MONASH University

NET ZERO PRECINCTS

Stage 1: Orienting

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May 2023

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RESEARCH LAB

Acknowledgements

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Published by

Monash Sustainable Development Institute
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Photography and participant materials

All images in this report come from our research and portray those participants who agreed that their images may be shown in publications. All names, quotes and images are used with participants' consent, in accordance with our human ethics procedures. Monash University Human Research Ethics Approval #27723.

Suggested citation

Sharp, D., Quilty, E., Pink, S., Farrelly, M., Rye, S., & Raven, R. (2023). *Net Zero Precincts Stage 1 report: Orienting.* Monash University, Melbourne, Australia. https://doi.org/10.26180/22827113

Acknowledgement of Country

We wish to acknowledge the people of the Kulin nation on whose land we work. We pay our respects to their Elders, past and present and extend this to all Aboriginal and Torres Strait Islander People.

Funding acknowledgement

The research was funded by the Australian Government through the Australian Research Council's Linkage Projects funding Scheme ('Net Zero Precincts: an interdisciplinary approach to decarbonising cities' project number LP200100296) in partnership with Monash University, ENGIE, City of Monash, ICLEI Oceania, CSIRO, City of Greater Dandenong, Energy Efficiency Council and Swinburne University.

Cover image: Emma Quilty
Sculpture artist: Stuart Ringholt

Participant acknowledgement

We gratefully acknowledge the contribution of our research participants.

Chief Investigator acknowledgement

We would like to thank Chief Investigators Prof Rob Raven, Prof Sarah Pink, Assoc Prof Megan Farrelly, Prof Geoff Webb, Prof Ariel Liebman, Assoc Prof Selby Coxon and Assoc Prof Peter Graham.

Advisory Group acknowledgement

We would like to thank the members of the Advisory Group for their advice and feedback: Anna Quillinan (ENGIE), Trish McGee (City of Monash), Steve Gawler (ICLEI Oceania), Guy Barnett (CSIRO), Jody Bosman (City of Greater Dandenong), Luke Menzel (Energy Efficiency Council), Peter Newton (Swinburne University), Graham Currie (Monash University), Margot Delafoulhouze (Climateworks Centre), Vanessa Campbell (Suburban Rail Loop Authority), Mariella Smids (Monash University) and Hade Dorst (TNO Netherlands).

Partner acknowledgment

We gratefully acknowledge our partner organisations for their time and contribution, with special thanks to Anna Quillinan, Jonas Pigeon and Mures Zarea from ENGIE.

How to read this report

If you want to know the key findings from this report and you don't have much time, start with the **Summary (page 4).**

If you are after details about the project's aims and objectives, the two disciplines we are trying to bring together (transition management and design anthropology), then head to **Chapter 1 (page 11).**

If you want to get straight into the practicalities of how we did the research, how we found our participants and the methodologies we based our techniques on, head over to **Chapter 2 (page 15).**

If you want to understand the place-based context of our work with a discussion of the precinct and key institutional actors, start with **Chapter 3 (page 18).**

If you want to jump straight to the findings from the interviews with frontrunners, the drivers and barriers, and the diverse framings of net-zero transitions at precinct scale, check out **Chapter 4 (page 22).**

Bringing together transition management and design anthropology is not without its challenges; **Chapter 5 (page 31)** details the complications and possibilities that we see emerging from our interdisciplinary approach.

The remaining chapters are all based on the ethnographic research we conducted, mostly through video-recorded walking interviews. We have organised them according to four domains: energy, mobility, buildings, and data and automation.

If you are interested in the ethnographic findings on energy, check out **Chapter 6 (page 40).**

If you are interested in the ethnographic findings on mobilities, check out **Chapter 7 (page 50).**

If you are interested in the ethnographic findings on buildings, check out **Chapter 8 (page 68).**

If you are interested in the ethnographic findings on data and automation, check out **Chapter 9 (page 81).**

Summary

Net Zero Precincts is a four year Australian Research Council (ARC) Linkage project that brings together two key areas of research for the first time — transition management and design anthropology — to develop a new interdisciplinary approach to transitioning urban environments to net zero. The project uses the Monash University Clayton Campus and Monash Technology Precinct as an action-oriented Living Lab to experiment, test and learn in a real-world setting.

The project aims to validate an approach for net-zero transitions that can deliver for the real-life experiences of the precinct community and its businesses, government, knowledge sector and civil society actors. It can also provide significant benefits to our Linkage partners and other stakeholders seeking to enhance community engagement for accelerating urban transitions. This report summarises the research findings from Stage 1 of the project based on over 50 interviews with participants living, working, commuting or connected to the Monash University Clayton Campus and the surrounding precinct.

Research process

The research was conducted using qualitative social science research methods. Interviews were undertaken with 25 frontrunners with an interest in net-zero transitions that included Monash University staff and students, local and state government, and people from the SME, corporate, NGO and social enterprise sectors. Walking interviews using video ethnography took place with 29 everyday precinct community members including, staff, students, residents and visitors.

Stage 1 findings

Our data analysis enabled us to identify four frames of the Monash Net Zero Precinct, drivers and barriers to net zero, and everyday experiences across the domains of energy, buildings, mobility, and data and automation which are summarised below.

Four frames

Through our interpretive analysis of the frontrunner interviews we identified four frames of the Monash Net Zero Precinct (see page 5):

1. "Electrify Everything" which is focused on technology deployment to achieve carbon emission reductions
2. "Place Matters" which attends to liveability, mobility, inclusivity, sociality and amenity
3. "Going Green" which embraces circular economy principles, nature-based solutions and green infrastructures
4. "Innovation Hotspot" which emphasises net zero entrepreneurship, industry development, job creation, international recognition and connectivity.

These frames are the discursive structures through which frontrunners perceive the precinct's main sustainability challenges, drivers, barriers and uncertainties. Each frame prioritises and enables certain transition strategies and collaborations, while it obscures and challenges others. This calls for transition governance approaches that take real-life multiplicity and differences of views as a reality rather than wishing or hiding them away.

Frame 1: Electrify Everything

Frontrunner focus	Priority outcomes
Deploy electricity-based technology solutions across scales to achieve required carbon emissions reductions.	▪ Energy providers taking on more responsibility for microgrids ▪ Provide infrastructure that enables behaviour change ▪ Actively engage with businesses in the precinct and guide them towards net zero ▪ Make net zero visible and tangible in the precinct

Frame 2: Place Matters

Frontrunner focus	Priority outcomes
Prioritise liveability, mobility, inclusivity, sociality and amenity.	▪ Live, work and socialise locally ▪ Involve Traditional Owners in decision-making ▪ More active transport options and improved cycling infrastructure ▪ Improved connectivity and walkability in the precinct

Frame 3: Going Green

Frontrunner focus	Priority outcomes
Embrace circular economy principles, nature-based solutions and green infrastructures.	▪ Green roofs, walls and facades – reduce urban heat island effect ▪ Closed-loop circular precinct: food production, waste utilisation ▪ Diverse range of land uses and water-sensitive urban design ▪ More open green space to support health and wellbeing

Frame 4: Innovation Hotspot

Frontrunner focus	Priority outcomes
Emphasise the potential of the precinct to become a major geographical agglomeration for net zero entrepreneurship, industry development, job creation and international recognition.	▪ Utilise the Monash Precinct Network as a trusted third party ▪ Grow knowledge-worker jobs through co-location of industry R&D within the precinct ▪ Mobilise champions from every stakeholder group in the precinct ▪ Develop a searchable precinct map and directory ▪ Support flexible work arrangements post-COVID

Frontrunners identified the following drivers and barriers to net zero in the precinct.

Governance and leadership

Drivers:

- There is an appetite for frontrunners across the precinct to engage in governance activities at different levels to support the transition to net zero. This relates to bringing key actors together to collaborate on agenda setting and utilising communication to clearly articulate a net-zero direction and brand for the precinct.

Barriers:

- Frontrunners were overwhelmingly confused about "who needs to do what" when it comes to net-zero targets, infrastructure changes, precinct boundaries, multi-level leadership and accountability across the precinct.

Business and investment

Drivers:

- The business community needs dedicated support through a range of measures to chart a path to net zero. This ranges from incentives that make the business case for infrastructure or skills investment to programs that drive participation through peer mobilisation and case studies to demonstrate commercial viability.

Barriers:

- The role of business, infrastructure and skills investment is seen as crucial to net zero. Commercial activity in the precinct spans from sole traders, and small-to-medium (SMEs) to large corporates and major institutions. Awareness, capability and understanding of how business actors can operationalise net zero is very mixed.

Community engagement

Drivers:

- The Clayton Campus and Technology Precinct is seen as having an abundance of community assets that include University staff and students, local residents, businesses, entrepreneurs, scientists and health professionals. Frontrunners advocate for community mobilisation to drive net zero through further waste reduction, material reuse, food production and the circular economy.

Barriers:

- Net zero is perceived by frontrunners as something abstract that is led top-down with little to no involvement from the local community. There is no clear idea on who should lead community engagement efforts. First Nations perspectives and knowledge of place is perceived as largely absent from net-zero transition processes.

Technology and infrastructure

Drivers:

- Deployment of decentralised renewable energy technologies is seen by frontrunners as critical for net zero. Rail connectivity to Monash Clayton Campus through the future Suburban Rail Loop, and links to Huntingdale and Clayton train stations will be an important driver of public transport use in the precinct. This includes better integration between the Monash Clayton bus interchange, cycling and walking paths.

Barriers:

- Inertia, habits and path dependencies are seen by frontrunners as major technology and infrastructure obstacles to net zero. There is a wide gap between the shift to energy-efficient buildings inspired by Passive House principles at the University compared to the inefficient post-war residential and light industrial building stock in the broader precinct. The lack of a train station to the University is a barrier to net zero that leaves single-occupancy vehicle trips as the preferred mode of travel.

Everyday experiences

The key findings from the ethnographic interviews were brought into dialogue with the analysis of the frontrunner interviews to complicate the underlying assumptions about everyday life (See Chapter 5):

Domain 1: Energy

- Many participants routines and habits are changing in response to the recent and rapid rise in energy-related costs. This has been compounded by other changes in lifestyle patterns. Studying and working from home has become increasingly normalised: this in turn has led to an increase in energy consumption in homes. Responses to this include the use of energy data and innovative "work-arounds" to reduce energy use.
- Participants approach the consumption of energy on campus differently to in their own homes, and this is exacerbated by a hybrid work model. In light of these lifestyle changes, new charging routines have emerged. Participants are also considering switching to electric vehicles as one of their primary modes of transportation.
- For the future of energy on campus, people were positive about sustainable technologies (such as sensors and solar) with an emphasis on control over automation. In general people were either unaware or confused about the Monash University microgrid.

Domain 2: Mobilities

- Driving is the way most participants commute to campus. Their reasons shift depending on their life circumstances. For some it's more convenient than public transport, for others it allows them to perform care work for family and friends. Parking on campus is sometimes tricky to navigate – certain times are busier than others.
- Public transport options in the Clayton area are limited, with most people experiencing difficulties getting to campus using public transportation. Being on public transport opens up more opportunities for people to do things such as work tasks or listening to music.
- The Clayton campus has many green and open spaces that people enjoy walking through, sitting on and seeing throughout the day. Since the campus is quite large, commuting between buildings is a reality for most people; most prefer to walk rather than drive to get to places on campus.
- Participants have ideas about what a future Net Zero Precinct would look and feel like, however, most of these visions were unclear. Most viewed the inclusion of electric vehicles and chargers positively. The Suburban Rail Loop is anticipated to change how people travel to campus (in a positive direction), however, there's a sense of hesitancy about when the vision will be put into action.

Domain 3: Buildings

- Heating and cooling trends are changing due to variable temperatures as well as increased time spent working from home post-lockdown. Most view air-conditioned cooling and heating as essential, however, there are inconsistencies between buildings on campus which require adaptation. There is a growing interest in technologies for improving and monitoring air quality. Additionally, there is emerging interest in sensor-controlled lighting.
- Participants expressed that issues like water and waste are sometimes forgotten since they represent less "shiny and exciting" pathways to achieving net zero. As one person joked that if you call something net zero – like "net-zero waste", then it might have a chance to get funding.
- While people commute in the morning and leave in the afternoon, there are many people who call the campus home. The people (and plants and animals) who live in the precinct make their own unique ecosystem of relationships, connections and stories. Understanding and interweaving into these stories and connections is a key ingredient for the future of net zero.

Domain 4: Data and automation

- Data collection on campus is so commonplace that most participants in our research did not notice it on an everyday basis. Cybersecurity has become a commonplace conversation, especially with the rise in scam calls and text messages that people receive.
- Automated lighting systems are being trialled in selected buildings across the campus, with mixed results. The installation of sensors in the future (not just for lights) will need to take into account the people who use the buildings and the primary activities they undertake.

Contents

Glossary of terms

Design anthropology	a future-focused, critical, engaged and interventional mode of scholarship research and practice. It develops innovative ethnographic and design futures methods of research, communication and engagement with community, government and industry stakeholders. It emphasises the role of people, environment and other species in shaping possible futures, and highlights how this complicates predictive and top-down visions of futures driven by technological advancement or policy.
Electric vehicle (EV)	any vehicle, usually an automobile, that uses an electric motor for propulsion.
Ethnography	a genre of writing often used by anthropologists (and other social scientists) to provide an account of a particular community, culture or society.
Frontrunner	innovators who are keen to pursue a net-zero transition agenda.
Living Labs	material and social arenas that utilise processes of multi-stakeholder collaboration, social learning and participant co-creation for experimentation and socio-technical innovation in real-world settings.
Net zero	achieving an overall balance between greenhouse gas emissions produced and greenhouse gas emissions taken out of the atmosphere (Source: Climate Council).
Precincts	spatially bounded urban environments loosely delineated by a particular combination of social economic activity, such as a university precinct, a retail precinct or a residential precinct. From an urban planning perspective, precincts are a functional scale at which planning and construction of urban infrastructure is routinely organised. Precincts are also places that connect people, politics and place through the lived experiences in the everyday life of precinct community members.
Suburban Rail Loop	an ongoing major infrastructure project in Victoria that aims to deliver a 90 km rail line linking every major train service from the Frankston Line to the Werribee Line via Melbourne Airport. Plans for the Suburban Rail Loop include building a new Monash train station in the precinct to become one of three 'super hubs'.
Transition management	a multi-stakeholder governance approach that mobilises frontrunners in transition arenas like living labs to develop sustainability agendas for system-level transitions. It uses future visioning to develop pathways and trial experimental interventions that can inform reflexive learning and coalition building.
Video tours	a research method (Pink 2007) that involve walking with and video recording participants as they experience and show us their material and social environments.

1. Introduction

The Net Zero Precincts ARC Linkage project is unique in both its interdisciplinary approach and empirically driven insights. Our goal is to help cities and urban regions reach net-zero emissions by taking the precinct as an optimal scale for urban transition. To do this, we bring together transition management with design anthropology to outline a new agenda on generating change towards sustainability.

Project aims and objectives

This project aims to develop an innovative approach to net-zero transitions that can identify and account for the complexities and needs associated with everyday human futures. As a research team, we are creating and testing a precinct-scale urban transition management process that explicitly connects with the everyday social, political and organisational experiences and challenges of the people involved.

To achieve this we are adapting the transition management approach to the precinct scale, where the process can be more grounded in the day-to-day sense of place, experiences and challenges of local participants. We are also mobilising design anthropology using ethnographic fieldwork to provide new insights into human experience and possible futures of urban places in transition; to develop and evaluate experimental design interventions, and to engage innovative techniques for bringing human-centred insights into interdisciplinary and multi-stakeholder actions.

These innovations intend to ensure both locally embedded transition visions and actions and transferable principles and frameworks. Our interdisciplinary approach will deliver to the needs and real-life experiences of the "precinct community" of business, government, knowledge institutes, civil society and community stakeholders.

Net Zero Precincts project objectives:

1. Understand the drivers and barriers that frame the precinct community's experiences, expectations and visions of the precinct and net zero futures.
2. Co-create and envision collective and shared pathways to Net Zero Precinct futures which are aligned with the precinct community's everyday social, political and experiential realities and expectations.
3. Design and test Living Lab experiments which are aligned with the precinct community's shared future visions.
4. Develop a theoretical and methodological approach to net-zero transitions, which proposes new modes of understanding and envisioning sustainable futures and brings a design anthropological approach to the sustainability transitions literature.
5. Develop a transferable step-by-step transition framework that will support the design and roll out of net zero precincts by industry and government in Australia and elsewhere.

Transition management shapes the overall operational and conceptual process, drawing on experiences from partners to guide local sustainability transitions in the urban context through orienting, agenda-setting, activating and reflecting (Roorda et al., 2014). The project will be conducted in four stages over four years (Figure 1), which is critical to ensure sufficient time for the action research underpinning the project:

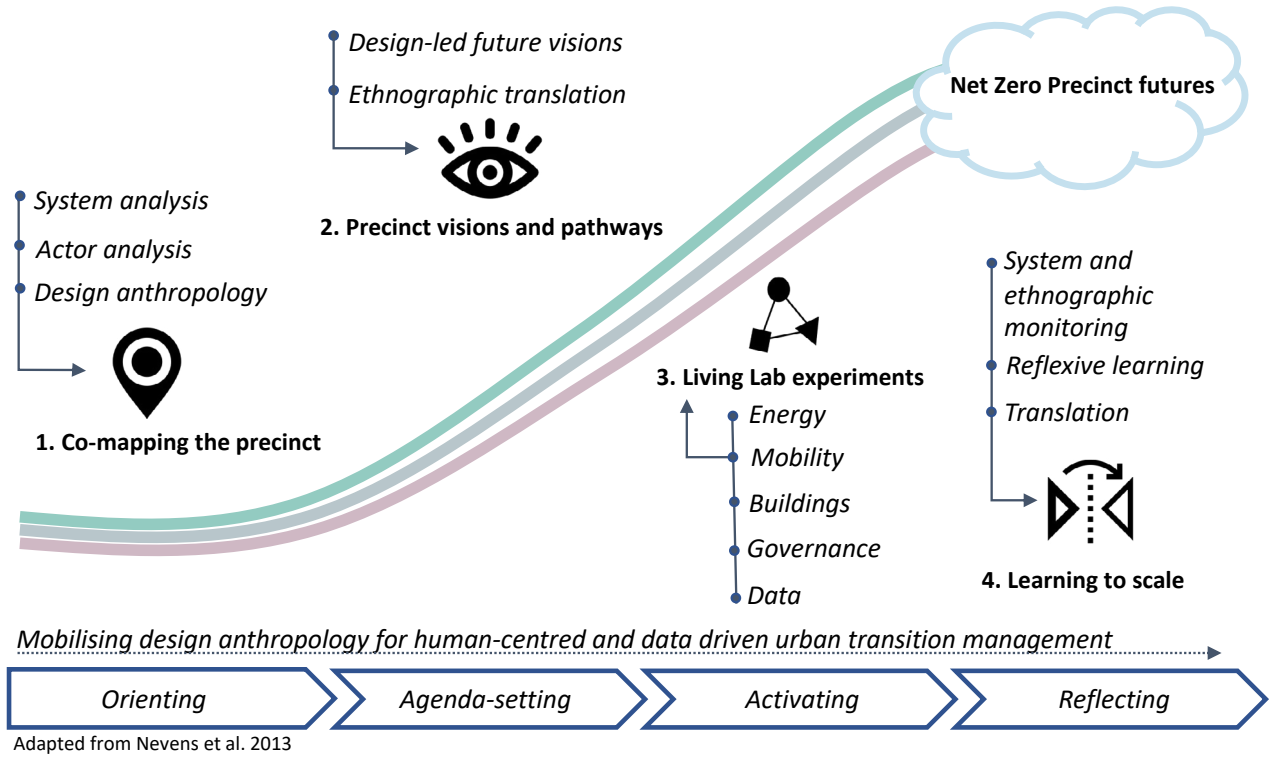


Figure 1: Net Zero Precincts research design

Transition management[1]

Transition management is a governance framework that suggests how various actors can be mobilised for sustainability to overcome path dependencies and enable system-level transitions (Kemp et al., 2007). A key aspect of transition management is that it uses future visioning and backcasting techniques to identify short-term opportunities for interventions that can inform reflexive learning and coalition building. Transition management can be understood as a multi-stakeholder governance approach that is process-oriented and shaped by experiences from practice through a process of "searching, learning, and experimenting" (Loorbach, 2007, p. 71; see Figure 2). As a process-based approach, transition management is concerned with the participatory engagement of change agents, known as frontrunners, in transition arenas for problem framing, the design of future visions and pathways, and to undertake transition experiments in real-world settings such as in living labs (Nevens et al., 2013). Frontrunners are selected by members of the transition team as individuals who may be nonexperts from different backgrounds but share an appetite for using radical innovation to solve complex societal problems (Loorbach, 2007).

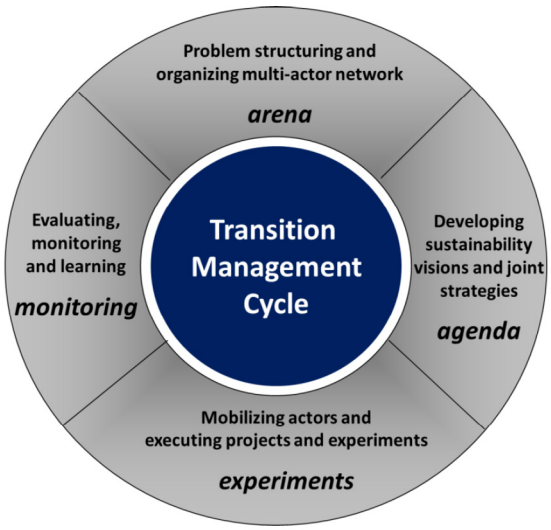


Figure 2: The transition management cycle.
Source: Loorbach, D. (2010).

[1]This draws on a chapter in the Routledge Handbook of Energy Transitions (Sharp et al., 2023).

Design anthropology

Design anthropology is a theoretical, ethnographic, experimental and interventional practice. It is rooted in the ethics of the everyday while being attentive to the politics that situate life as lived and is both critical and practical. Design anthropologists critique the predictive narratives and assumptions regarding the societal impacts and benefits of (for instance) emerging technologies and energy systems proffered by industry, policy and government organisations (Pink et al., 2019; Dahlgren et al., 2020; Pink, 2021). Design anthropologists seek to create future visions that are realistic and plausible because they attend to knowledge about, and imagined futures derived from the experience, ethics and sites of the everyday. That is, they offer insights and foresights (Lindgren et al., 2021, Pink et al., 2022) that are rooted in knowledge from those sites where change is often incremental. In doing so, design anthropology develops theoretical and situated empirical accounts of how incremental change already happens as well as how radical changes are experienced and engaged with in everyday contexts, which are place and time-sensitive. These accounts are used to produce understandings of the characteristics of change processes in the present and the possible futures these invoke or imply by harnessing uncertainty as a generative site for learning and change (Pink et al., 2015; Akama et al., 2018).

Design anthropology shares with transition management an ambition to co-create futures with stakeholders by creating new socio-technical human-centred knowledge about current and possible near and far future alternative transition scenarios. However, in contrast with the system-level focus in transition management, design anthropology does so through in-depth theoretical–ethnographic research, innovative futures ethnography experiments and participatory design techniques (Smith and Otto, 2016; Pink and Salazar, 2017; Salazar et al., 2017). When undertaken from a human-centred design perspective, the approach directly responds to how humans are conceptualised in technical and planning disciplines. In doing so it focuses on how the complex and contingent lives of people are entangled with wider socio-technical systems, and how this enables and constrains possible net-zero transition futures.

People, politics and place

This project is situated in a wider research ambition to improve the governance of urban infrastructure transitions at the precinct scale (Marvin et al., 2018; Sharp & Raven, 2021; Sharp & Salter, 2017). There is growing interest from urban actors to move beyond the scale of individual buildings or sectorally-bounded infrastructures to develop precinct-scale ambitions for net-zero futures. Precincts are natural sites of everyday experiences associated with commuting, working and living, i.e. places where meaningful urbanism at the human scale is situated (Hajer et al., 2020). While precincts are potentially an appropriate scale for net-zero transitions, applying transition management at this scale raises three challenges:

1. People, i.e. challenges of transition management to connect with the everyday experiential reality of people
2. Politics, i.e. challenges of transition management to accommodate complex issues of diverse and inclusive participation, and empowerment and navigating the risks of capture by vested interests and incumbency
3. Place, i.e. challenges of transition management to embed transition processes in particular places and their transformation.

This report begins our team's journey to explore and understand how the concepts and practices of design anthropology both complicates and creates new possibilities for transition management and the creation of net-zero futures (see Chapter 5).

2. Research process

This report presents the findings from Stage 1 of our project, which asks the question: *What drivers and barriers enable the precinct community to co-create a shared understanding of the current and future precinct that aligns with their everyday experience?*

Our findings paint a picture of the precinct drawn from the perspectives and experiences of our research participants through a framing analysis of 25 frontrunner interviews and design anthropology analysis of 29 ethnographic interviews.

Recruitment

The research team employed the same recruitment method for both the frontrunner interviews and the ethnographic fieldwork. Participants were invited to participate through personal and professional contacts. Snowballing was also utilised to recruit participants to the project. The opportunity to participate was also advertised through faculty-specific and broader Monash University communication channels.

Frontrunner interviews

Frontrunner interviews were conducted between November 2021 and June 2022 over Zoom with 25 participants. For the purpose of this project, frontrunners are defined as members of the precinct community with an interest in net-zero transitions. Participants included Monash University staff and students, representatives from local and state government, an engineer from a national telco, a sustainable buildings coordinator from CSIRO, the CEO of an SME accelerator, the founder of a social enterprise and the executive officer of a climate change NGO.

Interview questions covered the following topics:

- Sustainability challenges
- Precinct visions to 2030
- Key shifts that need to happen (drivers)
- Obstacles to overcome (barriers)
- Seeds of innovation and change
- Mobilisation opportunities.

Ethnographic fieldwork

Ethnographic fieldwork was conducted over the course of six months using walking interviews and innovative video ethnographic methods with 29 precinct community members. The sample of participants chosen for interviews represent everyday precinct community members and includes employees (University academic, professional and service staff), students, residents and visitors.

Interview questions covered the following topics:

- Everyday routines and practices
- Building features
- Energy use
- Current and future mobility
- Values, expectations and hopes
- Digital data and automation
- Possible futures.

The majority of the interviews were conducted in person at Monash University Clayton Campus, and each of the interviews was video and audio recorded. Participants were invited to show the research team member their everyday routines through walk-alongs and re-enactments of key activities. These methods are in alignment with visual ethnography and design anthropology principles and methods (Pink, 2007; Pink, 2020; Pink et al, 2022).

Data analysis

Interviews were audio and (in the case of ethnographic fieldwork) video recorded, as agreed to by the participant, and the audio was transcribed. We uploaded these transcriptions into NVivo qualitative analysis software. The research team developed a broad coding structure around key topics examined in the interviews to enable systematic analysis of the interview data. The themes created in NVivo were imported into Miro to allow for further interpretive coding and clustering of key themes.

The framing analysis was conducted using Entman (2004) and Huttunen & Hildén's (2014) work on the construction, adoption and influence of frames by different groups of actors. Each of the four frames is unpacked in terms of 1) the problem that needs to be addressed, 2) the causal diagnosis in terms of key drivers that give rise to this problem, 3) a moral interpretation of the problem and underpinning drivers, and 4) the type of actions and solutions that follow from this analysis.

Use of participant data

The remainder of this report includes direct quotes from research participants that were gathered in the process of our research. Depending on the preference of the research participant, either a pseudonym or their first name is used. Quotes from participants are essentially verbatim, but [square brackets] indicate language not spoken by the participant that is needed to provide greater clarity or context to the direct quote. Ellipsis points (…) signal a break in the quote where the participant said other words that were deleted for brevity. This editing is never used to alter the meaning of the quote, only to provide greater clarity for the reader

3. Embedding in place

We are utilising the Monash University Clayton Campus and Monash Technology Precinct as embedded sites for exploring complex urban sustainability challenges and possible solutions. The process of embedding is key to understanding how transitions are dynamically situated in local contexts that can respond to and seek to transform institutional arrangements, net-zero targets, policies and communities of practice.

Net Zero Initiative

Our Linkage project takes inspiration from the *Net Zero Initiative* — a large-scale and long-term program through which Monash University has committed to achieving net zero emissions across its four Australian campuses by 2030 with four pillars of decarbonisation: energy efficiency, renewable energy, electrification and carbon offsetting for residual emissions. With more than 70,000 student enrolments and over 150 buildings spread across four domestic campuses, Monash University is a significant consumer of energy. To reduce its energy consumption, Monash has upgraded 60,000 lights to energy-efficient LEDs and improved the performance of its buildings by optimising air-handling systems, heating and cooling equipment, and building automation systems. The University has built five all-electric buildings and is in the process of investigating the replacement of gas boilers with electric heat pumps and building thermal precincts to provide renewable powered heating and cooling. Monash has installed 4 megawatts of solar across its four Australian campuses, providing approximately 7% of its electricity requirements, with more being planned. To achieve its goal of 100% renewable power, Monash entered into a Power Purchase Agreement with the Murra Warra wind farm in 2018 for the remainder of its electricity needs.

Alongside the four core pillars of decarbonisation, Monash has developed strategies targeting emissions from transport including commuting and air travel. The University is substantially expanding its EV charging network to support electrification of Monash's intercampus bus, light-vehicle fleet, carsharing service and public charging. Furthermore, Monash University has offset residual emissions from its fleet vehicles since 2002. The low-carbon travel program will help Monash keep air travel emissions to a minimum by 2025, and the University will offset the emissions associated with business air travel and study abroad programs. The University is also committed to supporting its suppliers to measure and manage their own emissions to create more resilient supply chains, boost supply chain efficiencies and to reduce scope 3 or indirect emissions. Monash's commitment to net zero emissions by 2030 is strongly supported by our governance and strategic goals. Monash University's Strategic Plan, *Impact 2030*, outlines how the University will leverage research and education excellence and collaborate with government, industry and communities to address climate change. In addition to embedding net zero challenges into Impact 2030, the University has formally committed to driving sustainable outcomes through the second iteration of its sustainability strategy as outlined in the *Monash University Environmental, Social and Governance Statement 2021-2025.*

Monash Technology Precinct

Monash University's main campus in Clayton is at the heart of the Monash Technology Precinct (MTP), which is situated about 20 kilometres south-east of Melbourne's central business district (CBD). The MTP brings together together an integrated network of world-leading researchers and research infrastructure, some of Melbourne's most significant global businesses and a sizeable and expanding start-up ecosystem that has produced ASX listed companies across Victoria's knowledge-based industries, particularly in the fields of health, advanced manufacturing, future technologies, sustainable development and and education (See Figure 3). The region surrounding MTP is referred to as the Monash National Employment and Innovation Cluster (MNEIC), in the local government areas of Monash, Kingston and Greater Dandenong. This is the largest employment hub outside of the Melbourne CBD and it supports approximately 13,000 businesses, 95,000 jobs and contributes over $10 billion to the Victorian economy each year (Monash University, 2023; Victorian Planning Authority, 2017). At the local level, the MTP forms the core of the MNEIC cluster and has been identified by the Victorian Government as a Specialised Activity Centre (which performs functions outside of retail, commercial and residential uses) and is designated as a Technology Precinct in Metropolitan Melbourne (City of Monash, 2008). The MTP encompasses major institutions including Monash University, Monash Medical Centre and Children's Hospital, the Victorian Heart Hospital, the Monash Medical Trials Centre, the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and its National Vaccine and Therapeutics Lab, the

Australian Synchrotron, the Melbourne Centre for Nanofabrication, and Moderna's new mRNA vaccine manufacturing facility (under construction). The precinct is also home to significant global businesses, including ABB, Agilent, Bosch Australia, Lockheed Martin, Textron, Telstra Global Operations Centre, Woodside, Johnson and Johnson, Pfizer, Dulux/PPG and successful spin-outs such as Amaero International. Collaboration in the precinct is underpinned by the Monash Precinct Network, a newly established not-for-profit precinct organisation that drives better connections and engagement between industry, education, research, government and supply chains, and accelerates impactful initiatives and innovation pathways in the precinct and the wider Southeast Melbourne region. The Monash Technology Precinct is also part of a Global Network of Innovation Districts, led by the Global Institute of Innovation Districts, which has resulted in global interest in the precinct's governance and development.

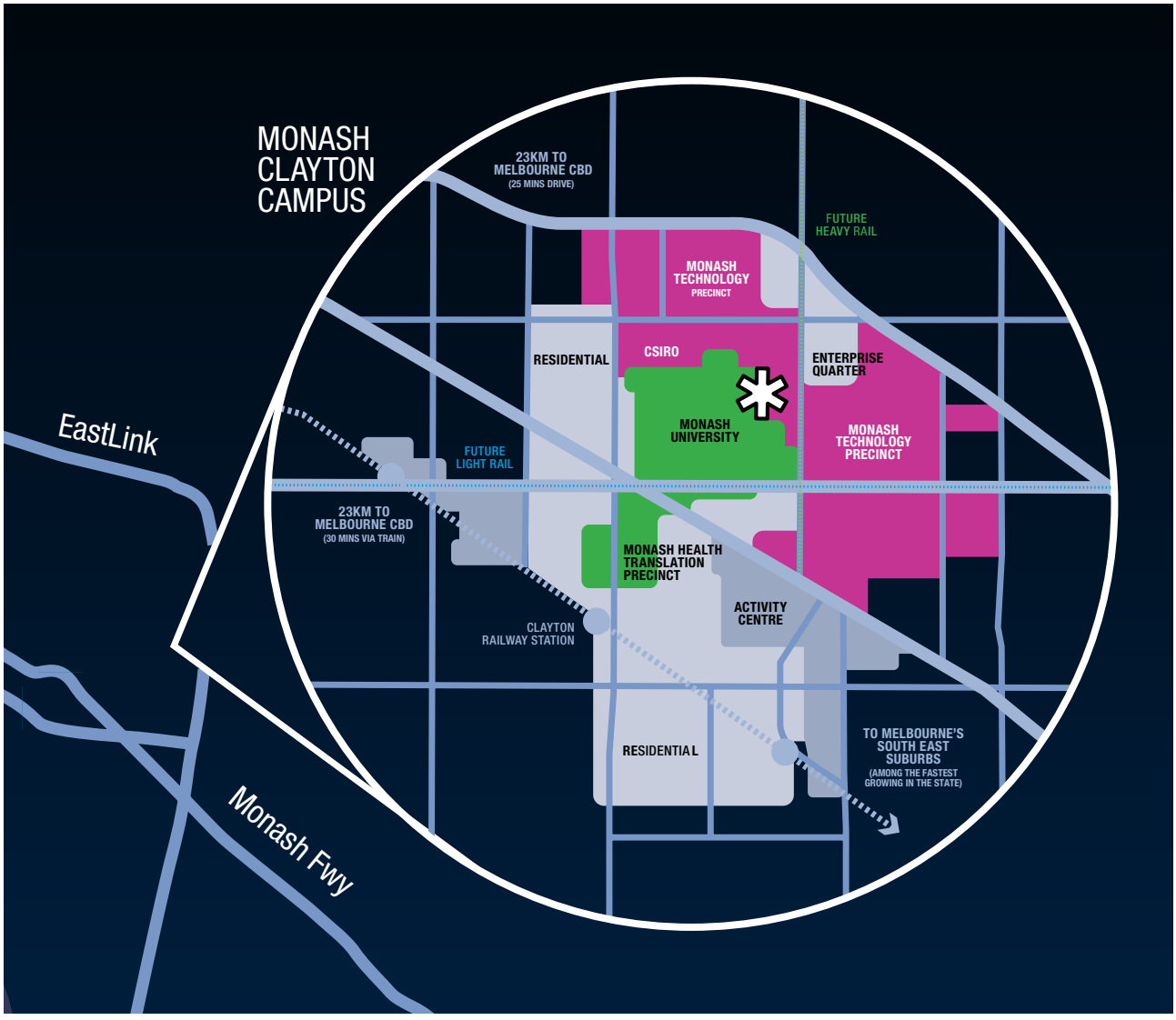


Figure 3: Map of the Monash Technology Precinct (Source: Monash University).

City of Monash

Monash University's Clayton Campus and the Monash Technology Precinct are situated within the City of Monash which is a vibrant and densely populated region of approximately 200,000 people in 81.5km2, making it one of the most populous local government areas in the State of Victoria.

The City of Monash is on the traditional lands of the Wurundjeri Woi Wurrung and Bunurong people of the Kulin nation who lived in this area for tens of thousands of years prior to European settlement in the 1830s. First Nations culture, history and knowledge continues to play a significant role. The City of Monash is named after Sir John Monash who was a revered engineer, lawyer and soldier who rose to lead the Australian Army by the end of the First World War.

The Monash region contributes significantly to Victoria's greenhouse gas emissions profile. In 2021, Monash's total emissions were estimated to be around 2.2 million tonnes of carbon dioxide equivalent (CO2-e). The major sources of emissions in the region are electricity (63%), gas (14%), transport (15%), with Monash having significant commercial and industrial contributions. (Source: *Snapshot Climate* - See Figure 4).

In 2020 Monash Council committed to a net-zero target through its *Zero Net Carbon Action Plan* which provides a pathway for Council's corporate operations to become carbon neutral by 2025 and its *Environmental Sustainability Strategy* has a range of measures to strengthen, care for and protect its natural environment.

Work towards net-zero transition in the City of Monash is also informed by a number of policy, strategy and regulatory instruments including the Victorian Climate Change Act 2017, Victoria's Climate Change Strategy 2021, the Regional Climate Change Adaptation Strategy for Greater Melbourne 2021, Victoria's Adaptation Action Plans, and the Federal Government's Climate Change Bill 2022, to name a few.

As we have noted elsewhere (Sharp and Raven, 2021), our project reveals the complexity of embedding net-zero transitions within a place-based context made up of a university campus, technology precinct, and innovation cluster that sit within a broader planning scheme. The range of net-zero targets, commitments, strategies, incentives and engagement reflects the complex multi-level governance activities which can be both complementary, supportive and pull in different directions all at once, across a range of overlapping boundaries and focus areas.

The next chapter of the report speaks to this multiplicity of perspectives about net-zero transition at precinct scale through a framing analysis of the frontrunner interviews.

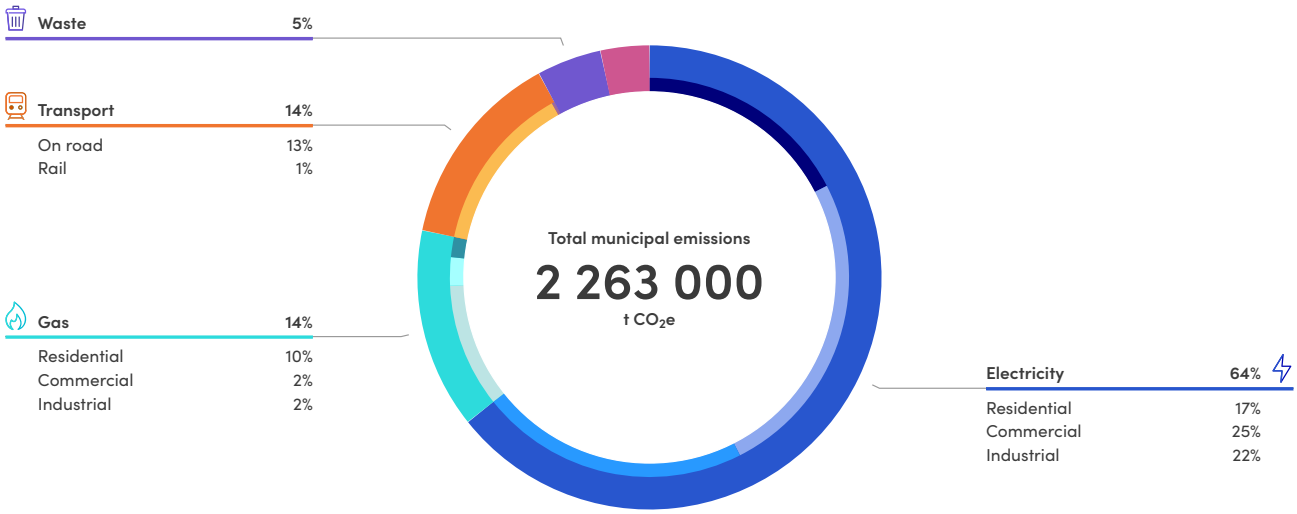


Figure 4: Monash 2020/21 municipal emissions snapshot (Source: Snapshot Climate)

4. Framing transitions

We define framing as socially constructed processes that discursively situate net-zero transformation in particular ways. People use stories and visions to foreground certain problems and propose specific social, economic and technological solutions to transform systems by influencing the scope or direction of change.

Given precincts have become critical arenas to undertake experiments in urban transformation, it is important to ask the question: What are precincts transforming into? While "net zero" structures much of the current context for precinct transformation, how net zero is framed and by whom, determines which actors get to play a role in driving transformative change which privileges certain preferences, power dynamics and governance logics over others.

In this chapter we are interested in understanding how frontrunners frame net-zero transformation of the Monash Clayton Campus and Technology Precinct. Frames are important; they emerge when people define 1) the context of action through visions of the future, 2) the key shifts that need to happen (drivers) and 3) the obstacles to system change (barriers). The next section details how frontrunners interviewed for this project perceive the key problems, uncertainties and solutions to net-zero transformation.

4.1 Drivers and barriers

Frontrunners identified a number of drivers and barriers to the realisation of a Monash Net Zero Precinct that are grouped together in the following themes:

- Governance and leadership
- Business and investment
- Community engagement
- Technology and infrastructure

Governance and leadership drivers:

Frontrunners identified a range of key shifts to enable diverse stakeholders across the precinct to engage in governance activities at different levels to support the transition to net zero. Much of this relates to bringing key actors together to collaborate on agenda setting and utilising communication to clearly articulate a net-zero direction for the precinct.

- A shared vision for the precinct that takes into account a range or perspectives
- A clear precinct brand, directory and map to support visibility and coordination
- Language about "gaining" not "losing"' to generate buy-in and shared ownership
- Using the Monash Precinct Network to connect key stakeholders across sectors
- Fostering closer cooperation between major institutions, local and state government.

Governance and leadership barriers:

Confusion over the role different stakeholders can play in the leadership and governance of net zero in the precinct is an overarching theme. Frontrunners were overwhelmingly confused about “who needs to do what” when it comes to net-zero targets, infrastructure changes, precinct boundaries, multi-level leadership and accountability across the precinct.

- Lack of leadership and coordination between local, state and federal government
- Length of time it takes to make changes to the local planning scheme
- Regulatory barriers to electricity sharing across organisations and households
- Local government's role in regulating choices in relation to embedded networks
- Competing priorities and interests in the precinct
- The role of vested interests and lack of political will to change the status quo.

Business and investment drivers:

According to frontrunners, the business community needs focused and dedicated support through a range of measures to set organisations on the path to net zero. This ranges from incentives that make the business case for infrastructure or skills investment to programs that drive participation through peer mobilisation and case studies to demonstrate commercial viability.

- Incentivise net-zero transition via rebates, stamp duty concessions and solar financing
- Provide net-zero onboarding and commitment for every business in the precinct
- A net-zero champions program to educate, connect and inspire others to take action
- Understand what individual businesses are doing and provide targeted support
- Support local businesses to lead by example to uptake EVs and solar, and "get off gas".

Business and investment barriers:

The role of business, infrastructure and skills investment is seen as crucial to reaching net zero. Commercial activity in the precinct spans from sole traders and SMEs to large corporates and major institutions. However, awareness, capability and understanding of how business actors can operationalise net zero is very mixed.

- What works for one business may not be in the interests of the precinct as a whole
- Facility managers don’t have the capacity or training to meet the net-zero challenge
- Upfront costs mean cheaper solutions are favoured over green alternatives
- Perception of individual responsibility perpetuates a “What's in it for me?” attitude
- Many small businesses are renting and would love to get rooftop solar but can't.

Community engagement drivers:

The Monash Clayton Campus and Technology Precinct is seen as having an abundance of community assets that include University staff and students, local residents, businesses, entrepreneurs, scientists, and health professionals. Frontrunners advocate for community mobilisation to drive net zero through further waste reduction, material reuse, food production and the circular economy.

- Work with Monash staff, students, businesses and residents to drive change and make the precinct more sustainable
- Celebrate community efforts – communicating success and "wins" is very important
- Use participatory processes, invite input and be open to community feedback
- Embrace First Nations culture and involve Traditional Owners in net-zero transitions.

Community engagement barriers:

Net zero is perceived by frontrunners as something abstract that is led top-down with little to no involvement from the local community. There is no clear idea on who should lead community engagement efforts in the precinct. First Nations perspectives and knowledge of place is perceived as largely absent from net-zero transition processes.

- People not the focus of net zero and need to "see themselves" in change processes
- Perception that "we do very little consultation in the precinct" which needs to change
- Net-zero literacy is limited, diverse community ownership over transition is critical
- Treating "place" as a commodity and bracketing out the past is a lost opportunity.

Technology and infrastructure drivers:

Deployment of decentralised renewable energy technologies including neighbourhood-scale storage like solar sponges, microgrids and community batteries is seen by frontrunners as critical for net zero to become a reality. Rail connectivity to Monash Clayton Campus through the future Suburban Rail Loop, and links to Huntingdale and Clayton train stations are seen as important drivers of future public transport use in the precinct. This includes better integration between the Monash Clayton bus interchange, cycling and walking paths.

- Energy-efficient buildings including LEDs, rooftop solar and insulation upgrades
- Batteries and associated storage and firming technologies will be necessary
- Desire for energy providers to take on more responsibility for microgrids
- The Monash Suburban Rail Loop station seen as a game changer when operational
- Monash's Net Zero Initiative is seen as an important proof point via energy-efficient buildings, battery systems, microgrid, power purchase agreement and LEDs.

Technology and infrastructure barriers:

Inertia, habits and path dependencies are seen by frontrunners as major technology and infrastructure obstacles to net zero. There is a wide gap between the shift to energy-efficient buildings inspired by Passive House principles at the University compared to the inefficient post-war residential and light industrial building stock in the broader precinct. The lack of a train station to the University is a barrier to net zero that leaves single occupancy vehicle trips as the preferred mode of travel.

- Legacy infrastructure, poor rail connections and dominance of car-centric transport
- Cycling, walking and active transport needs planning and infrastructure improvement
- Lack of state and federal investment in renewable energy at precinct scale
- Concern about capacity of solar and batteries to meet demand of high-energy users.

The drivers and barriers identified begin to paint a picture of the complex governance challenges associated with net-zero transition at precinct scale. The framing analysis that follows reveals the multiplicity of perspectives on what a Net Zero Precinct is or should be, the problems that need to be addressed, appropriate solutions that logically follow from that, including who should do what, and when.

4.2 Four frames

Frames are an important way to bring coherence to a range of themes related to how frontrunners perceive net-zero futures, the context of action through the key shifts that need to happen (drivers), and the obstacles to system change (barriers).

Through our interpretive analysis of the frontrunner interviews, we found that participants mobilised four frames of the Monash Net Zero Precinct which we identified as: 1) Electrify Everything; 2) Place Matters; 3) Going Green and 4) Innovation Hotspot.

These four frames are the discursive structures or lenses through which frontrunners perceive the precinct's present and future challenges, focus areas and priority outcomes.

Frame 1: Electrify Everything

Frontrunner focus	Priority outcomes
Deploy electricity-based technology solutions across scales to achieve required carbon emissions reductions.	▪ Energy providers taking on more responsibility for microgrids ▪ Provide infrastructure that enables behaviour change ▪ Actively engage with business in the precinct and guide them towards net zero ▪ Make net zero visible and tangible in the precinct.

Energy sharing in the precinct is seen as a priority by some frontrunners taking inspiration from Monash University's microgrid on the Clayton Campus that is able to receive and store energy from renewable sources to reduce demand and strain on the network. The current Australian regulatory environment prevents electricity sharing between businesses and households, however, community battery deployment trials between households is underway. Frontrunners note a lack of state and federal investment in renewable energy at precinct scale. Australia has historically low energy standards in building codes and limited incentives to encourage asset owners to purchase heat pumps, induction stovetops or electric hot water. EVs are also regarded by frontrunners as being prohibitively expensive and poor fuel efficiency standards have led to high greenhouse gas (GHG) emissions from passenger cars.

"You might start to see more visible change around transport, so you will see electric buses. That may mean you have got bus charging stations as part of your terminus, and things like that. Obviously, the [Suburban Rail Loop] station would still be coming at this point, but you would be building towards that. There would be a greater proportion of people probably driving to campus in EVs and wanting charging stations, so making provision for those things within your carparks. Similarly, if you have got a greater number of solar panels and things like that on buildings, that will become apparent to people too."

—Director in precinct planning, Victorian Government.

Frontrunners noted the lack of leadership and politicisation of climate change over the last two decades which has created inertia and prevented coordinated action for wide scale electrification of the Australian built environment and transport sectors from taking place. A number of frontrunners would like to see federal, state and local governments develop a coordinated approach to support the shift to electrify infrastructure, buildings and vehicles. This also extends to a desire for government support for EV charging infrastructure and incentives to landlords and asset owners to allow or co-invest in rooftop solar for renters.

Monash University plays a lead role in demonstrating how large organisations can drive net-zero transformations. As the CEO of SME Accelerator put it, Monash University is "the shining star" and "modeller of all the new technologies, and the showcaser of the different ways that industry can have a positive impact on the environment or on sustainability initiatives".

"Moving towards electric forms of transport. Moving towards fully renewable energy to support that electric transport system. Also, all of our buildings will have efficient electricity systems and will be well built. So, they'll have proper insulation, plenty of natural light, those kinds of things."

—Undergraduate student, Monash University.

Frame 2: Place Matters

Frontrunner focus	Priority outcomes
Prioritise liveability, mobility, inclusivity, sociality and amenity.	▪ Live, work and socialise locally ▪ Involve Traditional Owners in decision-making ▪ More active transport options and improved cycling infrastructure ▪ Improved connectivity and walkability in the precinct.

The precinct is very large and lacks a readily identifiable community beyond the transient nature of people coming to and from the precinct for work and study. Frontrunner interview analysis reveals that net-zero transition will only succeed if it supports lively places that are safe, welcoming and desirable. There is currently limited access to great dining, shopping and entertainment experiences. Major roads surrounding the precinct makes it feel unsafe for cyclists and pedestrians. Rail connectivity to Monash Clayton and links to Huntingdale and Clayton train stations will be important drivers of public transport use in the precinct. This includes better integration between the Monash Clayton bus interchange, cycling and walking paths.

"There's a whole lot of lifestyle aspects to it, I think. But I mean I would never move closer to Clayton because I know that I want to live near the beach (...). So how do I marry that, how do I breach the gap? So I don't have any alternative but to work there and live here so I'll need something to shuttle me back and forth easier."

—Staff member, Monash University

"Make sure that the Traditional Owners are involved in all the planning processes and that Monash is working with them to make sure that it's all culturally sensitive and also that they're using traditional techniques because traditional techniques can be quite good for a lot of stuff."

—Postgraduate student, Monash University

Net zero is seen by frontrunners as about much more than just reducing carbon emissions. The focus on technology deployment and infrastructure provision should not come at the expense of people-centric places. Frontrunners want to see a reduction in car travel and increased investment in public transport and active transport like cycling and walking infrastructure. Students are a great untapped resource who are motivated to participate in sustainability initiatives on campus. First Nations perspectives, knowledge and ties to place are highly valued and should be recognised in planning.

"We have that tie to Clayton. So, that sense of place is important. It's not just buildings and then the halls of residence, or the lecture theatres, or libraries. But intrinsically, people will have that connection for the rest of their life. So, it's important to recognise that. (...) So, they have that sense of, not only ownership. It's not just a commodity. It is something where people learn. It's the place where you get taught about your specific professional career or your passion or your skills, that's what connects you to that place. You learned that there at Monash. For Aboriginal people, that sense of place and connections is extremely important."

—Staff member, Monash University

Frame 3: Going Green

Frontrunner focus	Priority outcomes
Embrace circular economy principles, nature-based solutions and green infrastructures.	▪ Green roofs, walls and facades - reduce urban heat island effect ▪ Closed-loop circular precinct: food production, waste utilisation ▪ Diverse range of land uses and water sensitive urban design ▪ More open green space to support health and wellbeing.

The Monash Clayton Campus is noted for its significant tree plantings and well-designed landscaping. Outside of the University, green open space is seen as neglected in the precinct. E-waste is identified by frontrunners as a problem at the University as the transient student resident population follows a "take-make-dispose" approach to the consumption of durable goods. As student residents move in, they typically purchase a new set of basic household appliances which get thrown away on departure. Plastic waste is an ongoing concern for students and residents and the prevalence of COVID-19 related waste like disposable masks was also noted as a concern.

Waste streams could be better utilised at precinct scale to minimise the amount of plastics and e-waste going to landfill. Food production is currently marginal through community gardens and the Monash University Community (MUC) Farm but could be scaled up to divert green waste to be used as compost and ease Monash residents' cost-of-living pressures by providing access to affordable, locally grown food. The desire to shift to a circular economy at precinct scale was noted as a priority as it provides opportunities for demonstration of closed-loop systems of production and consumption. Nature-based solutions can also encourage biodiversity, social inclusion and support for the Sustainable Development Goals (SDGs). Frontrunners advocate for community mobilisation to drive further waste reduction, material reuse, food production and promote the circular economy.

The Victorian Government's Circular Economy strategy can improve access to recycling infrastructure in the precinct (Victorian Planning Authority, 2022). Existing programs at the University like Green Impact and Keep Cup promote a range of actions staff and students can take to reduce energy consumption and plastic waste. There is also potential to incentivise Monash students to access appliances via the Reuse Centre which makes a range of refurbished second-hand goods available to purchase at affordable prices. Frontrunners would like to see the limited use of single-use plastics by Monash vendors (problematic single-use plastics was banned in Victoria from 1 February 2023). An increase in green roofs, walls and facades could reduce urban heat island effects.

"I guess when I think of something in the future, I like to think that we develop a synergy with nature, like when you mention green, I kind of envision that some of the buildings would incorporate plants as part of the architectural feature of the building."

—Program lead, City of Monash

"If you can work together across council teams and businesses, around how you can create that linkage and better open space and access on streets; a greening, and cooling outcome around urban trees, supportive of the local community, including projects outside of the campus. They're some of the priorities that you probably see would demonstrate success."

—Senior Sustainability Advisor, Victorian Government

Frame 4: Innovation Hotspot

Frontrunner focus	Priority outcomes
Emphasise the potential of the precinct to become a major geographical agglomeration for net-zero entrepreneurship, industry development, job creation and international recognition.	▪ Utilise the Monash Precinct Network as a trusted third party ▪ Grow knowledge-worker jobs through co-location of industry R&D within the precinct ▪ Mobilise champions from every stakeholder group in the precinct ▪ Develop a searchable precinct map and directory ▪ Support flexible work arrangements post-COVID.

Frontrunners suggest the precinct must grow its position as a key employment and innovation cluster. There is a lack of clarity over who is responsible for driving net-zero innovation and investment within the Monash Technology Precinct. Workforce gaps show the need to train the next generation of future energy leaders (Rutovitz et al., 2021) and the Monash Technology Precinct has the capacity to become a regional and global leader in net-zero innovation through its research, education, technology and health offerings. Frontrunners see the merit in demonstrating net-zero innovation at precinct scale. The Monash Precinct Network is an independent intermediary organisation that could help to strengthen cross-sectoral links.

The role of business, infrastructure and skills investment is seen as crucial to net-zero transformation. The diversity of commercial activity in the precinct spans from sole traders and SMEs, to large corporates and major institutions. Awareness, capability and understanding of how business and commercial actors can operationalise net zero is very mixed.

"I'd like to hope that by the time we get to 2030 there's new technology that the precinct has championed in terms of net zero goals. I don't even know that that is. We've got a team here, (...), they're putting cameras on satellites for the agricultural industry. How long will it be before we put cameras on satellites to actually be able to heat map energy consumption, usage, wastage, I don't know, above a precinct area? I would in 2030 have seen two, three, five, 10 case studies, or even just shout-outs of how the precinct has come together to trial those innovations to raise awareness of what can be done, and what's coming in the future."

—CEO, SME Accelerator

"At Monash Uni we have focused more on the Monash Technology Precinct and on attracting investment in transport connections, R&D infrastructure and from industry partners. We have been successful at that and we do so, where relevant, in coordination with other anchors, like for example around the delivery of the Suburban Rail Loop or the attraction of Moderna. Complementary to the efforts of individual anchors, we now have an independent precinct governance structure in the form of the Monash Precinct Network. The Network will further accelerate the growth of the precinct ecosystem by driving and promoting the collaboration and interconnection of research and enterprise to create innovations of the future. The creation of the first independent precinct organisation is a significant step and demonstration of collaboration among key precinct anchors itself."

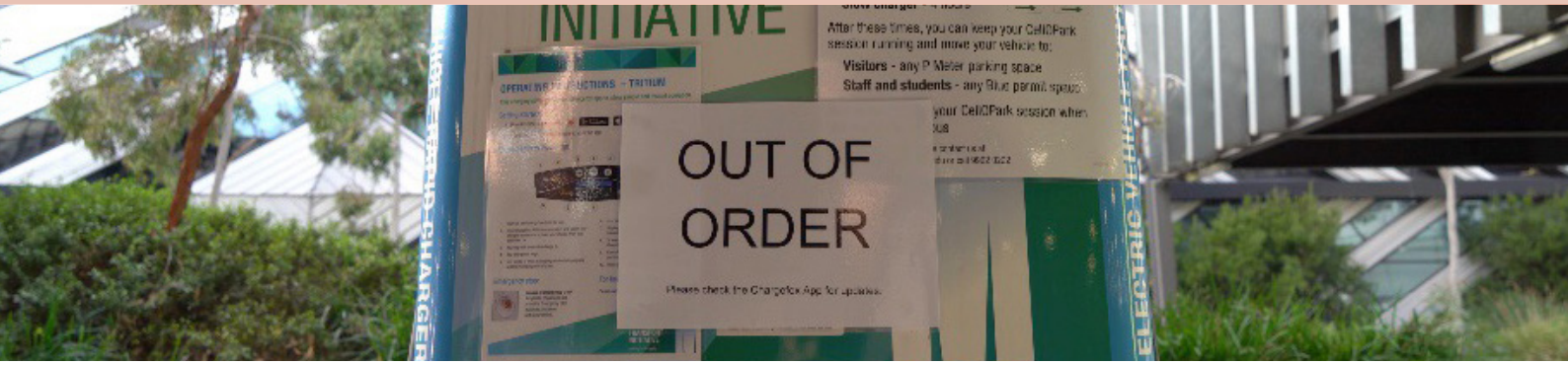
—Staff member, Monash University

The frontrunner interviews reveal a diversity of perspectives of Net Zero Precinct transitions. The framing of net zero affects the governance of precinct transitions by conveying a sense of purpose, meaning-making, and as a medium to communicate overlapping and sometimes competing stories of change. Frames are important in generating a deeper understanding of what shapes possibilities as well as tensions in accelerating a Net Zero Precinct transitions, because each frame prioritises and enables certain strategies, pathways and collaborations, while at the same time obscuring other possibilities. The four distinct but related net-zero frames point towards a challenge in balancing the desire for a clear and shared framing about the future to guide planning, directionality, investments and action versus keeping multiple pathways open in light of navigating complex governance realities and future uncertainties.

This project is an attempt to understand how the precinct community can also reframe dominant stories of net-zero transitions and put forward alternative visions and pathways to reorient the scope of possible city futures, the range of actors who get to play a role, and the choice of actions to drive transformative change. Thus we invite readers to be open to shifting perspectives; to think about transforming infrastructure systems and also engaging with everyday lived experiences and places as the generative sites from which we must instigate change.

5. Complications and possibilities

Taking an interdisciplinary perspective – to bring design anthropology and transition management approaches into dialogue – offers new opportunities regarding how we might envision pathways to net zero. New dialogues founded on the tensions between these two approaches reveal complications which we need to carefully and productively address in order to be able to shape realistic and plausible future visions and suggest that new frames, concepts and methods are required to guide these pathways.



Complications

Complications take different forms. In this report, we use the term "complications" to refer to the ways in which human values or practices disrupt or divert the pathways to net zero that dominant narratives assume will be taken. Such complications are invoked both through the assumptions of frontrunners, and through the values, priorities and everyday needs of precinct community members. Awareness of complications is important because it brings us foresight and allows us to preempt situations where transition pathways may not proceed.

Participants in our research were aware that transition to net zero was complicated by the relationship between infrastructure or technology-led change initiatives and what people do in everyday life situations. However, we found that both frontrunners and participants in the ethnographic study tended to rely on the same assumptions represented in dominant narratives to articulate these tensions. This limited the extent to which they could access viable models of change to apply to net-zero initiatives in the precinct.

In particular, we found that participants assumed that solutions would be led by changes in infrastructure which required people to “change their behaviour” or or "shift their thinking". Moreover, participants saw changing the behaviour of people who use the precinct as challenging. In order to accelerate change, we argue that people involved in transition initiatives within the precinct community need better access to the practical resources or conceptual tools needed to reframe the "problem" beyond conventional ideas that people who don’t exhibit the right behaviours need to be influenced to do so through top-down change. Doing so will enable precinct community members to better participate in driving transition to net zero in ways that correspond with and are supported by people’s everyday values and practices.

Possibilities

We found many examples of existing transition activities and initiatives which demonstrate how ground-up change shaped by the everyday ingenuity and improvisation of people and communities who live, study and work in the precinct are already generating pathways towards net zero.

Examples that demonstrate ground-up transition activities are possible through the participation of everyday people in the precinct community include:

Precious Plastic Monash

- Student-led chapter of a network using plastic waste streams to educate the community about the circular economy through design-based solutions.

Monash Wholefoods

- Student and volunteer-run vegetarian restaurant and event space established in 1977 to provide affordable and nutritious food for the Monash student community.

Monash Permaculture Garden and Monash University Community Farm

- Student-run community gardens based on permacultural practices with a focus on cooking and eating the produce grown on campus.

Green Impact program

- Monash University staff and student engagement program that embeds sustainable practices and healthy behaviours through team-based activities.

Community-led recycling stations

- Halls Cafe located near the Halls of Residence sorts various types of waste including e-waste and used cooking oil. The cafe also has its own reusable bowl system to reduce single-use items.
- Children's Centre has its own recycling station where families can drop off e-waste, printer cartridges and empty hair-care products. They can also purchase natural garden fertiliser (worm wee) made onsite in the centre's worm farms.

Hargrave-Andrew Library

- Staff-led soft plastics and e-waste collection.

Student-led compost bins in Halls of Residence

- Residents in student accommodation on campus were successful in overcoming objections and lobbying operations for the introduction of compost bins.

Monash Association of Sustainability

- A student-run association at Monash University that encourages participation in a range of sustainability initiatives on campus and beyond.

Biker Co

- Bicycle shop and repair centre at Monash Clayton operated by the Monash Student Association.

The Corner Store Network

- Social enterprise, coffee roastery and food preservery based in Oakleigh that supports direct trade with coffee farmers in Timor Leste.

Solar Decathlon Team

- Student-run team that develops practical net-zero building designs that are submitted annually to the US Department of Energy's Solar Decathlon Challenge.

Monash Reuse Centre

- Monash faculties and departments donate surplus furniture to the centre which diverts on average 60 tonnes of furniture from landfill every year.

Monash Tech School

- Provides industry sector-specific programs to students from participating schools in the City of Monash by partnering with universities, industry and community groups.

Solar Savers

- Provides eligible homeowners and renters with access to affordable loans for the installation of high-quality rooftop solar systems by professional installers.

Eastern Innovation

- Co-working community in the Monash Technology Precinct that provides an enabling ecosystem to a range of innovative start-ups across a range of sectors.

The success of the initiatives listed above is partially due to the alignment between the infrastructure and participation of Monash students, staff, local government, traders, entrepreneurs and precinct community members that are interested and available to support this work. Often, people who undertake ground-up work in the precinct are siloed and disconnected from other precinct community members, thus making it difficult for them to either lead in or coordinate processes of change. Further to this, constraints in how individuals conceptualise the possibilities of change serve to complicate their capacity to bring about or lead in change initiatives. Our interdisciplinary approach in this project seeks to:

1. Complicate the assumptions of traditional approaches to transition management through design anthropological reframings and ethnographic evidence
2. Moderate the disruptive nature of the complications made visible through the ethnographic research, by seeking to align them with the requirements for transition to decarbonisation
3. Propose interventions in the everyday which will harness the generative and creative possibilities of people who live, work, study in the precinct towards net zero.

Diverse Framings

The diversity of framings that this research has identified also signals a broadening of the scope, drivers, barriers, problems and solutions. The four frames suggest that Net Zero Precinct transitions are perceived by a selection of the frontrunners to involve much more than "carbon emissions" in a strict sense, i.e. a focus well beyond a commitment to emission reductions. Instead, the diversity of frames indicate a need to incorporate and relate to a broader set of issues, including issues such as sense of belonging, circular economy, community engagement, active transport, health, food production, nature, flexible work arrangements and green spaces. It is likely, moreover, that these frames are not static but dynamically change over time in response to new developments or a broadening of the stakeholder environment. Hence, future visions, pathways and living lab experiments ultimately need to be able to accommodate this diversity of interests and perspectives and be able to govern transitions towards net-zero precincts engagement within a plural and dynamic framing landscape.

All of the frames aspire to a net-zero future for the precinct, ask what the solutions will be to the challenges that are faced, and in some cases propose solutions. Also in common they see investment in infrastructure and technology, and policies that change the behaviour of people who use and live in the precinct as participating in paths to net zero. The frames capture the importance of people, politics and place, but these shared discursive structures are not yet able to articulate realistic and plausible pathways to net zero or the knowledge, understanding or capability to mobilise people, community or place towards net zero.

Design anthropology sets out to:

1. Critically engage with these frames, to identify where they are lacking and how they might be complicated and corrected with in-depth knowledge about people, politics and place.
2. Introduce a more plausible theory of change embedded in the everyday which enables us to acknowledge the continuous nature of change and the ways in which people and communities that constitute the precinct are entangled in change processes
3. Bring real and realistic everyday life stories and futures to the fore, to evidence, inspire and test possible future pathways to net zero.

Key questions for transition management:

- How to ask for "democratic legitimacy" for transition to net zero in such a way that recognises that transition must be reframed to appreciate the role of people's values, priorities and creativity in both shaping possible futures and in complicating top-down approaches?
- How to invoke and nurture initiatives from the ground-up which are supported by the framework and priorities of a shared transition process and enabled by human commitment, values and action?

Complicating the Frames

Frame 1: Electrify Everything

Frontrunner focus:

Deploy electricity-based technology solutions to achieve required carbon emissions reductions.

Priority outcomes:

- Energy providers taking on more responsibility for microgrids
- Provide infrastructure that enables behaviour change
- Actively engage with business in the precinct and guide them towards net zero
- Make Net Zero visible and tangible in the precinct

Mobilising diverse actors:

- Facilities and operations teams
- Energy generators and network providers
- Local businesses
- Communications teams
- Shared mobility service providers
- Infrastructure developers
- Local government
- Eastern Alliance for Greenhouse Action (EAGA)

Examples of complications:

- Lack of communication with staff, students and community about location, function and significance of microgrids and community batteries.
- Providing infrastructure (such as EV charging stations) does not change behaviour and cannot enable on-campus EV charging for people whose EV-charging possibilities are driven by social and caring priorities.

Examples of possibilities:

- Solar Savers is a local government initiative that enables households and businesses to access affordable rooftop solar installation from trusted suppliers.
- Members of the precinct community interviewed showed interest in community batteries and energy sharing to reduce emissions and lower energy costs.

Frame 2: Place Matters

Frontrunner focus:

Prioritise liveability, mobility, inclusivity, sociality and amenity.

Priority outcomes:

- Live, work and socialise locally
- Involve Traditional Owners in decision-making
- More active transport options and improved cycling infrastructure
- Improved connectivity and walkability in the precinct

Mobilising diverse actors:

- Campus residents
- Broader Clayton homeowners and renters
- Local business owners
- Local government
- Traditional Owners

Examples of complications:

- University life is seasonal and semester based; students are a mostly transient population and most staff do not live in or near Clayton, thus limiting long-term or continuous engagement in initiatives or activities.
- Monash University and the surrounding precinct is located on the unceded lands of the People of the Kulin Nations. Recognition of Traditional Owners connection to land, waters and culture, and reconciliation between Aboriginal and Torres Strait Islander peoples and the wider Australian community is critical for just net-zero transitions to take place. First Nations knowledge systems also have an important role to play in the planning and design of net-zero futures.

Examples of possibilities:

- Monash Reuse Centre provides a pathway to prevent durable goods from going to landfill by enabling residents in the precinct to purchase low-cost second-hand items including desks, chairs and computer monitors.
- The Monash University Learning and Teaching Building (LTB) uses clay and timber materials that reference the importance of landscape and place to the Clayton Campus and student learning experience.

Frame 3: Going Green

Frontrunner focus:

Embrace circular economy principles, nature-based solutions and green infrastructures.

Priority outcomes:

- Green roofs, walls and facades – reduce urban heat island effect
- Closed-loop circular precinct: food production, waste utilisation
- Diverse range of land uses and water sensitive urban design
- More open green space to support health and wellbeing

Mobilising diverse actors:

- Monash University Buildings and Property Division
- Students and faculty in relevant schools who can advise on the the development of nature-based solutions
- Retail vendors and staff working in hospitality venues
- Relevant operations teams, e.g. cleaning staff
- Facilities and operations teams in the precinct
- Gardening and related maintenance staff
- Local government
- Asset owners in the precinct
- Local business owners
- Traditional Owners

Examples of complications:

- The food miles (distance food is transported from the time of its making until it reaches the consumer) is not visible on Campus; ascertaining this information and the infrastructural capacity of food vendors will be needed before assessing whether a closed-loop circular precinct is possible.
- The Monash University Environmental, Social and Governance (ESG) Statement sets ambitious goals for University-wide sustainability through support for campus ecosystems, buildings, transport, circular economy, net-zero emissions and community engagement. How can this ambition be scaled out to the wider Monash Technology Precinct with its complex mix of institutional actors, public and private sector actors and local residents?

Examples of possibilities:

- Make infrastructure for energy, water and waste more visible in the precinct.
- Wholefoods is a student and volunteer-run vegetarian restaurant and event space established in 1977 to provide affordable and nutritious food for the Monash student community. This collective purchases their produce from local markets wherever possible and aims to create an atmosphere that promotes social awareness and possibilities for social change (Source: Monash Wholefoods website - Mission).
- Monash Permaculture brings together students, staff and members of the local community through the Monash Permaculture Garden (MPG) and the Monash University Community Farm (MUCF). Provides workshops and activities to promote and educate staff, students and the community about permaculture, sustainability and gardening (Source: Monash Campus Sustainability website - Permaculture).

Frame 4: Innovation Hotspot

Frontrunner focus:

Emphasise the potential of the precinct to become a major geographical agglomeration for net-zero entrepreneurship, industry development, job creation and international recognition.

Priority outcomes:

- Utilise the Monash Precinct Network as a trusted third party
- Grow knowledge-worker jobs through co-location of industry R&D within the precinct
- Mobilise champions from every stakeholder group in the precinct
- Develop a searchable precinct map and directory
- Support flexible work arrangements post-COVID

Mobilising diverse actors:

- Monash Precinct Network
- Monash University
- Monash Student Associations
- City of Monash
- Victorian Government
- Start-up founders
- Skilled tech employees
- Social entrepreneurs
- NGOs
- Civil society
- Residents
- SMEs
- Co-operatives

Examples of complications:

- Innovation implies developing new ideas or technologies or systems; equally important, if less "exciting" are notions like sharing, repair and reuse
- Everyday innovations (and modes of improvisation) created by the precinct community require infrastructures (and kinds of infrastructure) that are not commonly accounted for (and cannot necessarily be predicted) for in infrastructure investment. This includes recognition of volunteer time, coordination and community mobilisation.

Examples of possibilities:

- Student-led initiatives like Monash Association of Sustainability, Precious Plastic and Solar Decathlon can be better mobilised to support emerging net-zero leadership in the campus, precinct and beyond.
- Transformative innovation and sustainability leadership also emerges from the social enterprise sector.
- The Corner Store Network is a non-profit that is working towards providing food security and climate action to communities in Timor-Leste through a direct trade model with over 640 coffee farmers. It also runs a cafe in Oakleigh that sells the coffee and supports volunteers to transform excess produce into preserved food which helps raise money, prevents waste and supports local food banks.

Bringing together transition management and design anthropology

Bringing together the theoretical and empirical findings of transition management and design anthropological research helps to create a more comprehensive understanding of the present and future of the Monash Net Zero Precinct. This enables us to make the connections and bridge the gaps between transition management and design anthropology. In doing so, we hope to overcome what is often a critical stalemate between those practitioners and researchers who believe they can drive net-zero transitions through technological and infrastructural investment and innovation, and those who investigate and seek to nurture change in experienced and practical everyday circumstances.

We invite readers to be open to shifting perspectives from thinking solely about net-zero transitions in terms of systems change to also engaging with everyday lived experiences and places as the generative sites from which we must instigate change processes. The experiential map below (Figure 5) visually represents some of the emerging seeds of transformative innovation and change in the precinct. It also shows how net-zero transitions in the precinct appear very differently when seen from the perspective of everyday experiences, complications and possibilities which the following chapters explore in greater detail through the findings from the ethnographic interviews.

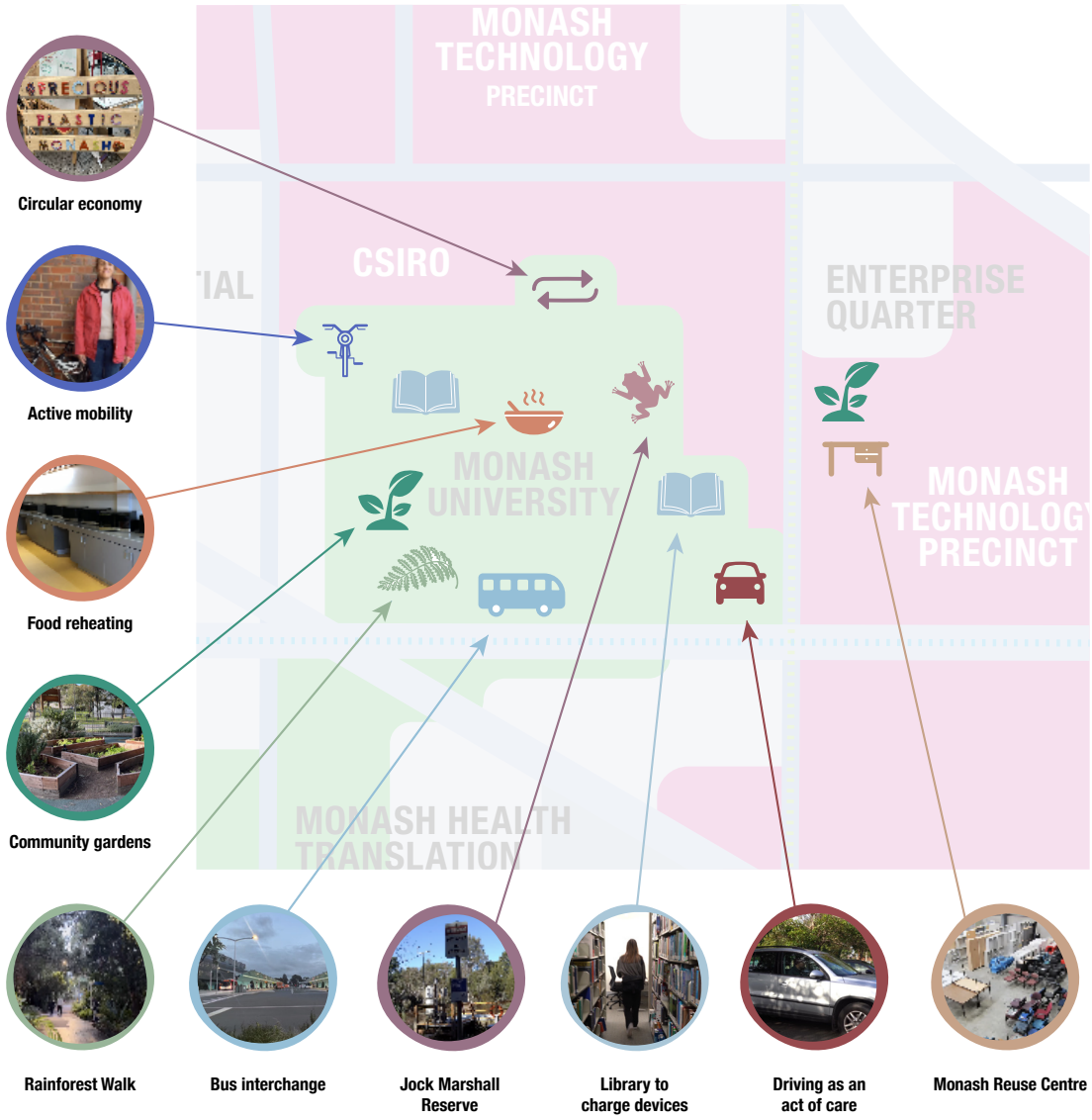


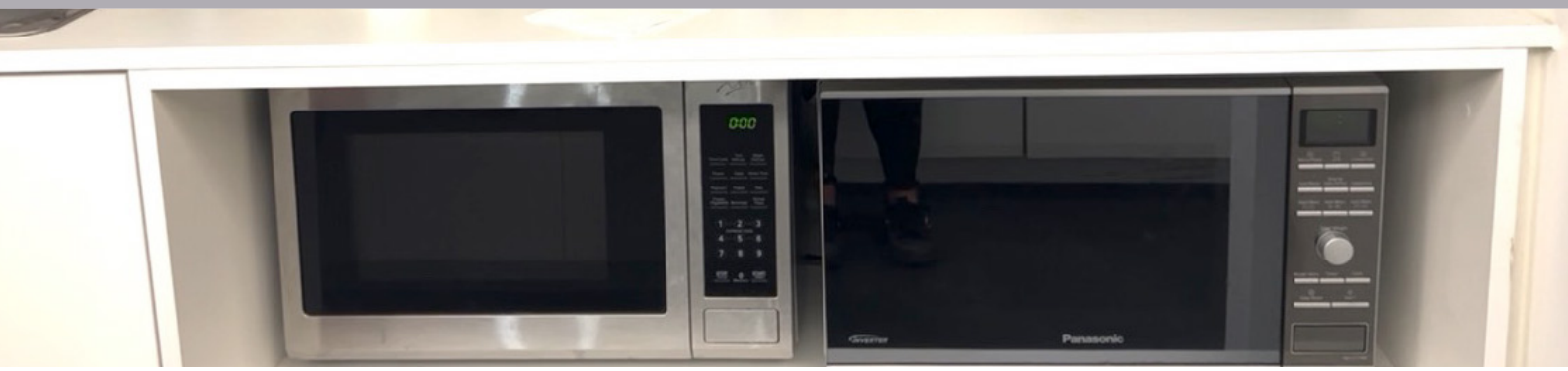
Figure 5: Experiential map of the precinct from the perspective of participants

The next sections of the report provide in-depth investigation across four domains of the precinct: mobility, energy, buildings and data and automation. Each domain explores detailed insights from the ethnographic research that focuses on the everyday lives of people which emerged through 29 walking interviews with members of the precinct community. The ethnographic findings that follow reveal that the precinct is not constituted simply through infrastructure but through a complex web of relationships between people, places, animals, buildings and technologies.

6. Energy

Energy routines at home

Many people's routines and habits are changing in response to the recent and rapid rise in energy-related costs. This has been compounded by other changes in lifestyle patterns. Studying and working from home has become increasingly normalised and this in turn has led to an increase in energy consumption. Responses to this include the use of energy data and innovative "workarounds" to reduce energy use.



A hybrid work and study model is becoming increasingly normal

At the time this research was conducted, Monash University was transitioning from an online study from home set up back to a face-to-face teaching model. During this transition period, most people who either worked or studied on campus took a hybrid approach where they would come to campus a few days a week and work or study from home for the rest of that time. Some preferred working from home so they could avoid commuting into the office, others preferred coming into the campus five days a week to create a clear delineation between work and home. Students primarily charge devices (such as laptops and phones) at home. Staff tend to charge their devices at work. Studying and working at home during lockdown made it evident to many of the participants that the heating and cooling systems they currently had were not adequate. During the transition phase many reported that even though they now had the option of going into the campus more, they preferred hybrid working even though this meant they would receive higher energy bills.

> *I had two other houses in Melbourne, the first one was too hot because it was west facing and the second one was too cold because it was a big 1920s building and airy. To make it warm you had to put on the ducted heating and I suspect that wasn't very good on the gas and economically, I think the heat leaked and all that sort of stuff.*
>
> *—Ben W, Monash staff (renter)*

Interest in energy data and bills is mixed and individualised

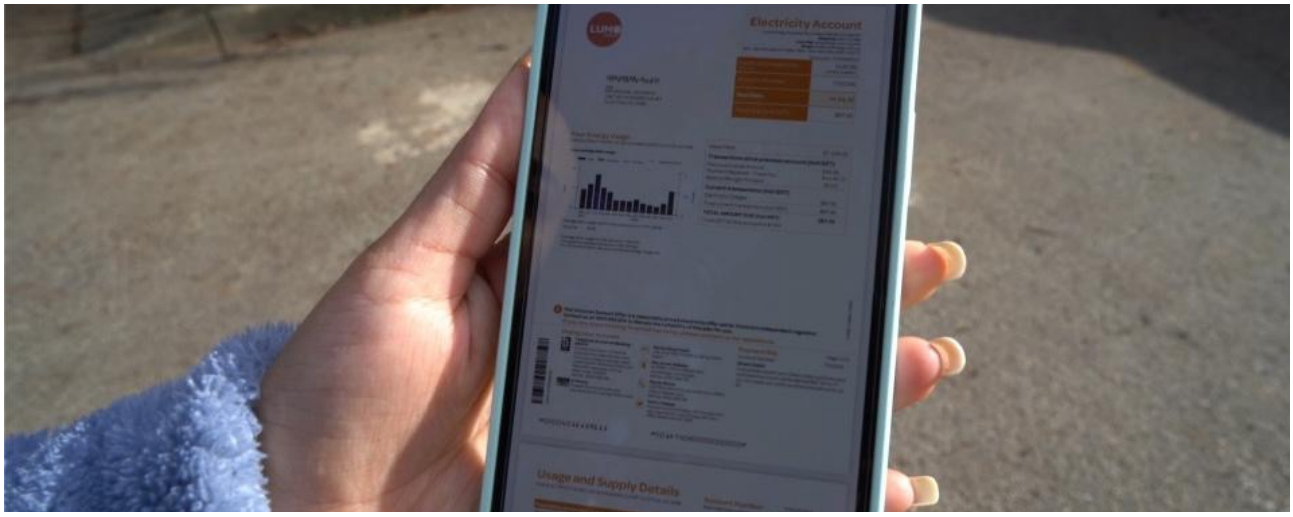
Most people reported that in the home it is normally one person who takes an active interest in household energy usage. This person would take measures to reduce or limit energy consumption, though the methods they use to do so varied. Some took a data-based approach, downloading the app (if available) by their energy provider to map out "peak" periods and avoiding the use of appliances during those periods. Despite the availability of this data, many people invested more time in manual energy-saving habits such as turning off lights, limiting air conditioning use (or not having an air conditioner at all) and air-drying clothes. These habits are grounded in the idea that "wasting" energy is bad and leads to high energy bills.

Renting plays an important role in energy consumption and the options available to people. Some live at home where the management of the bills is not up to them or they rent in sharehouses where the consumption of energy is multiplied by the number of people they live with. Few participants owned their own home; those that did had greater control over the use of energy-efficient appliances and energy technologies (such as solar panels) in their homes and were less interested in solutions that involved using energy data since they had already improvised energy-saving routines.

Image: Photo taken during fieldwork July 2022
Details: Student, Ava showing her electricity bill

> *That's something we're very, very conscious of, even if it's what time of the day you're putting the washing machine on, what time of day you're putting the dishwasher or [the] washing machine [on], leaving the lights on. It's always something we've been very, very conscious of. From a money-saving aspect, I think that's a lot of the time where my dad comes from. He's very aware of the costs of leaving lights on.*
>
> —Simon, Monash student (lives at home)

> *My electricity provider has an app as well, that's Amber Electricity, and they have your tariff on there, where you can see when the peak periods are going to be. I use that to see when the power's going to fluctuate, and try and avoid using appliances that consume a lot of energy.*
>
> —Pam, Monash staff (home owner)



People improvise creative and manual energy "workarounds" to save energy and reduce bills

Most people prefer implementing manual work-arounds to save energy; for example, switching off lights and appliances at the wall, or only using lights in the rooms that are occupied. Others, for example those who rented or had a lower-income, implemented methods that had impacts on everyday living and levels of comfort (including heating, cooling and clothes drying).

In winter when the discomfort of the cold was at its worst, people found creative ways to save energy, such as sleeping with pets to keep warm (and keep the pets warm). Others who live on the campus in Halls of Residence, who have even more restrictions than people who rent in the more conventional sense, would implement ways of saving energy even if this went against the rules of the building, such as changing the lights to more efficient bulbs.

> *The house actually has little holes everywhere. Because it's a weatherboard [house]… I made it my mission to go and tape up all the little holes. But it still doesn't keep the heat in. It doesn't keep the cold out.*
>
> —Miriam, Monash student

> *Because my mum is a single mother, and she just runs the house. So, she has a very financial mindset. She's very more about efficiency, and more pragmatic about the things she's using. Like not using the dryer is more cost efficient. But I think for me, it would also be cost but I guess also energy efficient. Yes. I think [the] same with my hair actually. I don't like blow-drying it that much.*
>
> —Teaghan, Monash student

Consuming energy on campus

People approach the consumption of energy on campus differently from use in their own homes, and this is exacerbated by a hybrid work model. In light of these lifestyle changes, new charging routines have emerged. People are also considering switching to electric vehicles as one of their primary modes of transportation. For the future of energy on campus, people were positive about sustainable technologies (such as sensors and solar) with an emphasis on control over automation. In general, people were either unaware or confused about the Monash University microgrid.

Increased number of people refrigerating and reheating food after lockdown

The COVID-19 lockdown prompted people to prepare and enjoy more meals at home given that eating out was no longer an option and ordering food quickly became an expensive habit. Transitioning back to campus has seen many people continue to prepare food at home that they then bring to campus to reheat and enjoy. When we asked people about their energy-related habits on campus, the majority of them connected their experiences with energy back to cooking and eating. The reasons for doing so varied; most people explained that this was a cost-saving practice, related directly to the increased cost of living. Buying food on campus was frequently described as an expensive habit. Preparing and eating food also contains important social dimensions; tea rooms or kitchenettes were a primary point of both energy use and social interactions. Every building on the campus has some form of meal preparation area. For students, this includes microwave and hydrotap stations – for example in the Learning and Teaching Building there are kitchenettes on each floor. In buildings that are primarily accessed by staff, kitchenettes are often accessed and utilised, especially by those who bring their own meals to campus.

> *I do have a system, I buy just enough food, and I cook just enough for the whole week. So that Saturday when I go shopping again it's a whole week pretty much. But yeah, I find that having food that I bring from home and heat up every day, it's nicer than buying food outside.*
>
> —Persie, Monash student

Image: Photo taken during fieldwork April 2022
Details: Persie reheating his lunch (sweet and sour pork) in the student kitchen in the campus centre

New charging routines are emerging

Charging has become integrated into people's daily life routines. Most people charge their personal devices such as mobile phones at home rather than on campus. The majority of staff members we interviewed charge their work laptops in their office whereas students tended to charged their laptops (if they bring one) at home or if they do charge on campus, the library is the main building they use.

As to why we do this and stuff, like sure, I could charge my laptop before I come into uni, but my laptop also will die.

—Teaghan, Monash student

Hargrave [Andrew Library] would probably be the one I'd spend most time in, because - I don't 'know, it had the nicest sections that were also the quietest, and had power points (Vlad, Monash Student)

—Vlad, Monash student

I usually work on campus Tuesday, Wednesday, Thursday. I'd leave my laptop at work on those days, take it home on Thursday and then bring it in on Tuesday.

—Romney, Monash staff

People envision flexible options for charging their electric vehicles in the future

Electric cars are anticipated as vehicles people (both staff and students) would purchase and use locally in the future. Most participants viewed EVs as more environmentally sustainable and their eventual ownership as almost inevitable. The flexibility offered by car ownership was a requirement for most participants, especially given the complex nature of public transportation to the Monash Clayton Campus. EVs are a preferred option that maintains individual car ownership above carshare or rideshare schemes. Most participants saw themselves as having EVs in the future and envisaged charging them at both home and at work.

Most people were aware that there were EV charging stations on campus, however, they did not feel confident about using them. For most of the participants, electric cars were not currently financially feasible. A few people mentioned that the energy source was a key factor in their decision-making around where to charge their electric vehicles. If the energy source was green (at work) then charging at work would be their preferred location for that activity.

> *In the future maybe. They're just quite expensive, and my partner is a tradie, so he's got a ute, which is definitely not electric. Just a good old regular ute. We considered maybe – we've just bought a – well, maybe a few months ago – a used car, and we were talking about maybe next time we'll get a used electric car. But for now, it's just outside of our budget.*
>
> —Carmen, Monash staff

> *Both [home and work are] kind of natural fits for where you spend a block of time [for charging] … the workplace might have more of a say and more control over where energy's coming from in the first place, whereas if … you live in some big apartment complex and you don't really have much say over the energy, where it's coming from, where it's going, you might feel like you're just getting it from coal in the first place.*
>
> —Ben L, Monash staff

Image: Photo taken during fieldwork May 2022
Details: Out-of-order EV charging station in the North (N1) carpark

Control over automation preferred for future technologies and upgrades to buildings

People consistently preferred personal control over automation for future heating, cooling and lighting systems in buildings. However, some acknowledged that the University could better manage and should be in control of the wider energy system for buildings. Few staff members actively sought out ways to adjust energy use in their own office spaces. In one office, staff were given the option by Buildings and Property Division (BPD) to install a desktop power switch that switches all of her energy-related desk appliances at the end of the day. Instead of letting them enter standby mode and waste energy, this switch allows them to save energy while also providing the convenience of doing it all with one switch.

> *I can see a purpose for them being automated and pre-set, because there's an entire team which manages it for the Uni, to make sure that all the buildings are performing and everyone's comfortable and it's all optimised. Like, there's my personal comfort in it, but then there's also the environmental side; or, can the building physically get to that temperature side; there's so many bits to it that I don't think [that] me, as an individual, should have that much control necessarily. Maybe at a local level.*
>
> —Sophie, Monash staff

> *I remember we went through the office, and everybody who wanted one had one of those big green switches made available for their desk, so instead of having to power off everything individually at the end of the day, and that being a task to manage, you could just hit the switch and everything's turned off and go home.*
>
> —Romney, Monash staff

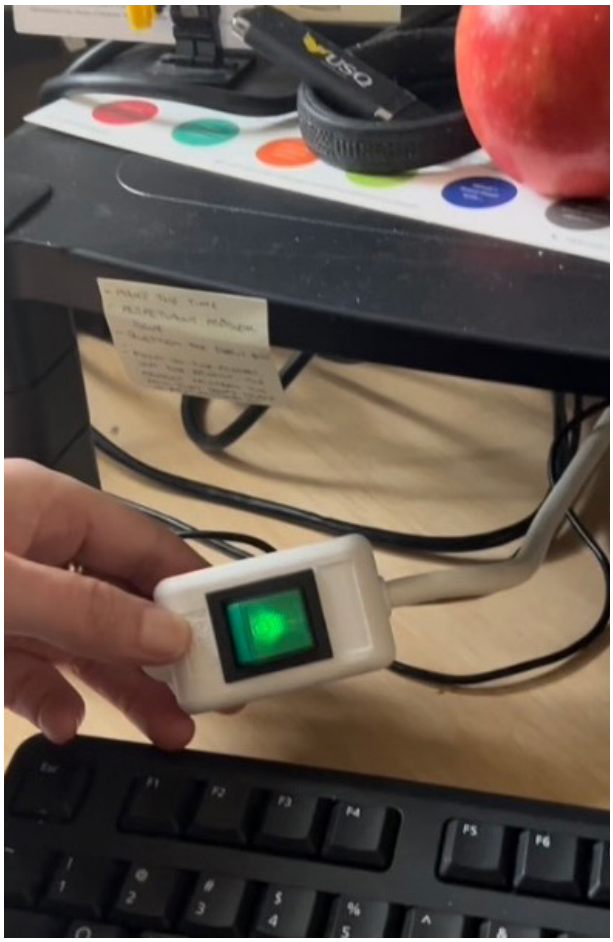


Photo taken during fieldwork June 2022
Details: Romney showing her desktop single point "off" switch

Confusion and general lack of awareness of status and value of microgrid

The majority of participants were not clear about what the purpose of a microgrid is, how it fits into the broader Net Zero Initiative's plan and how it might affect their everyday lives. For example, one student expressed that her understanding of microgrids was that they would contribute to a "self-sustaining" system, however, beyond that she had no knowledge of what that would look like or what was already happening in that space. A few of the participants who had some knowledge about microgrids and storage batteries expressed concerns that this transformation was not coming from the community, rather it was coming from the top down.

> *That's where, again, I don't know anything about that.*
>
> —Teaghan, Monash student

> *That's coming from the VC … A big part of – unfortunately a really big part of our image as a university. And I really hope that's not the only reason we're doing it, but I think it might be.*
>
> —Tim, Monash staff

> *It's the same corporate model. It's not a community model.*
>
> —Shane, Monash staff

> *Interesting. What about all the super energy-intensive equipment, like lasers and stuff: are they all going to be powered off batteries?… I imagine the amount of refrigerators they have in some of the biochem buildings, you wouldn't want some of those things getting out.*
>
> —Vlad, Monash student

Energy – Example 1

Aged in her mid-30s, Romney studied at Monash for both her undergraduate and graduate degrees and now works in one of the main libraries at the Clayton campus. Passionate about the environment, she does not drive into campus or own a car despite living in the northern suburbs. Romney said her commute into campus “isn’t as good as it could be” but she would rather be on the train than a car “with one person in them just clogging up the roads”. She uses two trains and a shuttle bus to come into campus three days a week.

Romney anticipates that she will own a car one day, however, this would be an EV, which at the moment is not feasible for her or her partner due to the “lack of subsidies” and government support. In addition, the government also needs to show “support … by rolling out more charging infrastructure”.

If the financial and structural barriers were to lift and Romney (and her partner) purchased an EV, she would like the option of charging both at home and at work. Her comfort level around charging the EV at work (Monash) comes from her confidence that it would be from a “green source”. Romney emphasised that she wants both “choice and diversity” when it comes to charging her future EV. She reflected on her interactions with her "loveable petrolhead ... neighbours" who represent the “Australian dream to be independent and own your own car [and] a big house".She hopes that EVs and car sharing and ride sharing will increase one day, despite these not being aligned with the cultural norm of individual (petrol) car ownership.

Romney mentioned that she was brought up in a home where she was encouraged to avoid “energy wastage”. For example, her parents owned a dryer that they never used. She observed them move the dryer “from house to house”. These habits have manifested in tensions in the present day between Romney and her partner. Her partner is “a big fan of having a lamp on in the bedroom” when they are not in the room because it “creates a nice energy”. These different approaches to energy in the home can create tensions.

Romney and her partner air dry their laundry rather than using a dryer, and during winter they do not let the temperature inside their home go above 22 degrees Celsius. Romney’s desire to exercise control over energy waste also extends to her work environment. At her desk she has a green switch installed which allows her to turn off all other devices at once at the end of the day. She shares her office space with one other colleague, both of whom do not like working with bright lights overheard so they applied to BPD (successfully) to have the “lights directly above their desks switched off”.

Energy – Example 2

Teaghan is a Monash student in her early 20s who lives who lives at home with her two sisters and her mum. As a single parent, her mother was her earliest role model when it comes to energy use and waste. Growing up there was always a dryer in the house, however, it was never used. Her “sister used it one time” and she was shocked at her for breaking the unwritten rule around the dryer. While her mother's reasons for these types of habits associated with energy are “pragmatic” and more about being “cost efficient”, Teaghan is “passionate about reaching net zero” and saving money at the same time.

While her mother focuses on large appliances, Teaghan has developed her own set of energy-saving practices that centre around hair drying:

Yes. I think the same with my hair actually. I don’t like blow-drying it that much. I don’t think I will ever use a dryer, to be honest.

At home Teaghan will avoid using lights and heating/ cooling systems when she can.. This also extends to her phone, which she will avoid using too much so she doesn't “have to charge it again".

These everyday practices have influenced Teaghan and the way she uses the campus. When she notices even slight instances of energy waste that she can prevent she will take action:

I don’t like to leave power points on. When I see a powerpoint on, and there is nothing in it, it really irritates me. I’m just like, “Turn it off”.

7. Mobilities

Driving to the campus is the most popular mode of transportation

Driving to campus is the way most people commute to campus. Their reasons shift depending on their life circumstances; for some it's more convenient than public transport, whereas for others it allows them to perform care work for family and friends. Parking on campus is sometimes tricky to navigate and certain times are busier than others. Carpooling and shared mobility schemes are less popular options for getting to campus.

The majority of people we interviewed use driving as the primary mode of transportation to the Monash precinct. The Clayton campus is not located in Melbourne's CBD and the majority of participants interviewed do not live in the Clayton area or nearby suburbs. Some participants reported that since returning from lockdown their travel patterns have shifted. Before lockdown they would catch public transport to the Clayton Campus, however, now they prefer to drive. This shift has occurred for a number of reasons. Firstly driving alone felt safer than travelling on crowded public transport people expressed they were concerned about catching COVID and other viruses. Second, catching public transport into the campus is complex and often takes considerable time and planning. People reported that driving and parking on campus was both more convenient and offered flexibility. Sometimes driving was not the most convenient option, for example finding parking during the semester often proved difficult and participants encountered busy roads during peak hours.

Number one would have to be that I get here a lot quicker than actually driving or walking, and the other thing is it's [riding a bike] a bit of fresh hair, clears your head out in the morning. It's just a nice way to get to work.

—Pam, Monash staff

Before COVID, I'd probably catch transport a bit more. Or if it was really expensive. But because parking is like 40 cents an hour, $2 a day, it's really – yeah. And I come here two days a week, so that's really not much in the scheme of things.

—Olivia, Monash student

Since I turned 18, the day I turned 18, I got a car and I was driving and buses just became a thing of the past. I just drove everywhere. The only time that I would ever really catch public transport is if I was going to the city and plan on having a couple of drinks and the trains are out and it's like "cool then I'm getting on the bus".

—Ryan, Monash student

For some of our participants, particularly those who are under 25 years of age, car ownership and therefore driving represents their entrance to adulthood. For many young Australians, it is a rite of passage to obtain their driving licence when they turn 18. It represents freedom of movement; the end of childhood and being reliant on family members to drive them.

Image: Photo taken during fieldwork May 2022
Details: Ryan showing Emma his new car

Driving is convenient

Driving to campus allows participants to avoid multimodal commutes, for example catching two trains and a shuttle bus. People who drive into campus enjoy the flexibility driving offers them. For some this means flexible arrival and departure times. Others enjoy the flexibility of being able to drive to meetings around campus to save time. Time was cited as one of the key reasons individuals choose one mode over another since driving was frequently described as the most time-efficient way to get to campus.

> *The flexibility. It's just basically the flexibility that I wouldn't have to – I could leave at any time that I wanted. And I could go anywhere – I think the thing is the limitations of public transport when you're in Clayton are much higher.*
>
> —Debbie, Monash student

> *I frequently have to go elsewhere. I might get called to a meeting at HR, or eSolutions, all of which are off campus. Or, I might have to go to Caulfield or Peninsula for a meeting. Like Friday, I have to go out to Peninsula campus from home in the morning for a nine o'clock [meeting], and then come back here, and then I've got another meeting off-site, and then I've got to come back here. So, it's kind of like I need the car.*
>
> —Logan, Monash staff

> *From my place, it's a seven-minute drive. If I was to catch public transport from my place, it would take me 45 minutes to get here.*
>
> —Jo, Monash staff

Driving is carework

Mobility plays a central role for the caring practices of our participants. For example, some of the people we interviewed described caring responsibilities they perform everyday and how driving enables them to fulfil these obligations. For a few, this involved driving fellow students into campus. Others travel to campus with family members who either work or study at Monash, so sharing in this instance is caring. One individual we spoke to explained that he would like to catch public transport, however, as a single father, driving allows him to ensure each morning his two sons are ready for school before he drops them off on his way to work.

> *I drive with her because she's also lived near to my apartment, and she's also my PhD friend. We started out on this journey together, so she's like a really good friend. That's why I ask her, "Okay, I'm driving to the uni so you can join me," and then she also joins.*
>
> —Daphne, Monash student

> *My sister also studies here as well so we go together, so it was also dependent on her classes as well. So sometimes 8 am, usually maybe about 10, [which is] a little more reasonable.*
>
> —India, Monash student

Parking on campus

Locating a park on campus close to one's desired work and/or study location is often a tricky task. This is especially true during the semester peak hours when the traffic coming into the campus is its heaviest. A few people get creative when it comes to parking, for instance some come to study after 4pm to utilise the free parking time-zone. Others, especially postgraduate students such as honours and PhD students, will come in to work on the weekends to avoid crowded car parks. Parking (and driving) is a source of anxiety for some people; a couple of students revealed to us that before lockdown they were involved in car accidents which changed how they related both to their cars and the experience of driving. In the quote below, India describes how after her accident she began driving to the top floor of multi-story parking structures on campus in order to avoid needing to be too close to other cars.

> *I just like it up there. It's just like it feels more guaranteed to get a spot. And I'm not a very good driver, I get quite anxious, so the more spots the better for me.*
>
> —India, Monash student

Recently, the Monash University Clayton car parks changed from half-yearly/annual permits for parking to a pay-as-you-go (PAYG) system. Most people who drive expressed that the permits were too expensive, especially for students and that the change incentivised them to drive to campus rather than take public transport since it was cheaper now and more convenient.

> *I remember we used to have the permits, the blue permits and stuff, and so I think people couldn't afford them, the one-off purchase of a $200 permit or whatever. But now since parking's $2 a day…I think it's unfortunately incentivised people to drive and park.*
>
> —India, Monash student

I guess because they shifted over to the pay-by-hour CellOPark app instead of the zones that they had for a number of years. They're just trying to keep costs ticking over when not so many people are coming to campus is my interpretation.

—Ben, Monash student

It's hard when we raise parking prices every year, and then every single year we get a large amount of feedback on "why are the parking prices going up? How dare [you]– my wages have only raised 2% but parking prices have gone up 10%". It just creates a lot of energy and discussion, which is hard to track.

—Sophie, Monash staff

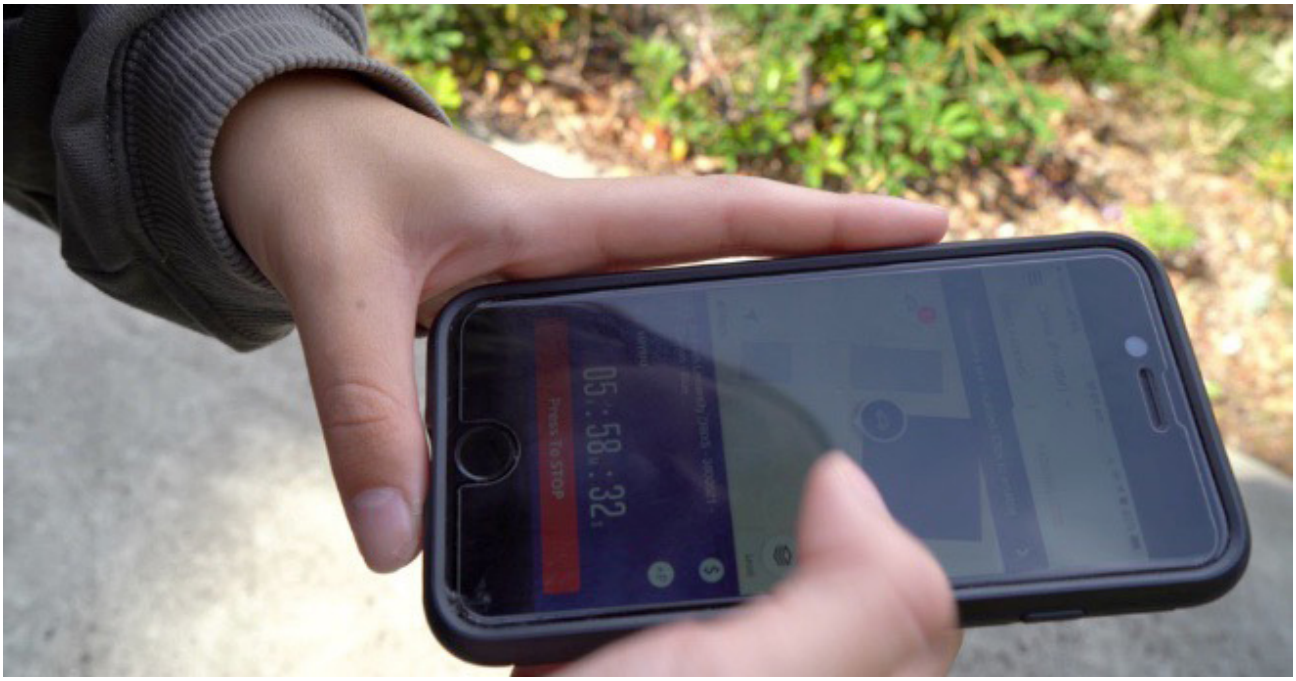


Image: Photo taken during fieldwork March 2022
Details: Olivia showing the CelloPark app on her phone

Shared mobility schemes (like car sharing) that have been made available on campus are not widely used

Several shared mobility schemes have been trialled at the Monash University Clayton Campus over the years but there is only one currently underway. Car sharing is offered at the precinct. Car sharing services make cars available for rent on-demand through allocated parking bays in limited locations. This system is operated by two companies: Flexicar and GoGet. According to the *Monash University Carshare website* there are a total of seven vehicles in Clayton: two Flexicars and five GoGet cars. Only a few participants described firsthand experiences with car sharing mobility schemes on campus or in their everyday lives; those that did described their experience in positive terms. One participant suggested that only having electric or hybrid car sharing vehicles on campus could be an opportunity to familiarise people with EVs/hybrid vehicles without having to purchase one themselves.

> *I know there's been a few times where I've had my friends on; I've been studying late on campus and my friends were like, "I'll drive you home", and they use a Flexicar. So it is very much used, however I definitely think a shift to electric Flexicars or something of the sort would be helpful, absolutely.*
>
> —Maya, Monash student

> *I'm really lucky: there's a GoGet at the end of my street and so I got a subscription, just as a back-up in case, in an emergency, I ever need to get somewhere fast, I know I can get a car. But I don't use it, really, very often.*
>
> —Sophie, Monash staff

Public transportation to the precinct is inadequate

Public transport options in the Clayton area are limited; most people experience difficulties getting to campus using public transportation. Since the campus does not have a designated train station, shuttle buses act as “gap fillers” between nearby stations that are too far away for people to walk to. However, being on public transport opens up more opportunities for people to do things such as work tasks or listening to music.

The Clayton precinct does not have a train station in a central location. The closest is Huntingdale station. The 601 Shuttle Bus runs between the train station and the campus bus top (but not across the large campus). For some participants this option was difficult to access, indirect, too time consuming and potentially unreliable, meaning it was often more viable to drive to campus. Not all participants live near a train station that is on the Pakenham or Cranbourne train line, therefore they need to change train lines. If people take public transport they have no option but to take a multimodal approach. Public transport is also subject to changes and alterations, such as replacement buses, trains or buses being late or full.

I would love to say that I get public transport but where I’m living it’s like a half an hour walk to the train station and then the train out to Clayton or Huntingdale and then the bus just – you need to be a bit more organised whereas driving I can really get here in 30 to 45 minutes.

—Anthony, Monash student

Image: Photo taken during fieldwork April 2022
Details: Monash University Clayton Bus Interchange

Taking public transport to Clayton

Public transport is sustainable

Most people recognised that the most sustainable form of transport is public transport (even if their primary mode of travel is via car). Some described their dismay observing traffic on their commute – especially post-lockdown – and the number of people sitting alone in their cars. Other forms of sustainable transport cited, such as cycling, were also mentioned. Some cited their own laziness for not riding into campus. Others were concerned for their road safety on major highways they would need to travel along in order to commute from home into the precinct. Overall, respondents reported a lack of cycling infrastructure connectivity.

> *Number one would have to be that I get here a lot quicker than actually driving or walking, and the other thing is it's a bit of fresh hair, clears your head out in the morning. It's just a nice way to get to work. Even if I lived further than what I do, I probably still would ride my bike in rather than drive or even [use] public transport. Public transport would be my second preference if I lived further away, but no, [the] bike is easy. Just get on it and you go.*
>
> —Pam, Monash staff

Public transport can also create new opportunities

Public transport options can also give people an opportunity to work and/or study while they travel which is not an option while driving. Some of the activities described by participants included studying, answering emails and marking essays. Others read or call family members. Some participants described the journey home on public transport as an opportunity to wind down and enjoy the transition.

> *I just kind of like transit at Melbourne Central which gets me home quicker. The point is that the train for me is a nice transitional moment and I can kind of wind down [from work].*
>
> —Ben W, Monash staff

Shuttle bus services function as gap fillers for the public transport system

There are three key shuttle buses that are utilised by staff and students, the first of which is the 601 shuttle bus that connects Huntingdale Station the closest station to campus to the Monash University Clayton campus. The second is the shuttle bus that runs between the Clayton and Caulfield campuses. People can catch the shuttle bus from the Clayton bus interchange for free. There are a number of conditions for using the bus service including scanning their Monash ID card when boarding (see page 84 for more details about the shuttle bus tracking system), no hot food or beverages, and wearing a mask (at the time the research was conducted). There are a limited number of seats on the bus and during peak semester times the bus can get very full, especially since seats are first-come, first-served. The third shuttle bus most commonly used by staff and students are the security buses. These buses run every 30 minutes on the Clayton campus from 5.30pm to midnight, Monday to Friday.

Daphne often walks to the campus in the morning and works on her PhD until late into the evening. She will sometimes call the security shuttle so she can be picked up from her office and dropped off home. After contracting COVID-19, Daphne has had residual symptoms including coughing and finds walking at night in the cold too difficult.

I'm not a morning person, so I normally come here around 11am, or like 10.30am, something like that, and then I can work till midnight. So, what I'll do is I'll work till midnight and then I'll call the security and they'll provide the campus buses; there's a van for the Monash students, so they'll provide that, so I'll use that as well.

—Daphne, Monash student

I take a train from North Melbourne, change at Flinders Street, get on the Packenham–Cranbourne train, get off at Huntingdale, and then take the 601 Shuttle from Huntingdale to here.

—Romney, Monash staff

Moving around campus

The Clayton campus has many green and open spaces that people enjoy walking through, sitting on and seeing throughout the day. There are a number of gardens and a lake that help create a tranquil atmosphere. Since the campus is quite large, commuting between buildings is a reality for most people; most prefer to walk rather than drive to get places on campus.

The Clayton Campus is large, especially in comparison to the other campuses in Victoria such as those located in Caulfeild, Parkville and on the Peninsula, where the majority of participants do not venture outside of their everyday routes. These routes often move from their entry point to the campus, a few key locations such as their classroom, favourite library and coffee spot.

Most people use walking as their preferred way of travelling on campus

The Monash Clayton Campus is the largest of all of the campuses; staff and students find they often have to walk long distances between classes and/or meetings. The majority of people enjoy walking through the campus as their primary mode of mobility.

> *And listen to the birdlife, it just makes me so happy. It's so peaceful walking through campus, through our areas of campus, you know?*
>
> —Layla, Monash staff

> *I love the architecture here of the Alexander Theatre, and the new LTB, and I love walking past these really old oak trees, as well. They remind me of home, because I live in a very green belt wedge suburb in Blackburn, with a lot of beautiful old established trees like this.*
>
> —Logan, Monash staff

People prefer taking green and quiet pathways to move around the campus

The peace and tranquility created by the greenery and soundscape of the native birds on campus can be best enjoyed via this way of moving. The campus includes many pockets of greenery in the form of gardens both small and large, as well as a lake. People will often carve their daily walking routes through these spaces so they can enjoy them.

> *You can actually walk through eucalypt groves and you get a nice smell of the eucalypts or there's a little in what's called Rainforest Walk is a very small clump of rainforest-type of plants. For 10 metres you feel like you're walking through rainforest and that's quite nice, in the summer it's cool. That's really nice … just [makes me] really happy, I really like it.*
>
> —Ben W, Monash staff

Image: Photo taken during fieldwork March 2022
Details: Rainforest Walk

Map-based mobile phone applications were the most commonly used form of wayfinding

A variety of map applications were used by people to navigate to and around the campus including Google Maps, Lost on Campus and the Public Transport Victoria (PTV) app. The majority of the people interviewed used Google Maps to wayfind on campus. The other key kind of map used to navigate on campus was Lost on Campus, which is an Australian campus mapping app (not unique to Monash University). The Lost on Campus map includes details not included on Google Maps or the official Monash Campus Map, such as the location of microwaves on campus. The Student Kitchen (located in the campus centre) does not appear on either of the aforementioned maps, however, the details of it are provided on Lost on Campus, including a description of the amenities and images taken and uploaded by students. Google Maps seems to be useful for getting to campus, however, getting around it can suggest longer and sometimes more convoluted routes due to its tendency to direct people to main roads rather than paths through the campus.

I think in first and second year, maybe they didn't advertise it or they didn't have it, or I just didn't know. Google Maps wasn't the go-to, we would use either Lost On Campus or the Monash map. I remember we were told to go to My Monash and then you click on Map or wherever, it was one of the tiles, so I think that's what we did. See now, all these kids come in with their Google Maps.

—India, Monash student

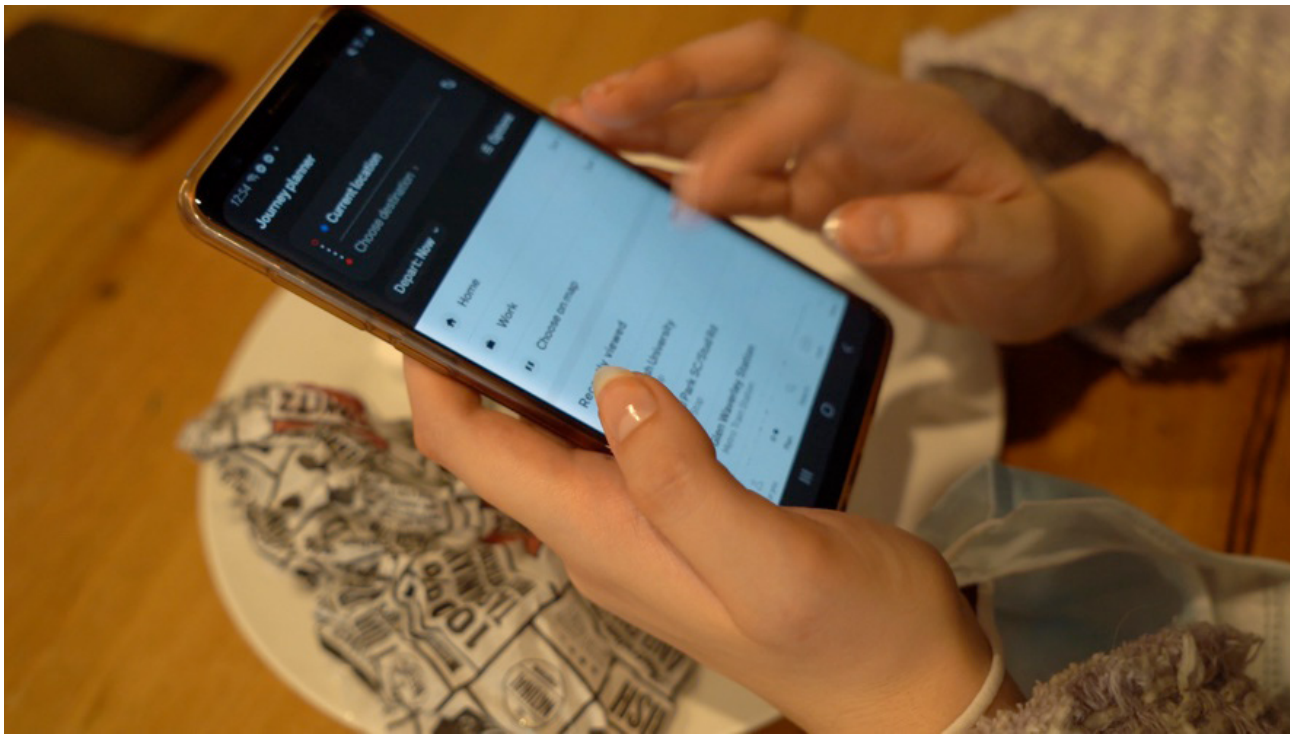


Image: Photo taken during fieldwork March 2022
Details: Olivia checking her PTV app for bus times

Previous micro-mobility trials

There have been several shared bicycle trials rolled out at the Monash University Clayton campus. The blue bike trial was run in early 2013 with Monash staff members, who were invited to participate in a bike share scheme. Monash University rolled out 40 blue bikes that were fitted with a locking system, facilities were required to register for the scheme and provided with a key (costing $300).

This was followed by the green bike scheme in 2016, which could be accessed via a key. The bikes did not come with a helmet, which was one of the major drawbacks of this scheme that contributed to a general lack of uptake. Students often did not wear a helmet which posed a problem for the campus security team.

The most recent bike scheme to be was the red bike scheme. The red bikes could be booked online or using an app and came with a helmet, bike loop to lock up and solar panel on the back. This made them less desirable to ride because the additional equipment made them heavier and more cumbersome. The bikes had several membership types available including pay-as you go, semester, annual (Monash Timeout Newsletter). The red bikes also came with GPS tracking, which was used to retrieve missing bikes.

Image: Photo taken by a participant and shared with Emma via email
Details: Red share-bike trialed at Monash

> *The [red] bikes themselves were much heavier than the green bikes, which means they weren't as good to ride. Just generally a bit shit, to be honest.*
>
> —Tim, Monash staff

> *[T]here was also a house in Clayton where someone had been collecting several bikes.*
>
> —Vlad, Monash staff

Future visions of transport and mobility

People have ideas about what Net Zero Precinct futures would look and feel like; however, most of these visions were unclear. Most viewed the inclusion of electric vehicles and chargers positively. The Suburban Rail Loop station is anticipated to change how people travel to campus (in a positive light), however, there's a sense of hesitancy about when the vision will be put into action.

Overall, respondents were generally positive about the future of sustainable transport on campus. Some even plan on purchasing an electric vehicle in the near future. Others are looking forward to the future Suburban Rail Loop being up and running so they can take advantage of the public transport near them more often.

A Net Zero Precinct that includes electric vehicles was viewed positively

When asked to imagine how EVs would fit into a future Net Zero Precinct, generally speaking their thoughts were positive. For some the focus was on decreasing fossil fuels and getting people out and commuting to campus via public transport, cycling or walking. Incentives for using EVs over traditional petrol vehicles were suggested – including installing more highly visible chargers.

> *We see a similar early morning spike in the electric vehicle charging, which is unusual, but I guess the same kind of thing. Our guess is that it's people like doctors, or people who work night shifts, who are returning home, and because our EV chargers are placed on busy roads, they'll charge on their way home.*
>
> —Sophie, Monash Staff

> *I reckon it would be electric vehicles, a lot more public transport. People who live close by would be happy to commute riding their bikes or walking. No fossil fuels whatsoever.*
>
> —Pam, Monash Staff

Future Suburban Rail Loop

People anticipate that the future rail loop will close current gaps and increase connectivity. The introduction of the rail loop has the potential to decentralise traditional petrol-based single-occupancy vehicles. Some feel that the Suburban Rail Loop is a bit of a myth, a rumour that has been circulating for years or a dream that is always just over the horizon. Those who look forward to the rail loop often added a caveat that by the time the loop is functional they will not likely still be there to enjoy the benefits. For the students who live on campus, the loop would increase their mobility options considerably and be very convenient. Some people had concerns around the increase of foot traffic in certain areas. There was some confusion about the future location of the rail loop, with most people uncertain about where the loop station would be situated on campus.

> *But I think we definitely want more electric cars as a proportion of cars, and we definitely want less cars overall because otherwise we'll have more highways and freeways, and that's why having this rail loop is, I think, a great idea; very overdue.*
>
> —Vlad, Monash staff

> *Well, I would have to take two trains, or a bus and a train, so the train is not really connected yet until the Suburban Rail [Loop] project kicks in.*
>
> —Logan, Monash staff

Mobilities – Example 1

Ursula is in her 40s and works in a professional staff role in an open-plan office on the campus. Ursula lives about 12 kilometres from the precinct, in a coastal neighbourhood which she considers to be her home and to be "close", given she previously commuted to the other side of Melbourne. Ursula works in the office three days a week, which she prefers since she shares her home with her husband, adult son, daughter and her mother, and finds it distracting to have so many people around her. But even Ursula's travel is focused around family and affective relationships of care, she has to drive to the campus every day anyway, because it is where her daughter's school is. If they leave the house on time, at 7.50 am, the drive takes them about 30 minutes, otherwise it can take a lot longer once the road becomes congested. Getting the bus would involve a 15-minute walk and 45-minute bus ride, which isn't viable as it would involve getting up much earlier.

Ursula, her husband and son all have their own cars. She and her husband have talked about getting an EV in place of their two existing petrol cars, but this is complicated because her husband works nights, so they would not be able to charge the car at home, and there are no adequate charging facilities at either of their places of work.

Mobilities – Example 2

Persie grew up in Ho Chi Minh City, Vietnam, and moved to complete his degree in the Faculty of Science at Monash University. Persie lives in the northern suburbs of Melbourne and commutes to the Clayton campus which is not a straightforward journey: he has to walk 15 minutes to North Melbourne Station, board a train to, change at Flinders Street station to the Pakenham line, disembark at Huntingdale Station, get off at Huntingdale station and then catch the university shuttle bus to the campus. Persie doesn't have a car and is afraid to ride his bike on the highways and is also unsure about the cycling laws in Australia.

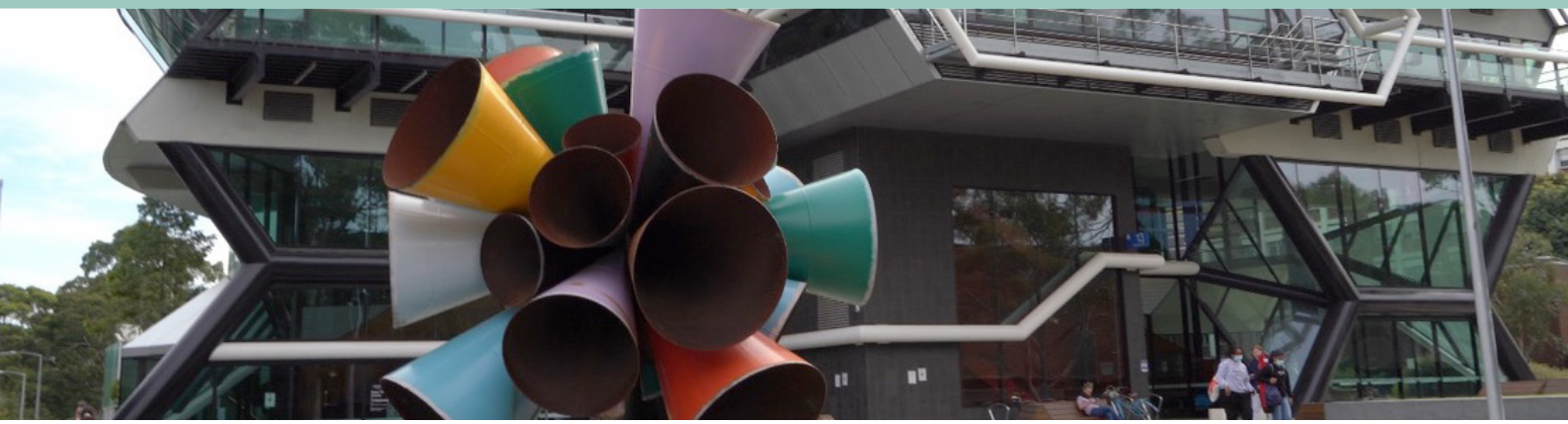
On his everyday commute he observes the large amounts of traffic on the road and he doesn't "feel safe enough with [his] bike skills to ride on that road". In his own neighbourhood he has tried out the e-bikes that are available for the public, however, he felt the price did not match the mobility benefits.

Persie's favourite place on campus is the Rainforest Walk. Even though it is outside of the most efficient way for him to move around the campus he will often detour to walk through it because he finds it so green and calming.

8. Buildings

Thermal comfort and clean air

Heating and cooling trends are changing due to variable temperatures as well as increased time spent working from home post-lockdown. Most participants viewed air-conditioned cooling and heating as essential, however, there are inconsistencies between buildings on campus which requires adaptations. There is a growing interest in technologies for improving and monitoring air quality. Additionally, there is emerging interest in sensor-controlled lighting.



Air-conditioned heating and cooling both essential and inconsistent

Overall, people reported that the thermal comfort levels in their buildings were inconsistent, and in response they implemented a variety of strategies to combat the irregularities. Some participants brought additional layers of clothing to keep warm during the colder months. Others had heaters near and/or under their desks. One participant suffered from dry eyes from the air conditioning in their office and regularly uses eye drops to treat the condition. Some were excited by the possibilities offered by technology to create self-regulating buildings that are able to automatically adapt the internal climate of the building with the temperatures outside the building. Others were interested in the opportunities offered by architectural design of buildings; for example, windows being designed to reflect the heat.

There are also buildings on campus that have large energy demands to be able to meet their cooling and heating needs – for example the Monash Sport buildings. The gyms in the Monash Sport buildings require air conditioning while people are exercising. The swimming pool is a major user of gas heating to heat the water itself, in addition to water filtration which requires additional energy.

The strategies implemented by staff who have the flexibility to make adjustments contrasts with students who live on campus in the residences. The students are restricted in the sense they are not allowed to have individual heaters in their rooms or studio apartments.

Some people put on an extra jacket, or we have little space heaters and things like that. Obviously, things will get reported to BPD [Buildings and Property Division] or whoever, builders of the property but, yeah, people just generally work out their own solutions. It's part and parcel of being in this building.

—Romney, Monash staff

Image: Photo taken during fieldwork May 2022
Details: Monash College Learning Centre

Growing interest in technologies for improving air quality

Interest in air quality management is increasing, especially during the return to onsite learning after the 2021 lockdowns. The emphasis on clean air extended beyond the campus itself, with some participants citing clean air as one of the reasons they prefer commuting to campus via their car rather than on overcrowded public transport.

On campus there was air purification operating in select venues prior to the COVID-19 crisis and 2020–2021 bushfires. The Monash Sport building for instance hosts two large heated indoor swimming pools as well as a spa, sauna and steam room. Combined with chlorine in the pool, these facilities require large amounts of air filtering to ensure the air inside the building is breathable. On top of this, there are three carbon dioxide monitors that measure the CO_2 levels in the pool that run 24 hours a day.

Another site on campus concerned with air quality is the Children's Centre. When it reopened after lockdown, air filters were introduced to monitor and improve the air quality. A number of factors were involved in this decision. The potential to reduce exposure to COVID-19 was a primary reason as was reducing the possibility of other airborne viruses being brought into the Centre by the children.

Now that we've come out of lockdown, just noticing, it's just the atmosphere's not as clear and clean as it used to be while we were in lockdown. You can see the difference now with all the cars out on the road. I mean, it's not so bad now, but you get those days where there's no wind at all, and you just see the smog and it's like, "This is horrible."

—Pam, Monash staff

I remember I was with my mum and we were on the Westgate Bridge, and then there was just this massive carbon dioxide cloud, and I was like to my mum, I'm like, "Why is that there?" And she was like, "We pollute the environment". And I was like, "Aww. Sad." So since then that's always been something important, the maintenance of the environment and sustainability as such.

—Maya, Monash student

Image: Photo taken during fieldwork May 2022
Details: Air filter located in the Monash Children's Centre

People are increasingly interested in sensors for lighting, with option for manual control

Most participants expressed an interest in installing sensors to control lighting in the primary buildings they access, with the option to override the sensors and make adjustments when desired. Some participants mentioned that their building's lighting was old fashioned and overdue for replacement with more efficient globes such as LEDs. In the residence buildings for instance, there are inconsistencies in the types of lighting installed. One staff member who works in the Halls of Residence mentioned the Passive House on the Peninsula that has both LED globes and automatic switch off.

> *Automatic lights are fantastic, I think I get more excited when I see them.*
>
> —India, Monash student

> *All our new lights are sensored. Mine sometimes go off. I'll be sitting here, it'll go off and I have to wave my hands around until it comes back on. [T]he ones in the children's rooms aren't, because the children might be too short.*
>
> —Audrey, Monash staff

Water and Waste

Participants stated that issues like water and waste are sometimes forgotten since they represent less "shiny and exciting" pathways to achieving net zero. As one person joked, if you call something net zero, like Net Zero Waste, then it might have a chance to get funding.

Waste collection is sometimes self organised rather than institutional

In the centre of the student residences in the north-east of the precinct there is a niche recycling station located in the Halls Cafe. Students often use this recycling station and it is emptied/collected regularly. The station organises waste into categories including batteries, bottle caps and e-waste. The Halls Cafe also features a cooking oil collection station where students can drop off their used cooking oil for recycling.

Monash University has its own Precious Plastic chapter. More details on this can be found in the Buildings example below.

In the Monash Sport building there there is some staff-led recycling happening; in one shared office space we toured, staff members separate batteries into their own recycling collection bucket. The necessity of this arrangement was due to the large amount of batteries used in their equipment (walkie talkies for example).

In one of the campus libraries the coffee grounds are picked up by an external company who convert the waste into compost for the Melbourne Zoo. The other recycling that happens in this particular library is organised by the staff members. They collect a variety of items, including mobile phones, soft plastics (see image), and used pens.

> *I see obviously a lot of soft plastic in the tea room downstairs, and up here as well, and I just think, well, if there's a box it's not very hard for me to take that at the end of the day, scrunch it all down. When it gets full just take the box back and take it along with my own soft plastics.*
>
> —Romney, Monash staff

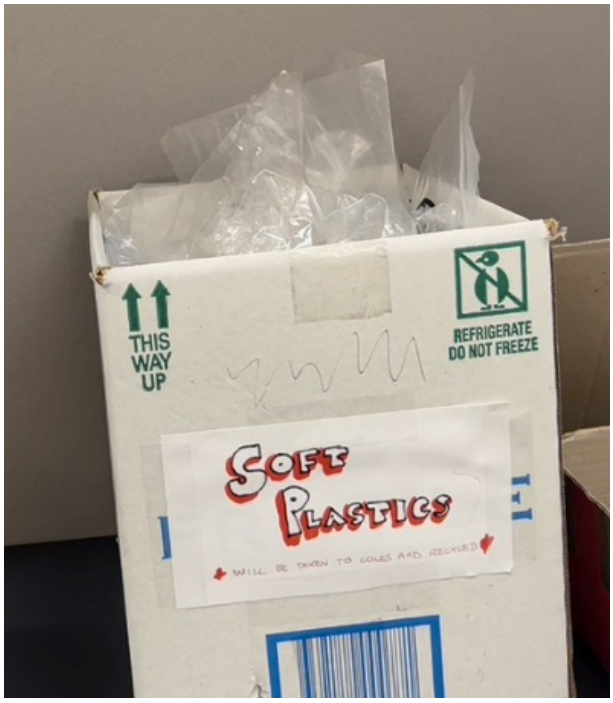


Image: Photo taken during fieldwork March 2022
Details: Soft plastics collection in workplace kitchen area

Waste reduction

Waste reduction on campus is organised around specific materials including paper, stationary and food. Some staff members raised concerns about office-related waste to their colleagues and supervisors, which led to an audit of the office stationary. Now supplies are ordered on a needs basis rather than auto-ordering. Other offices are working to reduce paper and printing, by using digital versions of documents or materials instead. Students who live on campus can take advantage of the reusable container system in the Halls Cafe.

> *So we've got as part of our waste-free dining program that we run is that these are our RETURNR Bowls. So what happens is you can, as a resident, you can come and get a RETURNR Bowl, pay six dollars, and then you basically have that bowl. Every time you come in you'll get your meal served in a RETURNR Bowl, you bring your old one in, and you return it to that place over there, and then you get a new one.*
>
> —Layla, Monash staff

Water

Water use and re-use on campus is of key concern. Some of the students we spoke to showed an awareness of the water saving and reuse practices on campus, most are not. There are a number of buildings that use grey water to flush their toilets (e.g. the Green Chemicals Building and the Jackomos and Briggs Halls of Residence. The Monash Sport Building harvests some of the water off of the roof to flush the toilets. Most people we interviewed did not indicate an awareness that grey water is used for the gardens, as indicated by the purple irrigation pipes woven throughout the beds in the campus. Most participants bring their own water bottles to campus and refill them at the numerous water stations located throughout the campus.

There are a number of water catchments located throughout the campus, some are quite aesthetic and add to the atmosphere of spaces. For example, the catchment near the South-East flats is located in front of the shared hang out space (complete with pool table and music room) and has a deck view of a catchment pond with its aeration unit. The Science Centre lake was frequently described by participants as a beautiful and tranquil place in the campus. Most did not indicate awareness that the lake is also a catchment area.

> *I mean it was funny – it was hilarious – I was walking around with my colleague a couple of weeks ago and she's like:*
>
> *"There's no sign, Shane, for the biofilter."*
> *I went, "Yeah it's there"*
> *And it's this tiny little thing.*
> *She went, "That? I've walked past that 100 times."*
>
> —Shane, Monash staff

Life on campus

While people commute in the morning and leave in the afternoon, there are many people who call the campus home. The people (and plants and animals) who live in the precinct make their own unique ecosystem of relationships, connections and stories. Understanding and interweaving into these stories and connections is a key ingredient for the future of net zero.

Halls of Residence

The Monash University Clayton campus has a total eight on-campus student residences: Clayton Urban Community, Briggs Hall, Campbell Hall, Holman Hall, Jackomos Hall, Logan Hall, Turner Hall and South-East Flats. Collectively referred to as the "Clayton Residential Village". Most of the residences are located in the north-east corner of the campus with a few in the heart, the south-east flats (as their name suggests) are nestled in the south-east sector of the campus. The College Head of the South-East flats (SEF) described them as unique compared to the other residences in terms of the layout. The newer halls are designed as studio apartments whereas the SEF have a share-house layout. Due to their location SEF can sometimes be isolated or left-out of community activities. This is exacerbated due to their location on the "wrong" side of "the Great Wall of Monash" i.e. Scenic Boulevard. Some of these community activities include "docos and dips" or documentaries paired with chips and dips, College Clash, Harry Potter movie nights, scarecrow competition and Christmas parties.

An important dimension of the residence village is the animal mascots. For example, Jackomos Hall is represented by the longneck turtle and Briggs Hall by the emu. Briggs Hall is named in honour and recognition of Mrs Geraldine Briggs AO (Aunty Gerry) the mascot for Briggs Hall is the emu, the dreaming totem of Geraldine Briggs. Jackomos Hall is named in honour and recognition of Mrs Merle Jackomos OAM, the mascot is a long neck turtle - a totem of the Yorta Yorta people. Briggs and Jackomos Hall sit side by side and share a common garden and outdoor gym installed by Monash Sport.

> *Roberts have a…common room where they have all their - like their lounging common room, is called the kennel. So all the pups go and hang out in the kennel.*
>
> —Layla, Monash Staff

Non-human residents

There are many non-human residents and visitors of the precinct who were mentioned by our participants. To name a few: Sir John the Possum, Roger the Magpie and Mr Fox. The Science Centre lake is home to families of ducks and the pond next to the Campus Park (Sports Walk) is full of goldfish. The eucalyptus trees that interweave throughout the campus are home to many varieties of birdlife. Many of the people we interviewed described the green spaces on campus and the non-human residents who live there as an integral part of why they enjoy the campus so much.

For some participants, the non-human residents are pests (like possums) who eat the apples off the trees and scatter rubbish. For others, possums are a part of the identity of the campus. One participant told us about the collective joke that the unofficial mascot for the whole university is Sir John the Possum, humorously named after the University's namesake, Sir John Monash. Participants encountered wildlife on campus in different ways. Some reflected on enjoying the animals on campus while others reflected on how their experiences with animals made them think more broadly about climate change and the impact humans are having on the environment. One participant, Ryan, stopped during our interview to gaze at the goldfish swimmingly lazily in the sun in the pond next to the campus park and reflected on his (and the world's) future in light of the changing climate.

Image: Photo taken during fieldwork September 2022
Details: Empty Dorties packet floating in the Science Centre Lake

> *I think this world's a bit of a scary place and raising a family in it but I don't think I could or really want to. I mean yeah, it just kind of brings it back to like if I'm not going to do that what else am I going to do with my life?*
>
> —Ryan, Monash student

Playing on campus

Staff and student participants who had been part of the community for ten years or more reflected that they had seen major changes to the buildings on campus from shrinking green spaces to expanding car-parking structures. Across the campus there are a number of recreational areas that have been installed in recent years. There are informal play areas and informal sports courts created by the team at Monash Sports. There is one basketball court located next to Building 63 that is frequently used by students. Some people walk or run through the campus, around the lake or using the tan track around the Monash Sports oval.

Local high schools such as John Monash Science School do not have adequate outdoor space for their students to utilise; to alleviate this they use the facilities at Monash Sport, including the outdoor areas, for lunchtime activities. This relationship between the University and high school is reciprocal – since Monash Sport offers sport scholarships, the activities they run for high school students gives students a pathway into the University.

Monash Sport is also a key site for recreational activities organised for and by the student residences. For example the College Clash is an annual competition hosted by both Monash Sport and the William Cooper Institute where students compete in a series of activities (including tug of war and shooting basketball hoops) to win the championship on behalf of their college.

Other participants mentioned more informal and micro-examples of play that form part of their everyday experience on campus. In one of the library kitchenettes for instance there is a communal puzzle on one of the tables that people contribute to each day as they enjoy their lunch or cup of tea.

> *We have a really strong relationship with the residential students. We run social sport competition programs for them. Come and try activities. Orientation days. We have major events. One is called College Clash, where they all represent their college and compete against the other colleges.*
>
> —Logan, Monash staff

Temporary and future buildings

The built environment in the precinct is not as stable as it may seem at first glance. Buildings are often undergoing construction or renovations which overflow into the paths available through the campus. At other times there are temporary buildings set up for specific events like graduation ceremonies, exams or even free food events. All of these contribute to changes in the landscape of power, water and people flowing through the campus.

Temporary buildings

Throughout the semester there are a number of temporary buildings and structures that are rapidly assembled and deconstructed. These buildings serve a number of purposes including graduations, exams and vaccination programs. These buildings shift the landscape of the campus as they are constructed (seemingly) overnight and sometimes interrupt the routine flow of people's movements through the campus. Many of these buildings require energy to operate and they make use of multiple power outlets (see image). The power cords run across major pathways through the campus and are covered to prevent students and staff from tripping. However, the power cord covering has no signage on the ground for vision-impaired students to let them know there is a change in the environment.

Image: Photo taken during fieldwork from December 2022
Details: Power running to graduation temporary building

Future buildings

There are a number of future buildings and infrastructure at different stages of construction on and around the campus. Some are in the final stages of construction or were recently completed at the time of writing (see image below of the Victorian Heart Hospital), while others exist in future imaginaries. Structures like the Suburban Rail Loop Monash Station are anticipated, but they are not yet active in terms of physical construction; however, they are just as important as those being built since they represent the future of the precinct.

> *I think that'll be – for us, we're going to try and work with … Monash will own the … there'll be a building next to the [new] railway station. We're going to try and work with them to create a clear pathway from the [new] train station to our building so that people can come from there to the gym, walk down to the gym and try and encourage people to do that or we want to put one of these little freestanding outdoor gyms at the train station or you'll see train stations these days have a half-court basketball court underneath them, something like that just to encourage movement but [I'm] not sure.*
>
> —Monash Sport staff

Image: Photo taken during fieldwork from March 2022
Details: Image of the Frearson Oval and soccer pitch in foreground and Victorian Heart Hospital in background

Buildings – Example 1

Image: Image taken during fieldwork from June 2022
Details: Image of air purification system plugged in and running in the Children's Centre

For ten years Pam has been working at the Monash Children's Centre, and for seven of those years she has been riding her bike into work. Pam lives with her husband and two children in Clayton and it takes her less than 10 minutes to ride to the Centre. She enjoys the ride: "it's a bit of fresh hair, clears your head out in the morning … it's just a nice way to get to work".

At home Pam is conscious of energy use; she feels as though she is constantly chasing after her children to stop wasting energy: "I'm always nagging at the kids, 'Do you really need two lights on in your room? Turn one off.'" Reflecting on their habits she said once her children move out they will realise how much energy waste is costing them once they are paying their own bills: "I think everyone goes through that rite of passage where … they're living at home with their parents and they take it all for granted". Pam's household does not use a dryer, opting for an Australian classic – the Hills Hoist. If it is raining she will set up a drying rack inside to take advantage of the ducted heating in the house. They have PowerPal installed at home to monitor their energy use and change their routines around appliance use depending on peak/off-peak periods. In the future they plan on buying an EV and installing solar panels on the roof to supplement their energy consumption.

In the Children's Centre there are a number of new appliances that have been installed since the lockdowns were lifted and families could return to the Centre. A number of sensor lights have been installed. Audrey who works at the front desk finds them to be annoying and inconsistent; "Mine sometimes goes off. Sometimes I'll be sitting here, it'll go off and I have to wave my hands around until it comes back on". The children's rooms were not installed with sensors after consultation with staff who recommended that sensors not be installed in the children's rooms since "the children might be too short … from an OH&S perspective … so they didn't want to automate the ones in the children's rooms".

In addition to sensors, the Centre has also installed air purifiers throughout the building "anywhere we don't have good circulation". The purifier in the image on this page is located in the reception area of the Centre; each morning and evening it is switched on and off again by a staff member. When asked about automating the system, they explained that initially the purifier had an attachment with a timer however it was "really bulky, and then it created something exciting for children to want to poke and prod at" since it was located down at their eye level. They would flick the little switches and halfway through the day she would realise that the heat lamps were on and the water dragons were getting cooked, "it used to drive me crazy in the end we ended up just getting rid of it". Turning it on and off again manually worked out to be the best option in this particular situation.

Buildings – Example 2

Anthony is studying engineering and science, and majors in environmental engineering as well as ecology and conservation biology. He is also a member of the Precious Plastic Monash chapter whose goal is to "tackle and provide solutions to the ever-growing presence of plastic pollution". The team is made up of engineers like himself as well as members who are from other faculties who are involved in the education and social media aspects of the group. He feels "it's good to see people that are from all the different faculties that are just passionate about sustainability and the environment and trying to – without sounding cheesy about make a difference, you know?"

Precious Plastic Monash is located in the Monash Makerspace which is a fabrication and prototyping facility for engineering students. The group have up until recently focused on smaller items which Anthony calls "trinket-style like earrings and keychains" and they are now transitioning to larger "cooler stuff like this … that people will have for a longer time and really get the most value". They believe that the transition to the larger items will give them "more opportunity for us to have a bigger impact on how much we're recycling".

Precious Plastic, Anthony explained, "is a global movement that was started by this guy called Dave Hakkens and so now there's different chapters all over the world and so we're just one chapter. It's all open source and so the machines that Dave Hakkens designed, he released those designs out into the world and we've now – our original team created our machine. Also this is our Integration unit and so the reason we went with something that's quite small in the grand scheme of things like if you look at other Precious Plastic chapters these machines are massive and when Dave Hakkens first made them, they were about the size of a shipping container."

The size of the Precious Plastic operation allows for mobility, which means they were able to take their machines to the Melbourne Home Show. They also transport the machines to schools to demonstrate the process of recycling the materials and explain the importance of both reducing and recycling plastic.

Waste - like water and energy - flows within and between buildings at Monash University, they help to remind everyone that buildings are not simply containers, they are sites for reshaping everyday practices and possibilities for net zero futures.

9. Data and automation

Lighting and sensors

Automated lighting systems are being trialled in certain buildings across the campus, with mixed results. The installation of sensors in the future (not just for lights) will need to account for the people who use the buildings and the primary activities they undertake.

Automating lights

Several buildings in the Clayton campus have updated their lighting systems to include automated lights, meaning they have sensors installed that sense when there are no occupants in a room or area and switch the lights off to conserve energy. These types of lights and sensors can be found in many buildings across the Clayton Campus. Audrey's experience in the Monash Children's Centre (see quote) points to the importance of taking diverse community needs into account in the design of automated systems. Some of the people we interviewed described their vision of the Net Zero Precinct as one that includes technologies like automated lights to conserve energy. For most people they felt these types of automated systems were invisible, becoming noticeable when they did not work.

> *All our new lights are sensored. Mine sometimes go off. So I'll be sitting here, it'll go off and I have to wave my hands around until it comes back on … the ones in the children's rooms aren't [automated], because the children might be too short.*
>
> —Audrey, Monash staff

I would probably imagine there would be a lot more automated lights, less light switches. Basically, sensors that sense when people are in the room. It'll switch on, switch off when people have walked out. We've got something kind of similar upstairs at the moment in the upstairs part of our gym. It senses how much light's actually flooding into the gym, and if there's a lot of light it might actually switch a couple of rows off.

—Phil, Monash staff

Data collection and security

Data collection on campus is so commonplace it has become invisible to most people. Cybersecurity has become a commonplace conversation, especially with the rise in scam calls and texts people receive.

Self tracking

Several people we interviewed regularly track parts of their day either via manually uploading the data into an app or wearable tracking devices such as Apple watches. The most common activity they tracked is the number of steps they take each day.

> *Sometimes it's good but sometimes – I also get a lot like "breathe". I mean I don't know why I get those alerts. It's time [to] breathe or something for breathing. So I get those alerts too which are a bit annoying sometimes.*
>
> —Ava, Monash student

> *So I track this stuff so that's just like how many calories you burn like active calories, exercise minutes, stand, steps. I used to be a lot more into making sure that all the rings were closed but it goes through phases. … It is nice, yeah, definitely but also I felt like during exams and stuff, that's when it really plummets and I've been on holidays as well but probably this week I'm starting back good.*
>
> —Anthony, Monash student

Other tracked activities included breathing (participants were reminded to take deeper breaths throughout the day), and some tracked their menstrual cycle.

Data collected by the University

There are multiple types of data that the University collects about the people who live, work and study at the Clayton campus. These range from building data - about who is accessing buildings, when and how long for; transport data about parking, driving, and public transport routes, and surveillance data from CCTV cameras located on buildings, security cars and body-cams on security staff members. This data collection is largely invisible to most participants, and those who are aware of the information being collected trust that the University has privacy and security measures in place to protect it. Some participants were positive about the University's data collection, giving the example of CCTV footage as something that can be used by them to recover lost property like stolen bicycles.

A variety of transport data is collected at different points around the campus. One staff member from the transport division of Buildings and Property told us that over the 14 years they have been documenting and measuring transport patterns the modes of transport have not changed significantly, "40% of people were driving; we're now at 36% of people driving … so it's pretty much the same as it was, and it's a really hard thing to move". The annual travel survey collects information about travel patterns: which campus they travel to, how they get there, how many days, what time they arrive and depart and their perspectives on the different transport modes that they choose. Other transport data that is collected includes parking data, occupancies in the different car parks, and vehicle loop counters to figure out how busy the traffic on the roads is.

Previously we outlined the various ways people move within and between campuses, with particular attention paid to how people travel between the Clayton and Caulfield campuses for work and/or study. In late June 2022 ID scanners for staff and students were installed into the Monash shuttle bus. According to the Monash University website, the purpose of this was to collect data to assess the demand for the shuttle bus and aid the design of timetables. When the scanner was first installed, travellers found it difficult to know where to hold their ID cards for scanning and some bus drivers adapted to this by placing a piece of yellow tape underneath to indicate where the ID needed to be placed. Sometimes this was not enough and the scanner could not detect the ID card; in these cases the driver themselves would hold the ID under the light to be scanned.

Image: Photo by Emma Quilty, taken during fieldwork in June 2022
Details: Sign at bus interchange informing passengers they need to scan their Monash ID card when boarding Monash shuttle buses, includes example image an ID card

I guess the way that we track our student data for transport is, everything is always deidentified. And so I don't feel an issue with looking at travel patterns, because we always look at them at quite a high holistic level. So, we're not going in and saying, "We know person A is literally travelling from their home here to uni; at this time they're doing this", in a way that would make it a bit stalkery and creepy. We don't do it at that level, which I think would be a problem if we did.

I don't have a problem with looking at the data, but I think it would be a good asset if … because we do collect so much data and it is personal things to people, even when it's aggregated – if we could – if any student could go in and see what we see. I think that'd be a good thing.

—Sophie, Monash staff

CCTV cameras

Monash University has many hundreds of cameras installed throughout the grounds and buildings at the Clayton campus. These include fixed CCTV cameras, mobile CCTV vehicle patrols, body-worn cameras that are worn by security staff members and number-plate recognition cameras. Most participants were unaware of the cameras, they are so numerous and normalised that they have become invisible. When the cameras were pointed out during walking tours, the most common response was that the cameras were there to provide evidence if a crime is committed such as theft, if a bicycle or laptop were to be stolen then the footage could be used to retrieve the item. When asked if they had any concerns about their data and its protection some participants expressed a sense of trust in the institution.

> *It's one of those things of uni though, they have so much social contract with society I feel they should be good with that sort of thing. Otherwise they're hypocritical in a sense because a lot of – isn't there a data security research centre or whatever?*
>
> —Izzy, Monash student

Others expressed concerns about the presence of CCTV being used as a means of surveillance and control:

> *I know there's a lot of people on Wholefoods who were quite concerned about the security cameras there … I was sort of thinking maybe it's not the best course of action that people are keen to … rather than finding a collaborative approach, use shame as a tool.*
>
> —Vlad, Monash student

Image: Photo by Emma Quilty, taken during fieldwork in June 2022
Details: CCTV camera located on campus

Cybersecurity

The topic of cybersecurity was raised by a number of participants during interviews, with the increase in scam phone calls and texts being an area of concern. The increase in these attempts to gain access to people's identities and accounts has led some people to be more vigilant. For instance, in the Halls Cafe located in close proximity to most of the on-campus residence halls, there are information guides to help protect against scam calls and texts. One staff member noted that this was particularly useful for students who were new to the cybersecurity threats facing Australians, such as international students. Others framed the scams as a part of everyday life, part of the flow of digital data and automated messages in their daily lives.

> *I guess that's everyday life, getting scam phone calls, because people can just access your bank account by calling your bank and having your voice, and being like, "Yeah, this is who I am," and that's scary but it's interesting.*
>
> —Shane, Monash staff

> *A lot of the time it's either a scam call or some internet fishing thing, so we just have to be vigilant. But we provide them information so they know, because we have a lot of international students that come and live with us*
>
> —Layla, Monash staff

Data and automation – Example 1

Tim possesses a deep knowledge of the Clayton Campus, having lived, studied and worked on campus for ten years. This staff member worked across both Monash Residential Services (MRS) in a residential staff role, as well as in a substantive position in a faculty on campus. Tim had lived across Jackomos Halls, Richardson Hall and South East Flats.

Isolation and mental health are serious issues, for many students and strong social networks are critical for students, not only during lockdowns but when facing stressful periods of their study such as final exams or undergoing postgraduate research. Tim told us that a few years ago a fourth-year medical student who lived in the student resident halls "in his sleep had a brain aneurysm and passed away". He was very busy with his final exams and as a result did not have an extensive social network. When he passed away in his sleep "nobody noticed for two weeks, until his mother basically called up the uni and was like, [he] has not called me in a while". As a result of this tragic event, the Monash Residential Services (MRS) instituted a new process of welfare checks and the swipe card program. Prior to this event, students had access via "metal dog tags" that allowed them to access their own student residence (but not others). However, this system did not track where people went and when, then "in the Halls of Residences … they upgraded all the dog tags to swipe access so you could then tell who had and who hadn't accessed the buildings by the swipe tag data".

The benefit from the tracking, Tim explained, is that it allows the MRS staff to assess who is at risk, such as "who has and who hasn't left the building" for extended periods of time. If this happens then someone will check up on that student: "every now and again we come across a student who hasn't left their room in seven days, hasn't contacted anyone, is actually really, really unwell, and is at really significant risk to their health and wellbeing". These welfare checks are designed to use the data to track their movements and if they appear at risk then they can make an "intervention to support their safety and their wellbeing". This type of data tracking can also be used for other "safety" reasons to see if someone has "has attempted or tried to access a building". He said for example:

If student A is stalking student B, we then have evidence of student A attempting to access student B's stairway. And then we can go to student A and say, "Are you trying to contact this person even though you've been told not to?" And they'll be like, "No, no. Never. I would never do that." And say, "Well, actually we have evidence of you doing that."

Tim feels conflicted about the fact that students are not fully aware of this process, or that when they "swipe into your building that's recorded by the building". This system was then co-opted by the contact-tracing method when the pandemic began. On the one hand Tim feels the systems are for "the benefit of the community", while on the other hand "it can be quite invasive". For instance, one student had his bicycle stolen and used CCTV footage (sent over to the police) to retrieve his bike. He does have "very strong feelings if CCTV was pointing in such a way that you could see into a resident's bedroom" however he does know that at Monash this is not allowed.

Data and automation – Example 2

Sophie began her journey at Monash as an undergraduate student, studying Environmental Engineering and Arts. In the final year of her degree she undertook workplace experience at Monash in the net zero team at the Buildings, Property & Campus Community division and then transitioned to a part-time position in the net zero data analysis team. She now works in the transport team, on sustainable transport and data management. Data collection and analysis forms a central part of both Sophie's work and personal life.

At work she collects transport data from a range of sources. This includes manually counting the number of people “getting on and off buses at the bus interchange, to figure out how many people are coming by different PT routes to Clayton”. Their team also conduct pedestrian and cyclist surveys, track the occupancies in all the different car parks and during peak semester times they use vehicle loop counters to measure road traffic. One of the major pieces of data collection they undertake is the “annual travel survey, which is a self-reporting travel pattern survey”. This is made available to both staff and students. This survey aims to identify people's travel patterns by asking them “which campus they travel to, how they get there, how many days, what time they arrive and depart, and then their perspectives on the different transport modes that they choose”.

Data also forms an important part of Sophie’s everyday life, for example, on her phone she uses the health app to track her steps. She also uses Clue which is an application designed for tracking menstrual period cycles. When visiting doctors for her autoimmune disease she will download her data from the app to identify if her periods are becoming irregular. She is able to download and interpret five years' worth of data on her period and this ability to take her data into her own hands and into a doctor's office backs up her own hunches: “I wanted to know whether I was just making it up”. Her autoimmune disease affects her “whole body” and as a result her medical team consists of several different health providers: “the more I can understand,” she explained, “and have all the information about what’s going on, then I can be that facilitator role between different healthcare professionals”.

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