Sustainable Communities and Waste

National Environmental Science Program

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Sustainable Communities and Waste Hub research plan 2022

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Introduction

The National Environmental Science Program

The National Environmental Science Program (NESP) is a long-term commitment by the Australian Government to environment and climate research. The program:

- provides evidence for the design, delivery and on-ground outcomes for environmental programs
- helps decision-makers, including from Indigenous communities, build resilience
- supports positive environmental, social and economic outcomes.

The first phase of the NESP invested over $145 million (2014–15 to 2020–21) into 6 research hubs and emerging priority research projects. The second phase is investing $149 million (2020–21 to 2026–27) into 4 new research hubs. These hubs are:

- Resilient Landscapes Hub
- Marine and Coastal Hub
- Climate Systems Hub
- Sustainable Communities and Waste Hub.

The NESP is administered by the Department of Climate Change, Energy, the environment and Water (the Department), formerly the Department of Agriculture, Water and the Environment. More information on the NESP is available at https://www.dcceew.gov.au/science-research/nesp.

Department role

The four NESP hubs have been formed to conduct applied research within their specific themes. Each activity year the Department will work with the minister, the hubs and other key stakeholders to identify and refine research priorities and develop projects that align with these priorities.

This annual review and evaluation of research outputs and impact provides the flexibility needed for the hubs to engage in new themes of research in an adaptive manner and ensures that the focus is on the delivery of relevant and practical research. Hubs are responsible for co-design of the research projects in consultation with research-users and in partnership with relevant Indigenous communities. Hubs are also responsible for monitoring and evaluating the research project outcomes during the life of the hub.

The research prioritisation is a rolling process and will be informed by key milestones in each activity year, such as the annual progress report and submission of the next research plan.

Hub role

The Sustainable Communities and Waste (SCaW) Hub is a consortium comprising five world-class research institutions led by University of New South Wales, Sydney (UNSW), including the Commonwealth Scientific and Industrial Research Organisation (CSIRO), Monash University (Monash), the University of Tasmania (UTas) and Curtin University (Curtin).

The Hub provides a collaboration space for academics, government, industry and the community, with the shared objective of enhancing sustainable community outcomes and reducing negative waste impacts.

Our research agenda is co-designed with the Department and other research-users at all levels of government, industry, non-government organisations (NGOs), national associations and Indigenous and other community groups in urban, regional and remote Australia.

Our Vision

Create more sustainable communities and reduce waste impact through innovative and collaborative solutions.

Transforming waste materials via new science to form the foundation of scalable and **local waste to value solutions** that are end user focused.

Working with our First Nation Peoples to build enduring relationships and sustainable communities.

Improving biodiversity and environmental outcomes through better management of waste, pollution and air quality, adoption of nature based solutions and strengthening our connection to nature.

Increased prosperity and jobs creation by aligning and boosting Australia's recycling and **manufacturing capability**.

Purpose of research plan

This Research Plan 2 (RP2) was developed by the SCaW Hub, in consultation with the Department and other research-users to address key priorities identified during co-design discussions that occurred in RP1 (2021).

It seeks to deliver holistic benefits to all communities and is founded on four pillars:

Holistic Benefits
Healthy, connected and prosperous urban, regional and Indigenous communities

Waste Impact Management Initiative

In addition to its Impact Priority projects, each hub is responsible for delivering a cross-cutting initiative. The four cross-cutting initiatives are:

Initiative	Lead Hub
Protected place management	Marine and Coastal
Threatened and migratory species and threatened ecological communities	Resilient Landscapes
Waste impact management	Sustainable Communities and Waste
Climate adaptation	Climate Systems

For the SCaW Hub, the Waste Impact Management Initiative involves cross-hub collaboration and may include multiple projects to deliver management options, data and information. Where appropriate, SCaW projects will also undertake research to support the SCaW-led Initiative.

Emerging priorities

Each year, specific emerging priorities may be identified by the Department, hubs or third parties for delivery as research projects. If endorsed by the Department, hubs will develop research project/s to address the emerging priority.

Hubs will be flexible and adaptable to respond to emerging priorities, with the ability to rapidly scale output, bring in external expertise or respond if additional resources are made available. Hubs are required to set aside 10% of their annual funding so that they can respond to emerging priorities; these funds can be rolled into the subsequent year if they are not used and be allocated to other research needs.

Emerging priority projects will be developed outside a hub's annual research proposal process. Once emerging priority projects are approved, a hub's Research Plan and Activity Budget for the relevant calendar year will be amended, and emerging priorities will be included in the hub's annual progress reports.

Research

Research priorities

The SCaW Hub is committed to a body of activity that includes short- and long-term research projects and the Waste Impact Management Initiative.

Following the implementation of the compressed first year's Research Plan No 1 (RP1), which was focused on eliciting and prioritising the research needs of the Department and other research-users, priorities for research have been identified, and projects developed to deliver against each under RP2. Some projects span multiple years and these will continue to be refined with our research-users through the life of the Hub. Several projects provide opportunity for cross-hub coordination and activities have been built into projects to work closely with key researchers in other NESP hubs to coordinate efforts, especially through the Initiatives. Ongoing engagement with the Department is paramount. No emerging priorities were identified for RP2.

RP2 will be delivered, in accordance with, and guided by our agreed Hub strategies for knowledge brokering, data management, Indigenous partnerships and communications. These strategies provide direction on Indigenous engagement, data management, communication and knowledge product outputs.

The SCaW Hub has 5 impact priority areas, with projects identified for delivery under RP2, as follows:

IP1.02: Sustainable people-environment interactions (led by Monash and UTas)

Links between the health of people and the health of ecosystems and the environment are being increasingly recognised in research, policy and programs. Great strides have been taken in national and international research exploring these links between human wellbeing, and environmental and ecosystem health, including through the NESP, yet critical gaps in knowledge remain. The Impact Priority Area 1 'Sustainable People–Environment Interactions' (SuPErInteract) is focused on supporting healthy people and place interactions via two projects.

These projects have been developed to meet the Department's and external partner research needs. Research needs and priorities have been, and will continue to be, determined through a co-design process with the Department and other research users, including state environment departments, local governments, non-government organisations (NGOs) and Indigenous and non-Indigenous communities, across urban, regional and remote contexts. Through these projects, this impact priority area will contribute to national commitments such as *Australia's Strategy for Nature 2019–2030* and the *National Climate Resilience and Adaptation Strategy 2021–2025*.

We will use the lens of 'nature-based solutions' (NbS), an approach widely adopted in global policy and standards (e.g., International Union for Conservation of Nature (IUCN)) but less commonly known and applied in Australia. A NbS approach encourages transdisciplinary methodologies for co-design and co-creation of research to address environmental, ecological and human health and wellbeing challenges. It fosters multiple benefits for people and place and promotes the resilience of social–ecological systems to environmental change.

IP2.02: Reduced impact of plastics and other materials (led by UNSW & Curtin)

Research in IP2 focuses on reducing the impact of plastics and other waste materials. This research aims to find solutions for waste materials included in the national waste export bans and other problematic materials identified as priorities during co-design in 2021: plastics, textiles, glass, and rubber.

IP2 researchers are guided by national priorities "*The National Waste Policy 2018*" and the "*National Waste Policy Action Plan*" and supported by further plans including modernisation of recycling and manufacturing capability; and sustainable protection of national materials supply (critical materials).

The low participation of Indigenous researchers in the RP1 process of IP2 revealed a mandate for increasing the engagement of Indigenous researchers in waste discussions and research.

For 2022, researchers will collaborate with industry and community groups, including both Indigenous and government, to find *"fit for purpose"* solutions addressing three key objectives:

1) To develop a monitoring protocol informing national policy on microplastics, investigating material properties and characteristics for different waste materials contributing to the issue, examining environmental impacts and current performance, undertaking trials and evaluating viable alternatives.
2) To trial practical technological solutions to waste management challenges across regional and remote communities and provide ready access to information for stakeholders.
3) Inform policy development regarding the utility of plastic in artificial reef construction.

To address these issues, IP2 proposes three multiyear projects.

IP3.02: Management of hazardous waste, substances and pollutants (led by CSIRO & Monash)

Chemicals in waste streams pose challenges to waste reuse strategies and to achieving National and State waste policy action plan targets. Even trace levels of chemicals in waste materials can result in a hazardous waste classification, and in some cases, the trigger limits for hazardous waste classification are not well characterised. The presence of chemicals of potential concern (CoPC) can impact recyclability and the safe reuse of materials in the economy.

Through partner, stakeholder and the Department's engagement in RP1, we identified and co-designed three key themes for prioritisation of research for RP2 and beyond, including:

1) understanding the chemicals in current and emerging wastes
2) de-risking the future through safe waste reuse and resource recovery, and
3) enhancing information flows and assessment for improved outcomes and governance on hazardous wastes.

Underlying these three key themes of research are critical data gaps on the composition/mass of chemicals in our wastes, their potential release to the environment, and the safe reuse potential of our waste streams. These are recurring issues for risk-based decision making, and de-risking the management and treatment of wastes, including the safe reuse of recovered resources.

These themes will be addressed through one multiyear project that aims to build national capability and generate quantitative data and methodological guides that can be used for evidence-based risk management of CoPC identified in our wastes and in repurposed materials. RP2 will start to build a knowledge platform for concentrations of chemicals of potential concern in waste streams, and in subsequent years, provide an indication of leachable components from these waste streams, and their behaviour under field or reprocessing conditions. Information sharing and hazardous waste governance will be enabled through improved baseline compositional and leachability data.

IP4.02: Improved air quality, forecasting and assessment (led by UTas & CSIRO)

Research in IP4 explores how air quality in Australia, while generally good, continues to cause significant health impacts from bushfire smoke, planned burns, wood-heaters, and local industrial pollution.

During 2021, researchers in IP4 worked with stakeholders and partners to co-design a series of impactful research projects under the 'improved air quality, forecasting and assessment' research theme for our SCaW Hub. These stakeholders and partners included the Department and other research-users such as state environment departments, local government, NGOs, Indigenous groups and other NESP hubs. This engagement included virtual meetings, a survey (completed by 80 participants), an interactive workshop involving 45 participants, and presentations to national bodies including the Healthy Environment and Lives Network, the Australia New Zealand Aerosol Symposium and the Climate Adaptation cross-cutting program of the Climate Systems NESP Hub.

The projects proposed here by IP4 for Research Plan No 2 (RP2) have arisen from the extensive stakeholder consultation undertaken by the IP4 team as part of Research Plan No 1 (RP1). These projects will address four key questions that arose from the co-design survey, workshop and conversations that occurred during RP1, and include:

1) How will a changing climate and emissions reduction measures impact sources of air pollution and secondary pollutant formation?
2) How can we reduce exposure to woodheater smoke?

3) How can we ensure that sensor networks produce useful information?

4) How effective are the interventions currently being rolled out aimed at reducing exposure to poor air quality?

The low participation of Indigenous researchers in the RP1 process of IP4 also led us to propose the question, how can we increase engagement of Indigenous researchers and stakeholders in air quality discussions and research?

To address these issues, IP4 proposes four multiyear projects.

IP5.02: Waste Impact Management Initiative (led by CSIRO & Monash)

For RP2, Waste Impact Management Initiative research will implement activities that were initiated through the engagement and the co-design process under RP1. Through engagement with the Department and other research-users three key research priorities for Impact Initiative research were identified:

- to provide information, data and management tools
- to inform design for repurposing waste and circular economy
- to inform the institutional and governance needs of community-based resource recovery and circular economy initiatives and to work on waste management and resource recovery opportunities for Indigenous communities
- to create an evidence base for decision makers based on novel science contributions and informing solutions for problems of national significance.

To address these issues, IP5 proposes four multiyear projects. In addition, a cross-cutting initiative for an integrated project has been proposed and will be scoped during RP2. Funding for project IP5.02.05 is not yet included in the budget and requires further cross-hub planning and decision-making.

Expected outcomes and outputs

The expected outcomes of NESP are to produce research that:

- enhances our understanding of Australia's environment and climate
- is communicated clearly to relevant stakeholders and the public
- is discoverable and accessible
- informs decision-making and addresses environmental priorities.

Research under NESP is expected to inform the Department's policy and program delivery. More broadly, it will engage and inform key stakeholders with an interest in the outputs of environmental and climate science research, including state and local governments, business and industry, community groups, Indigenous land managers, Indigenous communities, and education institutions.

Hub outcomes and outputs

The SCaW Hub is enabling a systemic, transformative response to Australia's sustainability, waste and pollution challenges through the integration of key research fields, including ecology, engineering, environmental monitoring, public health, data science, technology, behavioural change, environmental economics, business innovation, and regional and urban planning. We work closely with all levels of government, private industry, NGOs and communities, including Indigenous, to co-design research projects and co-create knowledge products that will help solve difficult problems that negatively impact

society. Governance, community participation and Indigenous knowledge underpin our co-design approach. We aim to produce actionable knowledge, methods, tools and data for transformation towards circular economies and more sustainable communities.

IP1: Sustainable people-environment interactions (led by Monash and UTas)

The short-term outcomes of this project are:

- new and strengthened partnerships among researchers, the Department, state environment agencies/departments, Indigenous groups, local communities, NGOs and other research-user partners
- greater understanding of the health benefits of participation in nature-based programs.
- a national approach to NbS in Australia
- awareness of the barriers to effective urban greening initiatives in regional communities
- integrating the social value of night skies for sustainable human–environment interactions into light pollution policy and dark skies programs
- a conceptual design and methodological framework for development of a national platform to support community-led, place-based participatory planning processes to advance water-sensitive outcomes for regional and remote communities and the evaluation of urban heat impacts and liveability outcomes, identifying research and infrastructure requirements.

The expected longer-term outcomes of this project are:

- new partnerships across the consortia and partners to foster innovation and creative solutions to improve people–environment interactions across Australia
- enabling federal, state and local governments to better implement and report on policy outcomes (e.g. *Australia's Strategy for Nature 2019–2030*, *Protecting Victoria's Environment – Biodiversity 2037*), and report on international obligations (e.g. Sustainable Development Goals (SDGs), Aichi targets, post-2020 Global Biodiversity Framework, Ramsar triennial reporting to the conference of the Contracting parties, post United Nations Framework Convention on Climate Change Conference of Parties 26, World Heritage Convention, IUCN)
- an evidence base for creating future-proof positive people–environment interactions through planning and program design in urban, regional, remote and Indigenous communities
- improved urban greening programs that build capacity in local governments and lead to improved outcomes for people and biodiversity across Australia.
- economic benefits – from reducing money wasted in planting/maintaining greenspaces that are not resilient, to reductions in the cost of healthcare productivity losses via management of heat-related health risk, and improved management of green infrastructure assets.

Significant community benefits, stemming from the application of tools/models/platforms that enable better planning of our cities and towns, improving liveability, sustainability, resilience, and health and wellbeing, including better understanding specific community needs and ensuring diverse perspectives are incorporated into decision-making processes.

IP1.02.01: Nature connection and urban greening

Project	Milestones - Outputs	Timeline (from Jul 2022)	Due date	Responsible person
IP1.02.01	Signing of project contract		30-Jun-22	Emily Flies (UTas)

Project	Milestones - Outputs	Timeline (from Jul 2022)	Due date	Responsible person
	Co-design workshops for RP3 commenced		01-Aug-22	Emily Flies (UTas) /Dave Kendal (UTas)
	Detailed project RP3 developed		29-Aug-22	Emily Flies (UTas)
	A summary report and/or fact sheet on the health benefits of participation in nature-based programs		31-Mar-23	Pauline Marsh (UTas)
	Summary report and/or fact sheet on NbS for Australia		31-Mar-23	Emily Flies (UTas)
	Summary report and/or fact sheet on inclusive urban greening for greater liveability in regional areas		31-Mar-23	Jason Byrne (UTas)
	Summary report and/or fact sheet on social values for access to dark skies		31-Mar-23	Dave Kendal (UTas)
	Annual report on project's RP2 activities		07-Apr-23	Emily Flies (UTas)

IP1.02.02: Water sensitive and liveable communities

Project	Milestones - Outputs	Timeline (from Jul 2022)	Due date	Responsible person
IP1.02.02	Signing of project contract		30-Jun-22	Malcolm Eadie (Monash)
	Co-design workshops for RP3 commenced		01-Aug-22	Malcolm Eadie (Monash)
	Detailed project RP3 developed		29-Aug-22	Malcolm Eadie (Monash)
	Conceptual design and methodological framework for the development of a national platform to advance water sensitive outcomes for regional and remote communities and manage urban heat impacts		31-Mar-23	Malcolm Eadie (Monash) / Atiq Zaman (Curtin)
	Annual report on project's RP2 activities		31-Mar-23	Malcolm Eadie (Monash)

IP2: Reduced impact of plastics and other materials (led by UNSW & Curtin)

The ultimate outcome of this research over the course of the NESP program will be an increase in materials circularity in Indigenous, remote, regional and urban Australian communities. This outcome will contribute to the delivery of the *National Waste Policy 2018" and the "National Waste Policy Action Plan,* particularly the goals of *"Helping to reduce total waste generated by 10% per person by 2030*" and "*Significantly increase the use of recycled content by governments, consumers and industry"*.

The project will advance recycling and plastic related policies, providing a framework to develop and promote new and sustainable national supply chains, reducing the impacts of waste materials subject to the export ban as well as the effects of microplastics on the environment, and inform the Department's policy design and decision making via community co-designed solutions and on-ground

success. The research will also provide innovative recycling solutions for waste streams, including plastics, tyres, textiles, and glass.

This new knowledge is expected to inform future policy discussion and considerations at all levels of government on addressing waste management, including microplastics in regional and remote communities and strengthen the capacity to implement fit for purpose solutions. The project's outcomes will catalyse supply chains and create new markets. This work will lead to opportunities for Australian Indigenous, remote, regional and urban communities to embrace circular economy solutions to drive social and economic benefits.

IP2.02.01: Understanding Microplastics

Project	Milestones - Outputs	Timeline (from Jul 2022)	Due date	Responsible person
IP2.02.01	IP2.02.02 inception meetings/discussions		30-Jul-22	Veena Sahajwalla / Arthur Wilson
	Plastic additives report		30-Sep-22	Veena Sahajwalla / Anirban Ghose
	A progress report of findings to predict microplastic risk for EPBC Act-listed threatened species		30-Oct-22	Veena Sahajwalla
	A progress report on a nationally consistent monitoring system (protocol) and national database for microplastic pollution		30-Oct-22	Veena Sahajwalla / Anirban Ghose
	Preliminary RP3 Plan		23-Sep-22	Veena Sahajwalla / Arthur Wilson
	RP2 Draft report submission		30-Dec-22	Veena Sahajwalla / Arthur Wilson

IP2.02.02: Finding Fit for Purpose Technological Recycling Solutions for Regional and Remote Communities Across Australia

Project	Milestones - Outputs	Timeline (from Jul 2022)	Due date	Responsible person
IP2.02.02	IP2.02.02 inception meetings/discussions		30-Jul-22	Veena Sahajwalla / Arthur Wilson
	Yearly progress report for the Department and other research users summarising progress and results		30-Oct-22	Veena Sahajwalla / Arthur Wilson
	Preliminary RP3 Plan		23-Sep-22	Veena Sahajwalla / Arthur Wilson
	RP2 Draft report submission		30-Dec-22	Veena Sahajwalla / Arthur Wilson

IP2.02.03: Plastic-Reinforced Artificial Reef Structures; Improving Understanding

Project	Milestones - Outputs	Timeline	Due Date	Responsible Person
IP2.02.03	A report provided to the Department outlining the key findings for Plastic-Reinforced Artificial Reef Structures		21-Oct-22	Veena Sahajwalla / Arthur Wilson

IP3: Management of hazardous waste, substances and pollutants (led by CSIRO & Monash)

The expected outcomes and value for this RP2 project include:

- Input to a co-designed set of guidelines for robust and representative waste sampling, characterisation, and risk assessment (reporting) for waste tyres and e-wastes
- Quantitative analytical methods and datasets for the composition, detectable limits and concentrations of chemicals in e-wastes and waste tyres before and after processing

- Input to a framework for waste sampling, characterisation and risk assessment that is sought to be transferrable to other emerging wastes and re-purposed materials in the future
- Facilitation of strategic management of wastes and their hazardous components, leading to economic environmental and social benefit, which is a long-term outcome we expect of the Hub.

IP3.02.01 Understanding chemicals of concern in our wastes and recovered resources

Project	Milestones - Outputs	Timeline	Due date	Responsible person
IP3.02.01	Signing of contract		01-Jul-22	UNSW
	Scopes refined to agree type and locations of e-waste and tyre wastes.		30-Jul-22	Leaders of analytical chemistry and leaching projects with Boxall and IP co-leads
	Analytical methodologies outlined for evaluation		30-Jul-22	Project team
	Sampling strategy for waste types drafted		31-Aug-22	Project team
	Circulation of draft priorities to include within RP3 – leaching and bioavailability studies.		01-Aug-22	Naomi Boxall, Greg Davis, Mitzi Bolton
	Analytical update for characterisation of CoPC		01-Oct-22	Project team
	Methodology for determining total leachable components		01-Oct-22	Project team
	Anticipated RP3 commencement (leachability and bioavailability)		31-Jan-23	Project team
	Draft report outlining approach to waste sampling, characterisation, and reporting. Feedback from co-design team and DAWE.		03-Feb-23	Project team
	Final RP2 report.		30-Apr-23	Naomi Boxall, Greg Davis, Mitzi Bolton – plus some of key R&D leaders

IP4: Improved air quality, forecasting and assessment (led by UTas & CSIRO)

The ultimate outcome of this research over the course of the NESP program will be the reduction of exposure of Australian communities to poor air quality. This outcome contributes to Goals 3 and 11 of the UN Sustainable Development Goals by reducing mean annual levels of particulate matter in cities and reducing mortality rates attributed to household and ambient air pollution.

This research will result in greater participation in air quality research and uptake of research outcomes by Indigenous researchers and stakeholders, with the production of a roadmap forward to continue the conversation to build relationships between the IP4 team and Indigenous researchers and communities. The research will provide the tools and knowledge that will empower all scales of government to undertake a co-ordinated approach to interventions that will reduce exposure to air pollution and save lives. Outputs in RP2 that will contribute to this outcome are the improved guidance

on the use of HEPA filters for air quality in public spaces, guidelines on the selection and use of low-cost sensor networks for the management of local air quality problems and a roadmap for interventions to reduce exposure to woodheater smoke. Finally, the research in this project will enable government to plan for the impacts of a warming climate on future air quality and to maximise the co-benefits of reducing emissions and improving air quality.

IP04.02.01 – IP04.02.04 Projects

Project	Milestones - Outputs	Timeline (from Jul 2022)	Due date	Responsible person
IP4.02	Contract signing		01-Jul-22	Melita Keywood
	RP3 proposal		23-Aug-22	Melita Keywood
	Contribution to RP2 Annual Summary Report including progress on the outputs listed in the Pathway to Impact Table		01-Apr-23	Melita Keywood
	IP4.02.01 Lets talk about smoke A roadmap forward for further conversations and if appropriate, the development of project ideas to carry out in further years of this project.		15-May-23	Erin Dunne
	IP4.02.02 – How will a changing climate and emissions reduction measures impact sources of air pollution and secondary pollutant formation? A short report outlining the design of several future modelling studies that will provide a lens on how altered we can expect air quality to be under future emission scenarios in Australia		15-May-23	Kathryn Emmerson
	IP4.02.03 Woodheaters: developing and testing novel solutions to a persistent problem Roadmap of novel interventions / actions for implementation in years 2 and 3 (RP3 and RP4)		15-May-23	Fay Johnston
	IP4.02.04 Intervention options and low-cost sensor networks to improve awareness, and reduce exposure to, air pollution Short report on progress towards development of guidance on the use of HEPA filters to improve air quality in public spaces and the selection and use of low-cost sensor networks for the		15-May-23	Donna Green

Project	Milestones - Outputs	Timeline (from Jul 2022)	Due date	Responsible person
	management of local air quality problems.			

IP5: Waste impact management initiative (led by CSIRO & Monash)

The waste impact management research will deliver a series of knowledge products that include metrics and data on material flows, waste, emissions, resource recovery and circular economy for decision makers in federal, state and local governments and for businesses in the waste management and resource recovery sector; it will identify novel approaches for specific resource recovery problems achieved though novel science and engineering contributions and amenable to be put to national and local use; and it will foster a science-based understanding of the institutional and governance arrangements to enable regional community based circular economy initiatives and networks that encourage value add to materials to occur many times over resulting in economic and employment benefits. The science informs business decision and communal approaches that result in reduce primary material requirements, increased secondary content in products and infrastructure, and workable cycles arrangements leading to tangible reduction in material use, waste to landfill and emission and also reducing the environmental impacts (climate change, natural resource depletion, biodiversity loss, toxic waste issues) that are related to natural resource use creating significant and measurable environmental benefits.

Project	Milestones - Outputs	Timeline (from Jul 2022)	Due date	Responsible person
IP5.02.04-D1	A list of key Aboriginal stakeholder groups identified for co-design process and further engagement		Sep-22	Heinz Schandl / Timothy Baynes / Yingying Lu
	Culturally appropriate community presentations developed			Heinz Schandl / Timothy Baynes / Yingying Lu
IP5.02.04-D1	Development of a shortlist of two locations for further research and analysis of local issues in a scoping and co-design process		Sep-22	Heinz Schandl / Timothy Baynes / Yingying Lu
IP5.02.01-D1	Comprehensive material flow dataset for the Australian economy including material input and output		Dec-22	Heinz Schandl / Timothy Baynes / Yingying Lu
IP5.02.01-D2	Dataset and visualisation of the complex material interactions within the Australian economy		Mar-23	Anna Kaksonen / Naomi Boxall / Ka Yu Cheng
IP5.02.01-D3	Australian Circular Economy Gap Report		May-23	Heinz Schandl

Project	Milestones - Outputs	Timeline (from Jul 2022)	Due date	Responsible person
IP5.02.02-D1	Report on regulatory and policy settings, environmental impacts of tyre and conveyor belt disposal, material flow and processing capacity analysis for used tyres and conveyor belts in WA and evaluation of market potential for products derived from used tyres and conveyor belts.		May-23	Heinz Schandl / Timothy Baynes / Yingying Lu
IP5.02.03-D1	A report summarising needs and capabilities for three LGAs		May-23	Heinz Schandl / Timothy Baynes / Yingying Lu
IP5.02.03-D2	Presentation of proto-type networked governance model for regional community-led CE activities at a Town Hall event co-convened with the ACE Hub		May-23	Anna Kaksonen / Naomi Boxall / Ka Yu Cheng
IP5.02.03-D3	A register of existing information resources relevant to regional community-led CE activities, detailing type of data and reliability		May-23	Heinz Schandl
IP5.02.04-D2	Report on the identified waste management issues and scope of circular economy practices among Aboriginal communities in Western Australia. Community reports circulated to the participating Aboriginal communities for feedback and suggestions		May-23	Anna Kaksonen / Naomi Boxall / Ka Yu Cheng
IP5.02.04-D2	Report on the stakeholder engagement and codesign outcomes and list of priority research issues for each Hub		May-23	Anna Kaksonen / Naomi Boxall / Ka Yu Cheng
IP5.02.01-D4	Identification of priority material supply chains and sectors for additional analysis		Jun-23	Heinz Schandl
IP5.02.04-D3	Community consultation report on waste management priorities and possible circular economy solutions		Sep-23	Anna Kaksonen / Naomi Boxall / Ka Yu Cheng
IP5.02.04-D4	Community reports and presentations to the participating Aboriginal communities for feedback and suggestions		Feb-24	Heinz Schandl

Project	Milestones - Outputs	Timeline (from Jul 2022)	Due date	Responsible person
IP5.02.02-D2	Report on best practice case studies (from other Australian states/territories or overseas) of tyre and/or conveyor belt recycling that could provide learnings for implementation in WA		May-24	Anna Kaksonen / Naomi Boxall / Ka Yu Cheng
IP5.02.03-D4	A descriptive categorisation of CE needs and capacities of regional and remote LGAs suitable for use by State agencies and DAWE and for aligning with technological solutions identified in IP2.		May-24	Heinz Schandl
IP5.02.03-D5	Submission of a refereed journal article on the development of the networked governance model with publication of a plain English version on the ACE Hub local government web portal		May-24	Heinz Schandl
IP5.02.04-D5	Community resources developed (as required)		May-24	Heinz Schandl
IP5.02.02-D3	Presentation of research findings at a conference, workshop or webinar		Jun-24	Heinz Schandl
IP5.02.03-D6	A report reviewing implementation of the networked governance model in targeted LGAs		May-25	Heinz Schandl
IP5.02.04-D6	Report on the circular economy implementation strategy for urban and rural Indigenous communities		May-25	Heinz Schandl
IP5.01-04	Conference presentation and journal articles		Ongoing	Heinz Schandl

Collaboration and partnerships

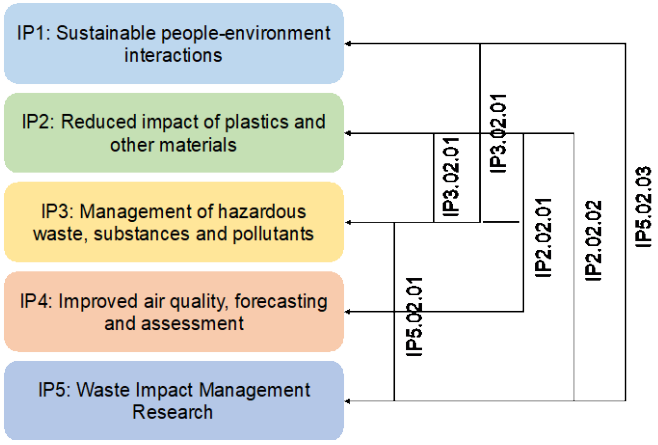
NESP encourages a collaborative, multi-disciplinary approach to environmental and climate research. Key to the success of the Hub is the capacity to foster partnerships across hubs and with a wide range of decision makers across the Australian community, including Indigenous communities, to achieve positive environmental, social and economic outcomes.

The SCaW Hub is a consortium comprising five world-class research institutions led by UNSW Sydney. Our Hub leaders have a track record of collaboration with research programs and centres across Australia and around the world to foster science innovation and produce high quality science, research-user focused outcomes, impacts and products.

Our collaborations and partnerships will be guided by all requirements within the Hub's four centralised strategies for data management, Indigenous partnerships, knowledge brokering and communications. We will not repeat here content from those strategies but reiterate the many

requirements within these strategies apply to all Hub engagement and outcomes, and all Strategy Leads' involvement across project work.

Impact priority areas will collaborate to deliver high-standard outcomes as part of RP2, as follows:



A variety of strategies are being used to enhance our collaborative effort and make sure we deliver the objectives of our research for each project. These strategies include:

External researchers and subcontractors

The SCaW Hub, through its universities and CSIRO, links with leading external researchers and universities globally. Hub research-users also have research and development (R&D) capability and connections – for example Water Research Australia – who link across all water utilities in Australia and their associated researcher cohorts. Such linkages will be brought to bear on the Hub and other NESP projects of scale and complexity where capability is not housed within Hub partners.

Related research programs

The SCaW Hub will leverage existing relationships with a range of organisations including:

- Centre for Air pollution, energy and health Research (CAR)
- CSIRO and health and environmental jurisdictions including the CSIRO/Bureau of Meteorology Smoke forecasting system (currently operating for fire agencies in Victoria and New South Wales)
- Darwin Living Lab - a 10-year initiative involving CSIRO, the Australian and Territory Governments and City of Darwin. Collaborating with UNSW, Charles Darwin University and Utas, testing and evaluating heat mitigation measures to improve Darwin's liveability
- CSIRO has a national program of missions related to plastics, critical energy metals, emissions issues, and organic waste. These are linked to government, industry and community interests, meshing strongly with the Hub vision
- UTas hosts the Healthy Landscape Research Group (HeaLa) that aims to understand the connections between the environment and human health - especially in the context of rural and regional areas and small cities. It uses that knowledge to drive and learn from local initiatives that will benefit health for Tasmanians and make Hobart a leading "healthy regional city". HeaLa is currently undertaking a range of projects, including on urban and regional microbiomes; benefits of biodiversity and nature in small cities; the multiple social and health benefits of ecological restoration programs and community gardens; and dark skies conservation
- various centres of excellence across UNSW, particularly the UNSW Sustainable Materials Research and Technology (SMaRT) Centre (a Hub partner) and its MICROfactorie technologies

- Monash was the lead in the Cooperative Research Centre (CRC) for Water Sensitive Cities, which wound up in June 2021, with the Water Sensitive Cities Institute, a SCaW Hub partner continuing to deliver against its mission to make cities more water sensitive
- Monash is leading an Australian Research Council (ARC) Linkage Project on 'Measuring the benefits of reuse in the circular economy' in partnership with the National Association of Charitable Recycling Australia, a SCaW Hub partner
- Monash is leading the ARC Discovery Project: Household Innovation and Transition the Low Waste City, which examines the potential of households to contribute as innovators in a low waste sustainability transition
- Behaviour Works at Monash has been collaborating since 2018 with Victorian and New South Wales -based policy partners to look at the issue of waste and how to encourage Australians to avoid, reduce, reuse and recycle waste and adopt circular economy approaches from a behavioural change perspective.

Government, Industry and community partnerships

The SCaW Hub has over 100 government, industry, NGO, Indigenous and community research-users spanning all states and territories, all levels of government, urban, regional and remote locations and representing a diverse collection of small and large enterprises working across all Hub priority areas.

Key research-users include:

- State Environment Departments (Victoria Department of Environment, Land, Water and Planning, Western Australia Department of Biodiversity, Conservation and Attractions, South Australia Department for Environment and Water, Tasmania Department of Primary Industries, Parks, Water and Environment, NSW Department of Planning, Industry and Environment)
- Environment Protection Agencies (EPAs) in all states and territories
- State/territory Health Departments (Australian Capital Territory (ACT), Tasmania (Tas), Western Australia (WA)
- Other state agencies (Waste Authority WA, Development WA, Melbourne Water, Royal Botanic Gardens Victoria)
- Local governments in capital cities (e.g., City of Melbourne, City of Fremantle, Perth City Council) and regional centres (York (WA), Launceston, Brighton (Tas), Ballarat, Newcastle)
- Aboriginal and Torres Strait Islander groups (Tasmanian Regional Aboriginal Communities Alliance (TRACA), Fisheries Research and Development Corporation Indigenous Reference Group, Dharriwaa Elders Group)
- Environmental NGOs (Conservation Volunteers Australia, TierraMar, Landcare Tasmania, the Tasmanian North East Bioregional Network, Planet Ark)
- Industry associations (Planning Institute Australia, Water Services Association of Australia, Nursery and Garden Industry Victoria, Australian Tyre Recycling Association, National Retail Association)
- Large enterprises (Veolia, Mirvac, Molycop, Deloitte, Woolworths, Wesfarmers)
- Small-medium enterprises (Instyle, ACT Recycling, Expand Glass Technology, Tellus Holdings, Textile Recycling Australia, Viewco, Emdo, Resmed, OZ Minerals, ABC Civil Group).

Indigenous partnerships

Our Hub aims to create sustained resilient and strong partnerships with Indigenous Australians through Hub projects. We recognise this enables identification of areas and issues related to social, economic, cultural and spiritual significance to Indigenous communities. We also recognise the importance co-designed research has towards reconciliation and to realise opportunities of mutual benefit to Indigenous and non-Indigenous research. The result is an advantage to Australia from both a research and social perspective.

Our Indigenous partnership approach seeks to facilitate appropriate participation by Indigenous people, groups, and communities when undertaking research activities. We will ensure compliance with Indigenous Cultural and Intellectual Property (ICIP) requirements. Our projects will seek to provide investment to enhance Indigenous research capability, including in regional and remote Australia. Our approach embeds skilled transfer to Indigenous people but also Indigenous people sharing traditional knowledge and skills about sustainable communities and waste management with non-indigenous people. Throughout the life of this Hub, we will foster increased cultural awareness between members of the Hub, the participating nodes, and the communities where we will be conducting our research.

Our Hub's Indigenous Partnerships Strategy outlines criteria the projects need to address to ensure appropriate engagement with Indigenous Australians, and we will use the Three Category Approach, a tool developed under NESP to assess each project and determine the appropriate level of partnership and engagement with Indigenous Australians.

Knowledge brokering, communications and data management

NESP expects that each hub will engage and communicate research outcomes with research-users and the wider public to facilitate uptake and adoption. As part of this, the program is committed to promoting open access to public sector and publicly funded information, including optimising the use and reuse of data. NESP expects that each hub will implement its data management plan to provide timely, open-access to the data products and research outputs.

Knowledge brokering

Knowledge brokering is a key function within the Hub that ensures that research projects are co-designed to meet the needs of research users, and knowledge products are delivered in usable formats to generate research impact.

The Hub's lead Knowledge Broker (KB) guides knowledge brokering activities and functions across the Hub, in partnership with the Department, all Hub partners, Indigenous facilitators and other NESP hubs, in accordance with the Hub's KB strategy. There is an active knowledge brokering presence across the Hub, with knowledge brokering roles in all Hub research institutions (also referred to as nodes), and in all Impact Priority projects, via a dedicated Hub KB group that meets regularly.

The KB group is involved in research project co-design across the Hub, supporting facilitated co-design workshops, connecting SCaW Hub researchers to research users within the Department and external partners, communicating Hub research capability to research-users, and ensuring that research user priorities are addressed by Hub research plans. As well as the KB strategy, supporting material is being developed to guide Hub research user engagement, co-design and knowledge translation activities.

Knowledge brokering is resourced through the lead Knowledge Broker (0.3 FTE) and supports the engagement of operational knowledge brokers to co-design activities (20 days per year) and knowledge translation (20 days per year). Resources have been allocated to develop training materials and conduct knowledge broker training for Hub researchers, and to support travel by knowledge broker actors. The budget for Knowledge Brokering in 2022, presented in the activity budget (Attachment C) accounts for 10% of the NESP funding. The Hub's KB strategy will be revised annually (next due September 2022).

Communications

Hub communication activities – at both Hub and/or Impact Priority project level – are guided by the strategic aims and objectives of the Hub, and in accordance with the Hub's Communications Strategy. Additional advice and guidelines, along with working documents, to assist with the implementation of the Communications Strategy and projects are provided in the various guideline, protocol and templates documents and resources located on the Hub's dedicated SharePoint portal.

The Communications Strategy is being implemented in conjunction with the KB and data functions of the Hub, considering strategies and plans for Indigenous participation, data, and individual projects, in addition to the annual research plans and Hub's guiding 'Strategy, governance and operating model' document.

A range of activities, including the ongoing interaction and engagement with the Department and internal Hub stakeholders, in addition to a cycle of regular meetings to address ongoing and emerging activities, ensures high- and low-level support across the Hub.

It is expected that any knowledge products generated through the co-design phase will be made publicly available through the Hub website, and in accordance with the Hub Data Management strategy. The co-design process will identify detailed knowledge products to be delivered through RP2, and detailed data and information management plans will be developed for each of these.

Data management

The Hub's Data Management Strategy provides a framework for how the Hub and its researchers will achieve findable, accessible, interoperable and reusable (FAIR) research products for when project outputs and outcomes are produced. It is recognised that discipline-specific standards of data management apply, and researchers are required and expected to apply these standards wherever possible.

This data management function:

- guides data wrangling activities in the Hub, in particular outlining how the Hub will manage data at all stages of research
- ensures that FAIR principles are embedded in all Hub activities, and that Hub activities are consistent with the NESP data and information guidelines
- provides clarity on the activities of data wrangling actor(s) in the Hub.

For the SCaW Hub, data management is guided by several existing programs and platforms, including the Australian National Data Common (ARDC), Australian Urban Research Infrastructure Network (AURIN), and Research Data Alliance groups on data management, physical samples, and research data collections. In addition, the projects in this Hub would benefit from the Research Data Alliance recommendations on Data Management Plans (DMP).

The SCaW Hub brings through its members an experienced and knowledgeable data management team already embedded in the SCaW research community. Additional resources from the ARDC bring

standards, infrastructure knowledge and economies of scale. Data and information management planning is essential to achieve the successful delivery of open-access research.

A replacement for the Data Wrangler is yet to be appointed for the Hub and a process is underway to identify one.