Strategic Transport and Travel Plan

Development Technical Note

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Table of contents

1 Introduction 2
2 Approach....2
3 Modelling Inputs....2
3.1 Baseline Data 2
3.2 Mode Share Changes....3
3.3 Diversion Factors....4
3.4 Allowed Distance Bands....5
3.5 Influence of Actions 6

4 References....7

1 Introduction

This Technical Note summarises the development methodology for the University of Glasgow's Strategic Transport and Travel Plan (STTP) 2024-2030.

In collaboration with the University, a series of travel planning actions were developed, and a high-level carbon modelling exercise was undertaken to identify what reduction in commuting-related carbon emissions the University could achieve if the actions are implemented. The outputs of this assessment were presented in a Power BI dashboard for publication on the University's website. This Note sets out the carbon modelling methodology and summarises the key evidence, assumptions, and decisions that informed the analysis.

2 Approach

The approach to the STTP modelling exercise is described below and illustrated on Figure 2-1.

1. An action is implemented (e.g. increase access to bike hire).
2. The action alters mode share, calculated as a function of total annual commuting trips. Diversion factors are applied to estimate the proportion of trips shifting from one mode (e.g. car) to another (e.g. cycling), resulting in revised annual trip totals by mode.
3. Changes in annual trips by mode lead to corresponding changes in vehicle kilometres travelled. Baseline trip distances are taken from the University's 2024 staff and student commuting travel survey.
4. As carbon emissions are proportional to distance travelled, changes in vehicle kilometres result in changes in carbon emissions. Carbon emissions are calculated using Department for Transport carbon conversion factors.[1] Carbon emissions are the metric the University committed to reducing in the Glasgow Green Climate Change Strategy.

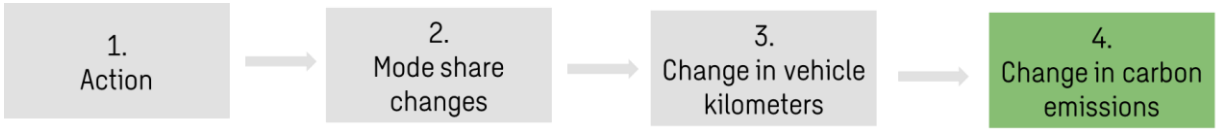

Figure 2-1: Illustration of approach to STTP carbon modelling

The modelling exercise was undertaken as a high-level, strategic exercise to provide an indicative understanding of mode share, distances travelled, and carbon emissions associated with commuting travel to the University. The analysis relies on a number of assumptions and derived inputs, using standard factors (e.g. Department for Transport factors detailed later in this Note) and typical travel behaviours rather than detailed, empirical data that takes account of local variations. Where data gaps existed, professional judgement was used to determine reasonable and proportionate estimates. As such, the results of actions should be viewed as broad, indicative outputs that are appropriate for comparing scenarios and identifying opportunities, rather than as a precise measure of predicted real-world impacts.

3 Modelling Inputs

This section presents the main inputs to the model.

3.1 Baseline Data

Baseline data was taken from the results of the University's 2024 staff and student commuting travel survey. Data used included: travel mode; engine type (if driving/car was stated as travel mode); 2024 carbon conversion factors[1], one-way commute distance; number of commuting days per week; number of commuting weeks per year; role (staff or student); and expansion factor (the factor applied to scale survey responses for the entire University staff and student population).

3.2 Mode Share Changes

Table 3-1 details the estimated mode share or percentage change in trips and supporting evidence for the actions presented in the STTP. **Appendix A** details the mode share change for each action option presented in the dashboard.

Table 3-1: Mode share changes and supporting evidence (continues overleaf)

Action	Maximum mode share change (%pt) or percentage change in trips	Evidence
Access to Bike Hire	A 2% increase in cycling mode share	Analysis of travel survey reports before and after the introduction of cycle hire schemes in UK university cities indicates modest increases in cycling mode share. The University of Reading experienced a 2–3 percentage point increase, the University of Bristol a 1–2 percentage point increase, and the University of Nottingham a 2–4 percentage point increase, with ranges reflecting differences between campuses and survey years.[2] In all cases, cycle hire was introduced alongside other measures within wider university travel plans. Taking this into account, and acknowledging the existing availability of Voi bike hire in Glasgow, a 2% increase in cycle mode share has been approximated if extended bike hire access is provided for staff and students.
Bike Hire Discount	A maximum 25% increase in cycling trips	Department for Transport guidance[3] was used to estimate the impact of a fare reduction. A 20% reduction in bike hire fares was approximated to result in a 5% increase in cycle trips. A low sensitivity to price changes was applied, reflecting that small bike hire price changes have a limited influence on travel behaviour. For example, a price reduction from £1.50 to £1.20 will not have a major impact. This conservative approach recognises that bike hire may not be suitable or attractive for all staff and students, so the overall increase in cycling is modest. Free bike hire is approximated to increase cycle trips by 25% where it removes cost barriers for staff and students already inclined to cycle as well as converting trips that were previously undertaken by walking. Considering weather constraints, trips distance and other influencing factors this is considered a reasonable prediction based on professional judgement without the availability of direct evidence. Additionally, although not considered in this carbon modelling, this action has potential to significantly increase the number of trips undertaken by bike for leisure journeys.
Cycle Parking	A 3% increase in cycling mode share	UK studies consistently show that high quality, secure, well-located cycling parking is a critical enabling factor for increasing mode share.[4] A maximum 3% increase in mode share has been approximated using professional judgement if enhanced cycle parking is available.
Cycle Plus Scheme	A 1% increase or decrease in cycle mode share	Almost 4 in 10 (38%) of the UK Government Cycle to Work Scheme users did not cycle to work and from work before using the scheme.[5] This suggests the scheme influenced the behaviour of this group of scheme users. A 1% increase or decrease in cycling mode share is approximated if promotion of the scheme is enhanced or stopped.
On-campus Infrastructure & Facilities	A 0.5% increase in walking or wheeling mode share and a 1.5% increase in cycling mode share	It is recognised that facilities such as lockers, showers, drying rooms, changing spaces play a critical enabling role in increasing the mode share of active travel.[6] If the University improves on-campus infrastructure and facilities a 0.5% increase in walking or wheeling mode shared is approximated and a 1.5% increase in cycling mode share is approximated. These estimates are based on professional judgement.
Off-campus Infrastructure & Facilities	A maximum 5% increase in walking or wheeling mode share; and a 10% increase in cycling mode share	There is strong evidence in Glasgow that delivery of high-quality active travel corridors increases active travel. For example, following the construction of the South City Way there was a 65% increase in cyclists and 13% increase in pedestrians using the route at commuting times.[7] With an enhanced delivery of off-campus infrastructure and facilities, walking or wheeling mode share is approximated to increase by up to 5%, while cycling mode share is approximated to increase by up to 10%.

Action	Maximum mode share change (%pt) or percentage change in trips	Evidence
Public Transport Services	A 15% increase to public transport mode share	DfT-commissioned research by RAND Europe indicates that improvements to public transport journey time, reliability and frequency lead to significant increases in bus demand and mode shift from car.[8] Building upon this evidence and professional judgement, a maximum 15% increase in public transport mode share is estimated if an enhanced offering of public transport services is delivered.
Public Transport Information	A 0.5% increase or decrease in public transport mode share	Given the wide availability of public transport information from operators and integrated map-based services such as Google Maps, removing or enhancement of this action is not expected to have a significant impact. Therefore a 0.5% increase or decrease in public transport mode share is approximated.
Public Transport Discounts	A maximum 13% increase in public transport trips	Based on Department for Transport guidance[3], reducing public transport fares by 20% would encourage more people to use public transport. Using typical evidence on how passengers respond to fare changes, this reduction is approximated to lead to a 13% increase in public transport trips.
Behaviour Change Promotion	A 2% increase in car mode share	There is limited evidence where universities have removed active travel behaviour change activities and then measured the effect on mode share. Evidence from the UK Department for Transport's Smarter Choices programme shows that while workplace travel plans can reduce car mode share by several percentage points, these gains are not fully sustained where behaviour change activities are withdrawn, with travel patterns tending to revert towards baseline over time.[9] A 2% increase in car mode share is approximated if sustainable travel behaviour change measures are removed.
Parking Review	A 10% decrease in car mode share	There is strong evidence that car mode share is influenced by parking pricing and parking availability. These factors can reduce car modal split by 25-50% compared to a baseline where there is ample free parking.[10] Given the existing availability and restrictions on parking at campuses a 10% car mode share decrease has been approximated.
Electric Vehicle Infrastructure	20%pt increase in proportion of car trips undertaken by electric vehicles (EVs)	Workplace charging availability substantially increases the feasibility of electric vehicle (EV) ownership for households unable to install home charging, however there are a number of other factors which influence owning an EV.[11] A 20%pt increase in commuters using EVs as opposed to non-EVs is approximated.
Local Business Travel	0.25% decrease in car mode share	There is limited evidence relating to the availability of e-bikes and car club vehicles for local business travel and the impact on commuting mode share. Due to the assumed small frequency and volume of local business trips undertaken by car per year relative to total commuting trips, the impact of the action is expected to be minimal with a 0.25% approximated reduction in car mode share.

3.3 Diversion Factors

Diversion factors (see Table 3-2) were applied to estimate the proportion of travellers that 'divert' from their original transport mode (e.g. car) to a different mode (e.g. cycling) as a result of a travel planning action.

Table 3-2: Diversion factors used in modelling

Main Mode	Walking or wheeling	Cycling	Public transport	Car	Taxi	No travel
Walking or wheeling		0	-0.38	-0.28	-0.07	-0.27
Cycling	-0.14		-0.33	-0.24	-0.06	-0.23
Public transport	-0.18	-0.06		-0.25	-0.10	-0.12
Car	-0.09	-0.05	-0.63		-0.08	-0.15

The diversion factors estimate the proportion of travellers that 'divert' from their original transport mode (e.g. car) to a different mode (e.g. cycling) as a result of an action. For example, referring to Table 3-2 and the final row for 'car', if an action led to an increase of 100 car trips, nine trips would come from people who previously walked or wheeled, five trips from people who previously cycled, 63 trips from people who previously used public transport, and so on.

The 'no travel' represents trips that previously did not take place and were prompted by the attractiveness of the intervention, rather than shifting from one mode to another.

The diversion factors were derived from the DfT's TAG Data Book for walking or wheeling, cycling and public transport.[12] Cycling diversion factors are provided directly in TAG; however, equivalent factors for walking or wheeling and public transport are not available. Walking or wheeling diversion factors were derived from the cycling diversion factors while public transport diversion factors were inferred from bus diversion factors. Car diversion factors were derived from a report produced for the DfT by RAND Europe and Systra which factors from UK data.[8]

3.4 Allowed Distance Bands

Table 3-3 and Table 3-4 present the allowed distance bands for 'new' trips for staff and students, respectively. The tool converts trips between modes subject to distance-based criteria to reflect expected behaviour. For each trip, the one-way distance is checked against a maximum distance for the target mode (for example, 25 km for cycling for staff). Only trips within this distance band can be subjected to mode shift diversion; trips exceeding the threshold are excluded and retain their original mode. This approach prevents implausible outcomes, such as excessively long walking or cycling trips. The 10-25 km allowed distance band for cycling was included for staff but excluded for students based on travel behaviours observed in the 2024 commuting travel survey and to avoid implausible changes in mode share.

The maximum one-way distance travelled by staff or students from the 2024 commuting travel survey data was 281 km.

Table 3-3: Allowed distances band for staff (green = allowed, red = not allowed)

Distance band (km)	Walking or wheeling	Cycling	Public transport	Car	Motorcycle	Taxi	No travel
0 to 5	1	1	1	1	1	1	1
5 to 10	1	1	1	1	1	1	1
10 to 25	0	1	1	1	1	1	1
25 to 50	0	0	1	1	0	0	1
50 to 100	0	0	1	1	0	0	1
100 to 120	0	0	1	1	0	0	1
120 to 999	0	0	1	1	0	0	1

Table 3-4: Allowed distance bands for students (green = allowed, red = not allowed)

Distance band (km)	Walking or wheeling	Cycling	Public transport	Car	Motorcycle	Taxi	No travel
0 to 5	1	1	1	1	1	1	1
5 to 10	1	1	1	1	1	1	1
10 to 25	0	0	1	1	1	1	1
25 to 50	0	0	1	1	0	0	1
50 to 100	0	0	1	1	0	0	1
100 to 120	0	0	1	1	0	0	1
120 to 999	0	0	1	1	0	0	1

3.5 Influence of Actions

Table 3-5 indicates whether actions presented in the dashboard apply to both staff and students, or staff only. For example, the Cycle Plus Scheme allows University staff to obtain a bike for commuting and, therefore, the action does not influence students.

Table 3-5: Influence of actions on staff and students, or staff only

Action	Influence
Access to Bike Hire	Staff and students
Bike Hire Discount	Staff and students
Cycle Parking	Staff and students
Cycle Plus Scheme	Staff only
On-campus Infrastructure & Facilities	Staff and students
Off-campus Infrastructure & Facilities	Staff and students
Public Transport Services	Staff and students
Public Transport Information	Staff and students
Public Transport Discounts	Staff only
Behaviour Change Promotion	Staff and students
Parking Review	Staff only*
Electric Vehicle Infrastructure	Staff only*
Local Business Travel	Staff only

**While students can park at some University locations, staff are the target cohort*

4 References

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- [2] – Various Travel Plans and Documents including:
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    - https://www.nottingham.ac.uk/sustainability/documents/transport/university-of-nottingham-travel-plan-2022.pdf
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- [10] - Tom Rye et al, Reducing car use through parking policies: an evidence review, 2023. Available at: https://www.researchgate.net/publication/376085984_Reducing_car_use_through_parking_policies_an_evidence_review
- [11] - Justin Yiu et al, Systematic Study of Battery Electric Vehicle Ownership in England, 2024. Available at: https://journals.sagepub.com/doi/10.1177/03611981241271595
- [12] - Department for Transport, TAG Data Book Tables A5.4.6 and Table A5.4.7, 2018 (last updated 2025). Available at: https://www.gov.uk/government/publications/tag-data-book

Appendix A – Detailed Mode Share Changes

Table A – Mode share change for each action option used in the STTP

Action Description	Action	Impacted Mode	Mode Share Change (% points)	Trip Change (%)
Access to Bike Hire	Existing	Cycling	0.0%	
Access to Bike Hire	Enhanced	Cycling	+2.0%	
Bike Hire Discount	No discount	Cycling	0.0%	
Bike Hire Discount	Discounted	Cycling		+5.0%
Bike Hire Discount	Free use	Cycling		+25.0%
Cycle Parking	Existing	Cycling	0.0%	
Cycle Parking	Enhanced	Cycling	+3.0%	
Cycle Plus – the University's Cycle to Work Scheme	No promotion	Cycling	-1.0%	
Cycle Plus – the University's Cycle to Work Scheme	Existing	Cycling	0.0%	
Cycle Plus – the University's Cycle to Work Scheme	Enhanced	Cycling	+1.0%	
On-campus Infrastructure & Facilities	Existing	Walking or wheeling	0.0%	
On-campus Infrastructure & Facilities	Enhanced	Walking or wheeling	+0.5%	
On-campus Infrastructure & Facilities	Existing	Cycling	0.0%	
On-campus Infrastructure & Facilities	Enhanced	Cycling	+1.5%	
Off-campus Infrastructure	Existing	Walking or wheeling	0.0%	
Off-campus Infrastructure	Planned	Walking or wheeling	+2.0%	
Off-campus Infrastructure	Full delivery	Walking or wheeling	+5.0%	
Off-campus Infrastructure	Existing	Cycling	0.0%	
Off-campus Infrastructure	Planned	Cycling	+5.0%	
Off-campus Infrastructure	Full delivery	Cycling	+10.0%	
Public Transport Services	Existing	Public Transport	0.0%	
Public Transport Services	Enhanced	Public Transport	+15.0%	
Public Transport Information	No promotion	Public Transport	-0.5%	
Public Transport Information	Existing	Public Transport	0.0%	
Public Transport Information	Enhanced	Public Transport	+0.5%	
Public Transport Discounts	Existing	Public Transport	0.0%	
Public Transport Discounts	Enhanced	Public Transport		+13.0%
Behaviour Change Promotion	Existing	Car	0.0%	
Behaviour Change Promotion	No promotion	Car	+2.0%	
Parking Review	Existing	Car	0.0%	
Parking Review	Parking reviewed	Car	-5.0%	
Electric Vehicle Infrastructure	Existing	Car	0.0%	
Electric Vehicle Infrastructure	Enhanced	Car		+10.0%*
Local Business Travel	Existing	Car	0.0%	
Local Business Travel	Enhanced	Car	-0.25%	

***** *10%pt increase in proportion of car trips undertaken by EV (no change to mode share)*

Appendix B – Technical Appendix

Further technical detail is provided for some actions presented in Table 3-1 in Table B below.

Table B – Mode share changes and supporting evidence for Bike Hire Discount and Public Transport Discounts

Action	Maximum mode share change (%pt) or percentage change in trips	Evidence
Bike Hire Discount	A maximum 25% increase in cycling trips	Using the Department for Transport (DfT)Transport Appraisal Guidance Unit M2.1 Variable Demand Modelling[3] guidance, a fare elasticity of -0.2 was applied to a 20% fare discount which has corresponding 5% increase in the number of cycle trips This elasticity was selected from the lower end of the public transport fare elasticity ranges as a proxy for bike hire user charges. Use of the lowest value reflects the assumption that bike hire will not be a viable or attractive option for all staff and students, limiting the overall population response to fare reductions. Free bike hire is approximated to increase cycle trips by 25% as it removes cost barriers for students already inclined to cycle as well as converting trips that were previously undertaken by walking. Considering weather constraints, trips distance and other influencing factors this is considered a reasonable estimate based on professional judgement without the availability of direct evidence.
Public Transport Discounts	A maximum 13% increase in public transport trips	Using the DfT Transport Appraisal Guidance Unit M2.1 Variable Demand Modelling[3] guidance, an average public transport mode main mode fare elasticity of -0.55 was applied to a 20% fare discount which has a corresponding 13% increase in public transport trips.