Australian National University

Analysing Commuting Patterns: Path to emission reduction at ANU

Chaitry Kariya

u7774793

Veronica Shehata

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Acknowledgment

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Executive Summary

This report explores the carbon emissions generated from commuting to and from the Australian National University (ANU) campus by staff and students. The project offers a thorough examination of commuter behavior, assessing emissions by mode of transportation, and pinpoints potential to encourage active and sustainable commuting methods as part of the university's goal to reach net-zero emissions by 2040. By leveraging survey data, suburb of residence statistics, through Excel analysis and Google Earth Pro mapping, the report sets a foundation for evidence-based decision-making and sustainable policy development.

Key findings reveal that cars account for more than 95% of the 6,341 tonnes of carbon emissions from commuting that ANU generates annually. While many staff and students live within active or sustainable commuting boundaries (20-30 minutes by walking, biking, or public transport), a significant portion continue to rely on cars. This highlights opportunities to shift commuting behaviors and reduce emissions through targeted interventions.

Background

As identified in the Intergovernmental Panel on Climate Change (IPCC)'s sixth assessment report, serious action need to be taken to reduce carbon emissions to zero. These ambitions are reflected in the University's environmental management program, Dhaagun, delivered by the Environmental Sustainability team (ANU Green). ANU Green focuses on managing the environmental impact of ANU through evidence-based practical action. By analysing staff and student commuting behaviour, ANU Green aims to inform strategy development to reduce the university's carbon emissions to below zero by 2040. The focus of this project lays the groundwork for setting emission reduction targets in the near future.

The purpose of this project was to identify commuting behaviours by staff and students when going to and from ANU campus and investigate the potential to change this behavior through observation. This helps in identifying the areas of potential improvement for emissions reduction from commuting. Behavioral patterns of the commuters were analysed to assist in setting achievable targets for promoting active and sustainable modes of transport. For the purpose of this project, active mode of travel refers to commuting using walking and biking while sustainable mode of travel refers to commuting using walking, biking and public transportation in the ACT. Furthermore, acceptable travel distances were identified for each mode of travel based on the 20-minute city concept.

The '20-minute city' is a theory that originated from Portland, Oregon's 20-minute neighborhood idea. It contributes to sustainable planning by prioritizing accessible transportation methods (Da Silva et al., 2019). The aim is to create urban areas where residents can access most of their daily needs such as work, school, healthcare, shopping, and recreation within a 20-minute walk, bike ride, or public transport trip from their home. However, this could differ for various locations. In Australia, for instance, the idea of a 30-minute city is considered more suitable (Sarkar et al., 2024). Thus, the project identified acceptable travel distances for various modes with 50, 30 and 20 minutes travel distances. Given that the average commuting time in Canberra is 27 minutes (Transport Canberra, 2023) a 30 min threshold was deemed suitable for this project.

Urban planners worldwide have been inspired by the 20-minute city concept to pursue sustainable development for cities, neighbourhoods and universities. In consideration to universities, emissions from commuting are an important source of environmental, social and institutional impact. For years now, public and private universities have been conducting commuting surveys to not only analyse their impact on carbon emissions but also to achieve their individual travel objectives. Oxford Brookes university in England conducts regular travel surveys to reduce the university's reliance on single occupancy vehicle trips. Interestingly, it was identified that the stakeholder's overreliance on driving when commuting to campus does not hinder their willingness to make a change to more sustainable forms of transportation (Moore & Hayden, 2019). This report suggests that individuals are willing to make changes to their behaviour if presented with an inexpensive, environmentally friendly alternative with an acceptable travelling time and distance.

Cambridge university, on the other hand, has been using its travel survey to minimize the traffic impact in Cambridge and improve its air quality. To achieve this, the university makes regular commitments by forming a strategic partnership with the city council and city's business board as a sure way of influencing the usage of sustainable modes of transport among their stakeholders (The Cambridge Green Challenge, 2024). The report outlines parking policies as one of the main ways of introducing sustainable transport to existing car drivers in Cambridge. Notably, this can likely be applied to ANU as well. Historically, high parking permit costs at ANU have made driving more affordable than public transport. Additionally, public transport in the ACT fails to be highly effective or flexible, motivating commuters to take up driving as an alternative.

OBJECTIVES

The key objectives of this project were:

- Understanding the modes of transportation used by students and staff and their frequency while commuting to campus
- Reviewing and refining current available data to create a potential pool of individuals whose commuting behaviors can be positively changed to reduce emissions.
- Developing recommendations on the potential to encourage active and sustainable modes of travel and influence commuting behaviour
- Additional task included assisting in calculating carbon emissions from commuting. For a detailed look at carbon emissions accounting, refer to the Commuting and Working from home survey report (ANU Green, 2024).

METHODOLOGY

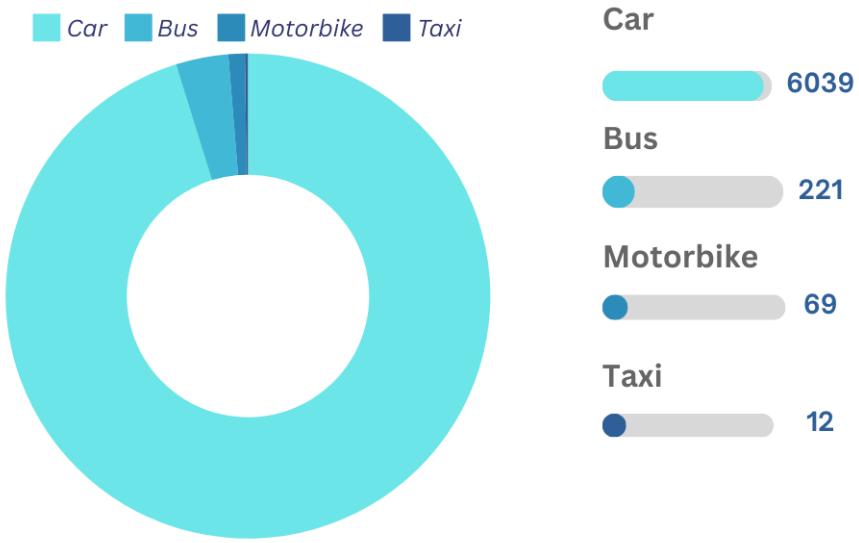
The project began with gathering data such as commuting survey data, staff and student address (suburb-level) data and parking and public transportation costs. An analysis and comparison between these were drawn using Excel. Google Earth Pro was then used to identify the acceptable distance boundaries for various travel modes. This was used to identify the potential pool of people who could encourage the change in their commuting behavior to be more sustainable. This project's methodology can be broken down into the following steps:

1. Primary analysis of the project was based on the commuting survey that was conducted by ANU in September 2024. This was the first survey on commuting that investigated the commuting patterns of staff and students at ANU. The survey excluded staff and students who lived on campus and had 1030 valid responses. The respondents were given the opportunity to provide details for up to three separate commuting journeys. For each journey, respondents were able to provide details on two different transport modes (ANU Green, 2024).
2. The survey data was compared against the suburb data that was received from the Planning and Service Performance Division at ANU. The suburb data included details on the residential postcodes of staff and students. Given that students are able to provide up to four different addresses on enrolment, it was difficult to infer which suburb a student may reside in while studying on campus. This data was cleaned as much as possible by removing duplicates, data parsing and TRIM function. However, the staff data was clean from the outset (given staff only need to provide one address when commencing employment) and assumed to be accurate.
3. Using Google Earth Pro, the estimated time taken to travel to and from ANU in specified distance boundaries was identified. This provided a list of suburbs that fell in those distance boundaries making it comparable to the suburb data. The main focus was specifying 20- and 30-minute boundaries for different modes of transport to determine the inclusion of suburbs for each distance boundaries.
4. The self-reported distance from ANU and suburb data was then used to extrapolate the number of people living in a certain area and the number of people using active or sustainable transport in that area.
5. Parking costs including vehicle running expenses (registration, fuel, servicing, insurance and depreciation) were compared with public transportation costs in the ACT to establish the most viable options for drivers in terms of overall expenses (Australian Taxation Office, 2024). This was done by working out the number of commuting days in a week and running expenses based on the annual distance travelled in kilometers.

These steps put together provided the best fit for working out the number of staff/students who have the potential to change their commuting habits to more sustainable forms of travel.

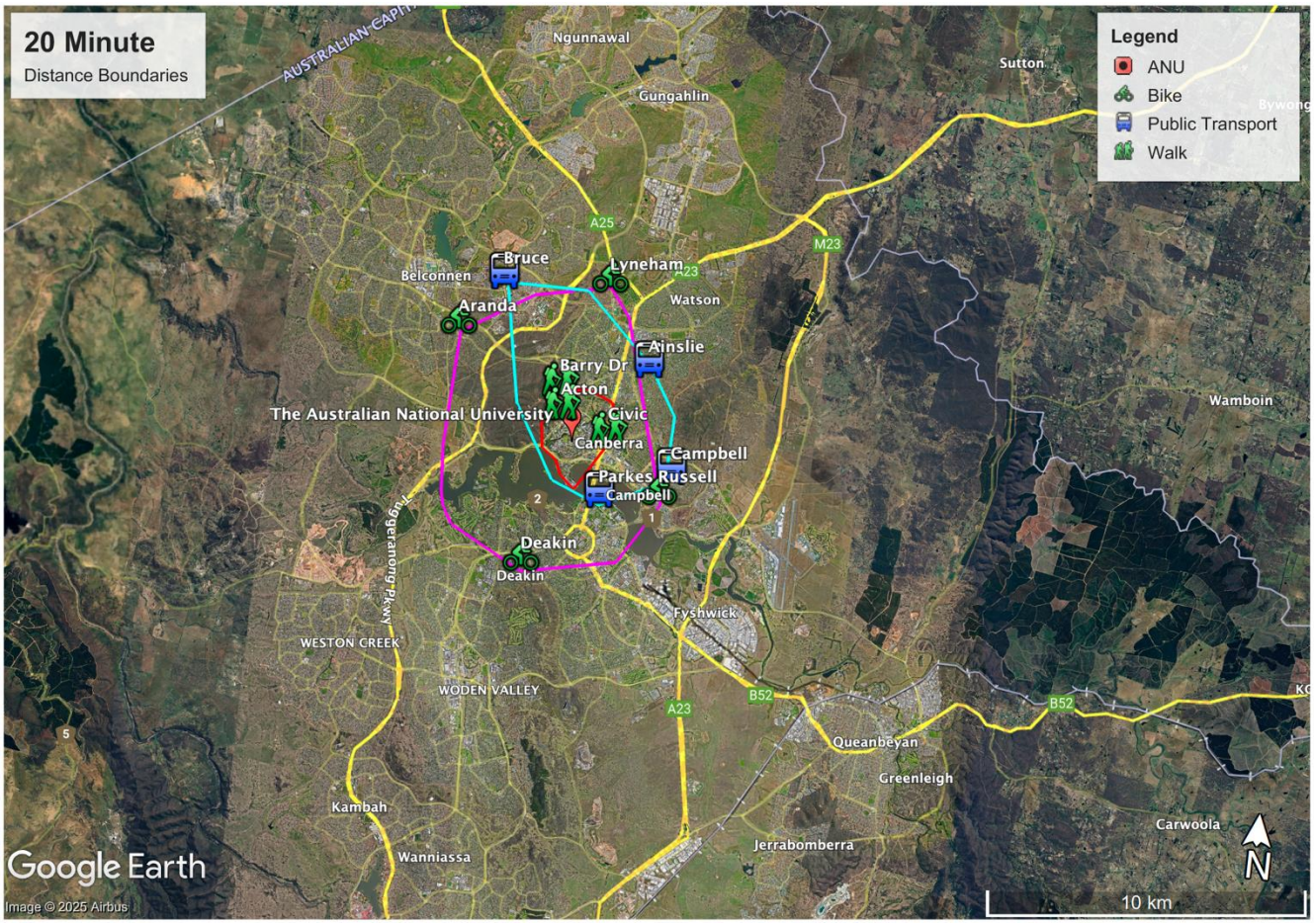
OUTCOMES

- Scope 3 emissions: It was estimated that ANU generates a total of 6341.02 tonnes of carbon every year from commuting under Scope 3. Driving is the biggest emission generator:

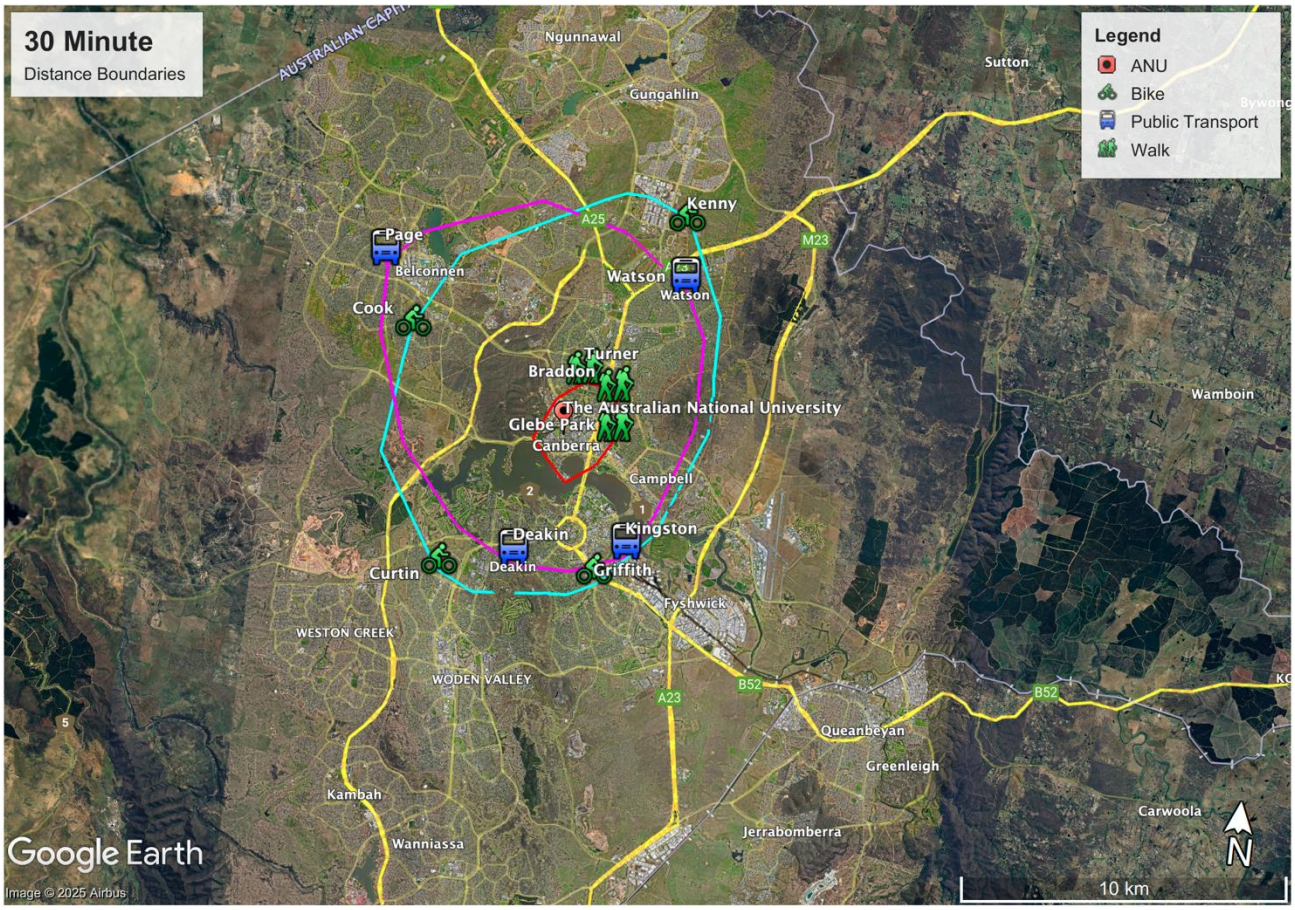


Graph 1: Annual emissions from commuting

- Distance boundaries: Following distance boundaries in the form of suburbs were identified for sustainable modes of transport for one way 20-minute and 30-minute trips. Interestingly, the public transport boundary observed for both trips is narrower than the biking distance boundaries. It further reveals that the north side of Canberra is better serviced than the South side. Mostly on the account of the light rail to Gungahlin, people living further away in the North are able to get to ANU in 20 and 30-minutes trips while people in the South need to make longer trips. For detailed analysis on time and km distance for these boundaries refer to Appendix A.

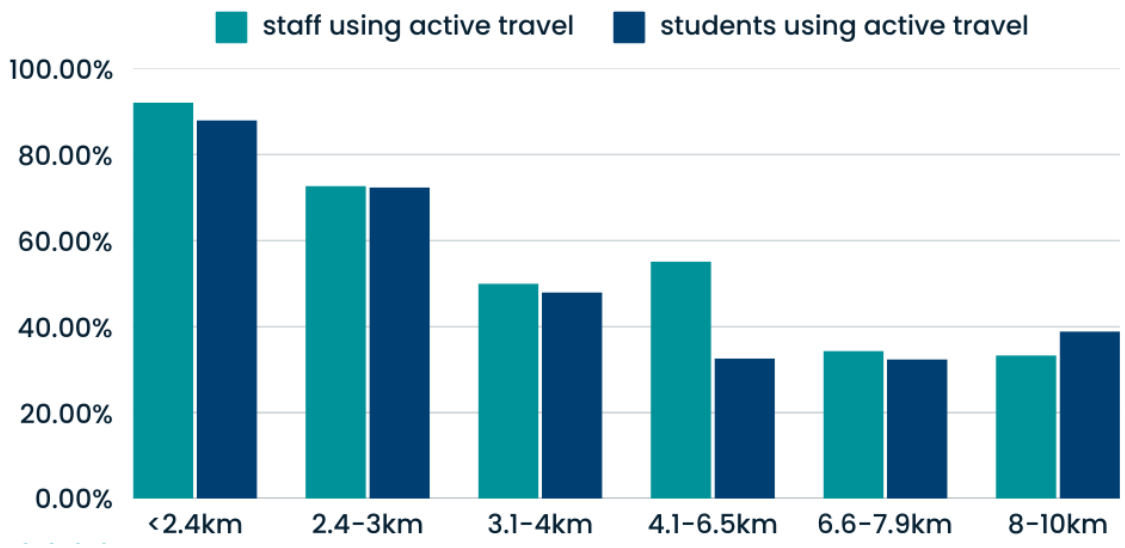


Graph 2: Distance Boundaries ~ 20-minute trip using Google map time estimations

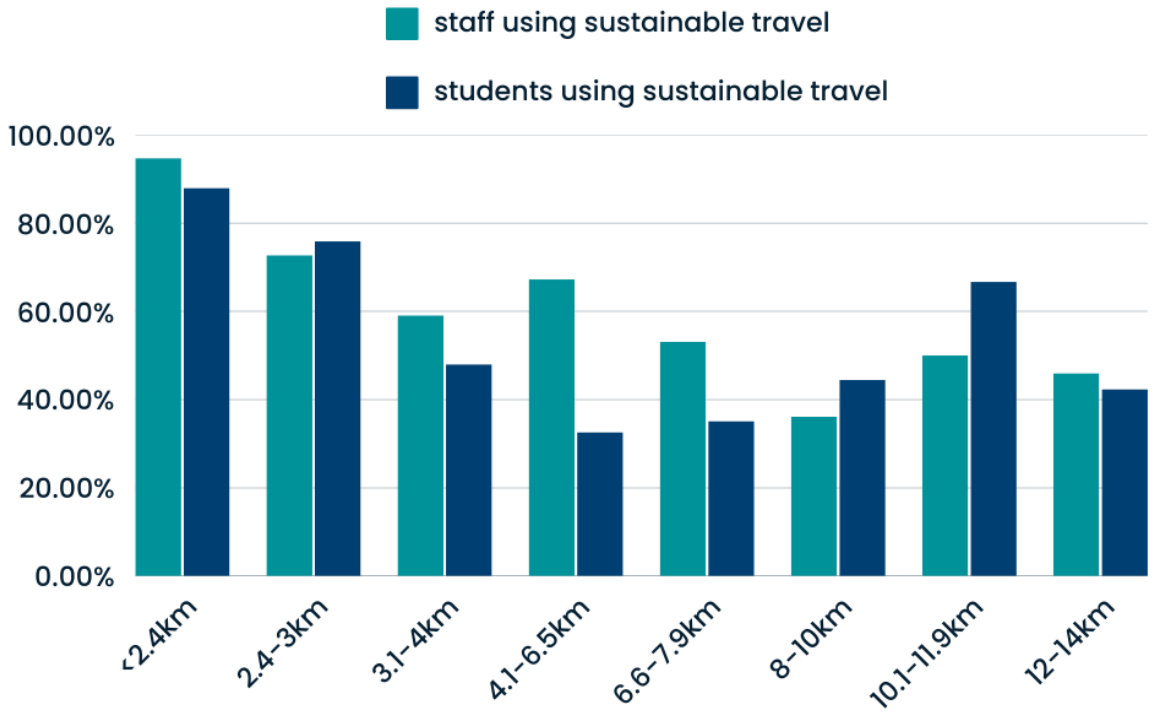


Graph 3: Distance Boundaries ~ 30-minute trip using Google map time estimations

- Potential to change: The following graphs compare the number of respondents who live within these active and sustainable transport boundaries with the number of respondents who actually use these modes of transport.



Graph 4: Active travel usage



Graph 5: Sustainable travel usage

Major conclusions that can be drawn from these findings are:

1. As the distance boundaries increase the percentage of respondents using active and sustainable travel modes decrease in both student and staff populations.
2. Overall, the staff population is more likely to use active and sustainable modes of transport.
3. Active travel usage falls below 50% once the distance boundary goes beyond 6.5km while sustainable travel usage falls below 50% once the distance boundary goes beyond 7.9km for staff population.
4. There is a substantial number of staff in the 8-10km boundary who could be encouraged to switch to biking instead of driving.
5. 67% of students living in the distance boundary (10.1-11.9km) use sustainable transport compared to the 50% staff living in the boundary and using the sustainable transport. This is the only notable higher difference between student and staff population which could be explained by staff switching to driving once the distance boundary goes beyond 10km.

The final potential pool of individuals whose commuting behaviours can be positively impacted for active travel (staff) is 1069 and students is 3599. While the final potential pool of individuals whose commuting behaviours can be positively impacted for sustainable travel (staff) is 1236 and students is 4534. Precise numbers for each distance boundaries can be observed below:

Table 1: Potential to change – Active Travel

Distance	Estimated potential to change - staff	% potential to change - staff	Estimated potential to change - students	% potential to change - students
<2.4km	28	0.50%	170	1.20%
2.4-3km	56	1.10%	227	1.70%
3.1-4km	102	2.00%	368	2.70%
4.1-6.5km	242	4.80%	878	6.40%
6.6-7.9km	195	3.80%	708	5.20%
8-10km	446	8.80%	1247	9.10%
total potential to change for active travel	**1069**	**21.00%**	**3599**	**26.40%**

Table 2: Potential to change – Sustainable travel

Distance	Estimated potential to change - staff	% potential to change - staff	Estimated potential to change - students	% potential to change - students
<2.4km	19	0.40%	170	1.20%
2.4-3km	56	1.10%	198	1.40%
3.1-4km	84	1.60%	368	2.70%
4.1-6.5km	177	3.50%	878	6.40%
6.6-7.9km	139	2.70%	680	5.00%
8-10km	427	8.40%	1133	8.30%
10.1-11.9km	84	1.60%	142	1.00%
12-14km	251	4.90%	963	7.10%
total potential to change for sustainable travel	**1236**	**24.30%**	**4534**	**33.20%**

Economic analysis:

Since the increase in parking costs on campus after the survey, now for the first-time public transport in ACT is cheaper than parking permits at ANU. This is in the interest of the project as it implicitly promotes sustainable modes of transportation. While staff can save almost half of their commuting cost ($1333 annually for a 5-day commute) if they take public transport to work every working day, students can save 70% of their cost ($915 annually for a 5-day commute) if they take public transport every commuting day. The savings are even more significant when taking car running costs into account (Australian Taxation Office, 2024). For instance, a staff member who lives 10km from ANU and commutes 5 days a week would save 80% of their commuting costs in a year ($5470). For detailed analysis on the running costs based on distance travelled, refer to Appendix B & Appendix C.

Table 3: Parking permit vs public transportation costs - Staff

Yearly surface permit fees	$2,581.55				
Public transport - 2 way	$6.64				
Commuting days in a week	Permit ($)	PT rate $ (non - Fridays)	Savings ($)	PT rate $ (Free Fridays)	Savings ($)
5	2581.55	1248.32	1333.23	1248.32	1333.23
4	2581.55	1248.32	1333.23	936.24	1645.31
3	2581.55	936.24	1645.31	624.16	1957.39
2	2581.55	624.16	1957.39	312.08	2269.47
1	2581.55	312.08	2269.47	0	2581.55

Table 4: Parking permit vs public transportation costs - Students

Yearly surface permit fees	$1,287.45				
Public transport rate - 2 way	$3.32				
Commuting days in a week	Permit ($)	PT rate $ (non - Fridays)	Savings ($)	PT rate $ (Free Fridays)	Savings ($)
5	1287.45	371.84	915.61	371.84	915.61
4	1287.45	371.84	915.61	278.88	1008.57
3	1287.45	278.88	1008.57	185.92	1101.53
2	1287.45	185.92	1101.53	92.96	1194.49
1	1287.45	92.96	1194.49	0	1287.45

Values

This project adds theoretical and practical benefits to the organization and beyond. The theoretical benefits are listed here:

- Provides concrete data on commuting patterns of ANU staff and students, providing a foundation for evidence-based decision making
- Enhances understanding of behavioural preferences, contributing to research on transportation and sustainability
- Provides data to set achievable carbon emission reduction targets, strengthening ANU's commitment to environmental stewardship
- Fosters a sense of community by promoting shared transport options and equitable access to sustainable modes of commuting

Some of the practical benefits of the project are:

- Identifies distance boundaries with the highest potential for emission reductions, allowing ANU to prioritize impactful interventions
- Supports future policies that encourage active and sustainable commuting, ensuring alignment with ANU's broader sustainability objectives
- Demonstrates how commuting costs for staff and students can be reduced by highlighting savings to be made by using affordable alternatives such as public transport and active travel

Limitations

- The commuting survey was designed primarily to estimate emissions and thus, does not capture the relationship between distance and time taken for commuting, which can influence mode preferences. Additionally, the survey did not ask for reasons why people did/did not use sustainable transport, and there may be valid reasons why people need to drive, so the number of people who could potentially change their behaviour would likely be less than what it estimated.
- The reliance on self-reported data introduces potential biases, such as over- or underrepresentation of certain groups.
- Incomplete and inconsistent information on students' postcode locations limits the precision of commuting pattern analyses.
- Use of generalised campus postcodes for students may obscure specific commuting trends.
- The report reflects commuting patterns at a specific point in time and may not account for future developments, such as new transport infrastructure or population shifts.

Recommendations

- Conduct follow-up commuting surveys annually or biennially to monitor evolving patterns and include time as a critical variable. It would be important to conduct the survey again next year as parking prices increased after this survey was done which is likely to have a significant impact on people's commuting behaviour.
- Utilize simulation tools to predict the long-term impact of proposed changes on carbon emissions through commuting behaviours.
- Collaborate with city councils and transport authorities to align ANU's policies with broader urban sustainability strategies.
- Explore the effects of proposed interventions observed conclusion on different demographic groups to ensure equitable access to sustainable transport**.**

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Appendix A

20-minute distance boundaries for walking, biking and public transport

Suburb Boundary	Distance (km)	8:30am (minutes)	5pm (minutes)
Acton	1.3	16	19
Civic	1.6	23	23
Barry Dr	1.7	22	23

Walking

Suburb Boundary	Distance (km)	8:30am (minutes)	5pm (minutes)
Lyneham	6.1	21	20
Russel	5.2	16	19
Deakin	6.3	21	26
Aranda	6.8	25	25

Biking

Suburb Boundary	Distance (km)	8:30am (minutes)	5pm (minutes)
Bruce	6.6	21	20
Ainslie	3.3	24	26
Parkes	4	19	17
Campbell	5	25	26

Public Transport

Appendix B

Parking permit vs Single day rate vs Public Transportation costs for commuting 5 days a week in a year including car running costs as per ATO (Staff)

Running expense rate per km - ATO		0.88		
Yearly surface permit fees		2581.55		
total km in a day	**total km in a year - 5 days**	**parking permit cost**	**single day rate cost**	**PT rate**
20	4700	6717.55	8112.2	1248.32
20.5	4817.5	6820.95	8215.6	1248.32
21	4935	6924.35	8319	1248.32
21.5	5052.5	7027.75	8422.4	1248.32
22	5170	7131.15	8525.8	1248.32
22.5	5287.5	7234.55	8629.2	1248.32
23	5405	7337.95	8732.6	1248.32
23.5	5522.5	7441.35	8836	1248.32
24	5640	7544.75	8939.4	1248.32
24.5	5757.5	7648.15	9042.8	1248.32
25	5875	7751.55	9146.2	1248.32
25.5	5992.5	7854.95	9249.6	1248.32
26	6110	7958.35	9353	1248.32
26.5	6227.5	8061.75	9456.4	1248.32
27	6345	8165.15	9559.8	1248.32
27.5	6462.5	8268.55	9663.2	1248.32
28	6580	8371.95	9766.6	1248.32
28.5	6697.5	8475.35	9870	1248.32
29	6815	8578.75	9973.4	1248.32
29.5	6932.5	8682.15	10076.8	1248.32
30	7050	8785.55	10180.2	1248.32
30.5	7167.5	8888.95	10283.6	1248.32
31	7285	8992.35	10387	1248.32
31.5	7402.5	9095.75	10490.4	1248.32
32	7520	9199.15	10593.8	1248.32
32.5	7637.5	9302.55	10697.2	1248.32
33	7755	9405.95	10800.6	1248.32
33.5	7872.5	9509.35	10904	1248.32
34	7990	9612.75	11007.4	1248.32
34.5	8107.5	9716.15	11110.8	1248.32
35	8225	9819.55	11214.2	1248.32
35.5	8342.5	9922.95	11317.6	1248.32
36	8460	10026.35	11421	1248.32

36.5	8577.5	10129.75	11524.4	1248.32
37	8695	10233.15	11627.8	1248.32
37.5	8812.5	10336.55	11731.2	1248.32
38	8930	10439.95	11834.6	1248.32
38.5	9047.5	10543.35	11938	1248.32
39	9165	10646.75	12041.4	1248.32
39.5	9282.5	10750.15	12144.8	1248.32
40	9400	10853.55	12248.2	1248.32

Appendix C

Parking permit vs Single day rate vs Public Transportation costs for commuting 5 days a week in a year including car running costs as per ATO (Students)

Running expense rate per km - ATO		0.88		
Yearly surface permit fees		2581.55		
total km in a day	**total km in a year - 5 days**	**parking permit cost**	**single day rate cost**	**PT rate**
20	4700	6717.55	6504.8	371.84
20.5	4817.5	6820.95	6608.2	371.84
21	4935	6924.35	6711.6	371.84
21.5	5052.5	7027.75	6815	371.84
22	5170	7131.15	6918.4	371.84
22.5	5287.5	7234.55	7021.8	371.84
23	5405	7337.95	7125.2	371.84
23.5	5522.5	7441.35	7228.6	371.84
24	5640	7544.75	7332	371.84
24.5	5757.5	7648.15	7435.4	371.84
25	5875	7751.55	7538.8	371.84
25.5	5992.5	7854.95	7642.2	371.84
26	6110	7958.35	7745.6	371.84
26.5	6227.5	8061.75	7849	371.84
27	6345	8165.15	7952.4	371.84
27.5	6462.5	8268.55	8055.8	371.84
28	6580	8371.95	8159.2	371.84
28.5	6697.5	8475.35	8262.6	371.84
29	6815	8578.75	8366	371.84
29.5	6932.5	8682.15	8469.4	371.84
30	7050	8785.55	8572.8	371.84
30.5	7167.5	8888.95	8676.2	371.84
31	7285	8992.35	8779.6	371.84
31.5	7402.5	9095.75	8883	371.84
32	7520	9199.15	8986.4	371.84
32.5	7637.5	9302.55	9089.8	371.84
33	7755	9405.95	9193.2	371.84
33.5	7872.5	9509.35	9296.6	371.84
34	7990	9612.75	9400	371.84
34.5	8107.5	9716.15	9503.4	371.84
35	8225	9819.55	9606.8	371.84
35.5	8342.5	9922.95	9710.2	371.84
36	8460	10026.35	9813.6	371.84

36.5	8577.5	10129.75	9917	371.84
37	8695	10233.15	10020.4	371.84
37.5	8812.5	10336.55	10123.8	371.84
38	8930	10439.95	10227.2	371.84
38.5	9047.5	10543.35	10330.6	371.84
39	9165	10646.75	10434	371.84
39.5	9282.5	10750.15	10537.4	371.84
40	9400	10853.55	10640.8	371.84