



NSSN
NSW Smart Sensing Network

NSW SMART SENSING NETWORK
ANNUAL REPORT FY22/23

PROUDLY FUNDED BY



NSW
GOVERNMENT

FOREWORD BY BOARD CHAIR

At a time of significant demand for advanced technologies, the role for organisations such as the NSW Smart Sensing Network has perhaps never been more opportune.

Smart sensing is increasingly viewed as an enabling technology in solving some of the world's most pressing challenges, and the outlook for the future of the Network is very positive.

As global unrest continues and the effects of climate change are becoming more numerous and severe, it is technological innovation that will help to alleviate the significant disruption to communities, the environment and economies.

The projects led by the NSSL and illustrated in this annual report show that smart sensing as a disruptive technology can contribute to the common good to address critical economic, social and environmental challenges and increase prosperity.

The NSSL is delivering on its promise of positioning NSW as a global leader in smart sensing innovation. We are translating the world-class research in smart sensing across NSW & ACT universities into compelling solutions in the environment, manufacturing, Medtech and more which will also lead to future industries. The NSSL is an important part of the NSW innovation ecosystem.

My second year as NSSL Board Chair has seen this impressive network attain new heights, and people and relationships are the key to our success.

We are responding to some of the most critical challenges of our time through our Grand Challenge program which addresses complex questions about ageing, clean technology, natural hazards, smart cities, and water.

As the national focus shifts to sovereign capability and productivity, the NSSL is well-positioned to deliver valuable dual-use applications across sectors, including natural hazards and defence.

I am proud to Chair a Board that consists of experienced leaders across the policy, research and industry spectrum who are committed to the network's future. In FY22/23 we welcomed the Head of Technology - Climate and Industry at Cicada Innovations, Hebbat Manhy as a Board Member. We also thanked and recognised the service and contribution of retiring Board member Sally-Ann Williams.

I take this opportunity to sincerely thank the NSSL's myriad of stakeholders – our member universities, brilliant researchers, innovative partners, inspiring Co-Directors, talented COO and dedicated team, accomplished Board and the unwavering support of the NSW Government through the Office of the Chief Scientist & Engineer, Professor Hugh Durrant Whyte.



Jo White
Chair of NSSL Board

CO-DIRECTOR'S MESSAGE

Smart sensing is critical to Australia's economic success. From clean energy and renewables to AI and quantum technologies, smart sensing will be a driving force for Australia's scientific advancement, future prosperity and resilience.

The National Reconstruction Fund Priorities and Australian Critical Technologies List at Commonwealth level and the NSW 20-Year R&D Roadmap at state level all refer to smart sensing as a key enabling technology.

At the same time, it is also gratifying to note that the role of organisations such as the NSSN are recognised in key policy discussions. We point particularly to the Commonwealth Government's Australian Universities Accord Interim Report, released in mid-2023, which highlighted the importance of research broker bodies like the NSSN in sharing and translating university research. The report recommends broker bodies – like the NSSN – be used more widely to bolster the use of university research further.

The NSSN is delivering impressive results by identifying challenges, pulling together the right researchers, project managing, and attracting funding to achieve targeted research outputs.

The rationale for the NSSN remains as strong today as it did in 2016, when the concept of the NSSN first emerged. As a mature network, the NSSN now proudly celebrates 28 completed projects to the value of \$12.4 million and 19 active projects to a value of \$20.6 million. The majority of these projects are multi-university and multi-disciplinary. We have built a solid reputation among our university, industry and government stakeholders as a trusted, independent broker and activator of innovation.

Our collaborative projects range from next generation wearable sensors for better health, to sensor-enabled motorcycle helmets for improved road safety, to new models of measuring urban heat in Western Sydney. These R&D projects of today will have a real impact on the daily lives of Australians in a wide range of areas including health, environment, defence and economic prosperity.

As a forerunner and model of innovation networks, we are working ever closer with our sister innovation networks at the Defence Innovation Network (DIN), Space Research Network (SRN), Connectivity Innovation Network (CIN), Decarbonisation Network, Sydney Quantum Academy (SQA) and

Semiconductor Sector Service Bureau (S3B). We share the insights of our own journey and work collaboratively towards mutual outcomes.

We invite you to read on for a more detailed report on the NSSN's achievements in FY22/23.



Benjamin Eggleton

Professor Benjamin Eggleton
Co-Director, NSSN



Julien Epps

Professor Julien Epps
Co-Director, NSSN

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ABOUT THE NSW SMART SENSING NETWORK (NSSN)

The NSW Smart Sensing Network (NSSN) was established in July 2016 with funding from the NSW State Government through the Office of the Chief Scientist & Engineer. It was founded on the premise that the economy and people of New South Wales face key challenges in energy, resources, manufacturing, the environment, transport, agriculture, space and health that cutting-edge research in smart sensing could play a critical role in solving.

The market for smart sensing across a broad range of industries is growing. The NSSN brings together the world-class research taking place in NSW universities with state government agencies and industry to develop innovative solutions to these key challenges and, at the same time, position NSW as a leader in sensing technology.

OUR MISSION

To translate world-class research in smart sensing into compelling solutions that create value for the economy, environment and society of NSW and beyond.

OUR VISION

NSW is a recognised global leader in smart sensing.

OUR VALUES

SOLUTIONS-ORIENTED

We seek out and solve challenging problems faced by our partners.

INNOVATIVE

We translate outstanding research strengths into opportunities, products and services that add.

TRUSTED

We are the go-to source for quality solutions. People rely on us as suppliers of knowledge. We offer value for money and the best solution for our partners.

COLLABORATIVE

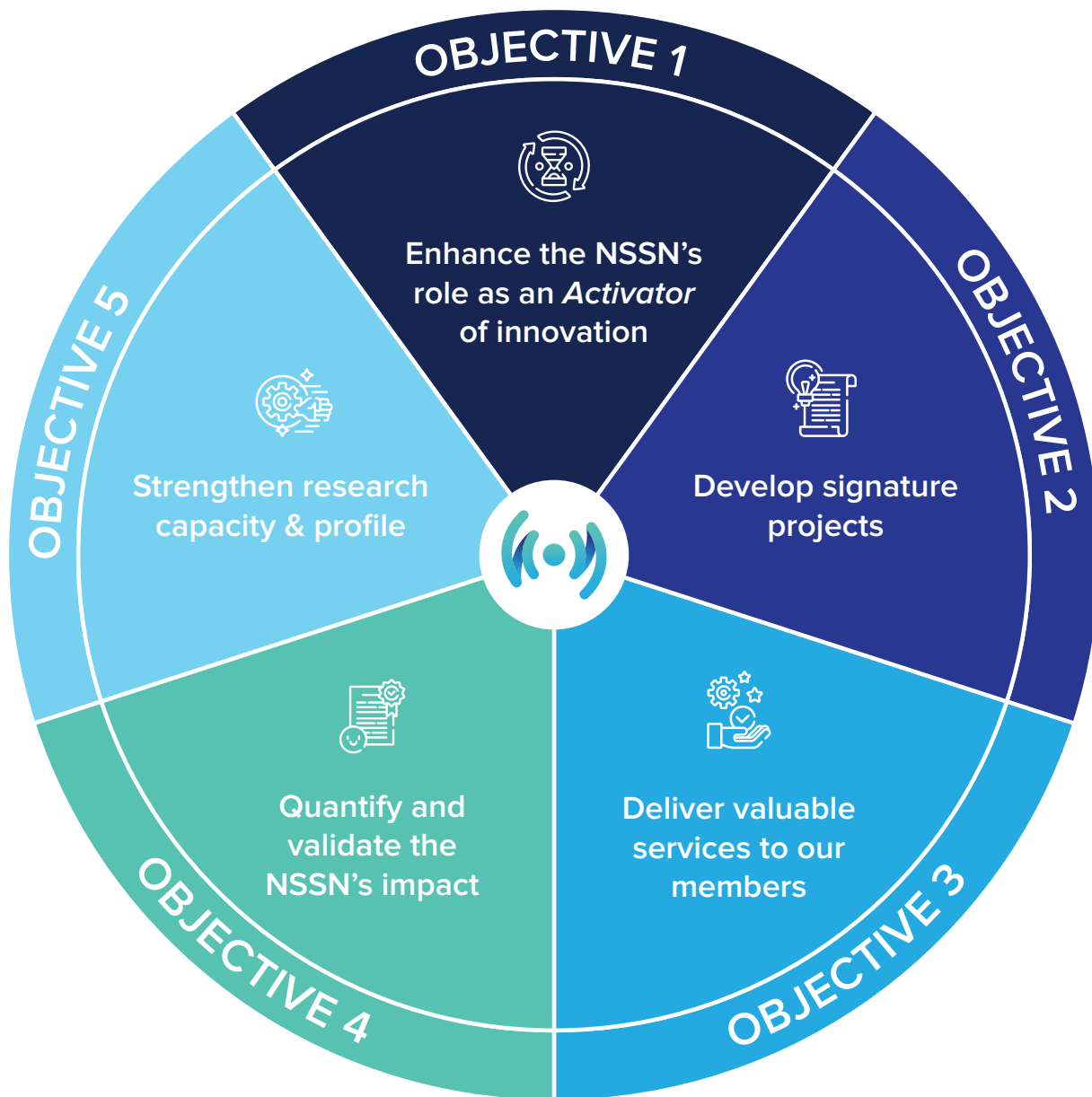
We offer a single point of entry to expertise across multiple institutions and disciplines, from our core in science and engineering to diverse disciplines that can contribute to successful solutions.

CELEBRATE SUCCESS

We create value and build prosperity. The success of our partners is our success. We are thrilled when research is converted to real-world impact, and we celebrate this success.

DIVERSITY

People are at the heart of all that we do and our people represent rich diversity in all its forms. Diversity breeds innovation and we cultivate a culture of inclusion.



MEMBERS

We bring together smart sensing expertise from across the leading universities in NSW & the ACT to develop innovative, interdisciplinary solutions to complex challenges.



Australian
National
University



Charles Sturt
University



THE UNIVERSITY OF
SYDNEY





MACQUARIE
University
SYDNEY · AUSTRALIA



THE UNIVERSITY OF
NEWCASTLE
AUSTRALIA



UNSW
SYDNEY



UNIVERSITY
OF WOLLONGONG
AUSTRALIA

WESTERN SYDNEY
UNIVERSITY



PEOPLE

The NSSN is led by two internationally recognised scientists who are leaders in their respective fields of physics and electrical engineering and bring a wealth of expertise to the network's ambitious program of research, innovation and industry collaboration.

The NSSN Board, chaired by Jo White, and consisting of experienced leaders across the policy, research and industry spectrum provide guidance and oversight on network strategy and direction.

The NSSN Members' Committee consists of senior representatives of each of the member universities and the NSW Office of Chief Scientist & Engineer. It ensures that member universities and government imperatives guide the strategy and activities of the network.

A lean central team of talented staff lead the research programs and coordinate the operations of the network.

CO-DIRECTORS



Professor Benjamin Eggleton
Co-Director, NSSN



Professor Julien Epps
Co-Director, NSSN

BOARD

The NSSN Board, chaired by Jo White, and consisting of experienced leaders across the policy, research and industry spectrum provide guidance and oversight on network strategy and direction.



Jo White
Chair



Dr Diana Day
Board Member



Dr Jill Freyne
Board Member



Hebbat Manhy
Board Member



Dr Ian Opperman
Board Member



Fiona Rankin
Board Member



Frank Zeichner
Board Member



Caroline Residovic
NSW Government Representative

MEMBERS' COMMITTEE

The NSSN Members' Committee consists of the Deputy Vice-Chancellors (Research & Innovation) or equivalent and represents the members' interests in the strategic direction of the Network.



Professor Julie Cairney
Pro-Vice-Chancellor
(Research - Enterprise & Engagement), University of Sydney



Warwick Dawson
Pro Vice-Chancellor
(Industry & Engagement),
University of Newcastle



Dr Paul Di Pietro
Dean of Research
Knowledge Exchange and
Translation, University of
Wollongong



Professor Michael Friend
Pro-Vice-Chancellor
(Research & Innovation),
Charles Sturt University



Professor Dan Johnson
Pro Vice-Chancellor
(Research, Innovation &
Enterprise),
Macquarie University



Professor Dane McCamey
Pro Vice-Chancellor
(Research), UNSW



Professor Kathryn McGrath
Deputy Vice-Chancellor
(Research), UTS



Professor Ute Roessner
Director, Research Initiatives
& Infrastructure, ANU



Professor Deborah Sweeney
Deputy Vice-Chancellor
and Vice-President,
Research & Innovation,
Western Sydney University

STAFF

The NSSN consists of a lean central team of talented staff who lead the research programs and co-ordinate the operations of the network.



Nicholas Haskins
Chief Operating Officer



Sam Ashby
Industrial Futures
Theme Leader



Laura Earl
Business Development
Manager



Tomonori Hu
Environment & AgTech
Theme Leader



Kimi Izzo
Electronics Engineer



Diane Nazaroff
Media & PR Manager



Catherine Oates Smith
MedTech Theme Leader



Peter Runcie
Natural Hazards & Smart
Cities Theme Leader



Ayu Saraswati
AI & Machine Learning
Engineer



Danielle Seagrave
Project Administrator

EXECUTIVE SUMMARY

FY22/23 marked continued growth in our R&D program, with 19 projects under active management. New signature projects include the Advanced Rider Assistance Systems for Motorcyclists (a collaboration involving Macquarie University and Western Sydney University with industry partners Forcite Helmets, Harley Davidson and Transport for NSW) which aims to improve road safety for motorcyclists with a sensor-based system that can pre-empt hazards. The EcoEar Detection of Koala Calls project led by Western Sydney University in collaboration with Biodiversity Monitoring Services is developing an acoustic sensor to efficiently record koala populations. These projects hold the promise for significant impact on society and the environment respectively.

The highly successful OPENAIR project drew to a close and final reports were delivered to the NSW Department of Planning & Environment. The \$1.78 million project was funded by the NSW Digital Restart Fund and brought together the NSW Government with nine local councils and researchers at UTS, ANU, WSU, UNSW and the University of Sydney to develop best-practice methodologies for localised air quality monitoring and forecasting. Conversations are already underway to develop follow-on projects.

The third round of the NSSL Grand Challenge Fund directly invested \$320,000 of NSSL funds to seed innovative R&D projects that saw universities collaborate with industry/government partners address challenges across the five defined NSSL Grand Challenges. Twelve applications were received to the 2023 fund, and five proposals were funded, representing a 42% success rate and leveraging industry co-investment of \$331,608. Importantly, concerted efforts to boost gender diversity in the NSSL's programs led to an 18% increase in women involved in project teams applying to the fund.

Our Business Development program continues to build a strong pipeline of commissioned research leads and opportunities to our member universities. In FY22/23, the NSSL attracted an impressive \$7.3 million in commissioned research across 11 new projects. The NSSL demonstrates real value in not only brokering relationships with industry partners who invest in R&D projects but leveraging Commonwealth and state government funding schemes such as the CRC-P, SBIR and others.

We continue delivering value to our members beyond our R&D and business development activities. We take a proactive approach to strengthen the research capacity of our member universities and supported 14 funding bids. We also secured state government funding for two projects and federal government funding for one project. Feedback from a range of stakeholders on the NSSL's financial and intangible value creation is very positive.

The NSSL also led two major submissions to federal government funding programs: the ARC Industrial Transformation Research Program for data analytics and the Department of Defence's JP9360 program for space situational awareness. We also looked for new opportunities as the federal government rolled out its National Reconstruction Fund Priorities and Australian Critical Technologies List. Ongoing relationships are being nurtured with AusIndustry and the Department of Industry, Science & Resources.

Our busy Industry Engagement program expanded to 24 events in FY22/23. The increasingly popular NSW Sensing Industry Connect series travelled the state providing a forum for manufacturers, SMEs, designers, deployers and researchers of smart sensing to share opportunities and build networks. A focus on building connections in regional NSW saw the event hosted in locations like Port Macquarie, Albury and Wollongong, as well as in Sydney and Parramatta.

We were also very proud to establish an ongoing Women in Sensing series that shines a spotlight on women making an impact in the sensing industry. In August, the NSSL hosted the Smart Sensing for Flooding Workshop at Western Sydney University's Hawkesbury campus, resulting in several collaborative projects and input into the 2022 NSW Flood Inquiry. In November, we hosted 120 delegates at the NSSL Innovation in the Circular Economy Conference in Newcastle, where we explored smart sensing solutions for building a better circular economy in NSW.

FY22/23 also saw new steps to enhance the NSSL's Global engagement. In March, we welcomed an international scientific co-operation delegation of 31 from Germany's Helmholtz Institute and continue to explore areas of synergy with this like-minded organisation. We also continue to explore areas of co-operation and best practice with the only other dedicated smart sensing innovation consortium in the world, Scotland's CENSIS. The NSSL is an official partner of the UK's

Quantum Technology Hub at the University of Birmingham and is a named collaborator on their EPSRC-funded International Network for Sensor and Timing Applications in Quantum Technologies.

We continued to broaden our audience through our Public Outreach program. Across our events and digital, social and traditional media, we seek to engage, educate and inform the scientific and general community on issues relating to smart sensing innovation. Our Twitter (now known as X) reach grew to 3,130 followers, and our LinkedIn community grew by 34% to 2,794 followers. We achieved 53 mentions across print, online and broadcast media and increased readership of the monthly NSSN e-newsletter, The Sensor, to 2,369 readers.

We are proud of the contribution we continue to make to the NSW innovation ecosystem and are excited by the evolving opportunities driven by the NSW Government's bold vision.

We invite you to read on for a more detailed report on the NSSN's achievements in FY22/23.



FY 22 / 23 BY THE NUMBERS



19
ACTIVE R&D MULTI-PARTNER
PROJECTS UNDER NSSN
MANAGEMENT



\$7.37 MILLION
NEW CONTRACT RESEARCH
FUNDING



24
INDUSTRY ENGAGEMENT EVENTS
HOSTED BY NSSN



\$318,534
GRAND CHALLENGE FUNDING
AWARDED



2,794
LINKEDIN FOLLOWERS



3,130
X FOLLOWERS

N S S N R & D P R O G R A M

THE N S S N RUNS AN ACTIVE RESEARCH AND DEVELOPMENT PROGRAM, WITH 19 ACTIVE R&D PROJECTS UNDER MANAGEMENT IN FY22/23:

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OPENAIR: OPERATIONAL NETWORK OF AIR QUALITY IMPACT RESOURCES

CASH FUNDING \$1.78 Million

PARTNERS **NSW Department of Planning & Environment (NSW DPE),
9 Local Governments across NSW**

UNIVERSITY MEMBERS



Australian
National
University



WESTERN SYDNEY
UNIVERSITY



Poor air quality caused by bushfires, woodfired heaters, agriculture, transportation, industry and urban heat is a significant cause of health problems, premature death and lost productivity in communities.

Currently, official ambient air quality monitoring in NSW is conducted by the NSW Department of Planning and Environment (DPE) using high-precision (and high-cost) regulatory equipment. Until now, some local councils have collected localised air quality data using low-cost environmental sensors. Unfortunately, a lack of skills and methodologies for project design, procurement, data management and interpretation has resulted in many of these projects falling short of creating meaningful impact.

Led by the NSSN, in collaboration with NSW DPE, this project has armed local governments with the latest know-how in the use of low-cost air quality sensors and has, for the first time in Australia, establish a best practice methodology for all aspects of council-led air quality monitoring to positively impact local communities. In addition, a prototype data sharing system has been developed to enable seamless and open sharing of air quality sensing data.

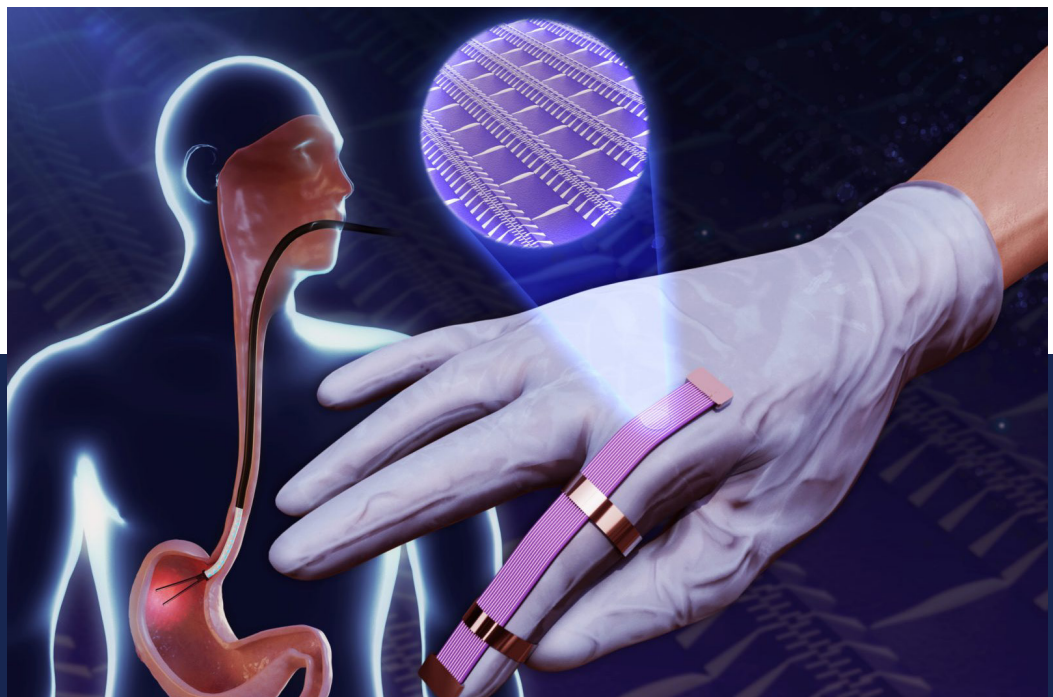


ARC INDUSTRIAL TRAINING RESEARCH HUB FOR CONNECTED SENSORS FOR HEALTH

CASH FUNDING **\$10.1 Million**

PARTNERS **Sante Innovation, Nutromics, Genesys, Electronics Design, Vlepis, nthalmic and 15 other industry partners across the MedTech sector**

UNIVERSITY MEMBERS



The mission of this Industrial Transformation Research Hub, funded by the Australian Research Council, is to position Australia at the forefront of designing, manufacturing, and certifying connected sensors to improve health outcomes for Australians and people worldwide.

By bringing together a diverse range of expertise from academia and industry, the Hub is paving the way for innovative approaches to diagnosing, monitoring, predicting, treating, and preventing diseases.



ARC RESEARCH HUB FOR
**CONNECTED
SENSORS
FOR HEALTH**

SMART TRIAGING AND WELLBEING IN AGED CARE

CASH FUNDING **\$1.48 Million**

PARTNERS **Vlepis, Allambie Heights Village, Careteq**

UNIVERSITY MEMBERS



The NSSN worked with industry partners on this project to secure funding from the Commonwealth Government Co-operative Research Centres Projects (CRC-P) scheme. The project is building an integrated smart triaging platform that leverages data science and new Australian-manufactured sensing technologies to automatically identify health and wellbeing events that notify the relevant care staff.

The project develops and then leverages low-cost, unobtrusive wearable sensors that will actively monitor the user's wellbeing biomarkers such as heart rate, blood oxygenation and temperature. The technology is using real-life data for optimal detection and triage. It has a clear target of improving the well-being of at-risk Australians and

reducing hospital admissions, saving lives and improving access to care in remote communities. Meanwhile, the collaboration is growing Australia's sovereign manufacturing capability and is directly addresses care providers' compliance risk through ongoing health and wellbeing monitoring.

INSTANTANEOUS DETECTION OF HIGH-RISK LIGHTNING WITH PINPOINT ACCURACY

CASH FUNDING \$250,000

PARTNERS Fire Neutral Network, NSW Rural Fire Service,
ACT Government, ACT Fire & Rescue

UNIVERSITY MEMBERS



With funding from the NSSN Grand Challenge Fund, this project utilises novel lightning detectors capable of measuring the attributes of High Risk Lightning (HRL), including long continuing currents and charge transfer that lead to heating. Fire agencies can then efficiently target this small proportion of HRL strikes. In addition, the smart detectors are able to map lightning in 3D, leading to superior detection efficiency and location accuracy, thereby facilitating both a quicker and more efficient inspection of high-risk ground strikes.

This outcome is accomplished using a machine learning algorithm to analyse electric field waveforms from the lightning detector, to identify the presence of long-continuing current. This unique characterisation of

lightning strikes is combined with information about weather and fuel attributes derived from satellite and airborne sensors, to enable a more thorough characterisation of the conditions under which lightning ignitions occur. An historical analysis of lightning-initiated bushfires, conducted in tandem with the HRL project, will facilitate rapid parameterisation of the risk factors for lightning ignition, without waiting many years to achieve results.

SMART ENERGY ASSET MANAGEMENT INTELLIGENCE

CASH FUNDING **\$200,000**

PARTNERS **Global Sustainable Energy Solutions, APVI, Lake Macquarie
City Council, 5 Local Government Councils across NSW**

UNIVERSITY MEMBERS



With funding from the NSSF Grand Challenge Fund, this project enables automatic performance monitoring of distributed energy systems by leveraging in-built sensors in system inverters, power electronics and control systems. The knowledge, methods and algorithms developed as part of this project is providing smart energy asset owners with the actionable intelligence required to maintain their portfolio of systems. This reduces operational administration for the asset owners, allows for financial and performance transparency, and ensures that maintenance regimes are optimised and tracked for asset owners.

AUTONOMOUS DRONES ON RESERVOIRS FOR SMOKE DETECTION

CASH FUNDING \$199,985

PARTNERS Sydney Water, NSW Rural Fire Service,
NSW Fire & Rescue, Southern Cross Drones

UNIVERSITY MEMBERS



With funding from the NSSN Grand Challenge Fund, this project is developing a prototype tethered autonomous air vehicle system that will be housed in enclosures atop Sydney Water's elevated reservoirs and potentially on fire trucks used by the NSW Rural Fire Service. Once operational, these vehicles will periodically or on-command ascend to preset altitudes and capture 360 degree video of the surroundings. Once operational, these vehicles will periodically or on-command ascend to preset altitudes and capture 360 degree video of the surroundings, providing fire agencies with real time visual information from multiple remote locations.

University of Sydney and University of Newcastle are collaborating on systems design and understanding tether dynamics in windy conditions. They are collaborating with industry partners Flame Security International and Southern Cross Drones. Sydney Water, Rural Fire Service NSW and Fire Rescue NSW are providing end user needs and several testing locations in the Sydney region.

PAIMCOS QUARANTINE MONITORING SYSTEM

CASH FUNDING **\$184,076**PARTNERS **Visicase Pty Ltd**

UNIVERSITY MEMBERS



This project aims to strengthen the Pandemic Impact Control System (PAIMCOS) by using Machine Learning (ML) and Artificial Intelligence (AI) to optimise the sequence for fraud prevention, high scalability and protection against cyber-attacks.

Researchers from the UTS Data Science Institute are using advanced AI algorithms to optimise the timing of compliance checks based on the circumstances of each individual user, which minimises the risk of non-compliance and ensures interruption for the users is minimal.

Researchers from the University of Sydney's School of Computer Science have brought their expertise in cybersecurity and data privacy to the project, ensuring the data is collected securely and is permanently destroyed after some time.

NEW GENERATION OF ADVANCED FIBRE OPTICS FOR INTELLIGENT STRUCTURAL HEALTH MONITORING OF BRIDGES

CASH FUNDING **\$119,652**

PARTNERS **Transport for NSW**

UNIVERSITY MEMBERS



This project is producing high performance, low-cost fiber optics and advancing their use in health monitoring of civil infrastructure by carrying out an integrated experimental and field analysis, machine learning modelling and digital twin solution. Outcomes of this novel approach provide a holistic, end-to-end fiber optic structural health monitoring strategy that effectively integrates embedded optical sensors, artificial intelligence and computational modelling for real time remote monitoring of critical infrastructures. This provides significant benefits by digital transformation and expanding application of advanced technologies in a built environment, enhancing resilience and sustainability of infrastructure.

SENSING MICROPLASTICS IN WATER

CASH FUNDING **\$1,000,000**PARTNERS **Pegras**

UNIVERSITY MEMBERS



This project uses novel smart sensing technologies to identify and remove medical plastics waste from entering the wastewater stream.

After successfully completing Phase I of the inaugural round of the NSW Small Business Innovation & Research Program (SBIR), this project progressed to Phase II in FY22/23, which is focused on developing the solution's proof-of-concept model. The ultimate aim of the program is to create a pathway to government procurement and provide a long-term clean tech solution to NSW Health's Healthshare program.

ECOEAR DETECTION OF KOALA CALLS

CASH FUNDING \$903,000**PARTNERS** [Biodiversity Monitoring Services](#)**UNIVERSITY MEMBERS**

After successfully completing Phase I of the inaugural round of the NSW Small Business Innovation & Research Program (SBIR), this project secured Phase II funding to build a proof-of-concept model.

This project successfully tested the feasibility of changing from traditional acoustic recording systems to an AI-powered edge device, the EcoEar. It has been developed by researchers at the International Centre for Neuromorphic Systems at the University of Western Sydney in conjunction with Biodiversity Monitoring Systems and Neurabuild. The EcoEar is only triggered by koala calls for enhanced monitoring of NSW's endangered koala population.

These neuromorphic systems are specially built to react to changes in the environment, like our sensory systems, and only detect and record data when calls are made. Such a system is extremely power-efficient, would overcome the issue of data overload, and produces targeted, actionable data making large-scale monitoring feasible and efficient.

SATELLITE-BASED FOREST STRUCTURE ASSESSMENT AND ITS IMPACT ON FUEL MOISTURE AND FIRE BEHAVIOUR MODELLING

CASH FUNDING **\$310,000**

PARTNERS **Forestry Corporation NSW**

UNIVERSITY MEMBERS



This project is investigating ways to improve information available from satellite-based soil and vegetation indices by incorporating ground-based verification data across a range of different forest types. Ground-based data collection is being used to confirm and calibrate satellite-based data and provides information that is not readily available from satellite imagery, such as ground fuel moisture levels. The data collected can also be used as a source of training data to assist with future model development.

Information from this project is supporting subsequent projects to develop location-specific predictions of fuel load and fuel moisture, potentially using AI and plot imputation methods. Existing photo-point data collection sites on the north and south coast are being used to monitor changes in vegetation over time, especially in a post-fire recovery phase, to monitor the recovery of vegetation for different fire severity areas.

AMMONIA SENSING ON AN URBAN WATER NETWORK

CASH FUNDING **\$77,022**

PARTNERS **Trility**

UNIVERSITY MEMBERS



When Sydney Water recognised the need for smarter ways to monitor water quality in their 22,000km water pipe network, they turned to infrastructure services company, Trility, to develop a low-cost, in-line device for measuring total and free ammonia. As part of that important project, Trility turned to the NSSN and UTS to research and test market-ready ammonia sensing instruments for quick and efficient deployment. The project successfully identified a cost-effective and user-friendly adaptation of a fit-for-purpose ammonia analyser.

MODELLING THERMAL COMFORT INDICES FOR GREATER SYDNEY

CASH FUNDING **\$333,000**

PARTNERS **Sydney Water, SmartSat CRC**

UNIVERSITY MEMBERS



THE UNIVERSITY OF
SYDNEY



Escalating intensity and frequency of heatwaves in Sydney are impacting urban liveability, leading to increased water demand and exacerbating negative health outcomes.

Outdoor human thermal comfort is a key metric to assess urban liveability. There is a need to provide real-time, high spatial resolution outdoor human comfort data that can capture how radiant heat changes depending on the amount of urban greening, irrigation, change of seasons, and the built environment.

In this project funded by Sydney Water and the Smartsat-CRC, researchers at the University of Sydney are characterising urban

heat around the Greater Sydney Region using earth observational imagery, land segmentation and ground truth data.

A model is being developed using site data gathered around Sydney from an assortment of environmental sensors in combination with a machine learning algorithm to segment Greater Sydney into distinct urban topologies. This is being computed at the edge on a nanosatellite, where periodic earth observation updates of Sydney's continually evolving terrain is allowing for dynamic and scaled outdoor human thermal comfort calculations.

ADVANCED RIDER ASSISTANCE SYSTEMS FOR MOTORCYCLISTS

CASH FUNDING **\$3,995,423**

PARTNERS **Forcite, Harley Davidson, Transport for NSW**

UNIVERSITY MEMBERS



Motorcyclists have a fatality rate which is 30 times higher than other road users. While collision avoidance systems in cars are now common, similar technology for motorcyclists is rare and ineffective. Forcite is building on their current Smart Helmet System which provides navigation and alerts via audio and a safety-focused peripheral display.

This collaborative project partners with researchers at Macquarie University, Western Sydney University and Harley Davidson to develop an advanced rider assistance system based on new sensing technologies in computer vision and machine learning that can pre-empt hazards and enable swift evasive action by the rider, therefore

reducing the risk of accidents and death. Additionally, an evidence-based assessment of the technology's impact on rider perception and performance is expected to become a foundational guide for the smart helmets and rider safety markets.

HIGH-SPEED COUNTING OF BLACK SOLDIER FLIES FOR OPTIMISED WASTE RECOVERY

CASH FUNDING **\$50,000**

PARTNERS **ARC EntoTech**

UNIVERSITY MEMBERS



The world is generating mixed solid waste (MSW) in volumes far exceeding its capacity to recycle and manage effectively. In Australia, the total volume of MSW generated in 2018 was 67 million tonnes, of which 45.6 million tonnes was buried into landfill.

The use of black soldier fly larvae to process MSW provides an environmentally friendly option. However, optimising the breeding process of the flies is yet to be fully developed and there is a key role for smart sensing in measuring fly reproduction behaviour.

This project utilises the world-leading neuromorphic vision capabilities at Western Sydney University. These event-based sensors

have shown high-speed counting of targets under difficult imaging conditions. The analysis techniques are being adapted to count flies as they move between different breeding cycles. This data provides clear insights on how the flies are reacting to interventions. The project is also partnering with Macquarie University to deliver the robust hardware that allows the operation of the sensor inside the breeding cages.

IMPROVED OPERATIONAL FLOOD INTELLIGENCE FOR WESTERN NSW CATCHMENTS

CASH FUNDING **\$128,600**

PARTNERS **Schematic Intel, NSW SES**

UNIVERSITY MEMBERS



In the Western catchments of NSW, flood events can stretch for weeks and months as the flood wave travels downstream. To respond better, emergency services need more data on the flood rate of rise and of the critical flood levels. In addition, uncertainties on this information are also needed on an easily interpretable schematic diagram. This project provides a proof of concept in using machine learning methods to provide extra flood intelligence to the NSW State Emergency Service based on data from a range of sensors. Partnering with Schematic Intelligence, this data is being built into a live schematic for response planners. Machine learning methods have been

implemented in similar cases like this but have seen constrained effectiveness due to the availability of the data to train them. This project is looking carefully at using relevant flood data and incorporating other sources including near real-time optical satellite data.

SMART SONAR AND ACCESSIBLE HYDROGRAPHY

CASH FUNDING **\$60,000**

PARTNERS **CEE Hydrosystems**

UNIVERSITY MEMBERS



Sonar technology has been well established over many decades to conduct underwater measurements surveys such as measuring riverbed make up for environmental assessment. However, these surveys require extensive training, skills and unwieldy equipment. The industry is also moving towards the usage of autonomous survey vessels (drone-based) to perform sonar measurements, which require more portable and simpler systems for single-person operation. There is a need to develop enhanced manufacturing capabilities of these sonars, and a more automated way to capture and analyse the data.

The solution is to create a single-operator survey vessel built with a custom sonar and integrated software. Collaborating with CEE Hydrosystems, a team of researchers from Macquarie University and the University of Wollongong is leading the path to building custom transducers able to improve the minimum depth measurement and reduce the size, weight and power for drone operation. The project is looking at a new design of a piezo transducer and integrating existing bathymetry software to the drone-based system.

NOVEL TESTING METHODOLOGIES FOR DEPLOYABLE DETECTION OF WATER PATHOGENS

CASH FUNDING **\$200,000**

PARTNERS **BioPoint Ltd**

UNIVERSITY MEMBERS



The widespread access to clean drinking water is said to be one of the most significant health achievements of the 20th century. Testing the safety of drinking water remains a critical component of safe water supply, however the methods to test contaminated water have not changed in decades. Pathogens such as *Giardia* and *Cryptosporidium*, coming from faeces of infected people or animals, are difficult to detect with sensors as their signature molecules become extremely diluted. Existing tests are slow to produce results, and often the consumption of water occurs before the results appear. A testing kit is needed that both has ultra-low level of detection and able to be rapidly performed.

This project explores the use of CRISPR technology (awarded the Nobel Prize in 2020) to develop a biosensor with ultra-low detection limits. The specific technique of using CRISPR sensors, developed between UNSW and industry partner BioPoint, has achieved sensitivities orders of magnitude higher than state-of-the-art methods – enabling rapid testing times. This project is building on this development and is scaling up the manufacturing of necessary reagents for the test.

THE MOSAIC STUDY: MOTION OPTIC AND SOUND SENSORS TO ASSESS INTERACTIVE COMMUNICATION

CASH FUNDING **\$213,008**

PARTNERS **Cochlear, Google**

UNIVERSITY MEMBERS



Hearing loss disrupts the pathway to healthy ageing and independent living by increasing communication difficulties. While hearing devices are helpful, listening through devices means communication can still be difficult, and breakdowns inevitably still occur. Hearing devices need to be tailored to the dynamics of the communication environment, including background noise which impacts intelligibility (e.g., TV, street traffic, cafes).

Data from sensors can predict conversational difficulty and communication breakdowns by tracking gaze and head movements in the lead-up to the breakdown. The next step is to leverage this knowledge to selectively enhance hearing devices. We are identifying which biomarkers have the greatest predictive power in detecting communication

difficulty and in predicting communication breakdowns. This will allow us to fuse sensor networks with next-generation signal processing algorithms and hearing technologies.

We are also assessing a large cohort of normal-for-age hearing listeners across the lifespan (baseline data and ageing effects) as well as older bilateral cochlear implant recipients.

NSSN GRAND CHALLENGES

The **NSSN Grand Challenges** respond to some of the most gripping challenges of our time. Complex challenges that are critical to our environment, health, economy and society and which demand innovative solutions that will impact future generations.

AGEING Smart sensing for healthier, safer ageing, both at home and in care settings

Australia’s population is getting older. An ageing society is placing increased pressure on our healthcare system and demands an age-friendly future in which our seniors can live in their own homes with dignity, independence and access to high quality care.

From real-time, wearable monitoring of vital signs to smart homes equipped with automated appliances, smart sensing is at the heart of technology for healthier, safer ageing both at home and in care settings.



CLEAN TECH Smart sensing for a low-carbon economy

As NSW – and Australia – strive towards a low-carbon economy, the development of clean technologies is critical. Clean Tech refers to innovative technologies that improve environmental sustainability but also offer compelling opportunities for economic growth. From renewable energy to circular supply chains, Clean Tech innovation will lead to lower emissions, a cleaner environment and power efficiencies.



NSSN GRAND CHALLENGE FUND

Since 2021, the **NSSN** has offered its annual **NSSN Grand Challenge Fund** in order to foster collaboration and build a cadre of research programs around the **NSSN Grand Challenges**.

Grants of up to \$100,000 per project are offered to support innovative, collaborative research projects that partner with industry and government. Grants must be matched or exceeded by concomitant industry/ government investment.

Applications to the fund are assessed on the following five criteria:

- Significance – how the proposal represents a significant and novel approach to addressing the defined

The Grand Challenges have been selected for the important role smart sensing can play in responding to the issue and where technological innovation holds the promise to change the game. They have

also been selected for the NSSN's unique ability to mobilise the world-class R&D capability across our member universities in partnership with industry and government for practical, impactful outcomes.

NATURAL HAZARDS

Smart Sensing for bushfires, floods, storms & extreme heat

Catastrophic bushfires, floods and storms that have ravaged NSW in recent years have galvanised the need for fresh thinking in how we respond to and live with natural hazards. Climate change will continue to result in more intense, more frequent, more devastating emergency events unless a new approach is taken.

From real-time satellite monitoring to next-generation airborne and ground-based sensor networks, smart sensing holds the key to better natural hazards prevention, response, mitigation and recovery.

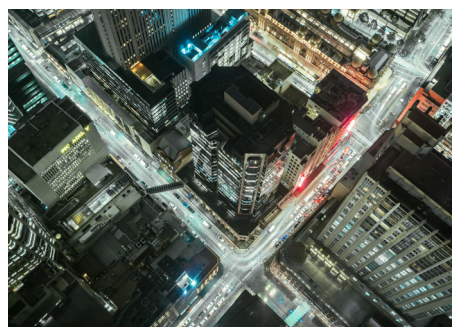


SMART PLACES & BUILDINGS

Using technology to create vibrant, safe and sustainable spaces

Despite having a large geographical area and modest population Australia is a highly urbanised country with over 86% of the population residing in cities and towns.

Australia's population is expected to increase from approximately 26 million to almost 36 million by 2050. The majority of this growth will be accommodated by existing urban places or by new large-scale urban development initiatives such as in Western Sydney and South East Queensland.



WATER

Smart sensing to better understand our water resources and to build a drought resilient NSW and ACT

Water is a shared, limited, resource that is used by many across the land. In order to best manage our water we first need to sense both its quality and quantity. Smart sensing of water aims to fill the gaps in our understanding of the complex water cycle, so it can be rightfully allocated and treated to protect our environment, safeguard our key industries, and supply for residential use.



Grand Challenge (30%).

- Collaboration – how the proposal integrates and fosters genuine collaboration between NSSN member universities (15%).
- Partnership – how the proposal integrates genuine partnership with industry and government partners and responds to a defined industry or government need (15%).

- Governance – how the proposal defines a realistic research plan and the measures that will ensure delivery on milestones (15%).
- Impact – how the proposal defines a pathway to subsequent funding, commercialisation and/or operationalisation (15%).
- Diversity – how the proposal champions diversity in the team or addresses

diversity as an issue (10%).

The fund enables researchers to team up with industry and government partners to develop innovative solutions to NSSN Grand Challenges.

The Fund is offered in November each year, with applications closing in February of the following year.

NSSN BUSINESS DEVELOPMENT PROGRAM

One of the key ways in which the NSSN delivers financial return on investment to its members is through its business development program. Drawing upon its large network of government and industry partnerships and contacts, the NSSN serves as a broker matching client smart sensing demand with member university research expertise to activate collaborative R&D projects.

The NSSN also invests significant effort into identifying and leveraging relevant Commonwealth and state government R&D grants to further support collaborative projects.

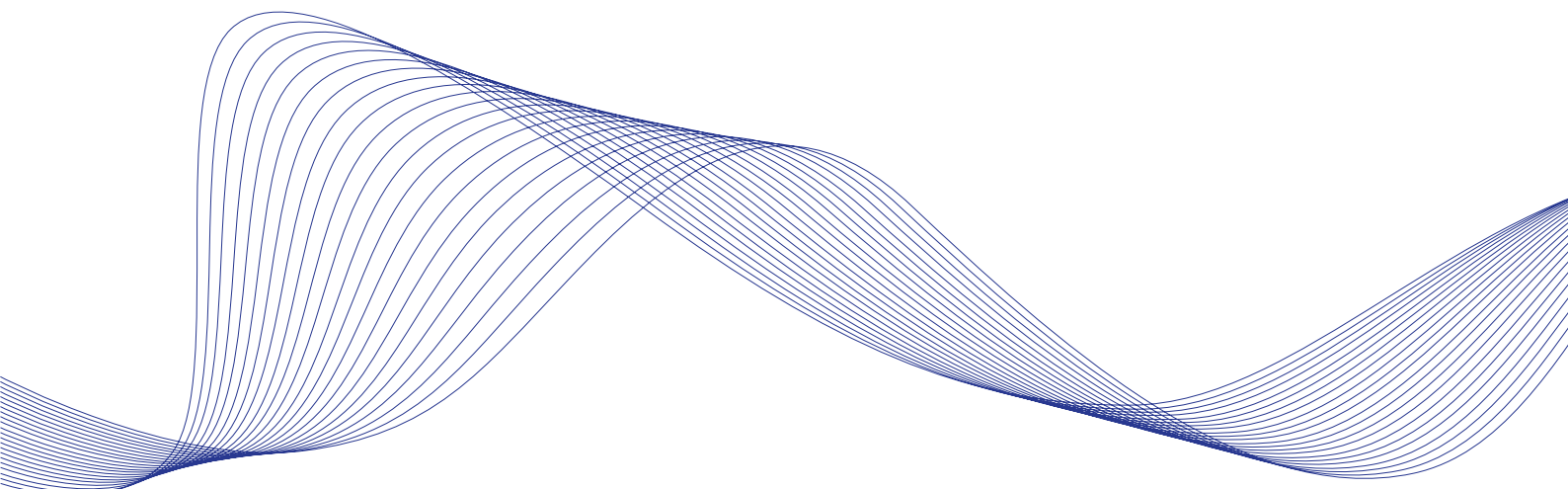
In FY21/22, the NSSN attracted **\$7,365,519** in cash across 11 commissioned research projects.

PROJECT	CLIENT	CASH FUNDING \$
Advanced Rider Assistance Systems for Motorcyclists (CRC-P Round 13)	Forcite, Harley Davidson	\$3,995,423
Sensing Microplastics in Water (NSW SBIR 2021 Phase II)	Pegras	\$1,000,000
EcoEar Detection of Koala Calls (NSW SBIR 2021 Phase II)	Biodiversity Monitoring Services	\$999,240
Modelling Thermal Comfort Indices for Greater Sydney (SmartSat CRC R&D Fund)	Sydney Water	\$333,000
External Investigation of Satellite-based Forest Structure Assessment and the Impact of this on Fuel Moisture and Fire Behaviour Modelling (Resilience NSW Fund 2022)	Federal Corporation NSW	\$310,000
The MOSAIC Study: Motion Optic and Sound sensors to Assess Interactive Communication (NSSN GCF 2023)	Google, Cochlear	\$213,008
Rapidly deployable sensing for water pathogens (NSSN GCF 2023)	BioPoint Pty Ltd	\$200,000
Improved operational flood intelligence for western NSW catchments (NSSN GCF 2023)	NSW SES	\$128,600
Ammonia Sensing on an Urban Water Network	Trility	\$77,022
Smart sonar and accessible hydrography (NSSN GCF 2023)	CEEE Hydrosystems	\$60,000
High-speed counting of black soldier flies for optimised waste recovery (NSSN GCF 2023)	ARC Entotech	\$50,000

More information on each of the above-listed projects can be found on the projects page of the NSSN website.

NSSN BUSINESS DEVELOPMENT PIPELINE

The NSSN tracks its business development activities through its business development pipeline, which maps partnerships from lead stage through to active stage and on to completion. The figure below shows the NSSN Business Development Pipeline as at 30 June 2022.



NSSN INDUSTRY ENGAGEMENT PROGRAM

Emerging strongly from the constraints imposed by COVID, the NSSN hosted a record 24 industry engagement events across FY22/23.

EVENT	DATE	LOCATION
NSSN Data Working Group (with Microsoft as guest speaker)	July 2022	UNSW
NSSN Successfully Adopting Smart Sensing Technologies seminar	August 2022	University of Sydney
NSSN Smart Sensing for Flooding Co-Design Workshop	August 2022	WSU Hawkesbury
NSSN <i>Where is All the Water?</i> Project seminar to DPE staff (171 attendees)	August 2022	DPE Parramatta
NSSN Sensing Industry Connect	September 2022	WSU Parramatta
NSSN Women in Sensing Forum	September 2022	Macquarie University
Modern Manufacturing Expo (NSSN panel discussion)	September 2022	Sydney
National Space Research Conference (NSSN panel)	September 2022	Sydney
NSSN Innovation in the Circular Economy Conference	October 2022	Newcastle
NSSN Sensing Industry Connect	November 2022	ANU
NSSN Smart Sensing CRC for Situational Awareness Industry Scoping Workshop	November 2022	University of Sydney
NSSN Ageing Taskforce Meeting	January 2023	Sydney
NSSN Sensing Industry Connect	February 2023	University of Wollongong
NSSN Women in Sensing Forum	March 2023	CSU Port Macquarie
NSSN Sensing Industry Connect	March 2023	CSU Port Macquarie
NSW Health Industry Co-Design Workshop (Drones)	March 2023	Sydney
NSW Health Industry Co-Design Workshop (VR)	March 2023	Sydney
NSSN OPENAIR Stakeholder Reception	April 2023	UTS
NSSN Ageing Taskforce Meeting	May 2023	Gosford
NSSN Sensing Industry Connect	May 2023	Macquarie University
IoT Impact Conference (NSSN hosted panel discussion)	May 2023	Sydney
NSSN Sensing Industry Connect	June 2023	CSU Albury
NSSN Women in Sensing	June 2023	UNSW
Resources Energy & Industry Forum (NSSN panel)	June 2023	Dubbo

These events are important in engaging with industry and government partners, showcasing the work of the NSSF and building high-value partnerships towards funded R&D projects.

Highlights of the year include the NSSF Smart Sensing for Flooding Co-Design Workshop in August 2022, which brought together stakeholders from across universities, government, industry and civil society to explore innovative solutions for flood detection, response and mitigation. The workshop took place at Western Sydney University's Hawkesbury campus, in a region of NSW that was heavily affected by the 2022 floods. The workshop was opened by then Member for Hawkesbury and Parliamentary Secretary for Science, Innovation & Technology, The Hon. Robyn Preston MP. Findings from the workshop were included in the 2022 NSW Flood Inquiry.



Images from the NSSF Smart Sensing for Flooding Co-Design Workshop, WSU Hawkesbury, August 2022.

The NSSF Innovation in the Circular Economy Conference was held over two days in Newcastle in October 2022, welcoming over 120 delegates across a two-day conference to explore smart sensing solutions for building a better circular economy in NSW. The event included talks by the Minister for Science, Innovation & Technology; local members for the seats of the Upper Hunter and Newcastle; CEO of the Committee for the Hunter, Alice Thompson; Director of Corporate Affairs at AGL, Rob Cooper; and Chair of Circular Australia, Teri Butler.



Anne-Ma
Alix Zieb
Professo
Associat

Moderator



Images from the NSSL Innovation in the Circular Economy Conference, Newcastle, October 2022.

The NSSL was delighted in 2022 to establish a new series shining a spotlight on the achievement of women in sensing. The inaugural Women in Sensing Forum was hosted by Macquarie University in September 2022, followed by forums at Charles Sturt University's Port Macquarie campus in March 2023 and UNSW in June 2023. The forum highlights not only the work of researchers but of entrepreneurs and women working across the sensing industry. It is now an ongoing feature of the annual NSSL events calendar that will rotate across the network.



Images from the NSSL Women in Sensing Forum Series: Macquarie University, September 2022; UNSW, June 2023.

The NSSN's ongoing Sensing Industry Connect series continues to prove a popular forum to bring together manufacturers, designers, deployers and researchers from across the smart sensing community. The casual networking event travels around the state, featuring events in Sydney, Parramatta, Canberra, Wollongong, Albury and Port Macquarie.



Images from the NSSN Sensing Industry Connect Series: ANU, November 2022; Wollongong, February 2023; Macquarie University, May 2023; CSU Albury, June 2023.

Throughout the year, members of the NSSN team participate in a vibrant calendar of events across the NSW and Australian innovation ecosystem, attending and contributing to dozens of conferences, workshops and seminars.

PUBLIC OUTREACH PROGRAM



3,130
TWITTER FOLLOWERS



2,794
LINKEDIN FOLLOWERS



53
MENTIONS ACROSS
PRINT, ONLINE AND
BROADCAST MEDIA



2,369
NSSN NEWSLETTER
READERS



31,000
VISITS TO THE NSSN
WEBSITE



50
NEWS STORIES
POSTED TO WEBSITE

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