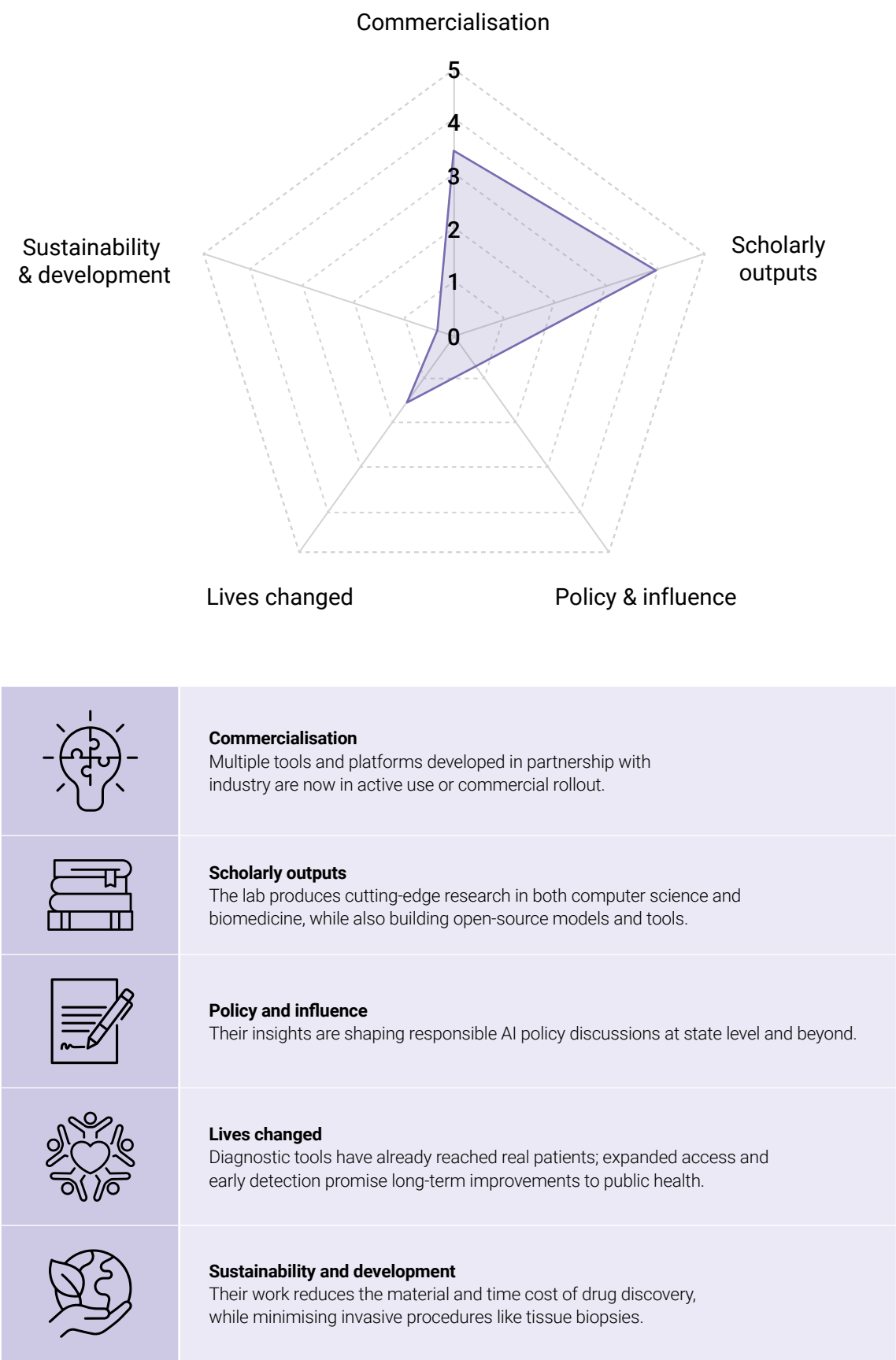
The social dimension of her work is rooted in accessibility and equity. She envisions a future where high-quality diagnostics are available to everyone, regardless of age, geography, or proximity to specialist facilities, delivered through routine pathology services using simple blood tests. “That, by itself, is democratisation,” she explains: ensuring that accurate diagnosis does not depend on where you live or the expertise available locally, but is reliable and consistent for all, everywhere.

Yet behind every dataset and algorithm is a simple motivation. “One day,” she says, “a blood test will tell you if you’re at risk long before symptoms appear.” Seven years ago, she could not have imagined that her work would translate so directly into people’s lives, but that is the impact she strives for. What began as a leap of faith from computer engineering into biomedicine has since evolved into a globally recognised model for AI-driven health innovation. From enabling blood-based screening beyond major hospitals, to advancing rare-disease diagnostics and mentoring the next generation of biomedical innovators, Professor Vafaei is reengineering science for a world that demands both precision and compassion.



Professor Fatemeh Vafaei processing blood samples in the UNSW Biomolecular Sciences Laboratory.

Research Impact Indicators



Pathway map





Professor Angela Nickerson

Psychology

Uniting psychological science with humanitarian policy to transform global responses to refugee mental health.

Professor Angela Nickerson's scientific journey began not in a laboratory, but in a moment of moral reflection. As an undergraduate studying International Relations, Professor Nickerson learned about the impact of immigration policies on refugees around the world. "I couldn't stop thinking about what would lead someone to leave their home and undertake a dangerous journey on foot or by boat. I wondered what could be done to help people recover from an experience like that?" That question reshaped her studies and, ultimately, her contribution to the field of psychology.

Her early academic work in psychology and international relations explored the public perception of asylum seekers, revealing how social attitudes and policy environments intertwine with moral reasoning. She soon recognised that there was a need for a stronger evidence base to guide psychological treatments for refugees. Existing clinical frameworks, largely developed for veterans or single-incident trauma survivors, failed to capture the complexity of displacement, persecution, and prolonged uncertainty. This realisation set her on a path to develop new treatments grounded in both scientific rigour and lived experience.

At UNSW, Professor Nickerson co-founded the Refugee Trauma and Recovery Program, a research laboratory dedicated to understanding and improving refugee mental health. Her research provided some of the first empirical evidence for the mechanistic role of emotion regulation difficulties in refugee mental health. Building from this foundation, her group developed an intervention combining emotion regulation training with exposure therapy and have gone on to test novel interventions with refugees across Australia and internationally.

The scope of the lab expanded to encompass national policy. In partnership with the Australian Red Cross and Settlement Services International, Professor Nickerson co-led a landmark longitudinal study tracking 1,085 refugees living under different visa conditions. The findings were stark: those living under temporary protection visas exhibited dramatically higher levels of depression, anxiety, and suicidality. When some participants later transitioned to permanent residency, their symptoms rapidly declined.

These findings contributed to a larger body of evidence that was used in government briefings, human rights submissions, and Senate inquiries to inform visa reform and contribute to policy changes that granted permanent protection for thousands of former temporary visa holders. This work demonstrates how science can exert quiet but powerful influence "As scientists, our role is to provide impartial evidence that can be used as a tool to advocate for policy change."



Professor Angela Nickerson meeting with a colleague from Regional Opportunities Australia (ROA).

"As scientists, our role is to provide impartial evidence that can be used as a tool to advocate for policy change."

The influence of her research has extended beyond Australia. In Indonesia, where tens of thousands of refugees remain stranded without work rights or resettlement options, her team drew on knowledge regarding key psychological mechanisms underlying refugee mental health to test a low-intensity therapy. In this research, Professor Nickerson's team partnered with local academics, NGOs and refugee-led organisations to deliver the program to hundreds of participants. In addition to providing much-needed mental health support, this project-built research and clinical capacity amongst refugee communities in Indonesia, demonstrating how research can lead to both individual and structural impact.

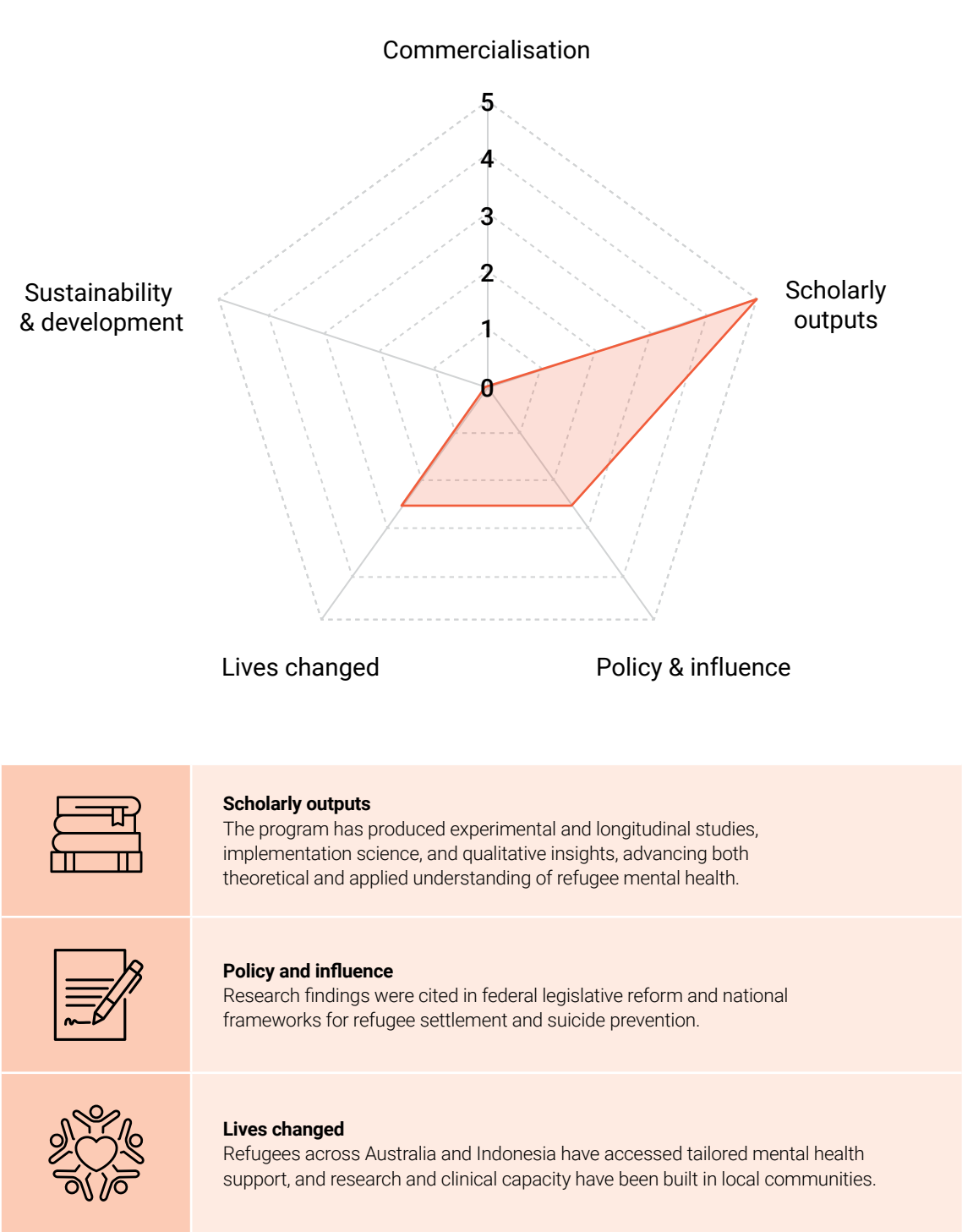
How is this impact achieved? At the core lies partnership and trust. Professor Nickerson and her team have cultivated long-term collaborations with refugee communities, NGOs, policymakers, and international agencies. Their research informs and is informed by evolving refugee frameworks, embedding psychological wellbeing as a key pillar of settlement

and protection policy. These partnerships demonstrate how academic credibility and policy impact co-produce one another. Through formal collaborations, the research now contributes to regional consultations and international settlement frameworks that recognise mental health as essential to refugee support.

Education and mentorship form another layer of her impact. Professor Nickerson has been involved in training clinicians across Australia, delivered national workshops on refugee trauma treatment, and built a culture of experiential learning at UNSW. Her students routinely participate in community-based research and see their findings translated in real-world outcomes, from clinical interventions to policy reform. "You want them to see the pipeline," she says. "The honours project analysing a dataset today might become tomorrow's evidence in Parliament."

"The basic scientific work provides the critical building blocks," she reflects. "But the research only matters if it can be used to change how people live."

Research Impact Indicators



Pathway map



Pathways to impact: process and Pact for Impact Indicators



Impact framework

Indicator based frameworks are becoming increasingly common in research impact assessment. These frameworks provide a structured foundation for demonstrating both impact and the processes through which it occurs. In this report, the indicators are also used to generate an aggregated impact pathway map across all eight UNSW scientists, enabling identification of common patterns as well as important differences in how impact is achieved.

To develop the indicator framework, each scientist's impact narrative was first analysed to produce concise statements summarising their pathway to impact. These statements were connected with arrows to represent causal or temporal relationships, as evidenced in the interview transcripts. Each statement was then coded to either a Pact for Impact category or to what was subsequently defined as a process dimension. The four process dimensions categorise the activities that the scientists undertook in the pathway to creating impact. These processes are therefore important to examine because they explain how impact happened.

Participants' process statements were analysed using an inductive, data-driven approach. Statements were initially coded line by line and then grouped into higher order categories, resulting in four process sub-dimensions, each comprising five to six sub-categories framed as process indicators. The coding was iterative, with early codes reviewed, refined, and in some cases reclassified as analysis progressed.

The Pact for Impact statements were analysed using a combination of deductive, framework-driven coding and inductive, data driven analysis. Each statement was first coded to one of the Pact for Impact categories. A second layer of coding was then undertaken using the same iterative approach described for the process indicators, allowing categories to be refined and adjusted as the analysis progressed.

As shown in Table 1, this process resulted in the development of a societal impact indicator framework for UNSW Science, grounded in the work of the eight scientists. While the case studies provide rich, detailed accounts of individual impact pathways, the indicator framework offers a concise overview. More importantly, it establishes an organising structure for identifying and quantifying instances of both process and impact, and for systematically linking these to supporting evidence.

If UNSW Science were to scale this approach across all academics, it could extend the framework iteratively until thematic saturation is reached, while developing a central repository to store evidence associated with each individual impact pathway. Likewise, the indicators in the UNSW Societal Impact Framework could also be used. However, to fully realise the value of this approach, it is necessary to make explicit the connections between research processes and societal impact, as well as the interrelationships among the processes themselves. This is addressed in the next section.

² *Understanding needs* reflected participants' focus on identifying and responding to basic human needs, organisational and industry requirements, and unresolved or emerging problems. *Research as a pathway* to change captured the use of rigorous research processes, including basic or lab-based research and longitudinal survey methods, often underpinning innovation. *Community engagement* described intentional efforts to build and sustain respectful, reciprocal relationships with communities, sectors, and networks connected to or affected by the research. Finally, *Partnership building* encompassed planned and emergent collaborations across academic, industry, and cross-sector contexts that supported research impact.

Table 1. Societal Impact Indicator framework

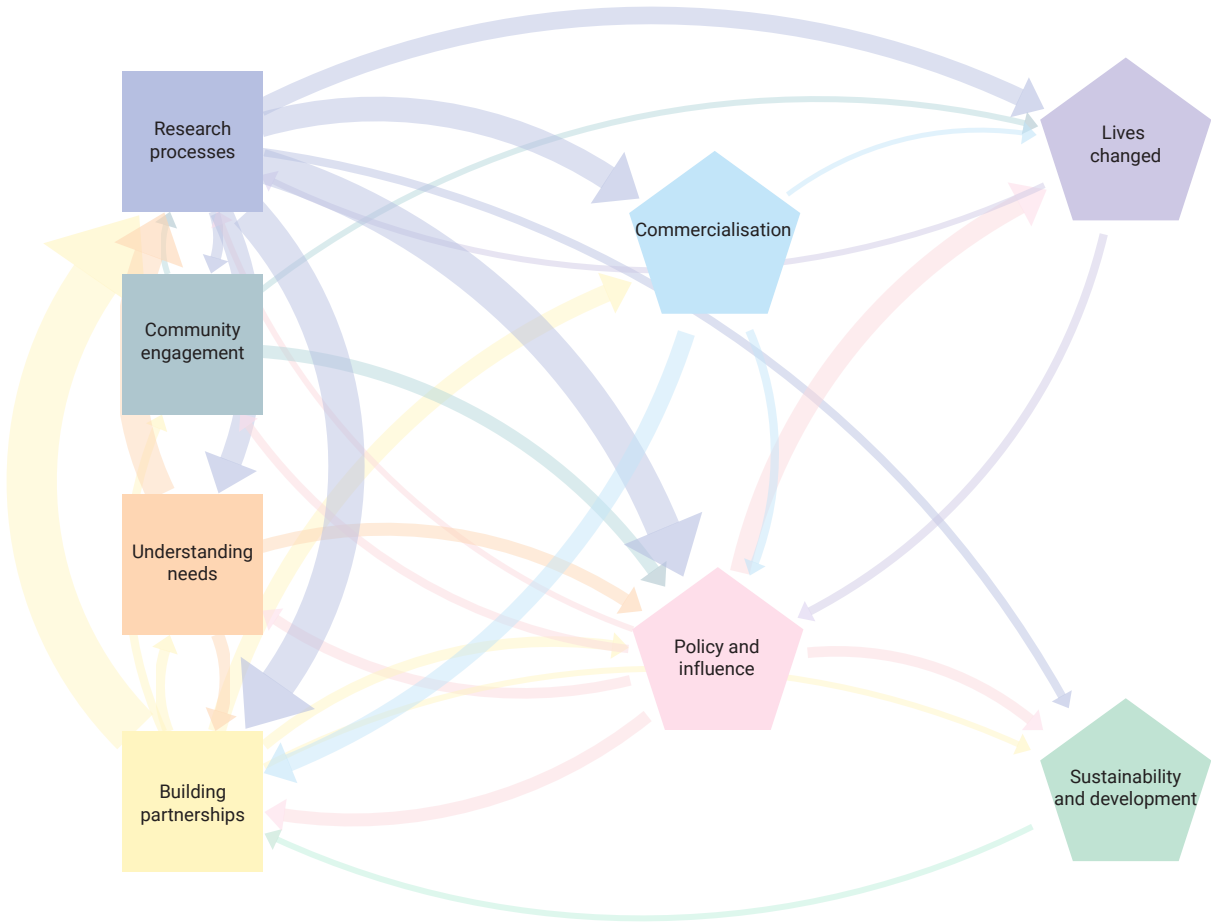
Process dimensions and indicators				
Understanding needs	Research processes	Community engagement	Building partnerships	
Communication needs Identified	Lab/applied/traditional research	Capacity building	Academic partnerships developed	
Human needs identified	Technological innovation	Contributing to professional bodies	Networks built	
Industry needs identified	Traditional grant funding	Supporting social cohesion	Government partnerships developed	
Technology needs identified	Early motivations	Building networks	Community partnerships developed	
Organisational needs identified	Research evidence	Outreach	Industry partnerships developed	
			Industry approaches UNSW	
Pact for Impact categories and indicators				
Scholarly outputs	Commercialisation	Policy and influence	Lives changed	Sustainability and development
Peer-reviewed articles Conference presentations Books Book chapters Reports etc	Commercialisation for environmental benefits	Knowledge exchange: - Through media - With government - With industry - With communities - With NFPs	Creating employment opportunities	Reduced carbon footprint
	Commercialisation for government use	Influencing clinical policy	Improving gender equity	Reduced environmental damage
	Commercialisation for clinical use	Influencing government policy	Improving health	Reduced reliance on fossil fuels
	Commercialisation for industry use	Influencing organisational policy	Improving life skills	
		Supporting start-ups	Reducing stress	
		Promoting defence capabilities		
		Promoting industry growth		

Impact pathways

The mapping approach drew on systems thinking methodologies that construct models from existing transcripts rather than through live group facilitation (e.g., Kim & Andersen, 2012), while also enabling aggregation without the potential power imbalances associated with group processes (Craven, 2017). Following Craven's approach, a spreadsheet was generated for each individual pathway map, structured according to the coding of the Pact for Impact categories and the four process dimensions.

These spreadsheets were then combined into a single consolidated file, which was subsequently converted into an aggregated impact pathway map, shown in Figure 4. This approach ensured that each individual pathway remained intact, while also allowing consistent classification across cases. Where similar sequences appeared across multiple accounts, the corresponding arrows are depicted as wider in the aggregated map, highlighting common patterns through which societal impact is achieved.

Figure 4. Aggregated impact pathway of eight individual scientists



³ Note that Scholarly Outputs are not included in the diagram as these were not a focus of the report. Instead, the limited talk that was related to scholarly outputs were coded under the research process.

Pathway summary

The widest arrows in Figure 4 indicate the most typical pathways for the scientists. For readability, the Pact for Impact domains are positioned on the right of the map³ to represent eventual impacts, while the process domains are arranged on the left.

There are several patterns of note:

1. There is a reinforcing loop between developing **partnerships** and the **research process**. The research process is supported through partnerships, and undertaking research also generated new and deeper partnerships.
2. There are weaker feedback loops between **understanding needs** and the **research process**, and between understanding needs and **partnership** development. Together, these patterns show that impact pathways often evolved iteratively, with research, partnerships, and problem understanding reinforcing one another.

3. The **research process** was a common precursor and driver of the **Pact for Impact** (especially commercialisation, lives changed and policy and influence), but it was not the only mechanism. Community engagement and understanding needs also connected directly to the Pact for Impact domains (lives changed and policy and influence) for some of the scientists.
4. The Pact for Impact domains fed back into the process domains and into one another, suggesting that impact operates as a reinforcing process for further impact.

Finally, the map demonstrates many pathways for just eight scientists. So, while the patterns are important to acknowledge, the diversity in how impact is achieved is just as relevant. There is no one way to impact.



³ Note that Scholarly Outputs are not included in the diagram as these were not a focus of the report. Instead, the limited talk that was related to Scholarly Outputs were coded under the research process.

Implications for understanding and enabling impact

For academic leaders, extensions of this work could help identify the pathways that most consistently lead to impact and those that are less effective or take longer to materialise. With a larger sample, such mapping could inform Faculty or School resourcing by supporting academics to pursue more effective pathways or explore new ones.

Nevertheless, even this focused piece of work:

1. Highlights the importance of basic research as a recurring foundation for partnerships and downstream impact pathways.
2. Shows that relationships are not peripheral but fundamental to knowledge production, with impact emerging through sustained interaction with industry, government, and community actors.
3. Reinforces the role of co-production, where partners act not only as collaborators in research but as adopters, advocates, and investors who carry impact into policy, practice, and markets.
4. Points to the presence of feedback loops, where impact activities such as partnerships, policy engagement, and commercialisation reshape and extend the research process rather than following it linearly.
5. Suggests that impact pathways are cumulative and reinforcing, with successful outcomes strengthening partnerships and enabling further collaboration over time.

For early career researchers, advice to build relationships with industry, community and government is not new. However, the aggregated pathways highlight how central these relationships are. Basic research was also a key driver of partnerships for the eight UNSW scientists in this study, suggesting that the training researchers receive and the research they undertake remain highly relevant. While early career researchers may not yet generate impact at this scale, it is important to track the relationships they form, what led to them and what emerges from them. Mapping these pathways can provide evidence of contribution to impact that materialises later. More specifically, this report:

1. Indicates that community engagement extends beyond public communication to include mentorship, teaching, and capability-building, which can act as early-stage pathways to longer-term impact such as policy influence.
2. Suggests that scientific careers oriented towards impact are not defined by departure from core research, but by the extent and quality of interactions surrounding that research development.
3. Co-creation requires a willingness to share power, to listen, and to work across institutional boundaries. Scientists spoke about their work in terms of service, collaboration, and responsibility to the communities and systems affected by their research.

For the social impact measurement field, the pathways provide a methodology for evidencing impact pathways at both the individual level and, where more academics are engaged, at the School or Faculty level. The structured description of the pathway is itself a form of evidence for contribution, as it makes visible the sequence of relationships, activities and decisions that link research to impact. In this sense, the approach complements narrative case study models such as the REF while providing a clearer representation of how impact develops. The method could also incorporate additional evidence sources where appropriate, for example through a repository linked to selected statements in the pathway that could be peer reviewed.

Overall, this report:

1. Supports a shift from linear models of impact to system-based representations characterised by interaction, iteration, and feedback.
2. Provides a way to evidence contribution without relying solely on end outcomes, by documenting the processes, relationships, and decisions that enable impact.
3. Opens up the possibility of recognising field-shaping activity, capacity-building, reciprocity and co-creation as legitimate and measurable forms of impact.

Understanding and demonstrating the societal impact of science

How science impact happens

The eight UNSW scientists profiled generated a wide range of societal outcomes, including medical technologies used in clinical practice, safer aviation systems, policy reform affecting refugee wellbeing, environmental restoration of urban coastlines, and innovations improving industrial efficiency and sustainability.

The findings show that there is no single route from research to societal impact, but a system of interdependent and reciprocal pathways. Participants' accounts align with the literature in depicting impact as a process of co-production between scientists, stakeholders and societal institutions (Jasanoff, 2004). In this view, impact emerges all throughout the scientific process at the interfaces of science, technology and societies through productive interactions rather than simple input-output relationships (Nowotny, 2005; Spaapen & van Drooge, 2011). Across the cases examined, impact did not only occur after research was completed but through sustained relationships, negotiation, adoption and adaptation, and shared problem-solving. The absence of a single pathway is therefore not a weakness, but evidence of science impact's dynamic, relational and coevolutionary nature.

Strategic knowledge translation

At both the individual and aggregated level, the maps show how impact unfolds over time through need identification, research activity, partnerships, and engagement, rather than through a single linear act of translation. Our findings suggest the simple message that "making knowledge available will lead to impact" may not be the most effective approach. This does not mean that knowledge translation should cease. Rather, it recognises that traditional notions of dissemination that typically occur when science leaves the lab or is published, may restrict opportunities to understand broader impacts and how they unfold over time. Often without deliberative intention, scientists in this study strategically embedded processes of knowledge co-production at the core of their approach, thereby demonstrating research translation as iterative and ongoing.

Demonstrating social impact as a system

The individual and aggregated pathways display the hallmarks of a system: reciprocity, non-linearity, dynamism, and feedback loops. It follows that methodologies for assessing impact should examine how such systems behave and the consequences they produce. Our approach provides a foundation for this, particularly when aggregated pathway maps are compared over time to reveal how impact pathways evolve. This is especially relevant to the REF, which requires evidence not only that change occurred, but also how research contributed to that change. By documenting relationships, decisions, and feedback loops, pathway mapping makes these contributions more visible, particularly where outcomes are difficult to measure directly. Aggregating pathways also reveals recurring patterns across cases, supporting comparison and institutional learning. In this way, pathway mapping offers universities a practical way to understand how scientific impact emerges, strengthen the conditions that enable it, and demonstrate its contribution to society.

UNSW Science Impact Indicators

Scientific impact is often assessed using quantitative metrics such as publications, citations and patents. While important, these measures capture only part of how science contributes to society.

The UNSW Science Impact Indicators framework was developed to help make visible the broader pathways through which scientific research creates value. This includes contributions that are often difficult to capture through traditional metrics alone, such as collaboration, policy influence, community engagement, sustainability outcomes and long-term societal change.

Purpose of the framework:

Purpose	What it does
Storytelling	Communicates how societal impact occurs across diverse scientific fields
Strategic reflection	Helps scientists and institutions identify pathways to impact
Institutional learning	Supports understanding of how partnerships and engagement contribute to societal outcomes
Evidence of contribution	Demonstrates broader forms of societal contribution beyond traditional metrics
Advocacy and translation	Helps communicate the societal value of science to governments, funders, partners and broader audiences

Understanding the charts

The radar charts in this report provide a visual snapshot of how individual academics perceive the societal impact of their work across five categories: Commercialisation, Scholarly Outputs, Policy and Influence, Lives Changed and Sustainability and Development.

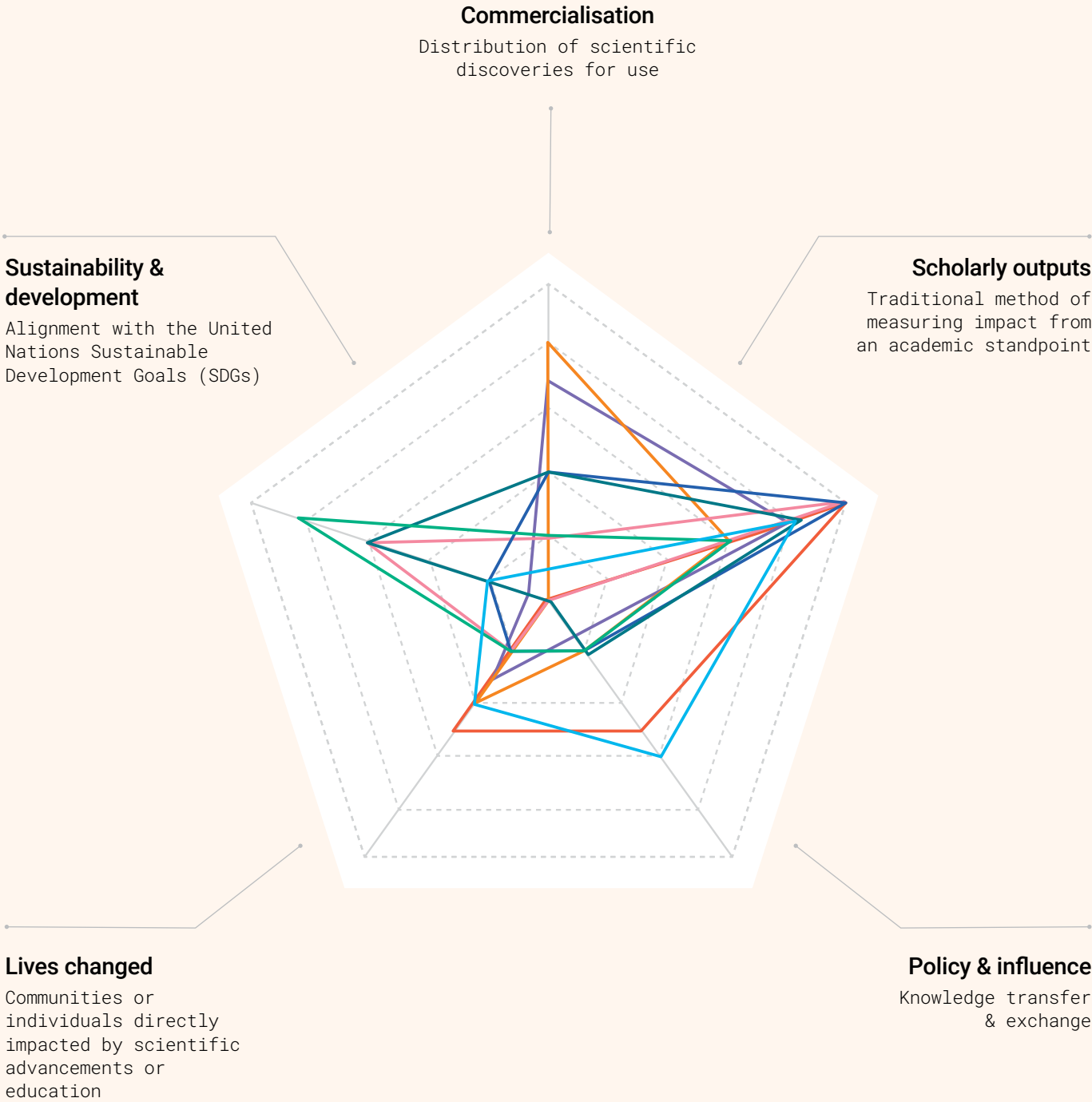
Each UNSW scientist was allocated 100 points to distribute across the five categories based on where they perceive their research has generated the strongest societal contribution. These reflections are supported by the qualitative evidence, partnerships, outputs and outcomes discussed throughout each case study.

The charts are not intended for benchmarking or direct comparison between UNSW scientists. Nor do they imply that all scientists should demonstrate

equal impact across every category. Instead, they highlight the diversity of pathways through which scientific research creates societal impact, recognising differences in disciplines, career trajectories and forms of engagement. The charts are designed to showcase individual strengths and illustrate the varied ways UNSW scientists contribute to society.

A larger chart area should not be interpreted as indicating greater or "better" impact. Rather, it reflects the areas in which an individual scientist identified their strongest societal contributions and where supporting evidence was most evident within the case study narrative. Each colour in the figure represents a different UNSW Scientist featured in this report. While individual scientists demonstrate different strengths across the five areas, together they illustrate how societal impact can emerge through different combinations of discovery, collaboration, translation, policy influence, community engagement and innovation.

UNSW Science Impact Indicators





Conclusion

Science delivers its greatest value when knowledge moves beyond discovery and contributes to positive change in society. The stories in this report demonstrate the diverse ways that impact is created, from safer aviation systems and improved healthcare technologies to healthier marine environments, stronger communities and more sustainable industries. Together, they show that impact is not a single outcome but the result of sustained engagement between researchers, partners and communities.

This report also highlights the importance of recognising the full spectrum of scientific contribution. While publications, citations and commercial outcomes remain important indicators of success, they capture only part of how science creates value. Through the UNSW Science Impact Indicators framework, this report makes visible the pathways that connect research to societal benefit, revealing the relationships, capabilities and activities that underpin meaningful change.

In doing so, the report challenges a persistent misconception: that societal impact begins when research leaves the laboratory. The experiences of UNSW scientists suggest that impact is embedded throughout the research process itself. Long before it becomes visible through a policy change, clinical application, commercial innovation or environmental outcome, impact is taking shape through collaboration, knowledge exchange, capacity building and discovery.

Recognising these pathways matters. If society values only the impacts that can be easily counted, it risks overlooking the very conditions that make those impacts possible. Supporting the people, partnerships and processes that enable impact is therefore essential to maximising the contribution of science to society.

Ultimately, the report reinforces a simple message: science creates impact not only through what it discovers, but through the people, partnerships and pathways that transform knowledge into societal benefit. By making these pathways visible, UNSW Science provides a richer understanding of how impact is created and a stronger foundation for supporting research that contributes to a more sustainable, equitable, resilient and prosperous future.



Looking ahead

The scientists featured throughout this report represent only a small fraction of the research taking place across UNSW Science. Every day, researchers are making discoveries whose full impact may not be realised for years—or even decades.

Making these pathways visible is about more than demonstrating accountability for research investment. It is about recognising the full contribution of science, understanding how societal impact develops over time, and creating the conditions for even greater impact. As universities, governments and industry increasingly seek better ways to understand and demonstrate the value of research, we hope this pathway-based approach contributes to a broader conversation about how societal impact can be recognised, understood and strengthened.

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Continue the conversation

The societal impact of research is a shared endeavour. Through the Pact for Impact, UNSW Science is working with partners across government, industry and the community to strengthen how research impact is recognised, communicated and supported.

If you are interested in collaborating with UNSW researchers, contributing to future initiatives or exploring how this approach could be applied in your organisation, we invite you to join the conversation.

Become an impact partner.



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