POLE POSITION
5 cities poised to be Antarctic gateways

COOL BURNING
Indigenous fire management

A SUNBURNT COUNTRY
How Australian grasslands survive

FUTURE-MAKERS

ENVIRONMENT & SUSTAINABILITY

ROOM FOR GROWTH

Mega-greenhouse a fertile test-bed for horticulture research

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Stage 2: Supervised research project.

The degree involves two years full-time (or equivalent part-time) study.

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Aboriginal and Torres Strait Islander peoples should be aware that this publication may contain the images and names of people who have died.

ABOUT

Western Sydney University is a large, student-centred, research-led university, embracing Australia's global city, Sydney. Established in 1989, the University proudly traces its history to 1891 through the Hawkesbury Agricultural College. Today the University has more than 200,000 alumni, 45,000 students and 3,300 staff.

The University is now ranked in all major global university ranking systems, and is in the top 2% of universities worldwide. Through investment in its academic strengths and facilities, the University continues to build its profile as a research leader in Australia and is nurturing the next generation of researchers. Western Sydney University graduates go on to take up rewarding careers that make real contributions to societal change, lifting the pride of students, staff and the community.

A guiding principle for the University is that there is no limit to potential success for those with drive, talent, confidence and ambition.
westernsydney.edu.au

ON THE COVER

↗ Bringing agriculture indoors
page 10

Cover image:
© Daniel Boud

GREEN RESEARCH FOR A SUSTAINABLE FUTURE

Western Sydney University's campuses span Greater Sydney's metropolitan cities and its outer urban areas, and occupy the traditional lands of the Darug, Tharawal, Gandangara, Bundjalung and Wiradjuri peoples. Today, these campuses are thriving, living labs for innovation and collaboration through local, national and global research partnerships, motivated by the grand challenges of environmental change, including those defined in the United Nations' 2030 Sustainable Development Goals.

The University's innovative research in environment and sustainability focuses on sustaining and managing diverse urban, agricultural and natural systems; the governance and management of social-ecological systems for human wellbeing; and the long-term sustainability of construction, infrastructures and ecosystems.

The seven case studies presented in this special issue of *Future-Makers* provide a glimpse into Western's wide-ranging applied and interdisciplinary research projects. These projects both enhance Australia's environmental and sustainability research capacity and deliver outcomes relevant to government, industry and the communities of Western Sydney.

For example, our researchers are: exploring how plastic has transformed the way we live (page 6); explaining how recycling construction and demolition waste can reduce landfill (page 7); and collaborating with local indigenous experts to understand the benefits of controlled 'cool' burning of bushland in natural hazard management (page 8).

In our feature story on page 10, we discuss how our 1,700 m^2 glasshouse facility will contribute to the new Future Foods Co-operative Research Centre. In our second feature (page 14), we look closer at the work of ARC Laureate Fellow and Distinguished Professor, Belinda Medlyn, on grassland productivity in the context of a rapidly changing climate.

The two remaining case studies take us to Cambodia and Antarctica. In the first instance (page 13) to illustrate the significance of community economies in allowing people to adapt to dramatic seasonal climatic variations. The second case shows how five 'Antarctic gateway cities' are ascertaining a shared identity in connection to the Antarctic and working with government and industry to celebrate and protect this vital and fragile part of the planet (page 4).

These stories are a testament to the research excellence arising from the extraordinary work of Western Sydney University researchers who are tackling multidimensional problems and challenges taking place at an unprecedented scale and speed.

Professor Juan Salazar
Research Theme Champion

Associate Professor Sarah Zhang
Research Theme Champion

Dr Sebastian Pfautsch
Research Theme Fellow

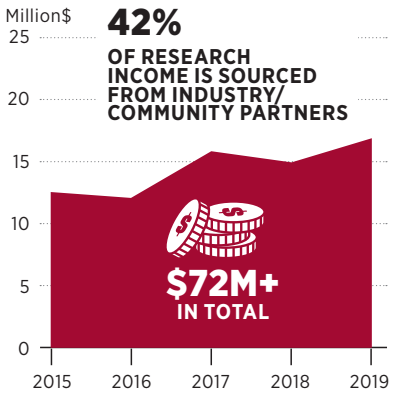
WESTERN SYDNEY UNIVERSITY IN NUMBERS

Located in Greater Western Sydney, one of the fastest growing regions in Australia, Western Sydney University is home to a vibrant and diverse community of staff and students.

ENVIRONMENT & SUSTAINABILITY

RESEARCH

RESEARCH INCOME



TOP PUBLICATION WITH HIGH ALTMETRIC SCORE

TITLE
Quantifying global soil carbon losses in response to warming

1020

AUTHORS
Yolima Carrillo, Peter Reich, Elise Pendall

PUBLISHED IN
Nature, November 2016

ENVIRONMENT & SUSTAINABILITY

2018 EXCELLENCE IN RESEARCH FOR AUSTRALIA DISCIPLINES ABOVE WORLD STANDARD

★★★★★

- Cultural Studies
- Ecological Applications
- Ecology
- Evolutionary Biology
- Forestry Sciences
- Microbiology
- Plant Biology
- Soil Sciences
- Zoology

★★★★

- Environmental Science and Management
- Materials Engineering
- Communication and Media Studies
- Human Geography
- Performing Arts and Creative Writing
- Sociology

RANKINGS

2020 Times Higher Education World University Rankings **TOP 2%**

THE WORLD UNIVERSITY RANKINGS 2020 YOUNG

36th in the THE Young University Rankings

THE IMPACT RANKINGS 2020 TOP 10

2nd in Australia
3rd in the world

NATIONAL RANKINGS FOR INDIVIDUAL SUSTAINABLE DEVELOPMENT GOALS

1st
- 6 Clean Water and Sanitation
- 14 Life Below Water
- 15 Life on Land

TOP 5 worldwide

2nd
- 5 Gender Equality
- 10 Reduced Inequalities
- 12 Responsible Consumption and Production
- 16 Peace, Justice and Strong Institutions
- 17 Partnerships

QS WORLD UNIVERSITY RANKINGS TOP 100 2020

Communication & Media Studies, Nursing, and Sociology

ACADEMIC RANKING OF WORLD UNIVERSITIES (ARWU) 2020

23rd Ecology

TOP 75 Agricultural Sciences, Automation and Control, Civil Engineering, and Nursing

2019 LEIDEN RANKINGS FOR RESEARCH COLLABORATION

80th in the world
3rd in Australia

11 SUSTAINABLE CITIES AND COMMUNITIES

CUSTODIANS OF THE ICE

At the southernmost reaches of the globe, five 'Antarctic cities' are discovering a shared identity in relation to a fragile frozen continent.

Western Sydney University is leading an initiative for five diverse cities to unite around one commonality: their ties to the Antarctic.

Five key cities surround Antarctica and are officially recognised as gateways to the ice continent: Christchurch (New Zealand), Puntas Arenas (Chile), Ushuaia (Argentina), Cape Town (South Africa), and Hobart, Australia. Professor Juan Francisco Salazar, of Western Sydney University's Institute for Culture and Society and the School of Humanities and Communication Arts, has led the Australian Research Council Linkage Project, Antarctic Cities and Global Commons, since 2017. The project team includes 15 researchers in five countries, and aims to unite these gateway cities as a Southern Ocean rim cooperative network of Antarctic urban hubs.

"We want to think of these five cities as more than thoroughfares on the way to Antarctica, rather as urban centres embodying the values of Antarctica — international co-operation, scientific innovation and environmental protection — as a custodianship network that can learn from and benefit each other," Salazar says.

Developing such a network is a twofold challenge. First, the initiative must strengthen each city's ties to the Antarctic on economic, ecological, political and cultural levels, and secondly their ties to each other, overcoming historic separation and rivalries.

In Hobart, Salazar's collaborator, Professor Elizabeth Leane, from the College of Arts, Law and Education, University of Tasmania, says magnifying each city's Antarctic ties will require a genuine cultural shift in the cities. "We're essentially

NEED TO KNOW

- Five southern hemisphere cities are gateways to the Antarctic.
- An ARC Linkage project team seeks to unite these cities into a cooperative network
- The cities' youth are being recruited to lead the initiative.

This research was supported by the Australian Government through the Australian Research Council.

"WE'RE ENCOURAGING PEOPLE TO THINK CAREFULLY ABOUT CULTURAL COMPONENTS."

creating a series of tools for the councils to use from this project. We're encouraging people who are connected with the Antarctic sector to think really carefully about cultural components," Leane says.

Bringing the cities together for a united purpose poses an array of obstacles. "On many occasions the cities chose to compete for scarce resources and international investments, rather than find ways to cooperate and share resources," says Salazar. A memorandum of understanding was signed in 2009 by city mayors requiring the cities to explore the benefits of collaborative best-practices for Antarctica. However, as Salazar notes, the substantive relationship between these cities remains tenuous. The project aims to address these issues, and the first step has been to engage young people.

Alongside an online, educational game *Antarctic Futures*, led by Associate Professor Liam Magee, simulating Antarctic policy decisions on a 50-year scale, an Antarctic Cities Youth Forum is also being launched. Through an expedition to Antarctica in February 2020, five exceptional young people from each city will travel to the frozen continent to develop the guidelines for a youth custodian network.

Juan Salazar, Project Leader of the ARC Linkage project Antarctic Cities and the Global Commons in Antarctica in February 2020 with the young leaders from the Antarctic Cities Youth Expedition representing Hobart, Christchurch, Cape Town, Ushuaia and Punta Arenas.

The initiative aims to recast these five cities from simply north-serving gateways at a far-flung periphery, into five capitals of a new united focus on the Antarctic. Together, they might then become true custodians of a fragile region, celebrating and stewarding this vital part of our planet.

ANTARCTICA
is nearly
TWICE
THE SIZE OF AUSTRALIA,
at 13,661,000 km²

The Australian Antarctic Territory spans
42% OF ANTARCTICA

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

FROM PLASTIC FANTASTIC TO A WASTE QUAGMIRE

Charting the history of plastic packaging can lead to new insights on how to manage it.

NEED TO KNOW

- Gay Hawkins is investigating the history of plastic packaging.
- The rise in plastic packaging transformed attitudes towards food and freshness.
- 'Naked' food needs to be normalised again to reduce waste.

From food packaging, to contact lenses and credit cards, plastic is used in almost every aspect of daily life. How did it become such a ubiquitous material in just a few decades?

Professor Gay Hawkins, director of engagement at Western Sydney University's Institute for Culture and Society, is investigating the history of plastic packaging and how it has transformed food production, markets and waste streams. Her insights can be used to develop better strategies for managing plastic waste and reducing our reliance on plastic packaging.

"Just like the Iron Age and Bronze Age, the 20th century can be thought of as the Plastics Age," says Hawkins. "It's the material that has defined our culture."

While most research on plastics focusses on unravelling its environmental impacts, Hawkins is exploring how plastic became a normal part of everyday life and the factors that shaped our reliance on it.

"Plastic has had an unbelievably profound impact on how we live, and our environment," says Hawkins. "I wanted to understand how it became so popular."

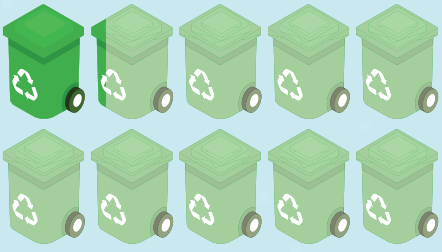
To trace the emergence of plastic over the last century, Hawkins delved into the history of the material and how it was promoted to the public. Before 1950, food was packaged in glass, cardboard, paper or metal. But the development of light and flexible thermoplastics — plastics that can be moulded using heat — heralded a new era of food products. Fresh fruit and vegetables were covered in cling wrap on polystyrene trays, coffee was served in Styrofoam cups and polyethylene bottles replaced cartons of milk.

With the advent of plastic packaging came various tactics to convince the public of its virtues and life-changing uses. In post-World War II Australia, Hawkins says that the transition to plastic was driven by promotional material from the fast-growing plastics industry.

Ads and articles in newspapers and women's magazines touted plastic as a new 'miracle' material. Cling wrap promised to keep food fresh, and frozen goods sealed in plastic packaging were promoted as convenient and economical.

Plastic industry newsletters also began landing on the desks of executives of food production

IN 2016-17, ONLY ABOUT 12% OF WASTE PLASTIC was recycled in Australia



(Source: National Waste Report 2018, Department of the Environment and Energy)

"IT COMPLETELY CHANGED OUR PERCEPTIONS OF FOOD, FRESHNESS AND CLEANLINESS."

This research was supported by the Australian Government through the Australian Research Council.

and packaging companies. They promoted plastic as a superior industrial material that would open new pathways for circulating goods.

"It completely changed our perceptions of food, freshness and cleanliness," says Hawkins. "People thought food was better and safer in plastic, but it also changed how we managed waste."

But not everyone was sold on the idea of plastic-wrapped cheese sticks and frozen peas. A 1972 article in *The Canberra Times* titled 'Women Drop Wraps' revealed that a group of women unwrapped their newly bought groceries and dumped the packaging in front of the supermarket in protest.

The article reported that the demonstration aimed to educate people about unnecessary and polluting packaging and to offer alternatives to carting home huge quantities of plastic and cardboard packaging with the weekly shopping.

While plastic remains pervasive in daily life, efforts to reduce its detrimental impacts have gained momentum in recent years, from supermarkets banning single-use plastic bags, to popularising reusable coffee cups.

Hawkins points out that removing plastic isn't the only work to be done to tackle wasteful habits. Just as the public became accustomed to throwing plastic packaging away decades ago, there is a need to normalise 'naked' foods once again.

"It's a matter of reconfiguring cultural attitudes so that people aren't disturbed by the absence of plastic," says Hawkins.

13 CLIMATE ACTION

MAKING CONCRETE CHANGE

Recycling construction and demolition waste to reduce the amount going to landfill.

Demolition of apartments in Hong Kong inspired reuse of concrete waste.

© subtik/E+/Getty Images

In Australia, more than a third of all the 54 million tonnes of waste generated each year comes from the construction and demolition sector. Much goes directly to landfill. Even when it is recycled, it is usually into low-grade applications such as road-base. Professor Vivian Tam from the School of Built Environment at Western Sydney University has an idea that could help reduce construction waste.

"It was when I was living in Hong Kong, where all the buildings are high-rise, that I thought about all the material going to landfill when they are demolished. I thought it's a better option if we can reuse the material and save the landfill space," says Tam.

Concrete, a mix of rubble, cement and water, is an extremely versatile material. Tam and her colleague, Associate Professor Khoa Le from Western's School of Engineering, have developed a method to use carbon dioxide to strengthen recycled concrete aggregate. The resulting product is as strong, but cheaper than virgin concrete, and up to 29% stronger than normal recycled concrete, when tested using the Australian Standard AS1012.

Tam puts commercially available crushed recycled concrete into a pressure chamber and injects 99.9% pure carbon dioxide. This forces the calcium hydroxide in the aggregate to undergo a chemical change into calcium carbonate, "which is a good thing for concrete," says Tam. It's an accelerated version of the curing reaction that usually takes place over the lifetime of concrete.

She's not the only researcher exploring the idea, but with commercial partner Volumetric Concrete Australia, she's had some success in pouring test concrete slabs. A year later, the slabs are showing no signs of cracking or shifting and strength-test results are all clear. She believes her process delivers better economic and practical benefits compared to existing solutions and hopes that her spin-off company Ecobond will find investors as a result.

If adopted widely she says the technique could easily displace some of the 24 million cubic metres of virgin concrete used in Australia each year.

NEED TO KNOW

- Much of the waste from construction and demolition goes to landfill.
- Concrete waste is usually recycled for low-grade applications.
- Western researchers have devised a way to strengthen recycled concrete aggregate using carbon dioxide.

This research was supported by the Australian Government through the Australian Research Council.

A COOL APPROACH TO LAND MANAGEMENT

Researchers are collaborating with Indigenous people to understand the benefits of controlled 'cool' burning of bushland in natural hazard management.

Aboriginal and Torres Strait Islander peoples should be aware that this story contains the images and names of people who have passed away.

With unprecedented bushfires raging across southeastern Australia in the summer of 2019/20, Australians are all too aware of the continent's intrinsic relationship with fire. Western Sydney University researcher, Dr Jessica Weir is documenting the cultural practices and intimate knowledge that Australian Aboriginal people have with fire in order to gain a better understanding of how to manage bushfires.

Weir has learned from her collaborative work that many Aboriginal people involved in land management engage with fire differently. Fire is understood to be central to living with and respecting Country.

Australia has always had large destructive bushfires, and for tens of thousands of years Aboriginal people have used 'cool burns' to mitigate their impact, as well as to assist plant growth, hunting, protecting species, and accessing areas.

Cool burns are distinct from prescribed burns, in that fires are lit not just for hazard reduction; a range of ecological and cultural considerations go into the choice of where, when and how to set the fire. These fires don't destroy tree canopies, wildlife have time to escape, and by reducing fuel loads they can also protect lives and property from destructive 'hot burn' bushfires.

Working with fire on these terms can have local, regional and national benefits as a way to mitigate bushfire risk, create social-ecological spaces, and support Indigenous cultural practices and land management, including support for Indigenous rangers and firefighters.

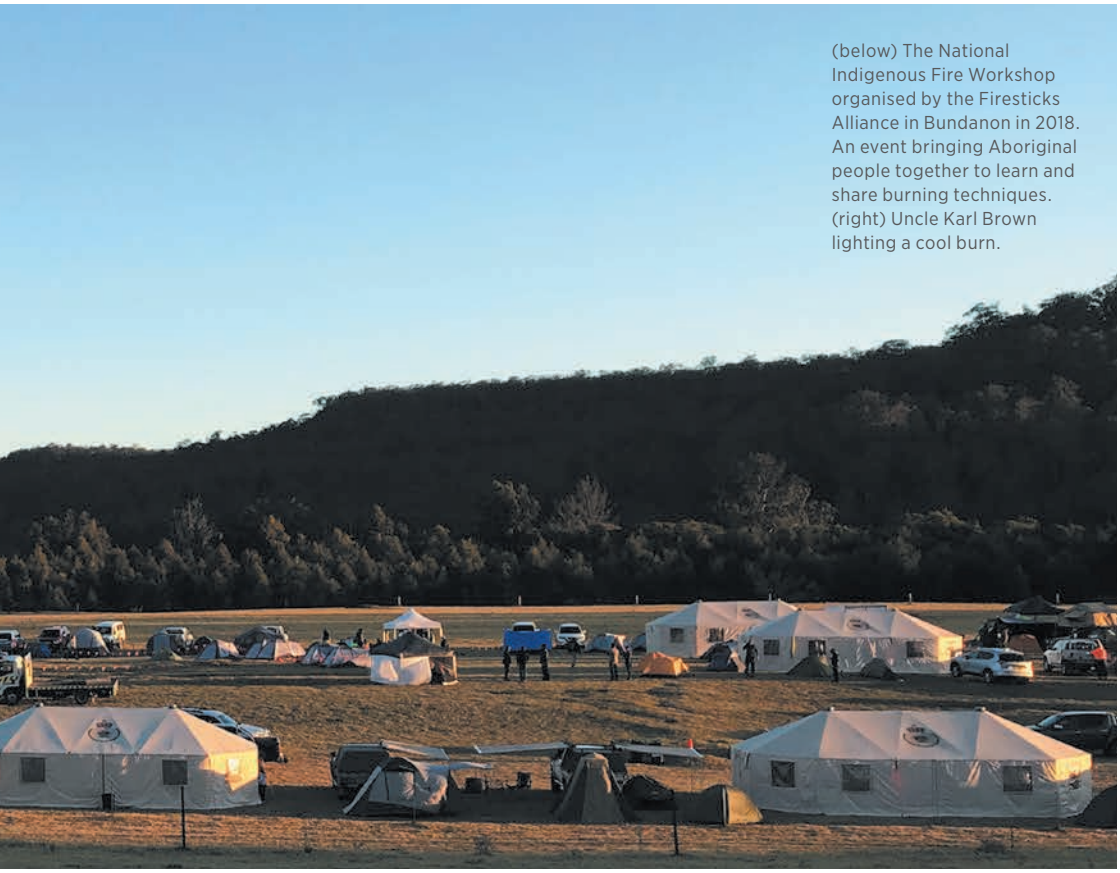
NEED TO KNOW

- Cool burns have been practised by Indigenous people for tens of thousands of years.
- The Bushfire and Natural Hazards CRC is investigating the relationships between hazards, culture, and Indigenous communities.

However, carrying out cool burns presents many challenges, due to historical and contemporary land justice issues, and many conflicting interests vying for a stake in land management, from timber, to farmland, to mining.

"We're very good at debating the science involved in land management, but we need to involve more research about our values, and that's what we're doing at the Institute for Culture and Society. We're looking at what society thinks is normal and appropriate in bushfire risk mitigation," says Weir.

Weir is co-leading a research project with Deakin University, with funding from the Bushfire and Natural Hazards Cooperative Research Centre, that examines the relationship



(below) The National Indigenous Fire Workshop organised by the Firesticks Alliance in Bundanon in 2018. An event bringing Aboriginal people together to learn and share burning techniques. (right) Uncle Karl Brown lighting a cool burn.

COOL VS PRESCRIBED BURNS

The difference between cool burns, and prescribed or controlled burns is the intention and who is setting the fires. Cool or cultural burns are done by Indigenous people for a multitude of reasons including food, access and reduced bushfire risk; whereas hazard reduction burns are intended to reduce risk to properties and lives. Both require permission from relevant fire agencies.

between hazards, culture, and Indigenous communities.

One of several places where cool burns are influencing the fire sector is the Australian Capital Territory, where the ACT Parks and Conservation Service staff carry out a cultural burning program centred on learning from cool burns. "It's about changing industry practices in the ACT," says Weir.

In the ACT Parks and Conservation Service program, the Ngunnawal people, the traditional custodians of Canberra, identify priority areas and then a *Ween Bidja* (fire boss) lights the fire. "We call them 'the fire boss' because we are in control of the fire, it is not in control of us. Fire is a tool," says Dean Freeman, a Wiradjuri man and Aboriginal Fire Officer from the ACT Parks and Conservation Service.

"You can imagine it was very exciting when we got an elder, Uncle Karl Brown, to light the first match in Canberra in an area which hadn't been lit for 200 years. We are bringing our ancient techniques into the modern world. We also use it to protect our own cultural sites," says Freeman.

"It's extraordinary because it's a community of practice. Indigenous and non-Indigenous fireys working on risk-mitigation together," says Weir.

Weir's qualitative research involves interviewing Indigenous and non-Indigenous government staff involved in the burns and tracking their different assumptions, knowledge and practices they bring to fire management.

In public debates it is sometimes assumed that Aboriginal fire management and other traditions are set in the past and irrelevant to modern Australia. The interviews have revealed further understanding, that these are living traditions, always adapted to contemporary contexts, including bringing in new techniques and new knowledge. "This is a critical gear change in our maturity as a nation," adds Weir.

Weir is exploring how reinstating cultural burning in Canberra can support Indigenous peoples' cultural practices. "It's an opportunity to showcase Indigenous peoples' authority and care with respect to fire and the land." The work has also revealed that if traditional owners are to lead their own fire management, a much greater sharing of land management resources is required.

As part of the project, Weir and Freeman travelled to southern Western Australia to participate in a knowledge exchange on fire management with Indigenous groups there. "We've networked with groups doing similar practices across southern Australia, as well as learning from the north. It's about a nation healing itself through developing a community of practice. There's still a long way to go yet.

"Ultimately, it's about continuing to respectfully learn from each other about how to live best in Australia, and how to manage bushfire risk — which is only increasing."

This research was funded by the Bushfire and Natural Hazards Cooperative Research Centre.

Chenchen Zhao (front) and Chelsea Maier (background) examining eggplants in Western's glasshouse.

This research was funded by Horticulture Innovation Australia and supported by the Future Food Systems Cooperative Research Centre. © Daniel Boud

2 ZERO HUNGER

BRINGING AGRICULTURE INDOORS

Australian-led advancements in indoor cropping technologies provide hope for an increasingly strained agriculture sector.

As Australia's climate becomes more volatile and protracted droughts and extreme floods undermine the reliability of food production, Western Sydney University researchers have embarked on an ambitious protected cropping initiative to lay the groundwork for the future of agriculture.

Distinguished Professor David Tissue's group at Western's Hawkesbury Institute for the Environment is investigating how plants might respond to a changing climate, including variations in carbon dioxide levels, temperature, water and nutrient availability, and extreme climate events, in order to develop technologies that could help improve productivity in an increasingly uncertain future.

"Historically, the Australian environment has been highly variable, but climate change has increased that variability, leading to much higher temperatures and greater intensity of extreme climate events, including heatwaves, droughts and floods," says Tissue. "These environmental challenges and a rapidly increasing population demand action to provide food security. Protected cropping is one solution for horticultural crops."

While conventional cropping is vulnerable to the elements, indoor or protected cropping allows food growers to control all aspects of the crop's environment and manage resources such as water and nutrients in a more systematic way. This can dramatically improve yields

NEED TO KNOW

- The future of food production may lie in protected cropping.
- The Hawkesbury Institute for the Environment has opened a 1,700 m² greenhouse to investigate ways to optimise food production.
- Photovoltaic 'smart glass' may help reduce a greenhouse's energy costs.

(Left to right) Chelsea Maier, Chenchen Zhou, Yagiz Alagoz, Norbert Klause and Xin He.

and reliability, but comes at a significant increase in cost.

One of the technologies that Tissue's team is investigating is transparent solar cells or 'smart glass' for glasshouses. "The idea is that innovative smart glass technologies and films can reduce the heat load inside a glasshouse and so reduce energy costs, while maintaining or improving crop productivity and quality with reduced water and nutrient use and the possibility of renewable energy generation," says Tissue.

In 2017, with the support of the industry research and development agency Horticulture Innovation Australia (HIA), the Hawkesbury Institute for the Environment commissioned the National Vegetable Protected Cropping Centre (NVPCC) — a huge, 1,700 m^2 research glasshouse with eight rooms that can be independently controlled to adjust environmental parameters such as carbon dioxide level and temperature. It also provided an ideal structure for the trial of smart glass technologies.

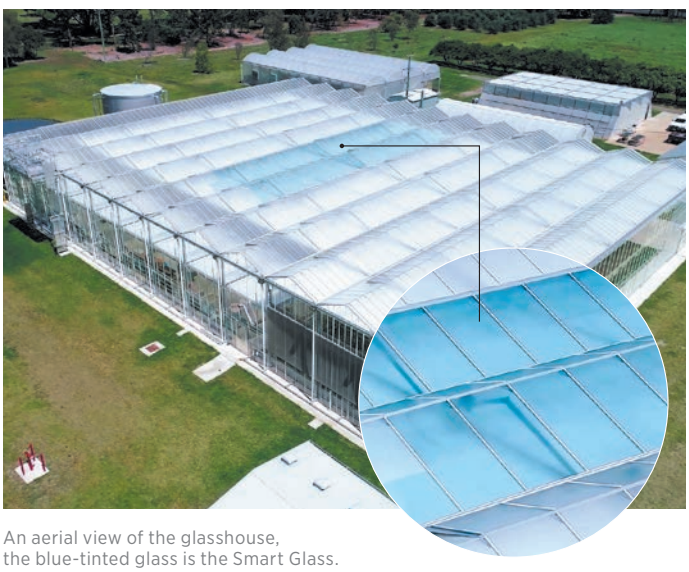
"We found that while the smart glass reduced energy use inside the glasshouse, it also reduced overall light intensity and some wavelengths of light, including red light which is important for photosynthesis," says Tissue. "Two plant varieties, eggplants and capsicum, were tested inside the smart glass," says Dr Chenchen Zhao, a postdoctoral fellow in Tissue's lab. "The larger fruit, eggplants, had a decreased crop yield, compared to the smaller fruit, capsicum, which were not affected as much in terms of crop yield in the smart glasshouse."

"The reduction in light led to reduced carbon availability and subsequently reduced crop production, although it also led to lower nutrient and water use," explains Tissue. "Importantly, we identified the limitations to the current smart glass specifications and have developed some ways to improve it."

"The research group is working toward developing a film that will reduce wavelengths of light unnecessary for plant development while allowing full transmission of wavelengths that are," says Chelsea Maier, the glasshouse's facility co-ordinator.

Research developed at the NVPCC will inform the research that will be carried out by the newly established Future Food Systems Cooperative Research Centre (CRC) at Western Sydney University in collaboration with the University of New South Wales and other institutions nationwide.

"Through the substantial support of HIA and, soon, the Future Food Systems CRC, we have been able to address many of our main objectives by involving technicians, PhD students, and post-doctoral researchers in the research, and developing new technical solutions to maximise food production while minimising resource use and costs," says Tissue. "We plan to expand on our significant progress on the smart glass project through Western's role in the CRC, where we can further modify the technology to provide even greater benefit to crop production by leveraging greater technical capacity including robotics and hyperspectral cameras."



An aerial view of the glasshouse, the blue-tinted glass is the Smart Glass.

(top left) © Daniel Boud

11 SUSTAINABLE CITIES AND COMMUNITIES

A BRIDGE TO THE FUTURE

An experimental geographical study captures the traditional socioeconomic fabric of monsoonal Asia as a lens for the future.

This research was supported by the Australian Government through the Australian Research Council.

Built every year for more than half a century, and dismantled before the annual floods, a 1.5-kilometre bamboo bridge spanning the mighty Mekong River between the rural island of Koh Paen and the booming city of Kampong Cham in Cambodia epitomises the ingenuity and resourcefulness of local communities. In 2017, the bamboo bridge was rebuilt for the last time, replaced by a permanent concrete bridge. Progress had come, and with it an end to a generations-long tradition and all its cultural, social and economic significance.

Capturing, understanding and gaining insight from these fading traditions is the focus of the work of economic geographer, Professor Katherine Gibson, at Western Sydney University's Institute for Culture and Society.

"This research fits within the broader agenda of the Community Economies Research Network, which is an international network of researchers, activists, artists, and others who are interested in new and different types of economies and building more ethical economic and ecological relationships," says Gibson.

"People living in Monsoon Asia have developed ways of adjusting to dramatic seasonal climatic variations," she says. "They also practice forms of mutual support that share workloads, mitigate against risk and distribute wellbeing across the community. "Although urbanisation and the modernisation of agriculture has destroyed some knowledge of these practices of resilience, our research shows that there is still much that can be documented."

She says these ways of working are unusual in an Australian context, but could provide lessons at home. "In the area of disaster preparedness and response, keeping diverse community economic practices alive can be crucial. For example, traditional ways of preserving food, collectively repairing buildings, saving and sharing finances, these are strategies that come to the fore in the aftermath of severe climate events that cut off communications and leave paths of destruction."

By collaboratively working with scholars in Australia and Asia, Gibson has documented current community economic practices in a multi-authored article published in the journal *Asia-Pacific Viewpoint*. She also produced a documentary called *The Bamboo Bridge*, written and directed by anthropologist and filmmaker Juan Francisco Salazar, also a Professor at the Institute for Culture and Society, which premiered in October 2019 at the Antenna Documentary Film Festival in Sydney and went on to screen internationally at several film festivals, and academic and community events in 2020.

NEED TO KNOW

- For more than 50 years, a bamboo bridge was rebuilt every year in Cambodia due to annual floods.
- The bridge was replaced by a permanent concrete bridge in 2017.
- Western researchers produced a documentary about this called *The Bamboo Bridge*.

© Credit

15 LIFE ON LAND

LEAVES OF GRASS

A study into why grass turns brown and what it means for grassland productivity is vital to Australian ecosystems and industry.

Belinda Medlyn at Western's Hawkesbury Institute for the Environment.

The prickly crunch of dry, brown grass is a familiar sensation in the Australian summer. But despite its ubiquity, little is known about when and why grass turns brown, and what it means for Australia's extensive grasslands in a changing climate.

ARC Georgina Sweet Australian Laureate Fellow, Distinguished Professor Belinda Medlyn and colleagues at Western Sydney University are embarking on an Australian Research Council Discovery Project to answer key questions about how grasslands respond to changes in temperature and rainfall, and what implications that has for the carbon they store in the soil.

Grasslands make up around 40% of the planet's terrestrial surface; from the vast prairies of North America, and the wind-swept steppes of Eurasia, to the pampas of South America and savannahs of northern Australia.

They're also vital for cattle farming. "There's a lot of interest around how to maintain pasture grasses during hot and dry periods, what kinds of pasture grasses, what will be able to survive and continue to perform when we have hotter and drier conditions," Medlyn says. "The grasslands are really interesting ecosystems, valuable in their own right, but they also support a huge industry."

The project was inspired by research conducted in the North American grasslands of Wyoming, which looked at the effect of increasing carbon dioxide levels and heating on the grass. Several vegetation models were applied to try and predict the responses in this experiment, but Medlyn says the models didn't adequately capture the impact of the grasses browning-off as the soil started to dry out. The probable reason was that a lot of models of the effects of carbon dioxide levels, temperature increases, and rainfall decreases, were originally developed for forests, which don't brown-off in the same way that grass does.

Browning of grass in dry conditions means that the grass isn't photosynthesising and therefore won't be capturing carbon or producing new grass. "If you're trying to predict how much productivity you have in a grassland, you need to be able to predict that browning process," Medlyn says.

Medlyn and her group are deploying devices known as 'phenocams', which are essentially time-lapse cameras that record changes in the grass colour over time. "By looking at those images, we get much more information about what's going on with the grasses than if we would just go and measure what had happened once a year."

The project also involves field and glasshouse experiments using technologies that enable researchers to subject grasses to different concentrations of carbon dioxide, and levels of heat and water to see how they respond over time.

NEED TO KNOW

- Grasslands are important components of Australia's ecosystem,
- Belinda Medlyn and colleagues are studying why and how grass browns.
- Researchers are collecting targeted data sets to develop and test model representations of key processes.

WHAT LIES BENEATH

One key challenge with grasslands is that so much happens below the surface, says Professor Elise Pendall, a soil ecologist and one of the four Western researchers leading the project.

This research was supported by the Australian Government through the Australian Research Council.

"In grasslands, roots make up around 75% of the biomass," Pendall says. Grass growth crowns sit right at the soil surface, with the leaves growing upwards from them, and the roots extending down. Study often involves digging pits to extract the entire plant and root systems. If that isn't possible, researchers take soil cores so they can extract the roots and measure factors such as biomass, respiration rates, carbon content and nutrient content.

Roots are vital for grass's survival during hotter, drier conditions, Pendall says. "They can get thicker when it gets warmer, and that might be to reduce water loss, but we want to know if that compromises their ability to absorb water."

One of Medlyn's post-doctoral researchers, Dr Jinyan Yang, is developing a model that will pull together all the information gathered in the project, and which can be used to predict grassland productivity, greening and browning under different climatic conditions.

"Then, you can start exploring different species and figure out what kinds of species might be able to cope best with different climatic conditions," Medlyn says.

She points out that many Australian grasslands, particularly in the country's interior are already well adapted to hot, dry conditions.

"Part of our work is really looking at how those grasses managed to survive during those hot dry conditions, what traits enable them to keep going during those dry periods," she says.

Pendall gives the example of a project in Tasmania, which compared soil carbon storage underneath kangaroo grass and wallaby grass. Kangaroo grass sequestered much more carbon, and this sequestration was shown to be fairly resilient to modelled climate change conditions.

In addition to storing carbon, grasslands also play an important role in stabilising Australia's fragile soils and preventing erosion. The deepening drought in central Australia is contributing to a loss of grasslands that is, in turn, enabling larger and more regular dust storms.

In all, the work is feeding into a bigger research project; Medlyn's ARC Laureate Fellowship-supported efforts to model Australian vegetation as a whole, from forests to woodlands to grasslands.

RESEARCH FOR A BETTER FUTURE

KYLIE BUDGE
Research Theme Fellow - Urban Living Futures and Society

SEBASTIAN PFAUTSCH
Research Theme Fellow - Environment and Sustainability

LYN TIEU
Research Theme Fellow - Education and Work

JENNIFER MACRITCHIE
Research Theme Fellow - Health and Wellbeing

Western Sydney University Research Theme Fellows discuss their work's impact.

Dr Kylie Budge, a creative arts researcher, Dr Lyn Tieu, a linguist, Dr Jennifer MacRitchie, a cognitive scientist, and Dr Sebastian Pfautsch, a tree physiologist, are among Western Sydney University's best and brightest academics. Their work is helping to shape a greener, smarter, healthier, inclusive, and creative future. These researchers recently came together to share their thoughts on their work's potential for creating impact in the world.

FUTURE COMMUNICATORS

Linguistics wasn't at the front of Lyn Tieu's mind when she began her university studies, but she quickly became fascinated by what the scientific study of language could reveal about society. Her work focuses on how children acquire meaning, and how they interpret a particular feature of language called linguistic inferences — the messages we sometimes don't even realise we're conveying through our choice of words and phrasing.

For example, the sentence 'girls are as good as boys at maths' seems to be an equitable statement. But Tieu, Research Theme Fellow in Education and Work, says some studies have shown that the implicit inference that comes from the way that statement is ordered is that girls are not as naturally gifted as boys are at maths. "So if teachers are saying things that convey additional messages beyond what they're attempting to convey, that could have an impact on how children are interpreting the content that we're delivering," she says.

In seeking to understand how children interpret these linguistic inferences, Tieu is hoping her research can help "bridge that gap between our scientific understanding and children's actual educational experiences."

> "POLICY-MAKERS AND GOVERNMENTS SOMETIMES PRESUME THAT SOMEHOW INNOVATION OCCURS IN AN ABSTRACT VACUUM."

She also believes that linguistics has much to offer in terms of moving society towards greater equality, because it recognises that all languages are equal. "Prescriptive authorities will have you believe that there is some standard version of a language that you must attain, but the danger with that is that people then use that to create prejudices, to marginalise," she says. "In linguistics we learn that that's not true — different languages and dialects are equally important and valid, and can offer rich insights into the mind. If linguistics could actually be taught earlier in the curriculum, not only would you get the scientific benefit of learning about scientific inquiry and hypothesis testing through linguistic studies, it could actually change attitudes."

FUTURE SPACES

Changing attitudes is something that Kylie Budge is working hard to do in the creative arts field; in particular, antagonism towards selfies and Instagram culture in museums.

"People like myself are arguing there is some kind of benefit to this Instagram culture because it's a platform where people can creatively express their experience, their engagement with the space, and with the artefacts that are on display," says Budge, Research Theme Fellow in Urban Living Futures and Society. "It's a way to upend the power balance that has perhaps existed for too long, where museums have told people what they should think, what they should look at and how they should think about certain exhibits or space."

"There are still a lot of people who won't go to a museum or gallery, and feel like that's not a place for them," says Budge. But she argues that allowing digital expression in these traditionally non-digital spaces can open these spaces up to new audiences who might otherwise not experience them.

Another area where attitudes are changing, but not always for the better, is around the concept of maker spaces. These communal spaces with shared equipment are popping up in cities around the world – and particularly in China, where they are viewed as hothouses of creativity and innovation.

There is growing awareness of the importance that these spaces have in encouraging innovation. "These are about participating, making, and contributing to society, rather than just consuming."

"I think policy-makers and governments sometimes presume that somehow innovation occurs in an abstract vacuum," Budge says. "Different support mechanisms and spaces need to be provided and created to allow innovation to flourish. It doesn't just happen."

Creativity and divergent thinking are nourished in maker spaces, but the spaces themselves need protection and support. Australia has a few maker spaces — one of the most well-known in Sydney is in light industrial estate land in Marrickville — but, many are under threat from development pressure. Budge hopes that her work will contribute towards greater understanding and appreciation of and access to these spaces in Australian cities, particularly outside metropolitan regions.

FUTURE CREATIVITY

Music is a familiar expression of creativity, but Dr Jennifer MacRitchie, Research Theme Fellow in Health and Wellbeing, believes it also could have significant health and wellbeing benefits, particularly in the elderly. Having studied electrical engineering and music, she was working on motion capture technology to study the movement of pianists' fingers when she became interested in the processes by which we acquire musical skills.

"PLAYING A MUSICAL INSTRUMENT IS SUCH A BENEFICIAL TASK FOR YOUR BRAIN, SO WE STARTED WONDERING, WHY IS IT NOT SOMETHING MORE PEOPLE CAN HAVE ACCESS TO AND BENEFIT FROM?"

"Your brain has to process symbols on a page if you're reading music notation, decide on an action, a set of fine-motor commands that you use to manipulate the musical instrument, listen to the sound being produced, and then refine the next set of actions accordingly and you're doing that at such minute time scales," she says. "Playing a musical instrument is such a beneficial task for your brain, so we started wondering, why is it not something more people can have access to and benefit from."

It has long been established that these skills have to be acquired early in life, but MacRitchie and her colleagues have recently published research results that show that the elderly are just as capable of taking up music for the first time, and there are significant benefits in doing that.

But some older people can face additional challenges in learning music; for example, having restricted movement due to stroke or arthritis, or cognitive decline experienced as part of dementia. Practical and economic concerns to accessing a musical instrument may be enough to put off potential learners. This is another area where technology is breaking down barriers; MacRitchie gives the example of new musical interfaces that can be used on an iPad.

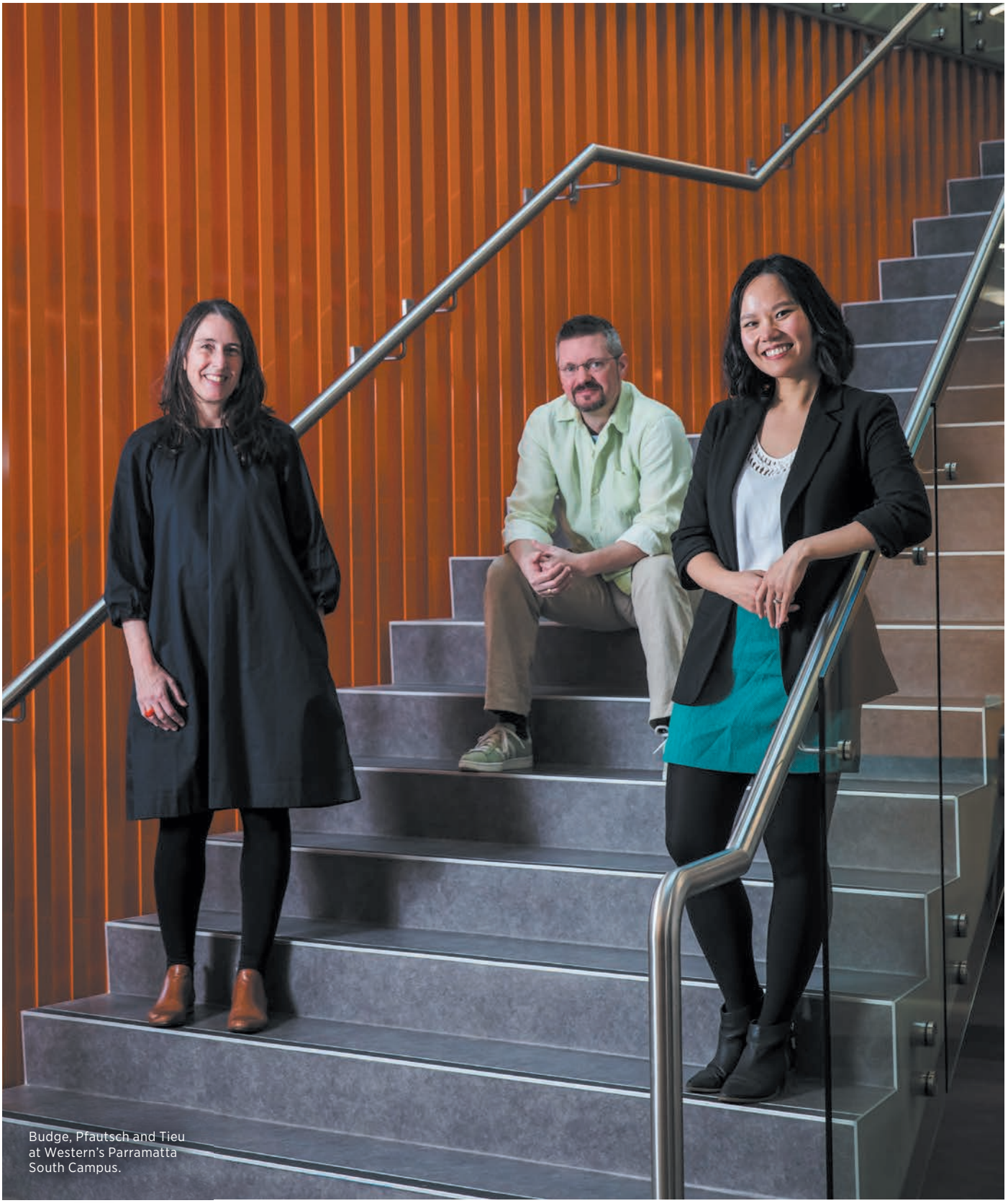
"A lot of my research is trying to devise ways to reduce some of those cognitive and physical barriers in learning to play a musical instrument so that we've got more people having access to musical activities and getting the optimal benefits for their wellbeing."

Researchers are still getting to grips with the extent of these benefits, because until now much of the work has focused on people with a lifetime of musical experience, not on those who are taking it up later in life. While there are likely to be physical and cognitive benefits, MacRitchie is also interested in the emotional and social benefits. "By doing a lot of group musical activities, you're giving people avenues to share something together and identify as part of a group," she says. "That helps reduce loneliness, for which older adults tend to be at risk."

FUTURE CITIES

The elderly, immobile and very young are more vulnerable than most to the effects of heat, and that's where Dr Sebastian Pfautsch's research comes in. As Research Theme Fellow in Environment and Sustainability, he's looking at how urban green

Music could have positive cognitive benefits in the elderly.



Budge, Pfautsch and Tieu at Western's Parramatta South Campus.

(left to right) Kylie Budge, Sebastian Pfautsch, Lyn Tieu, and panel moderator Bianca Nogrady at the Research Theme Fellow Panel.

infrastructure could help address the growing issue of urban heat.

Urban green infrastructure describes anything green in an urban space; from the grass, shrubs and trees along roads and in parks, to living walls and rooftop gardens. It's increasingly recognised that urban green infrastructure plays a vital role in cooling the urban environment.

Pfautsch and colleagues deployed temperature data loggers across several western Sydney councils, and found that a street with just 10% canopy cover experienced 12 days above 40°C in summer, while a street with 30% canopy cover had fewer than half that — experiencing just five days of summer above 40 degrees. "It's a huge difference that not only impacts the wellbeing of people living in tree-lined streets but also impacts power consumption for air conditioning in their houses," he says. "You have add-on effects once you start increasing urban canopy, where you reduce heat and energy bills in households."

But there are other benefits to increasing urban green infrastructure, Pfautsch says. "While green infrastructure helps make cities liveable, it also has benefits in biodiversity, liveability, public health, and even helps with reducing crime, and increasing property values," he says.

The challenge is how, where and what to plant to best combat the urban heat island effect combined with the climate crisis that is already seeing temperatures in Australia's major cities approach dangerous levels during summer months. But there's only so much that urban green infrastructure can do.

"If western Sydney gets hit by a heatwave, trees won't help cooling these very hot air masses, especially if they have no access to water that supports transpiration," he says. "We have to look at other ways to cope with these new conditions of repeated heat waves and low rainfalls. We're exploring how thermal benefits can be generated by different surface materials and colours used in urban design."

Pfautsch hopes his work can help guide local and state governments towards creating more liveable cities in the face of a heating climate. "We urgently need to expand green infrastructure, but we have to be smart about it if we want maximum cooling benefits in times of rapid urbanisation and a heating climate."

CENTRES OF DISCOVERY

Western Sydney University campuses are situated in locations throughout Greater Western Sydney.

Further information can be found here: **westernsydney.edu.au/future/our-campuses.html**

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