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**MEDICAL AND
HEALTH SCIENCES**

Electric City: E-bikes and the future of cycling in New Zealand

Using case study research and a small workplace e-bike trial we explore the potential contribution that electric bikes can make to improving efficiency, sustainability and wellbeing within New Zealand's urban transport systems.

Report on the
Electric City
research
programme

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Contents

Acknowledgements.....	0
Electric City: E-bikes and the future of cycling in New Zealand.....	5
Overview.....	5
Executive Summary.....	5
Key findings:	5
Recommendations:.....	7
Introduction: The Electric City research programme	10
Study one: The potential of e-bikes: An Auckland case study.....	10
Methods.....	10
The research site: Auckland’s transport challenges	11
The local context: E-bikes in New Zealand.....	12
E-bikes in Auckland	13
Our study participants	14
The e-cyclists in our study.....	14
The e-bike retailers and key informants	15
Becoming an e-cyclist: Motivations and drivers	15
What do retailers and policy makers say about who uses an e-bike?.....	15
What do e-bike users say about why they ride?	17
Dissatisfaction with current transport mode.....	18
Existing cyclists who want to make cycling easier or faster:.....	18
Dissatisfaction with public transport	20
Dissatisfaction with car commuting.....	21
People who want to return to cycling or who enjoy leisure cycling and would like to try it out for everyday transport	21
Seeking out new opportunities for exercise and movement after experiencing disability	22
Experience and values	22
A financial nudge	23
An environmental nudge	23
Encouragement from others and getting the opportunity to try a bike:	24
Advertising.....	24
The experience of using an e-bike: The best and the worst things	25
The best things about using an e-bike.....	25
Making everyday travel by bike more realistic.....	26
Turning up to work looking ‘professional’.....	26
Carrying more stuff	26
Improving commute efficiency and reducing commuting stress:	27

Improved arrival time reliability:	27
Reducing travel times	28
Eliminating parking hassles:	29
Improving safety.....	30
Improving confidence interacting with cars:	30
Being able to choose a safer route, even if it is longer or hillier:.....	33
Improved quality of life.....	33
Fun and mental health benefits.....	33
Make cycling more feasible for people with care responsibilities	36
More enjoyable, flexible opportunities for exercise.....	37
Saving money.....	40
Reducing car use.....	40
The worst things about using an e-bike.....	41
Safety concerns	42
Fears over the safety of riding on-road with cars.....	42
Worrying about harming pedestrians	45
Bike weight	46
Concerns about speed and injury	47
Concerns about bike path quality	49
Fear of theft	50
Biking in bad weather	50
Cost	51
Range anxiety.....	53
How can we make e-bike use safer and more attractive?.....	53
Reduce the up-front cost of e-bikes	54
Providing people with opportunities for try an e-bike for their commute	55
Improvements to cycling infrastructure.....	56
More separated cycle paths	56
Higher quality cycle paths	57
More cycle highways.....	58
Sweeping the cycle paths.....	58
A new approach to shared paths	59
More bike parking	59
Other biking infrastructure	60
The right to ride on the footpath when you feel unsafe	60
E-Bike training for new users.....	61
Driver education	62
Regulation to increase safety?	63

Summary	68
Study two: What’s it like to switch from car to e-bike for a month? The Auckland Hospital e-bike trial	69
Introduction: The study	69
Methods.....	69
Who took part?	69
How realistic is e-bike commuting? Did people use their bikes?	70
What were the best things about commuting to Auckland City Hospital on an e-bike?	70
Saving time.....	71
Less parking stress for everyone	71
Feeling happier and more alert when you get to work	72
Exercise and fitness.....	72
What were the worst things about commuting to Auckland City Hospital on an e-bike? ..	73
Safety and the experience of e-cycling.....	73
The weather – riding in the rain	75
Range anxiety – worrying about running out of battery	76
Parking disincentives	76
Cost	76
Needing to have a shower	76
How well is Auckland City Hospital set up to encourage mode shift from car to e-bike? ..	77
How could ADHB encourage more people to switch from car to e-bike?	77
Discussion: Comparison with previous studies	78
Conclusion and recommendations: Enhancing the potential for e-bikes to improve efficiency, sustainability and wellbeing within New Zealand’s urban transport systems	81
Recommendations:.....	82
References	85

Electric City: E-bikes and the future of cycling in New Zealand

Overview: We used Auckland as a case study to explore the potential of electric bikes to improve efficiency, sustainability and wellbeing within New Zealand's urban transport systems. We conducted two studies: First, we completed in-depth interviews with electric bike users, electric bike retailers, and cycling /planners policy makers to explore their 'expert' understandings of what it's like to use an e-bike for everyday transport, and what challenges and opportunities this group of transport users experience. Then we ran a small e-bike trial at Auckland Hospital. In this small exploratory trial, we examined the question of what it's like for motorists to make the switch from a car to an e-bike for a month. While the first study examines the experiences of more established 'expert' e-bike users, who were motivated themselves to go out and buy a bike, the second study explores the experiences of car commuters who are interested in the possibility of switching to an e-bike, and what it's like to be new to the technology, trying it out for the first time for everyday transport in one of our typically spread-out, hilly New Zealand cities.

Executive Summary

Key findings:

1. E-bikes are expanding Auckland's 'active transport radius'

Where we traditionally expect the average pedestrian to be willing to walk up to 3km, and those on pushbikes to commute up to 5km, a large number of participants in this study were regularly and comfortably commuting 15km each way to work on their e-bikes. E-bikes are making this expansion possible by a) making it less tiring to cover longer distances, and b) increasing cycling speed so longer distances now fall within expected commuting time-budgets. These expanded active transport commutes were particularly likely where high-quality cycling 'highways' like the Northwestern cycleway were available, that enable e-cyclists to safely take advantage of the speed-boosting capabilities of e-bikes.

2. E-bikes are making 'trip-chaining' easier for active transport users

E-bikes are enabling people to make more 'car-like' trips using a form of active transport. E-bikes are making it easier for people to make trips with multiple stops and multiple purposes: so-called 'trip-chaining'. Because pedal-assist makes trips quicker and less tiring, and it also makes it possible for you to carry more stuff, including shopping and children, participants found they could 'fit in' more diverse trips on their bike without needing to use their car as much.

3. E-bikes are increasing commuting efficiency and reducing commuting stress

Cyclists are consistently shown to be the most satisfied commuters. One of the key reasons for this is the higher levels of commuting 'control' and arrival time reliability experienced by cyclists, especially in congested conditions. The accounts of e-cyclists within this research suggest that e-bikes are further enhancing this level of commuting control amongst Auckland's cyclists: smoothing out the effects of things like tiredness, or environmental conditions like hills and wind, on commute reliability. The e-cyclists within this research report a number of key benefits associated with these improvements in commute quality and efficiency, including greater punctuality, improved mood at work, and reduced commuting stress.

4. E-bikes are making active transport more realistic for women

This research suggests that supporting e-biking is likely to be a particularly effective strategy for lifting rates of cycling amongst women. Our e-bike counts on the Northwestern cycleway showed that while women represented 27% cyclists, they made up 41% of e-cyclists. Accounts of female e-cyclists within this research suggest that by providing improved arrival time reliability, greater capacity for trip-chaining, and the ability to carry children and their stuff, e-bikes are making active transport more realistic for women, who are more likely to be juggling work and care responsibilities.

5. Increased speed is experienced as both a risk and an opportunity by e-bike users

There was considerable variability in the reported speed range of e-bike users in this study. Average speed generally ranged from 25km-35km. Those with longer commutes, and those who spent more time on-road were more likely to report spending greater proportions of their commute travelling between 30km-35km. As well as making longer distances more realistic to commute, participants generally felt that there were a number of key safety benefits associated with being able to reach higher speeds on a bicycle: reducing conflict with cars by being able to harmonise speeds and take off quickly at intersections, and being able to use a throttle to 'get out of the way fast' in dangerous situations, were consistently mentioned as key perceived safety benefits associated with using an e-bike. On the other hand a number of participants had experienced some of the negative effects of cycling at higher speeds, particularly falls and injuries associated with hitting or swerving to avoid obstacles. These types of single-bicycle injuries point to the need to design higher-quality infrastructure for the increasing number of faster cyclists using our bike lanes.

6. E-bikes are not currently an accessible active transport technology for low-income commuters

Consistent with similar studies overseas, all the e-bike users in this study were middle to upper-middle income people. The participants themselves commented on their frustration that cost makes e-bikes unaffordable to low-income commuters, who 'may need e-bikes the most'.

Recommendations:

1. **Provide more separated cycle lanes.** Like those riding pushbikes, e-cyclists list more separated cycle lanes as the thing that would be most likely to encourage them to cycle more.
2. **Provide free-flowing, protected cycle highways within the 15km e-bike 'goldilocks zone'.** In order to take advantage of the additional speed provided by pedal assist, e-cyclists need unobstructed routes. It is the additional speed provided by the auxiliary motor that enables e-cyclists to cover longer distances, expanding the active transport radius. As new, sometimes less confident riders, e-cyclists also have a high preference for protected, off-road cycleways. Cycle highways: wide, protected, high quality environments for fast cyclists, provide the best conditions for e-cycling. High priority should be given to investing in cycle highways that enable people within 15km of the CBD, and other key employment/education hubs, to use an e-bike for everyday transport.
3. **Separate pedestrians from cyclists where possible.** E-bikes mean more cyclists, who will tend to ride faster, on heavier bikes, on shared paths. Overseas research suggests that e-cyclists maintain similar speeds to pushbikes when sharing spaces with pedestrians, but in the New Zealand context we believe it is likely that many e-cyclists will need to ride at slightly higher speeds in order to cover longer distances. As a result, shared spaces will likely become less safe for both pedestrians and cyclists as e-bike use rises.
4. **If an e-bike speed cutout is introduced, it is recommended that it be 32km/hr rather than 25km/hr.** The majority of the participants within this study reported riding at speeds between 25km – 35km/hr. Participants with longer commutes (>10km), were particularly likely to report needing to travel at 30-35km/hr for at least parts of their trip in order to keep commute times within a realistic time budget (under 1hr). Participants who rode on busy roads were also more likely to report travelling over 30km in order to achieve great 'speed harmonisation' with motorists, increasing their sense of confidence with 'taking the lane', and reducing perceived conflict with motorists. International research has also suggested that the ability to achieve 30km speeds amongst e-bikers is

important because it provides active transport users with the opportunity to compete on an equal footing with cars in reduced speed, 30km/hr zones. For these reasons it is recommended that if a speed cutout is introduced for safety reasons that New Zealand should adopt the American 32km/hr cutout rather than the 25km/hr European standard.

5. **Reduce the speed limits on more urban roads to 30km/hr.** International research suggests that one of the best ways to increase e-bike use is to make e-bikes more competitive with cars by reducing the speed of all vehicles on urban roads to 30km/hr. Given the safety benefits of speed harmonisation to all road users, but the increased injury risk to cyclists riding above 30km/hr, the new capacity to 'speed bikes up' provided by e-bike technology should be accompanied by a proportionate safety focus on 'slowing cars down'. This recommendation is supported by reports from e-cyclists in this research who said that they felt particularly confident using the road in lower speed environments like the CBD and Wynyard Quarter in Auckland, which have 30km/hr speed limits.
6. **Provide opportunities for people to try out an e-bike for a trial period of 2 weeks.** Many participants, even individuals with fairly high incomes, reported that purchasing an e-bike feels 'extravagant' because they were unsure whether they would use it in their real-life commuting conditions. These findings are consistent with international research that suggests that people struggle with the cost of e-bikes because of cultural associations with bicycles as being a 'low-cost' item in comparison to cars. Participants who bought an e-bike from one particular retailer who provided them with the opportunity to take the bike home and try out their particular commute for two weeks reported that this had been particularly useful to enable them to feel less anxious about whether the price tag was 'worth it'. This experience is also consistent with feedback from potential participants in the e-bike trial we ran at Auckland Hospital, who frequently reported that they had had a chance to try an e-bike for a short ride, but really wanted the chance to try out their own commute to help them make a decision about whether they would actually use the bike, given its substantial price tag.
7. **Reduce the cost of e-bikes.** Recommendations include removing fringe benefit tax from bicycles and developing a tax exemption scheme like the UK's Cycle to Work scheme to enable employers to provide e-bikes to staff. Current tax rules disincentivize workplace provision of e-bikes. Other recommendations include supporting employers to lower the up-front-cost of e-bikes to staff by encouraging group purchases of e-bikes and salary sacrifice schemes to enable employees to pay off e-bikes over time.

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8. **Create a new 'E-bikes at work' website** to enable employers to access high quality information about how to a) establish a workplace e-bike fleet, and b) assist employees to purchase an e-bike for their commute. This research has highlighted the fact that employers currently have to invest a significant amount of time (and therefore money) in order to figure out how to meet taxation and health and safety regulations surrounding these type of schemes. These challenges mean that workplaces currently developing these schemes generally have strong cycling or e-cycling 'champions' who are willing to take on this significant time commitment. However, the majority of workplaces do not currently have such a champion and are likely to experience this significant investment in compliance research as an undue burden. Sharing stories, research, protocols, and success stories from e-bike friendly workplaces would significantly reduce this compliance research burden and likely increase workplace investment in e-bikes.

 9. **Investigate opportunities to make e-bikes available to low-income people.** Whether through subsidies, employer provision, lease schemes, rent to buy schemes, or bike share schemes, there is a need for further research into how to make e-bikes available to the groups who have the greatest need for the health gains and reduced transport costs associated with having access to an e-bike.

 10. **Provide more secure bike parking, with e-bike charging facilities.** This will reduce levels of anxiety about bike theft and range anxiety - both of which are limiting the generation of new e-bike trips amongst existing e-bike users.

Introduction: The Electric City research programme

The Electric City research programme is part of a larger MBIE-funded research programme, 'Healthy Future Mobility Solutions'. This umbrella project brings together a large, multidisciplinary team of transport, safety, and public health experts to explore how NZ can plan for a transport future where we maximise the use of healthy, active transport in our communities. We are entering a transport era characterised by considerable technological innovation, more compact urban forms, cultural shifts in mobility expectations, and climate change. The e-bikes workstream is one of several projects that explores how we might plan for these mobility shifts in ways that protect and enhance wellbeing.

As part of this research programme we conducted two e-bike studies. The first piece of research is an in-depth case study. Using Auckland as our research site we conducted interviews with e-bike retailers, e-bike users, and a range of key informants (cycling policy/planning practitioners) to explore their 'expert' understandings of what it's like to use an e-bike for everyday transport in Auckland, and what challenges and opportunities this group of transport users experience. Our second piece of research was a small e-bike trial at Auckland Hospital. We recruited five staff at the hospital who were using a car to get to work, and provided them with an e-bike for a month to use for their commute. In this small exploratory study, we examined the question of what it's like for motorists to make 'the switch' from car to e-bike for a month. While the first study examines the experiences of more established e-bike users, who were motivated themselves to go out and buy a bike, the second study explores the experiences of car commuters who are interested in the possibility of switching to an e-bike. This second study examines what it's like to be new to the technology, trying it out for the first time for everyday transport in one of our typically spread-out, hilly New Zealand cities.

Study one: The potential of e-bikes: An Auckland case study

Methods

In the first piece of research we used Auckland as a case study to explore the potential for e-bikes to increase efficiency, sustainability and wellbeing within New Zealand's urban transport systems. This research involved conducting interviews with 7 e-bike retailers, 7 cycling policy/planning experts, and 24 e-bike users between December 2016 and July 2017. Because this was an exploratory research project designed to increase understanding of an area of travel behaviour about which there is little existing knowledge, open-ended, semi-structured qualitative interviews were considered to be the best research method to utilise¹. All the interviews were conducted by Dr Wild. The retailer and e-bike user interviews were all conducted in Auckland. The key informant, cycling policy/planning expert interviews were also conducted primarily with Auckland-based experts; however, several phone interviews were also conducted with Wellington-based experts representing national organisations. A dialogical, participatory interview approach was used that enabled the researcher to ask key research questions, as well as providing important opportunities for participants to share their knowledge and experience around what they considered to be most important for advancing knowledge in this area of research. The interviews were coded and analysed using NVivo 11.

The research site: Auckland's transport challenges

Like many other urban centres, Auckland faces long-standing problems with automobile dependence, and growing problems with network congestion. The majority of Aucklanders use a car as their primary mode of transport². Frequent car use is associated with a number of increased risks to health and wellbeing, including cardiovascular stress, various types of cancer, musculoskeletal problems, and poorer mental health³. These effects on health and wellbeing are exacerbated by network congestion, which tends to increase both travel times and travel time 'unpredictability', both of which are experienced as a stress by motorists. Worsening congestion in Auckland means the average motorist now spends an additional 80 days per year sitting in their car due to automobile congestion⁴. Arrival-time reliability has also declined significantly in recently years, with Auckland motorists now needing to allow an additional 40 to 55 percent longer for their trips to be assured of arriving on time⁵.

Automobile congestion is having a negative effect on both the city's economic performance, as well as the quality of life of its residents. In 2013, 51% of the potential Auckland workforce was available to employers within a 30 minute car journey, while in 2016 this figure had declined to 39%, with fears that traffic congestion will undermine any potential productivity gains associated with future population growth⁵. And congestion is a growing source of stress for commuters and their families. While we know of no comprehensive New Zealand studies on the impact of network congestion on the work and personal lives of urban dwellers, international research shows that long car commuting times, and increased arrival time unpredictability^{6,7}, both have a significant negative effect on overall quality of life: lowering life satisfaction⁸; reducing partnership stability and satisfaction with family life⁹; and leading to lower levels of employee productivity and higher levels of stress-related work absences¹⁰. Studies show that the sorts of 'high impedance', unpredictable travel conditions experienced in congested urban networks have a particularly negative effect on the quality of life of women¹¹, who tend to have tighter time budgets due to a greater likelihood of having to juggle multiple responsibilities at work and at home¹².

As a promising new form of 'middle modalism'¹³, e-bikes show early potential as a technology we can use to address network congestion and declining travel satisfaction within our cities. Cyclists are consistently shown to be the most satisfied commuters¹⁴⁻²⁰, due to the fact that bicycles are a fairly nimble form of transport, so cyclists tend to experience higher levels of control over their commute, experiencing the highest levels of arrival time reliability, as well as the 'feel better' effects of exercise and time spent outdoors. The health and safety benefits from a just a 5% mode shift from car to bicycle travel for short urban trips in NZ are worth an estimated \$200 million²¹. However, there are a number of barriers associated with shifting travel away from cars to bikes: including distance, and the hilly terrain of many of our cities. With increasing investment in active transport infrastructure the number of New Zealanders who report that they would like to cycle is rising; but many adults report that they are discouraged from cycling by the levels of exertion required to climb hills, manage windy conditions, and cover long distances in spread-out NZ cities²²⁻²⁴. Situated on a volcanic field,

Auckland’s topography is both a source of beauty and a challenge for active transport promotion, as Auckland Council sums up:

*"Auckland enjoys a fantastic and challenging topography that gives the city a unique character. The volcanic field in which the city centre lies lends a distinct flavour to its streetscapes, and occasional views of the water and the landscape from the steep streets are fascinating and alluring. The topography is a blessing, but also a challenge for pedestrians and cyclists in places."*²⁵

Overseas research suggests that e-bikes are particularly effective at reducing barriers to mode shift from car to active transport, because they both a) Reduce exertion-based barriers to bicycle use (hills, distance, wind, fitness, disability, high body weight)²⁶⁻³¹, whilst also b) Increasing the possibilities for more ‘car-like’ use of a bicycle (longer trips, more trip chaining, carrying heavier, larger loads)³². E-bikes have also been shown to increase the sustainability of urban transport systems. Intelligent Energy Europe estimate that each e-bike on the road results in an average 900km less car kilometres per year; with a corresponding reduction of 108kg of CO2 per year³³. This research aims to provide a New Zealand-based e-bike case study that provides insights into the potential of this new technology to promote mode shift and improve network efficiency and sustainability in a local context.

The local context: E-bikes in New Zealand

It is difficult to get accurate estimates of the number of e-bikes being sold in New Zealand, as there is no retail sales data available, and until recently customs records did not use a single ‘e-bike’ category. Best estimates based on detailed analysis of customs data by ViaStrada suggest that we are seeing a steady increase in e-bike imports, with nearly 2,000 new e-bikes are being imported into New Zealand per month in 2018. Between April 2017 and May 2018, nearly 17,000 new e-bikes were imported into New Zealand.

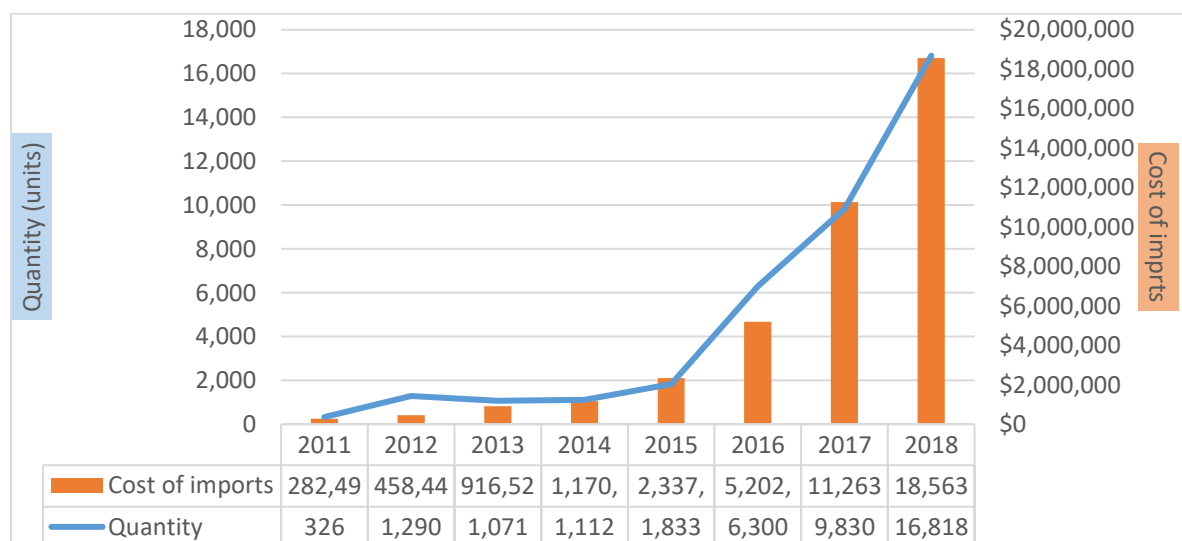


Figure 1. Estimated New Zealand e-bike imports April to May, 2011-2018.

Source: Viastrada, 2018, based on analysis of Statistics NZ Harmonised Trade – Imports data. Notes: NZ Import categories for e-bikes changed in Feb 2017. For future e-bike annual trend analysis, after Feb 2017 use actual data from category 8711.60.0000.

In line with New Zealand transport regulations, e-bikes within this study are defined as bicycles that have an auxiliary electric motor, but are designed to be propelled primarily by the muscular energy of the rider³⁴. Globally, e-bike regulations vary widely. In New Zealand e-bikes are fairly 'lightly' regulated compared to other markets – particularly the European market. In New Zealand, to qualify as a 'power-assisted cycle', with exemption from licensing, registration requirements etc, e-bikes are required to have a maximum power output of 300W. In 2017, NZTA undertook a review of regulations and safety issues related to e-bikes in New Zealand³⁵. This review recommended introducing new regulations around a range of things including classification of different types of e-bikes, introducing a top cut-out speed, and new rules for paths shared by both e-bikes and pedestrians. The review also noted that there is on-going debate and uncertainty about the benefits and costs of increasing regulation of e-bikes, given the desire to increase cycling in New Zealand. As yet no new rules have been introduced, and these debates are ongoing.

E-bikes in Auckland

In March 2018, we conducted a small bicycle survey on two of the busiest cycle routes in Auckland. On Tamaki Drive, an important cycling route in from the eastern suburbs, 15% of the cyclists travelling into the CBD were using an e-bike. While on the Northwestern cycleway, a route particularly suited to e-biking (both protected and free-flow), 31% of the morning rush-hour cyclists were using an e-bike.

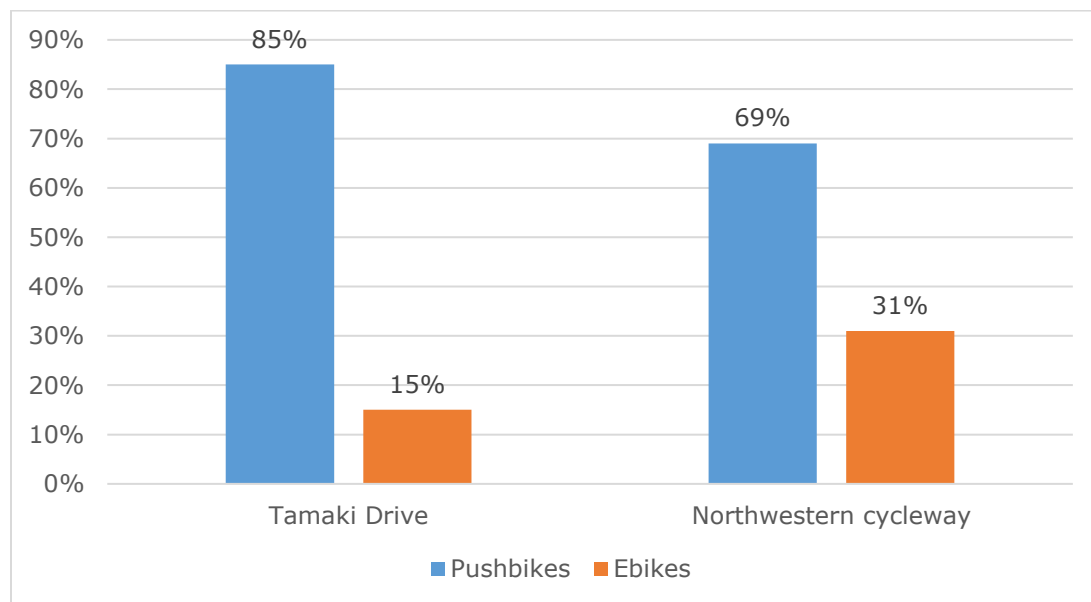


Figure 2. Bicycle type, Tamaki Drive and Northwestern cycleway, March 2018

Source: Nicholas Wilson. Counts were conducted on Tamaki Drive from 7.30-9.30am on the 20th March 2018 and 7.30-9.30am on the 21 March 2018 on the Northwestern cycleway.

We also broke down the figures for the Northwestern cycleway by gender. On the Northwestern cycleway, women made up 27% of total cyclists. However, they made up percent 41% of all e-cyclists.

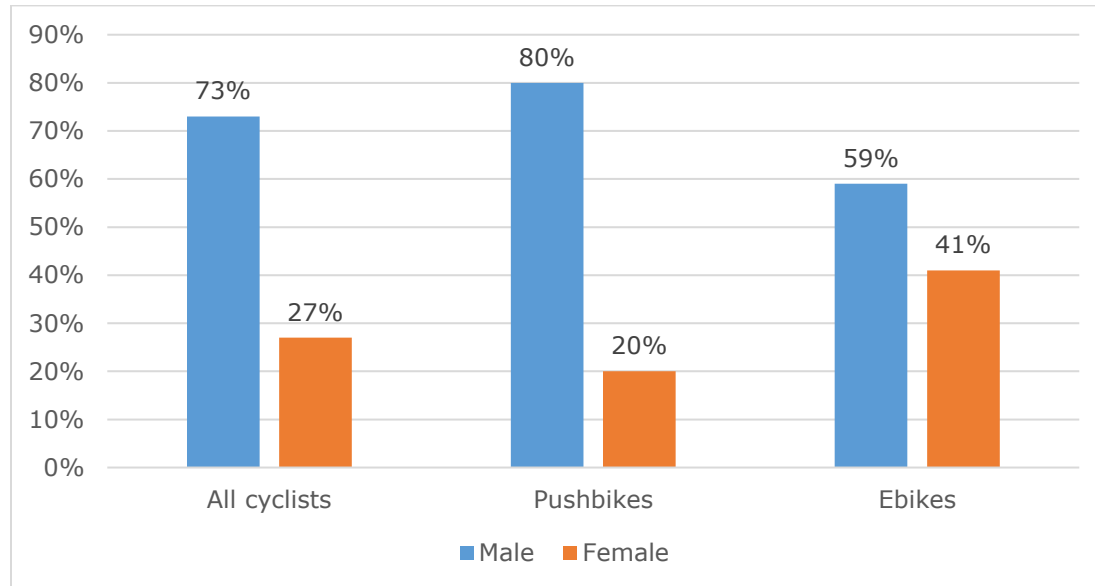


Figure 3. Bicycle type by gender of rider, northwestern cycleway, March 2018

Source: Nicholas Wilson. Counts were conducted from 7.30-9.30am on the 21 March 2018 on Upper Queen Street at the start of the Northwestern cycleway.

Our study participants

The e-cyclists in our study

We conducted indepth interviews with 24 e-cyclists in Auckland. Most were using their bike to commute to work, and two were retired and using the bike for other types of everyday transport. We recruited these e-cyclists through bike group social media pages. The majority of the participants were riding custom-built e-bikes. Three participants had their existing bikes converted, because they wanted a particular style of bike, and didn't like the look of custom-made e-bikes. Three of the e-bike riders were using e-cargo bikes: two to carry kids, and one as a business vehicle. One participant was also carrying a child on her standard e-bike. Most had been riding their e-bike for at least 6 months, and could be considered 'expert' e-bike users. Of the 24 e-cyclists thirteen were women, and eleven were men. Twenty of the participants identified as NZ European/Pakeha, one person also identified as Samoan, one as Indian, and four as other European. The biggest age category was 35-44. Given the figures on the gender split amongst e-bike riders on the Northwestern cycleway, it is likely that female riders are slightly over-represented in our study. Given the comments from retailers about the majority of their customers being middle-aged or older, it is possible that our sample is slightly younger than average.

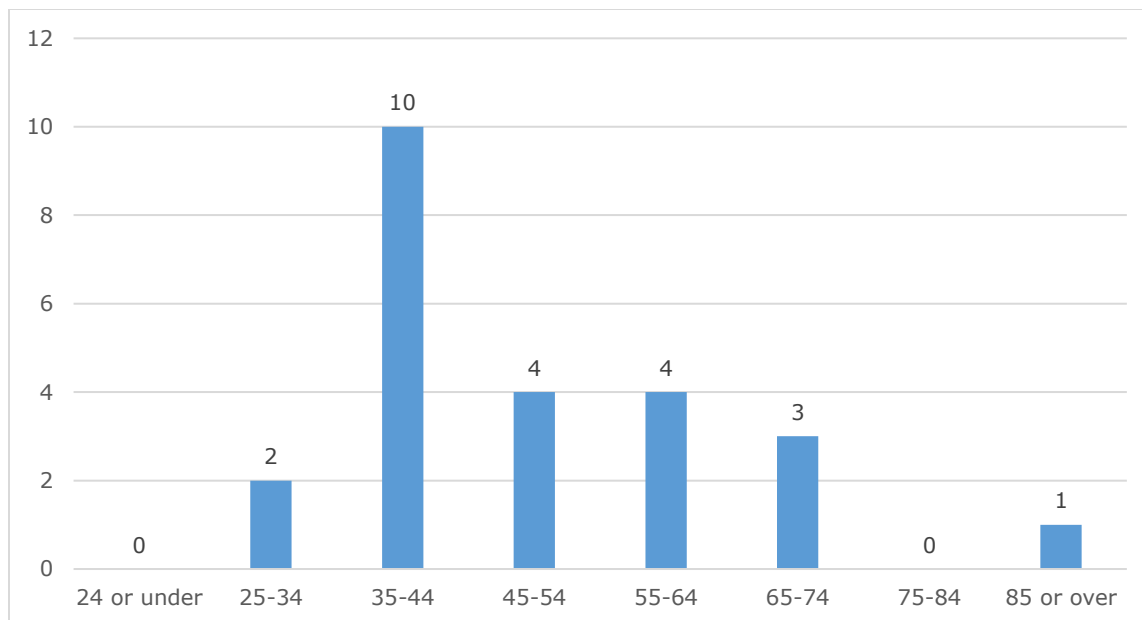


Figure 4. Case study e-cyclists by age

The e-bike retailers and key informants

We interviewed 7 e-bike retailers. Four were specialist e-bike retailers, either selling e-bikes, and/or providing e-bike retrofits; and three were general bicycle retailers with some experience selling e-bikes. The key informants were selected due to their expertise in cycling planning and/or policy: they included staff from local government, central government, bike-friendly businesses, and bicycle advocacy organisations.

Becoming an e-cyclist: Motivations and drivers

We asked retailers and the key informants who they think rides an e-bike and why. We also asked e-bikers to tell us why they started e-biking. We looked for commonalities as well as any knowledge gaps or areas of 'misunderstanding' or stigma operating in the perception of this group of cyclists.

What do retailers and policy makers say about who uses an e-bike?

Most of the retailers reported that their customers tended to be middle-aged or older and to have medium to high incomes:

"Everyone seems to have different reasons, but if I can generalise about the people we are seeing that are totally new to the E-bike thing, is slightly older, baby boomer and all that sort of thing, bit of spare cash and don't mind dropping it on a really good quality bike and that sort of thing." (Retailer 1)

Although most of the retailers and key informants suggested that as uptake increases they are seeing a diversification of both the e-bike demographic, and the reasons why people are becoming an e-cyclist. As one key informant, who rides an e-bike herself, explained:

"I think [e-cyclists are] people who want to cycle easily, so that fits into a range of different demographics: whether it's someone who wants to ... be able to push her kids and her heavy bike, or someone who wants to be able to travel further than they might

on a normal bike, someone who is less fit or less able, or someone like me who just wants to get to work without getting changed or getting hot, so the ease is the common factor and I think much less so now is it a, a single demographic, as in what it used to be people over a certain age were the e-bike demographic, it's now much, much broader than that." (Key informant 2)

Retailers commented that they thought that e-bikers were increasingly likely to be people who were relatively new to cycling, and shifting from car to bike:

"You walk into my shop, why do I sell so many locks and helmets? Cause people walk in, they've not biked 30 years, or they never have biked, period, and they hire me for a lesson to teach them.So, anyway, ninety five percent of our bikes are people out of car or scooter. Ninety five percent." (E-bike Retailer 2)

One particularly experienced e-bike retailer noted that he is consistently selling e-bikes to three groups of Aucklanders: 1) Cycling enthusiasts, often existing cyclists, or people who have come back from overseas after living in cycling cities, who want a way to make it easier to commute in such a hilly, spread-out city; 2) People who are looking for new sources of physical activity. Usually, although not always, an older demographic who "have a bit more time and a bit more consciousness that they need to stay healthy"; and 3) People who live near a cycling infrastructure 'sweet spot':

"[T]he final category for me which is probably the most exciting category, are the people who see bicycle paths being built, somehow they discover that, probably from colleagues and friends, and they go 'oh wow so I can get from home to work in half the time, for much less money, no stress and have more fun, and the only problem is a hill and I have an e-bike, amazing'. So we have a sweet spot at the moment selling e-bikes to people in Te Atatu, because they have a half hour e-bike ride into the city with no cars the whole way." (E-bike retailer 5)

Another retailer also argued that the Northwestern cycleway is driving e-bike growth, not just because in most parts it provides the sort of protected 'cycle highway' conditions that are particularly important to e-bikers, but because it is visible to motorists on the highly congested Northwestern motorway, prompting frustrated car drivers to make the switch:

"We've had lots of people who live out Te Atatu or Henderson way that sit on the Northwestern motorway and say, this is just a carpark. I can visibly see people on bikes flying past, but I don't want to get hot and sweaty for work, so there is a middle ground which is an e-bike." (E-bike retailer 1)

This retailer also thought increased congestion in the CBD caused by the rail link construction, and increased parking charges were driving e-bike sales:

"The construction of the new rail link in town is causing all sorts of chaos for easily getting around the central city. The other thing down in the central city is parking went up at the same time as they started construction on that central rail link. So people who live in this fringe here are going, hey, I pop into town lots but 1. It's almost impossible to find a park and 2. When I do find a park, it's expensive. And I can pop down there on my e-bike, park up exactly where I am going to, do my business, come back out and I'm back up here without breaking a sweat." (E-bike retailer 1)

What do e-bike users say about why they ride?

It was extremely common for e-bikers to say that several factors came together to encourage them to try out an e-bike for their commute. Their decision to buy a bike often involved a combination of 1) Dissatisfaction with current commuting experience, 2) Having an interest in trying everyday cycling or returning to cycling; 3) Life experience, 4) A financial nudge, and/or 5) An environmental prompt:

- 1) **Dissatisfaction with current commuting experience:** For existing cyclists, this was generally because they were starting to find using a push-bike too physically tiring; and for non-cyclists this was most commonly either because they found public transport too crowded or too infrequent; or they found car commuting in congested conditions slow and unpleasant, and/or they were concerned about the health impacts of such a sedentary commute.
- 2) **Having an interest in trying out everyday cycling or returning to cycling**
The majority of the participants either had previous experience with commuter cycling and e-bikes prompted them to have a go at returning to cycle commuting; or they were motivated to try cycling, and they felt that e-bikes made it more realistic for them to give commuter cycling a go.
- 3) **Personality, values, and life experience:** Consistent with other research on early adopters of new technologies, it was common for participants to talk about an openness to trying new technologies. Also consistent with previous research on cycling, commitment to environmental sustainability was also an important motivator for some participants. Finally, having previously lived in cities with higher bicycle mode share, and/or having previously owned a scooter were also cited as life experiences that made people more interested in trying an e-bike.
- 4) **A financial nudge:** This was either a new transport cost (most commonly new parking charges), or a financial carrot that enabled participants to overcome anxiety about the idea that buying an e-bike is 'extravagant'. This included the Mercury Energy \$250 cash back, and in two cases participants getting a small unexpected financial windfall.
- 5) **An environmental prompt:** Living near the Northwestern cycleway was identified as an important factor in the decision to buy an e-bike for many participants. Proximity to this cycleway, which is visible from the motorway and has a high e-bike mode share, provided three key prompts: a) Frustrated motorists getting to see cyclists moving freely, while they were stuck in congested traffic; b) Non-cyclists who were interested in trying cycling seeing that there was a safe, off-road route they could use to try

commuting to work; and c) Push-bikers getting to interact with e-bikers, in a setting where e-bike mode share is especially high. Living near the Northwestern cycleway meant that many people had the opportunity to move towards e-biking in 'stages'. It was common for people who had access to the Northwestern cycleway to start out as a motorist frustrated with congestion, to see the cycleway, to then start out by trying out the track on a push-bike, and then seeing that their commute felt safe but was physically difficult, move to using an e-bike.

- 6) **Encouragement from others and getting the opportunity to try an e-bike:** Getting the chance to try an e-bike, having e-bike champions at work or in your social circle, and both the Mercury Energy e-bike advertising campaign and Auckland Transport bike promotion campaigns were identified as contributing to decisions to buy an e-bike.

Dissatisfaction with current transport mode

Existing cyclists who want to make cycling easier or faster:

A number of the e-cyclists were existing cyclists who were starting to find their push-bike commute too tiring, or were experiencing increased time pressure due to combining family and work commitments:

"I was just like, I need to do this because the commute drive is killing me, and after about six or seven months of just riding...it's a long way. It's about 17ks and you do that and I'm a bit tired and doing that a lot. And then I've got commitments with my children and family and stuff, that gets a bit difficult." (E-cyclist 13)

Hills, wind and sweatiness

Hills and wind, and the resultant 'sweatiness' associated with high levels of exertion were consistently mentioned as the other ongoing barriers to cycling amongst existing cyclists, and key reasons why people made the switch to an e-bike:

"[W]hen I started doing my PhD, and I knew that I lived so close to the campus, I had made that commitment that I would buy an old-fashioned bike and I would cycle. So I decided for a variety of reasons to buy a 3 speed, so I had been using the 3 speed for about a year, 18 months – and it was really hard going anywhere there was a hill or anywhere there was wind. So I had decided that I was enjoying biking, most days I was biking from home to the campus, I think for me it is only 2km or something, it is really close but it was still hard work because of the hills. But also I was starting to do more recreational riding at the weekends, but there were all these places I couldn't go because of hills. So I decided I was either going to have to buy a bike with more gears or think about retro fitting my bike with a motor." (E-cyclist 23)

Age and disability

Two cyclists mentioned increasing age or disability as reasons why they switched to an e-bike. One cyclist switched to an e-bike after she developed a heart condition:

"[I]t used to take me forever because I couldn't, my heart wouldn't go up the hills, so I was like walking up the hills and it was taking half an hour just to get to work down the road which was ridiculous. ...[S]o there's probably a year and I just didn't bike, it was just sitting on the shelf, and then it was like I missed it so much." (E-cyclist 3)

Both this rider and another older cyclist said they also switched to an e-bike because continuing to ride with friends was really important to them, and they could no longer keep up:

"I go for a ride on a Saturday morning and sometimes during the week with friends who are a lot younger than I am. And, I could see I was spoiling somebody's ride to wait for me, so I thought the answer to that is to get an electric bike and then I can keep up with them and I'm not holding anybody up. (E-cyclist 2)

Biking when you have kids

Female cyclists with kids were particularly likely to report that e-bikes, including e-cargo bikes, were providing them with new opportunities to keep cycling and start cycling again. This is both because e-bikes 1) Make it easier to carry more stuff and heavier stuff on your bike, including children, and also because 2) They reduce cycling times and improve arrival time reliability, making it easier to meet dual responsibilities at home and at work. This e-cyclist bought an electric cargo bike, which she commutes to work on, carrying her two kids on the back, and dropping them off half-way at school:

"I used to cycle to work before I had children quite regularly, and that could mean you know 15-16km out to Henderson and back, so it was basically like doing your exercise in your commute, I really loved it, and then kids came along and that became really hard, and I would cycle whenever I could, so when I could organise for [my husband] to do a pick up, and or drop off then I would cycle, but couldn't do it otherwise. So I looked at trailers, but very quickly realised that we've got some pretty good hills round here, and my route to work has got a number of gnarly hills, including Grafton and the Domain, and then even this road here is a decent hill, and I just thought to myself if you do that then the chances are you'll use it one day out of five, instead of everyday which is what the aim is... It just makes the commute doable, I think, is the main thing, I could slog up the hills and everything with a standard cargo bike, or a trailer but I just, that's it, I don't think I would." (E-cyclist 21)

Another cyclist talked about how she uses an e-bike because it gives her the opportunity to bike to school with her kids, with her baby onboard, and drop everyone off at daycare and school, and then get into work quickly on her bike; thus enabling her to fit in all her responsibilities and keep biking:

"So my husband and I are opposite, so I will be a 7-4 day and he will do a 9.30-5.30, and then I do that Monday and Wednesday and then I swap. So Thursday and Friday my kids ride to school and I have the baby on a baby seat on the bike. So I ride everybody to school, drop them all off, leave the baby seat at day-care with my four year old's bike and then I ride in after that. And then I ride home again. Like today I have done a 7-4 today and at 4pm I will get on my bike and go like the clappers. ...Otherwise I probably couldn't take them, I would end up in the car." (E-cyclist 5)

Dissatisfaction with public transport

A number of e-cyclists mentioned dissatisfaction with public transport options as contributing to their decision to try e-biking:

'The train commute from here to is peculiarly messed up, so that was the motivation.' (E-cyclist 7)

One participant talked about the cost of public transport prompting him to purchase an e-bike:

"I was, you know currently taking PT, ... [and] that was also not that cheap, you know, the train ride, I think was like \$5 bucks each way." (E-cyclist 1).

In two cases a move prompted people in the western suburbs to purchase an e-bike, after they found their new public transport options less satisfying:

"I was living about 4 minutes walk from a train station ... then we moved not very far down the road but the walk became a 20 minute walk, and I thought to myself well this is adding 40 minutes to my commute, I'll get myself a bike so I can just bike to the train station. I got myself a conventional bike, and I was sitting there and one day I went all the way in. I went, oh, that's actually about the same time as the train from station to station, but I'm stuffed, is there another option? And I thought about getting a scooter, and then I thought about well just an electric bike, and my intention was to train in and bike home, but very quickly it became apparent to me that it was much quicker to cycle from home and back, and sling the train in." (E-cyclist 20)

"[I]t was going to be half the expenses of living in Parnell so I agreed [to move] and then I realised how awful the traffic is. So I spent the summer biking to the train station and then putting my bike on the train and that was okay until school students and uni students came back and it became completely impractical. You could barely fit your bike on the train and I wasn't really travelling at rush hour, and even then it was pretty bad." (E-cyclist 8)

Dissatisfaction with car commuting

Dissatisfaction with the experience of driving in Auckland was mentioned as a major motivator for trying e-biking:

"D]riving a car in Auckland is a desperately stressful experience even when it goes well, and when it goes badly it is really dreadful." (E-cyclist 7)

"I think if you've ever heard of a woman going mental on the Northwestern, it would've been me. Cos, there's serious road rage." (E-cyclist 19)

"I hated when I was having to do the drop offs, because the girls aren't locally at school, I was just hating it, I don't get to kind of move, you know. And I sit on my arse on the way, with everybody else whose sitting on their arses, in little air conditioned bubbles, I just hate it. It starts making me a bit grumpy." (E-cyclist 21)

Declining arrival time reliability associated with increasing congestion was listed as a major motivator for the motorists who have children:

"You could leave for work [in a car] and sometimes it is 15 minutes and sometimes it is 45 minutes, and if you are going to pick the kids up you can't be plus or minus an hour." (E-cyclist 5)

People who want to return to cycling or who enjoy leisure cycling and would like to try it out for everyday transport

The majority of the participants in the study were either people who had previously cycled and enjoyed it but had given up, or people who enjoyed leisure cycling and were keen to try it for everyday transport. Many people in this group mentioned being able to avoid sweatiness and changing clothes, as well as the lack of changing or showering facilities at work, as reasons why they were willing to give e-cycling a try, either as a way to return to cycling or to try it for the first time:

"So, what I figured out was, if the data was true, I could be at work on an E-bike in 15 minutes with my work clothes on. And, I've done riding to work before, but ..you know, I've got to bring a pair of shoes on my bike and my suit and you know all that sort of stuff and at this point, we didn't have end of trip facilities at work." (E-cyclist 1)

"[I] use the full assist because my aim is to get to work in the clothes I am wearing at work without having to shower in between. We do have showers here but it is such a pffaff. It feels like... we have workshop showers and they are all a little bit blokey and there is no hair dryers or anything like that, and I just think [about] the amount of paraphernalia I would have to keep at work." (E-cyclist 8)

"The benefits and I guess the reasons that I went to buy it were that when I arrive in [at the] hospital to work there isn't anywhere that I have that I can go and change. There are theatre changing rooms but it's not really set up for bike changing. There isn't anything like that. And so arriving without having to change is not fun but also not having to carry an extra change of clothes. I'm not a lycra cyclist, not having to cycle in lycra, I'll be able to cycle in my normal clothes were huge advantages." (E-cyclist 11)

"[W]ell I find cycling hard, and I've never really sort of persevered in the cycle fitness that you need in Auckland. I did for a little while, but what happened was that I was a little bit, and this sounds really shallow, but put off by being really sweaty at the end of the ride. For a long time on K Road there was a cycle cafe where they had showers, that you could do all your showering after you cycled, because I worked on K Road, but then they closed down, and so this E-bike was something that I thought hey this will be really great, because you don't actually have to worry about all that kind of stuff. (E-cyclist 15)

Seeking out new opportunities for exercise and movement after experiencing disability

Several people who were new to cycling or wanting to return to it mentioned that they were keen to try e-cycling as a way to get low-impact exercise after disability or injury reduced other options for keeping fit:

"Well, just that it means that people of advancing greyness...are able to cycle and it's gotta be overall good for people. I've had a couple, or a few serious accidents in the last 10 years - broke my back eight years ago, badly broke my leg skiing six years ago, broke my arm and dislocated my shoulder three years ago. So, in actual fact my exercise options were dwindling because of different issues that I have and I've found the cycling to be perfect." (E-cyclist 12)

"I was thinking I needed to get fitter – I won't say fit, but less unfit. And it seemed a good way of doing it. I used to run when I was younger and as a result my hips won't allow me to run or walk that far, but cycling is fine. So cycling was an obvious way of doing it. I am not fit enough even now to get up most Auckland hills without a bit of help, so the idea of having an extra set of legs for the hills was very appealing." (E-cyclist 7)

Experience and values

Consistent with previous New Zealand research on cycling motivators³⁶, four of the e-cyclists mentioned environmental sustainability as a motivator for using an e-bike:

"I'm ...a sustainable business advisor at my company, and if I'm not going to do it who the heck is, you know, so professionally there's a really good reason as well, which I fully believe in. I do believe that many people are jumping in cars who don't need to, and then it has effects, so that was a big driver as well." (E-cyclist 21).

"Feeling like I'm contributing something to the environment. Albeit's an e-bike and I have to charge it so it does take some energy, but it's very different to a car." (E-cyclist 11)

"I like it environmentally, and also the problems that we have with traffic in general in Auckland could be avoided if more and more people do what I do." (E-cyclist 4)

"I also quite like the fact that I am not producing carbon dioxide when I am going along like I would in my car." (E-cyclist 8)

Having lived overseas in higher cycling-mode cities, and having used a scooter were also mentioned by e-cyclists as experiences that made e-cycling seem more realistic:

"I used to ride a scooter and so the idea of riding an electric bike was not [daunting], and I've lived in China, and travelled a bit so it wasn't so odd to me as other options." (E-cyclist 16)

A financial nudge

New parking charges were a significant motivator for several e-cyclists:

"I was in a car and we had parking in the old building. So, I had access to parking but then we were gonna move here and I thought, right, I need to make that commitment. I need to do it. I think if you look at it, it's over \$100 a week to rent a carpark here and casual parking is \$6 an hour." (E-cyclist 19)

"They introduced parking at the hospital, about 4 years ago. Yeah, like, to park in the grounds, I think it's \$2.50 and it's gone up to \$3 each time, and I worked out I save \$600 a year by not parking in the grounds, so I vowed never to park in the grounds, and I pretty much biked a lot." (E-cyclist 3)

The Mercury Energy \$250 subsidy was mentioned as a motivator by two participants, and two of the e-cyclists also mentioned getting a small unexpected financial windfall that they used to buy a bike.

An environmental nudge

Consistent with the comments made by retailer five in the previous section, a number of participants said that being near the Northwestern cycleway had given them a nudge to try e-biking, either because it made commuter cycling more feasible, or because they were already cycling and it gave them a chance to mix with e-cyclists using the cycle 'highway':

"Cycleway all the way and that's the, that for me was the absolute transformation, in fact we moved from Swanson three years ago because I could catch the train from

Swanson, and part of the reason to move to Te Atatu Peninsula was the, I kind of had this little sense that biking would be an option there, and it absolutely is, yeah." (Key informant 4).

"I used to bike in London so I've enjoyed riding bikes. I got to Auckland, got to West Auckland and went, oh my god, State Highway 16 is broken. This was two and a half years ago. There was a lot of roadworks....So, I discovered there was a bike lane which is actually off the road, so it was rather nice and safe, and so I was just biking that as a normal biker, ...with my pushbike, and I started getting passed by a whole lot of other guys on bikes. I'm like, hang on a minute, what's going on here? And clicked that there was another alternative, that I could convert my existing bike into an e-bike." (E-cyclist 13)

Encouragement from others and getting the opportunity to try a bike:

Several people said that encouragement from e-bike enthusiasts had played a role in their decision to buy a bike:

"So, Electric Meg came in and I actually went out with Meg and did the training and then went for a ride and everything of what they were going to do. That was really good and I actually really enjoyed it. So, about a week later [I] came back and said, "Oh look, I wanna know if I can ride home on an electric bike." And so I actually started riding home and then it just evolved from there. I started with an 8k each way, so 16k return to Sandringham to start with and I did that all January, and then in February I moved to Avondale and so I tried it to Avondale and now it's a 16k each way. Once I'd made that decision, yes, I can cycle, I'm comfortable, then I decided I would get the electric bike." (E-cyclist 10)

"Well, my wife actually was interested in getting one because neighbourhood friends of hers have got them and were very enthusiastic and using them a lot" (E-cyclist 12)

"[W]hen I was first riding here there was a woman who had a really old set up and it was a Canadian company. I can't remember what the brand was. Basically I saw her on the thing. I stopped and talked to her. I said, "What's going on there? That looks really cool." She would have been in her sixties, late fifties/sixties and she told me, "It's an electric bike my husband put together for me. He imported it from Canada and it's amazing." I remember looking at it. It was pretty premium stuff and it was just really fast. So, I kept seeing her. I was like I gotta get a piece of this. And then another time after that I was coming up the way there and a couple came past me and we stopped at the lights and they had identical bikes, they were European, ...and they were talking and I said, "Oh, electric bikes?" and they were like, "Yes, yes. We imported these from Germany. They are very fast." I said, "Oh that's cool," and they were just, phew, gone. It was like, oh my god, I want that. I really want a piece of that." (E-cyclist 13)

Advertising

Two participants said that they were encouraged by bike promotion campaigns to give biking or e-biking a go:

"I think it was like an Auckland Transport one about just normal people riding to work and there was a couple of... oh, it could have actually been on the Bike Auckland thing where it says what to wear when you're cycling and there was the couple of people and I'm like, oh well, obviously they're riding and they're enjoying it so I can give it a crack." (E-cyclist 9)

"I think the thing that made me think about it initially, was the Mercury energy campaign, because I kept seeing that in facebook." (E-cyclist 16)

The experience of using an e-bike: The best and the worst things

In most ways the experience of riding an e-bike is similar to the experience of using a pushbike. Or it would be more accurate to say that in general e-biking provides a new combination of existing elements of cycling experienced by diverse groups of pushbike users. Overseas research shows that like road or sports cyclists, e-bikers tend to travel at slightly higher average speeds^{37,38}, and to prioritise 'free-flow' infrastructure conditions like cycle highways (or roads if necessary) that enable them to sustain higher speeds without encountering too many obstacles. They also both ride more expensive bikes. In other ways e-bikers are more similar to traditional slower cyclists: they are more likely to ride European-style upright, step-thru bikes; more likely to be new to cycling; more likely to be women; more likely to favour low-moderate exercise intensity³³. And some aspects of e-biking experience are fairly unique: in particular the weight of the bikes that people are riding (avge 25-27 kg), which presents particular safety challenges and opportunities. The experience of effortless acceleration, the so called 'zoom' effect when starting off on an e-bike is also unique amongst e-cyclists, and is more akin to the experience of other motorized transport users.

The best things about using an e-bike

We asked all three groups what they thought were the best and the worst things were about using an e-bike for everyday transport. It was common for people to talk about experiencing multiple benefits associated with switching to an e-bike. There were four key themes:

1) Making everyday travel by bike more realistic Reducing sweatiness Carrying stuff
2) Improving commute efficiency and reducing commuting stress Increasing arrival-time-reliability Reduced travel times Eliminating parking hassles
3) Improving safety Increasing confidence interacting with cars Being able to choose safer routes

4) Improved quality of life

Fun and mental health benefits
Making cycling more feasible for parents
Enjoyable, flexible opportunities for exercise
Saving money

5) Reducing car use

Making everyday travel by bike more realistic

Turning up to work looking 'professional'

The ability to adjust their exertion levels and to keep exertion levels low enough to avoid arriving at work all sweaty was considered to be one of the best things about using an e-bike for everyday travel, because it eliminates the time required to shower and change clothes, and provides the opportunity to turn up at off-site work meetings during the day looking 'professional':

"I go to work now dressed for work, pretty much every time, whereas I used to, I started off thinking well I will get a little bit hot and flushed, and I'll get changed or showered at work if I need to, and I've stopped doing that because I just don't need to. (E-cyclist 21)

"Sometimes I want that 50 minute ride and I don't really mind, but not always sometimes, I'm going to a meeting, or sometimes I've got two meetings or three meetings to go to in a day, and by the third one I look a little bit worse for wear if I've been a riding a bike back and forward, but on an e-bike I wouldn't be worse for wear. [S]o an e-bike for me ... it allows you the lack of effort that a car does, but it also allows you the freedom of the bike." (Key informant 1)

"There's a few times I've gone, actually I can't be bothered. Finishing work I don't bother getting my shorts and a t-shirt on, I'll just go back home. I might have had a couple of beers. It's like actually I just can't be bothered. And I don't get home too sweaty and messy. It's fine. As long as the weather's all right. I rarely change clothes because of the weather so I don't mess up my work clothes. But all of those reasons really. It's just I can count on it working and I don't need to put in a ton of effort. (E-cyclist 13)

Carrying more stuff

E-bikes tend to make it easier to carry more stuff because pedal-assist removes the need to keep your bike as light as possible to minimize exertion. Many of the participants talked about how they were doing more 'trip-chaining' on the e-bike as a result of being able to carry more stuff, i.e. doing more 'car-like' trips with multiple stops in different locations:

"[M]y wife will call me and say, "Can you pick up, you know some tomatoes from the store on the way home?" And, I have bags or panniers on the side of my E-bike where I can carry [stuff]. Like, one time I had box of files I needed to go through at home,

professional stuff that I wanted to bring into the office, and I packed 60 pounds of files and documents into two panniers and I drove them into work, on my E-bike. Right? It's a whole heavy box of stuff and similarly, I can get 4 to 6 bags of groceries in my panniers, 3 in each side. So, I can carry a lot of stuff. [A]nd the panniers, they're German and you know they're made really well and they're strong and you have a strong rack at the back of your bike. It's surprising what you can carry and you know what? You can go and park at the front door of the supermarket too by the way, you don't have to deal with that parking lot." (E-cyclist 1)

"You don't have to consider how much things are going to weigh when you are coming back home again because you know that you have the motor to assist you. I will do a quick grocery shop on the way home if there is milk and bread and just a few essentials that I need to do. I know I would be able to fit them in my bags and it won't make any difference to how quickly I can get home again." (E-cyclist 8)

"[T]hink being able to do a large amount of stuff on the back because you've got the power to take that, so on a Friday I'll quite often go to the supermarket on the way home and do the shop for the weekend for the family and it all fits in my panniers and I can do that. I wouldn't have done that on my pedal bike. ...And I'll stop off at Glengarry and fill up the panniers with the wine as well which I definitely wouldn't have done on the pedal bikes, it would be way too heavy. To be honest, I thought about buying a cargo bike while I was buying it because I wondered how much extra could I do if you had that capacity to take even more." (E-cyclist 11)

Improving commute efficiency and reducing commuting stress:

Improved arrival time reliability:

Reducing the unpredictability and stress associated with commuting by car in congested conditions was considered to be an important benefit of travelling by e-bike:

"[A]t the moment the north-western motorway is such a dog that I can get more reliably home on the bike than I can in a car. The car varies between 45 minutes to 2 hours depending on what's happening with traffic whereas a bike I know it'll be an hour. I will be home in an hour." (E-cyclist 9)

"You know exactly how long it's gonna take you to get from A to B." (Key informant 7)

"[I]t doesn't always take longer to drive but sometimes it does, so there's that unpredictability, it will always take them half an hour to ride." (E-bike retailer 5)

"I know it's gonna take me 23 minutes from door to door regardless of what the weather and the traffic is doing." (E-bike key informant 7)

Improved arrival-time reliability was seen as a particularly important gain for those with care responsibilities:

"If I could pull one example about a lady who lived in Mt Albert and worked in the city said, 'I can leave work at 5pm and I might be home in 20 minutes or I might be home in an hour. And I want to be able to tell my babysitter that I am going to be home at this time, and in my car, I can't do it. On an E-bike, I'm home at exactly the same time every time'." (Retailer 1)

"So I picked a friends of mine kids up from school yesterday because she took 2 hours to do her 15 minute commute to get them from work. It is just stupid. So the bike is not always quicker, it is often quicker but not always. But I justify it in that it is always exactly the same. You are plus or minus five minutes. So I can do it in 40 minutes or 45 minutes." (E-cyclist 5)

Reducing travel times

As well as becoming more reliable, many people reported that their commute was now shorter giving them more time at home in the morning, and saving time getting to meetings during the day. Those who were working in the CBD reported that using an e-bike is making it quicker to get to work meetings, especially with the additional traffic disruption related to the construction of the City Rail Link:

"Anything involving where there is lots of traffic, because you have access to the cycle ways or bus lanes, it is just quicker. Quicker around town." (E-cyclist 4)

"[I]f I want to come from here down to the city campus, I use my bike because it is quicker than the bus. It is just convenient." (E-cyclist 7)

"[I]t was quicker to get to work, and also I didn't sort of have to have a shower and things when I got to work, I didn't have to leave so early as well. ...Yeah it's just so much easier riding, arriving at work I can just ride straight into the building, because we can keep our bikes, there's a room there where we keep our bikes, and you know I'm at work and I can just get straight into my work yeah, I don't have to do anything." (E-cyclist 18)

"[S]ometimes in the car it's taken me 50 minutes to get to work here by car, and I could actually run here quicker than that so (How long does it take you on the bike?). Just under probably 25 minutes probably, I've still got traffic lights but if I could, if I didn't have the lights, the lights went smoothly I could be here probably in 20 minutes, it's not a problem but around about 25 minutes, so it's not much different when I, at times it's quicker than the car, but it's more enjoyable really." (E-cyclist 14)

"The Skypath will make an amazing difference just from the North Shore and things like that. ...From the moment that's in place, suddenly it will allow this massive number of people from over the Shore to ask... shall I take the bus which is going to take me

an hour or jump on my E-bike which is going to take me twenty minutes.” (E-bike retailer 1).

They also reported enjoying the flexibility of being able to leave whenever they wanted, and not having to wait for a bus:

“I just like the flexibility of being able to travel when you like, so not waiting for a bus. And I live on a bus route, it is one of the best in the city because it is all buses that go west out to Titirangi and Henderson and New Lynn – there are thousands. So I never have to wait more than ten minutes which is as good as it gets in Auckland, but at the same time, sometimes I am waiting ten minutes and a busy working mum; ten minutes is sometimes ... you have busted your arse to get out of the house on time, you miss your bus and that just puts you that much further behind for the day when you are already behind. So I love the fact that when I want to leave, I leave. And then I am not bound at the other end to take a bus that gets me home with a useless ten minutes of downtime, when I would much rather get on my bike and be where I need to be.” (E-cyclist 22)

Existing cyclists felt that they reduced their ride time by switching to an e-bike because they were now able to choose a more direct route, without having to worry about hills:

“Yeah. I couldn’t get up a hill without the electric bike. If I wanted to do additional shopping, food shopping, messages, going into town to pick something up, I kind of would end up choosing the route that had the least hills, whereas now with an e-bike one of the reasons of getting an e-bike was that I didn’t have to do that. I could just take the direct route.” (E-cyclist 10)

“I do take different routes than I would probably on a normal bike.So I would probably, I would venture onto a busy main road, just because I don't know I just feel like I'm more, not safer but I would do that, and also not having to go down the back streets because that's where the cycle ways are, and that's where the less hills are, so I don't think about how, what is the easiest way to get there. What's the flattest way, yeah, that doesn't come into my mind at all, so it's the quickest way for me” (E-cyclist 15)

Eliminating parking hassles:

Part of the reason why arrival times had reduced and become more reliable for e-bikers was the fact that they now spent less time looking for a park:

“Yeah just simply the ease of use, and you know I still get such a buzz when I, like tomorrow morning I've got a breakfast meeting in Ponsonby and then coming to work, and I know that I will just, I know exactly what time I will get to the meetings, I know how long it will take me, and I'll just bike up and then I'll just chain my bike, to a lamppost or whatever, and it's that complete, I've completely given up worrying about parking.” (Key informant 4)

"No down time lost to finding car parks, no frustrations, no lost time coming back going Jesus I'm sorry I'm late I couldn't find a park. 'It took me so long to find a park!' And everybody else says 'I know, it's crazy, eh.'" (E-bike retailer 3)

"[I]t's just so handy, you don't need to worry about parking. Like the other day I went up to, over the road from the mall, ... they're doing some building and so the car park was chockabloc, and I just dodged all my way up all the ramps, and up to the far end and parked on a pole, it was great." (E-cyclist 3)

"It's not just for commuting. I go to meetings in town cos it's faster and cheaper for me to go to a meeting on my E-bike than it is for me to drive. And, go on a parking space and I can rock up to the front door of City Hall and I can lock up my bike there and go in." (E-cyclist 1)

"It's actually easier to park the bike than it is to park the car. [A] few times I've gone to the mall after work, and the mall shopping car parks are horrendous, but parking your bike is super easy" (E-cyclist 16)

Improving safety

Most of the participants reported that they felt safer on an e-bike than a pushbike because their e-bike provides them with greater opportunities for speed harmonisation, helps them get across intersections more quickly, and makes them feel more confident interacting with motorists:

Improving confidence interacting with cars:

Making it easier to take off faster at intersections was seen as a key advantage of using an e-bike:

"I can probably afford to be a little bit more aggressive in terms of merging with the traffic. So, when I come into the peninsula at [name of suburb] there, I can get up to speed a lot quicker and so I know I can cross a road faster. So, if it was just my normal power obviously I don't have that speed to get up so quickly. So, I can merge into traffic quicker. I can get onto a roundabout quicker. All of those things. I know that I can get to the front of traffic and I'm not gonna be holding them up. I'll beat a car off the intersection. So, I feel a lot more confident to actually get up to the front of the traffic and be seen." (User 13)

"[A]nd I think the E-bike just makes you feel that you can get away quickly in traffic, and I've got, you know, with the throttle which to me is critical." (Key informant 4)

Most of the participants said that this ability to accelerate quickly when necessary makes them feel like more of an 'equal' road user, and they worried less about annoying or inconveniencing motorists:

"[A]nd you don't get stuck behind the traffic, so it kind of took a lot of the safety concerns out of it too, because suddenly you were a little bit more of a competitor rather than a, you know a secondary transit user." (Key informant 1)

"I think it's just more the idea of being able to get out of the way of things faster, that would be one thing ...You can, yeah, save yourself or whatever. I think that's it, and like you do feel like more of a vehicle on the road I guess, and yeah it is keeping out of people's way because, a lot of the angst from drivers is that they get held up by cyclists, but I feel like I don't really hold them up as much ..., so that makes me feel safer I guess." (E-cyclist 15)

"And because you can go quite fast – I like going quite fast – you can not be such a pain to the traffic because you are going pretty much the same speed as them." (E-cyclist 6)

"The 400W motor is enough to get me up some of the steep hills in Auckland at about 20kms. That is fast enough that you are not too much of a nuisance to passing traffic. ... I think that your interactions with other road users are much better on an e-bike than on a normal bike as I have said, so that is a positive." (E-cyclist 7)

Most of the participants felt that the throttle was an important auxiliary safety feature in this regard:

"I think it's amazing for commuting. It puts me on much more of a par with the cars. I feel like I am able to manage the volume of traffic, particularly with the throttle where I can take off in front of the traffic confidently and comfortably." (E-cyclist 11).

"[I]f you stop behind the car, you're not holding the other cars up because you can use your throttle and you take off every bit as fast as that car can take off." (E-cyclist 2)

"Well, its fast enough that they don't look at you and say 'get on with it' and get annoyed. So if you go around a roundabout for instance, you probably wouldn't hit more than 25kms, but you want to be able to get to 25kms reasonably smartly so that the other cars driving onto the roundabout, whilst you hope that they will keep a reasonable distance, it is much easier for everybody if you can match the traffic reasonably quickly. If you have an e-bike where it only offers pedal assist, you can't really manage that sort of manoeuvre in traffic as easily as you can if you've got one with a throttle." (E-cyclist 7)

Several participants also said that they felt that by being able to start off a bit more quickly and/or to go faster uphill that it reduced their experience of 'dangerous' overtaking by motorists:

"I don't feel any less safe than I did on my other bike, and in fact I feel more safe in many ways. (Why is that?) Because I feel that being at the front of the traffic I'm able to take off at speed with the throttle and get up to speed quickly and maintain speed quickly and travel at a similar speed to the cars when I'm on the road with cars; that they're not getting frustrated and cutting close to me. That still happens occasionally but the majority of the time I feel like I'm so far ahead of them they're actually probably stuck at the last set of lights. So, I think that definitely makes me feel safer." (E-cyclist 11)

"I think it's two reasons, the slower you go the more frustrated cars get, and that makes them dangerous, and there's also something to be said for being able to accelerate out of danger." (E-cyclist 16)

"In terms of safety, I think speed homogeneity is a big deal. So if I am going uphill at the same speed of traffic and am not getting passed by traffic then I don't have to worry about those dangerous overtaking manoeuvres to the same extent that if I am riding uphill at 10km/hour and it is just a constant stream of pressure of traffic behind me wanting to overtake on narrow roads." (Key informant 5)

"Because often on a bicycle that's a pushbike you kind of feel like you're in the way of the traffic that's coming behind you but if you can get away quickly, there's a sense, and it's not just a sense, it's a reality of safety." (E-cyclist 1)

Several of the participants said that they felt more comfortable riding on road, and didn't feel they always needed a cycle lane:

"I think because if you have the extra speed you feel more comfortable on the road and you need less of the shared paths in the world." (E-cyclist 1)

Throttles were also repeatedly mentioned as an important part of keeping safe when starting out on a hill or under load:

"If you are starting under load on an incline, which is often the case in Aotearoa, Rather than jump up on to the peddle and get your woohoo that way, you can just get a little awihi, assistance from the throttle, move it out and then get it to peddle. ...Yeah, I've had a throttle bike, and I really liked it for that reason: going up hills, going across intersections, being able to move out of the way fast when I needed to be safe.. [W]hen I'm at the lights, especially when I'm rolling in Auckland, I can get out in to the front of the traffic at the lights, and then I can pump the throttle just to push me out in front of the car, just to remind the driver, 'hey, I is here, I is in front of you'. They are more likely to see me and think of me, as opposed to if I am on the side, I am an afterthought. So it's a lot to do with driver behaviour, and road user behaviour. So for me a throttle is absolutely important." (E-bike retailer 3)

"And that was something, because I was a bit concerned of the throttle thing, I was like oh my God I'm going to get completely out of control as soon as I touch that, but you have to have it because if you have to stop on hills and you do sometimes have to stop on hills, you can't get started with two 20+ kg kids on the back without the throttle, so it just enables you to actually take your kids places without jumping in a car, which is bloody awesome, particularly Auckland." (E-cyclist 21)

Being able to choose a safer route, even if it is longer or hillier:

People also talked about how they liked being able to choose the safest or most efficient route, because they no longer had to factor in hills or distance as much:

"[A] lot of people started picking a much safer route once they got an e-bike, just going a bit further, doing the odd hill wasn't an issue anymore, so they had the freedom to pick the safest way possible." (E-bike retailer five).

"So, part of what we're looking at with e-bikes as well is if you're on a pushbike and you're riding from point A to point B, if that's the route you take in your car it's not the route you wanna do on your bike. It's normally high speed, high volume roads. So, lots of traffic going too fast, not safe for a cyclist. To then re-route means you might have to add on a couple of kilometres and it means you might have to add on a couple of hills. On a pushbike that was a pain in the arse." (Key informant 7)

Improved quality of life

Fun and mental health benefits

The e-cyclists within this study echoed findings from other studies that point to a number of key mental health gains associated with bicycle commuting. Cyclists are consistently shown to be the happiest commuters. Previous research points to a number of key reasons for this, including the feel better effects of exercise and time spent outdoors, greater opportunities to observe and feel connected to neighbourhoods, and greater opportunities for flexible social interaction. All these themes were reflected in the narratives of the study participants, who highlighted the ways that e-bikes can 'democratise' or increase access to the wellbeing benefits of cycling.

Having more time outdoors in the elements, was frequently mentioned as a key benefit of e-biking:

"[Y]eah general wellbeing of being out in the sun and in the wind, and you know that kind of thing psychologically probably, it does feel good yeah absolutely on a nice day, it feels good." (E-cyclist 15)

"I think it is good for you mentally to be out and whizzing around in the sunshine." (E-cyclist 6)

"Like coming home on Monday was just like it was, late in the afternoon, it wasn't raining, you know it was lovely weather, and it was just all along the motorway, first of all you go through all the viaduct and then you go through all the waterfront. It was so nice, and just the fresh air and it just blows in your face and it's just so nice." (E-cyclist 3)

The participants talked a lot about how much more they noticed their surroundings when they switched to an e-bike:

"I realised that when you are on your bike, even though the road you went on is just there and you are cycling just here, and it is maybe just 5 to 20 metres away from the road that you have driven on for years, actually you see things because you are on a bike and you are slower and you can stop and look to the side and not crash into someone. ...So I saw these things, just like trees and greenery and hills and little reserves and little picnic tables and then I see plaques, little historic plaques." (E-cyclist 23)

"You're sort of in your environment as well, so you get that benefit of cycling and being in your environment, and the benefit of being able to go little back roads and, you know, see bits of your city that you don't normally see." (E-cyclist 20)

"You have a different mindset, I mean, you notice things, the city sort of opens up in a lot of ways. ...[Y]ou have to be, in my opinion, more observant when you're on your bike, so yeah, you do see things that you don't necessarily notice when you're driving." (E-cyclist 12)

Time spent outdoors was seen to lead to a positive loss of time:

"Yeah. It's weird cos I'm not really in the nature but I feel like I'm in nature. I'm going past a tree and I'm just like, oh so pretty. Yeah, and you go past the water and oh so pretty. So, I feel like it's nice. It's a pleasant journey, I suppose. Yeah. I keep saying to my friend it takes me 40 minutes but it feels like a 10 minute bike ride." (E-cyclist 18)

The journey was also positioned as important time on one's own when you can enjoy your thoughts.

"You're outside, nobody can bother you, you're just pedalling along thinking about stuff." (E-cyclist 9)

The ride as a break from busyness was another key theme amongst participants:

What I like the most is that I actually get time out. I'm not very good at taking time and that 40 minutes riding there or riding home is just time to myself. As I said, I

wasn't very good at taking time out so while I'm cycling it's not intense exercise but I'm getting fitness benefits but I'm also getting time where I'm not sitting around or rushing from one thing to the next. (E-cyclist 10)

The 'feel better' effects of exercise were identified as another key benefit:

"[Y]ou feel quite happy when you have a bit of a cycle to work. ...Definitely I'm a person whose mood improves if I exercise." (E-cyclist 21)

"It is a healthy level of exercise. When my joints allowed me to run I used to enjoy running because it meditative and there is that pleasant level of exercise. You can get that on a bike. Particularly an e-bike because the unpleasant levels of exercise involved in getting up a steep hill are removed." (E-cyclist 17)

Like cyclists in other studies, social interaction was often positioned as one of the most valued things about cycle commuting:

"Yeah me and my friend we had a lovely ride last week, we just meandered along and talked, and all these different people were out there, someone was walking a dog and someone was jogging, and you just say hello." (E-cyclist 3)

In general fellow cyclists were portrayed as a fairly social group:

"You get to see a lot more, you know and you can go sort of, you can take shortcuts and you know so you get to sort of know the neighbourhood a lot better I think, you know you can greet people, you can say hi, I think the community is quite a friendly community, the cycling community". (E-cyclist 18)

'Oh, I like chatting with the other bikers. My car's really old, it's got no radio. Silence. Fifty minutes of silence thinking in my own head, it's really not fun. I went past some guy yesterday and he had a high viz with "Dad" printed on the back. I was like "so cool". My fluorescent jacket is the pinkest thing you've ever seen with a flashing light in it at the back. And, he says, "You think my high viz is cool?!" You just don't get that in the car. Yeah, so I think that's probably one of my favourite things. (E-cyclist 19)

"It is a lot of fun going along the Northwestern cycleway at the moment because you are pretty much guaranteed to get four or five other cyclists with you at every traffic stop. And so you are kind of comparing e-bikes or regular bikes and sorting out the difference between the MAMILS and the people on their BMX bikes and the off-rovers." (E-cyclist 8)

One participant echoed findings within previous studies about the ways that cycling provides 'flexible' opportunities for socialising, compared to other transport modes:

"[I]n terms of commute I could either drive, take the train or cycle. Driving is horrendous, it makes me really anxious, no one is very friendly. The train is pretty good, you can read, but when people are, sometimes other people aren't having a good day and they're a bit in your face. ...And [with cycling] it's actually quite social if you want it to be, and I often chat to people at the lights because I'm chatty, but you don't have to if you don't want to, and you can also go fast or not go fast depending on how you're feeling, like it's quite adjustable." (E-cyclist 16)

Make cycling more feasible for people with care responsibilities

Three of the participants were carrying kids on their e-bikes: two on a cargo bike, and one on her ordinary e-bike. This participant, who travels with three kids, talked about how being able to use a bike with her kids gave her more options than a pushchair, and enabled them to explore more of their neighbourhood together:

"[G]etting the kids on a bike as opposed to anything else is fun and in that sense it gives us a little bit more freedom as opposed to walking. We are able to go to places where I wouldn't walk because it would take too long to get there. Okay we could get there but then by the time you walk back it is too late or I am too tired or whatever." (E-cyclist 22)

Two other women also talked about how e-bikes made biking with kids more feasible because it makes it easier to carry all their stuff:

"Having the e-bike means that I can be the person who's carrying all the gear for all the kids and the waterproofs and the drink bottles and the snacks. I'm not having to really deal with extra weight on the bike without the power to carry as well." (E-cyclist 11)

"[I]t was culture day so my son had these two massive books and a flag and his swimming togs. Yeah and the baby and all the baby's stuff for day-care for the day....Yeah, it is quite a lot of stuff. But the panniers really help. I think you are more inclined to use panniers on an e-bike. [Because?] There is already a rack for the battery tray anyway. And part of the reason for the e-bike is arriving not sweaty. As soon as you put a backpack on you end up sweaty." (E-cyclist 5)

In general people with care responsibilities felt that e-bikes make cycling more realistic for parents:

"Well yeah, I mean, they're great. With them, it being sort of incidental as part of your normal day, you know, you can whack your kid on the back of it or you can whack

your shopping on the back of it and because you've got the battery to assist you it's not weighing you down so much as if you were pedalling on your own." (E-cyclist 9)

Interestingly, one of the participants was also using his e-bike to take his dog out. He said after starting e-biking, he soon realized that instead of biking home and picking up his car to take his dog out to the park, it was probably possible to put him on his e-bike:

So once I started to use my bike more, I started to get more frustrated that I would go for a bike ride and then I would go home and put the dog in the car to drive to an off leash area – and it was like what the hell? So I did spend a bit of time, what was the best kind of thing, and because my bike is already heavy on the back I didn't want to get a big carry thing..but I got this buddy rider set up....Yeah it attaches to the seat post and it cantilevers out so that the dog's seat with its straps is between me and the handlebars. So that has been fantastic and ...people think it is pretty cool and my dog just loves it because he has alert ears and he is just looking at everything the whole time." (E-cyclist 23)

People who carried kids on the back also generally found that people were curious about their family biking set-up, and that the kids enjoyed riding together:

"Well they love it because they love the attention, they absolutely do get lots of attention, all the time, and I think they just like it, and most of the time they do say are we taking the bike mum, are we taking the bike, and they don't ever go can we take the car. It's just generally quite fun being on the back." (E-cyclist 21)

More enjoyable, flexible opportunities for exercise

Research shows that the lack of enjoyable opportunities for exercise is a major barrier to undertaking physical activity for many people³⁹. The e-cyclists in this study talked about how they valued the ways that their e-bike provided them with a fun way to get some exercise, that didn't necessarily require high levels of fitness. They also talked about how they felt that the ability to adjust their levels of exertion meant that it is a form of exercise that is easier to maintain:

"You know if you're riding a regular bike and you're having a hard commute with some hills, you know some days you're going, oh this is just too hard, I need a break because, you know I'm physically tired. I need a day off. Like, you know you're doing a workout, right? But, here you don't need to get a break. You actually can ride every day at a moderate level and if you're feeling tired you just spin more and you just don't put as much effort in." (E-cyclist 1)

"I pedal more and less, so sometimes I will pedal a lot of the way home and arrive home as if I have done a spin class – I feel like I have done the same amount of exercise. But I have still got home quicker because it has boosted me up the hills." (E-cyclist 5)

"[O]n my way home I actually push it a bit harder, 'cause it doesn't matter. And I grab a beer out the fridge. I've earned it." (E-cyclist 12)

Several people talked about how they liked the fact that using your e-bike to commute meant that exercise was built into your existing day, rather than added on at the end:

"Yeah because people do need to go to work and back, and not everyone can walk so the idea that you hook in with something that you have to do everyday anyway, an e-bike is a great solution I guess. Transport is, thinking of it as transport/exercise rather than an extra thing you have to add onto your life, I guess makes it more easier for people who don't normally, can persevere with that kind of thing." (E-cyclist 15)

"[I]t's like incidental exercise that you kind of incorporate into your day without having to think about it too much. It's just a trip to the shops or like for me it's a trip to work and back." (E-cyclist 9)

"I used to hate the treadmill at the gym because I felt like I was just doing nothing and the TV options were always awful so you would be listening to your music and trying to kill your brain a little bit to get your 20 minutes of running in. ...And if I can work it in incidentally to my day then I don't have that guilty conscience of thinking you should probably go and exercise." (E-cyclist 8)

This participant talked about how she struggled to find enjoyable ways to get exercise to help her reduce her weight, and found e-biking had provided her with an enjoyable way to build exercise into her day:

"When I first got mine and I would take it on little trips up to the shop and get my fruit and veg and take it home and it would make me happy 'cause I was riding a bike and doing something, and as an overweight person there's nothing worse than being told, "You should exercise more," and you go, "Huh, I know but I don't want to." (E-cyclist 9)

Many of the participants said that their fitness had improved and/or they had lost weight since starting to use an e-bike:

"I think from my fitness perspective it's just got me exercising, and even though it's not the intensity, you know, I still climb stairs, but it's a good form of exercise without being really intense. ...So, I have from the basic stuff that I've been doing for the last couple of months noticed a change in my fitness. I'm not fit, fit, fit but I am more fit than I was and I'm toning down. That's just with the cycling. I cycled all January and February, just about three to four times a week to work and I did the 5,000 step challenge in Mt Eden which I did last year and I was incredibly unfit last year, took me about an hour and 45 minutes, and this year I did it in an hour and 10." (E-cyclist 10)

"I have noticed I have gone down about half a pants size which has been quite nice and that is 30-40 minutes of cycling each way every day. So even though it is low and you are not increasing your heart rate enormously you are still getting exercise out of it. [Also] yeah, I wouldn't even think twice about playing the two games of soccer tonight and then cycling home – it is completely feasible whereas before it never

would have been. And I have noticed my fitness difference between the season we had over the summer in the Domain and the season we are playing now over at St Peters – I am able to run around for longer before I need to sub off.” (E-cyclist 8)

“I’m much fitter. I’ve lost some weight. I’m only five weeks into my daily commute to work but already I’ve noticed a huge difference. ... I’m feeling that I’m exercising but I’m not killing myself every day.” (E-cyclist 12)

One of the women also talked about how she had found using an e-bike to increase her fitness and lose weight a more empowering experience than going to the gym, which was a much more intimidating, unwelcoming place for overweight people:

“I mean, amazingly I used to be a bit heavier than this years ago and my doctor would say to me, “Oh, look, have a green prescription and you can go to the gym and you can go there,” and the idea of me going to a gym back then when I was 25ks heavier was like, “Are you out of your f**king mind?” I would rather die than go anywhere near that kind of thing.” Yes, there was the fear of being mocked getting on a bike and riding to work, even now, but it was a lot less scary than that kind of thing.” (E-cyclist 9)

Not everyone felt like using an e-bike had improved their fitness, however:

“I thought also I’d lose a bit of weight. Oh, I’m getting a little bit fitter. There’s none of that with an E-Bike. [Laughter]. It’s too easy. There’s no exercise whatsoever.” (E-cyclist 19)

Three users thought that using an e-bike might have actually led to a decline, or at least a levelling out of their fitness. Two of these participants had previously maintained quite high intensity exercise regimes:

“Funnily enough it may have made me slightly un-fitter, because previously I’d be on the train and then I would go for a run one day out of two, now I don’t, I might go for a run on the weekend, I’ve just got back to realising I do actually need to keep going for a run, because the base line fitness will go down quite quickly if I’m not doing something, that’s not no effort using an E-bike but it’s certainly not the same as going for a run, so you can’t, I can’t replace it.” (E-cyclist 20)

“[I]t’s kind of like I almost now go ok tick the box I’ve done some exercise today, so I keep a base but I don’t get any fitter, because I’ve managed somehow in my head to just go well I’ve done some exercise.” (E-cyclist 21)

“Yeah see I would say it is a bit negative on fitness in the sense that before I did a lot of walking and pushing the stroller and I am much more likely to take the bike for those kinds of trips now and I think in all, that is probably a decrease in my activity

for length of time probably. Maybe it evens out. On the other hand I take the bike where I would have taken the car before, so ... I don't know exactly." (E-cyclist 22)

Saving money

Many of the participants mentioned saving money on public transport fares and parking:

"I am not paying for parking which is great because \$20 a day is \$80 a week and I figured my bike is paid off in 30 weeks." (E-cyclist 5)

"Well the other one is money, I mean they are expensive, but ultimately they pay themselves back, so you look at the train I don't know how much it costs these days, but it was about \$200 a month for me to take the train. I actually thought the train was good value, it was certainly cheaper to do that for me than having a car, for us having a second car, and parking in the city, but this is another step so it's essentially more or less free, but the only ongoing costs are maintenance, and I'd like to say that I take it in every couple of months, but it's probably a little but longer than that just to get a service. [A]nd that's it, so everything else, the upfront cost is a sum cost that's done, and then everything else is a benefit so I'm not paying \$50-70 a week on petrol, I'm not paying \$200 a month on the train, not paying to park and that's, I'm very tight I really like that aspect of it." (E-cyclist 20)

"[T]hree [train] stops was, how much was it, \$9 a day or something to do that. It doesn't cost me \$9 a day to take the bike." (E-cyclist 21)

"You save money, it's just like, because I had a really expensive vehicle and I traded that in and got a little hatchback, but like even all around town you could go through half a tank full in a week, just from around town. ...I reckon I save heaps in petrol." (E-cyclist 3)

Reducing car use

Consistent with other overseas studies^{33,40}, the participants were using their e-bike to replace a mix of car use, public transport use, and walking. Most people who owned a car felt that they had reduced their car use since getting an e-bike. One of the reasons for this was due to the ability to carry more stuff on a bike, including groceries and kids:

"What really used to annoy me, I live ... in Grey Lynn, is to get to the supermarkets there's big hills involved and so starting up your car, getting out into the traffic to drive for two minutes, how dumb is that? Yeah. So, pannier bags, I can fit six litres of beer in one. If on the weekends or after work we're going to the shops we're jumping on our bikes. I've used my car three times in the last five weeks." (E-cyclist 12)

"Yeah, school and day-care. Often I would come home from work and I get home about 2.30-2.45 and I get in the car to go and get [child's name] from school and I have done that much more often now by bike. If we go by bike, we have a little bit more time to chill out and she can take her time getting out of school and we can still make it to day-care easily. So definitely some of the trips replace the car for sure." (E-cyclist 22)

Two of the participants had decided to go car-free, and were finding that mostly they were now managing with just an e-bike:

"I bike everywhere with it, it's the only, I don't have a car so that's what I use, unless my flatmate has a car and I ask, if I'm going further afield I ask him can I use it, but otherwise I use the bike. ... the worst thing is that you can't carry much, not that that's stopped me I've carried a carpet on the side of the E-bike before, and tied plants and stuff." (E-cyclist 15)

"[W]hereas before I would drive if it was raining, and if I need to go to the grocery store I physically can't get there any other way (now) than, walking or cycling and I can take an Uber but I prefer not to ... so I'd say the number of times I'm walking or cycling has increased, because I've chosen the bike rather than a car." (E-cyclist 16)

Three others said that since they got their e-bike they have had conversations with their partners about the possibility of giving up the second family car:

"[M]aybe I get to a point where my family only needs one car." (E-cyclist 1)

"[My wife] and I have a car each and we're now having that conversation [about selling on]), because those 2 cars sit around quite a bit." (E-cyclist 17)

"[P]art of my motivation for biking more was that I thought and was very conscious that I was a drain on the household's finances while I am doing my PhD. So I was very conscious about things that I can save, so I can do more cooking and have more things for lunch and actually maybe I don't need my car. Maybe I can sell my car. So part of my motivation for biking more was fitness and a part of it was thinking can I do enough cycling to get to the places I am going to that I can say let's sell my car. [A]ctually my partner was really reluctant for me to sell my car. But actually I feel like it is really borderline that I can justify selling my car." (E-cyclist 23)

The worst things about using an e-bike

Many of things that people reported disliking about using an e-bike were similar to the concerns of other cyclists: Particularly fears about the heightened risk of accidents, injury or death associated with having to mix with cars on-road. Participants also worried about hurting pedestrians on shared paths, about biking in the rain, and about getting expensive bikes stolen. They also had a number of concerns that are more unique to e-bikers: In particular 'range anxiety' or the fear of running out of battery, and challenges managing the extra weight of their bike.

The worst things about using an e-bike:
<p>1) Safety concerns</p> <p>Fears over the safety of riding on-road with cars</p> <p>Fears about hurting pedestrians</p> <p>Bike weight</p> <p>Infrastructure</p>
<p>2) Fear of theft</p>
<p>3) Biking in the rain</p>
<p>4) Range anxiety</p>

Safety concerns

Fears over the safety of riding on-road with cars

Most of the participants worried about the possibility of injury associated with getting hit by a car when riding on-road:

"The not so great thing is just that risk of an accident, knowing that even a low speed thing is potentially dangerous. (I: Yeah, That weighs on your mind a little bit?) Yes. Certainly riding on the road, that's always on my mind, and riding on non-separated cycle lanes weighs on my mind. On a dedicated cycleway or a separated cycleway, no issue." (E-cyclist 7)

Many people said they felt that there was still a lack of general awareness and respect for cyclists amongst motorists in Auckland:

"Because people don't respect cyclists so much. I've been knocked off my bike on a cycle lane when I've been in a cycle lane (I: By a car?) Yeah, and you know like going along Carrington Road on my way home, you know, the traffic is backed right back, and so many cars are in the bike lane, they don't sort of consider bikes you know and I usually knock on their window and say look you're in the cycle lane, they don't even seem to realise that there's a cycle lane there, even though it's very clear because you know they have those parts that are sort of green." (E-cyclist 18)

Like those on push-bikes^{41,42}, close-passing was a source of stress for many participants:

"Im very, very careful but I have had a few cars, you know they squeeze past you, like sometimes a truck goes past and you think oh that's really a bit close, ...or a truck

and it's like don't move, you know, if there's nowhere to pull over you've just got to hold your ground. I've had a few like where I've been a bit nervous, but yeah it's sort of like no don't move, don't wobble and stuff so I try to be extra careful though, and always you know watch out for vehicles, listen out for them and all of that, and if I can avoid them like I'll do like, if there's any side roads anywhere I go there, but there's a bit between here and New Lynn and there's no side roads, nowhere you can go." (E-cyclist 3)

"[E]very day you'll have 1-2-3 people who are passing you far too close." (E-cyclist 19)

Even though they are going faster on their e-bike than a pushbike, many people still found they had motorists who were impatient to over-take them:

"[T]here are a couple of steep slopes that I go down on my route and I have a speedometer so I can be going down a hill at 55kms and people will still take risks with respect to the ongoing traffic in order to get around me in a 50km zone.... I have had people overtake me when I am doing 55 in a 50 km zone where there is an island, a pedestrian island in the centre of the road. So it's like if you were to make a list of all the places where you would not choose to overtake somebody, you would think that would be one of them. But they do it anyway because, ... there is some over-riding story in their head that says I must get past." (E-cyclist 7)

Near misses were also common:

"(I: Have you had any accidents or near misses on your E-bike?) Yes, most days, something most days." (E-cyclist 20)

"I nearly had an accident. Someone came in front of me and that really frightened the living daylights out of me. It was a bit wet. I managed to stop and not fall but they just didn't look at all." (E-cyclist 10)

"I've had a couple of very close calls with cars just missing me as they've come through, haven't sort of seen me, so now I've got this light, so as soon as I see a car coming I just face them there, and it's a big white bright flashing light, and they don't miss me in that regard so, it's probably that's made a huge difference just because I can actually shine the light right in their eyes, and then they see it." (E-cyclist 14)

"[A] car sort of, we were both turning, making a left turn and he, it was probably my fault, he or she we both turned at the same time, I was turning into a cycle lane but they sort of cut the corner, so they sort of bumped me a little bit, I didn't fall over or anything but it was just, they probably got more of a scrape on their car than me, and it might have been also that I wasn't aware of looking for that kind of thing, I just assumed they wouldn't come into the cycle lane but they did." (E-cyclist 15)

"I had someone left hook me, by which I mean overtake and then suddenly turn left the other day." (E-cyclist 7)

Three participants had also had accidents involving cars:

"Well I was on the cycle lane on Carrington Road going home, and this woman just turned straight into me. ...I don't know whether it was because she didn't see me but I don't know how she couldn't see me, because it was a lovely sunny day and it was you know, I had, I wear a bright pink jacket and I suspect that she just thought she'd be able to turn before, but she banged straight into my thigh and remarkably enough, she didn't damage me or the bike." (E-cyclist 18)

"There's two that stick in my mind, one with the children and one without, and it's at the same place which is the bottom of our road, there's a crossing, I'm on the main right of way but very few people go to the bottom of the road where the bike track is, so lots of people on the crossing don't necessarily look for people like me going downhill, and it's a difficult crossing anyway, it's on a bit of a hump, on my own I was coming downhill reasonably fast, just because I'm so used to doing it, and someone just basically, I actually don't know, I thought that they made eye contact with me and that they were going to stop, and they didn't and I basically ended up having to go sideways down the road, to avoid crashing into them." (E-cyclist 21)

One participant had a serious accident involving a car:

"[I was] hit by a car and left for dead in the middle of the night, I don't have any memory of it. Ian McKinnon Drive. I don't know, I remember coming to, had no idea where I was, somehow got back here, I walked because I was carrying the bike, the front wheel was bent out of shape." (E-cyclist 20)

Some people believed that their near misses or accidents were the result of 'time to arrival misjudgements' on the part of drivers, associated with the fact that e-bikes often go faster than cars are expecting: partly because drivers are not as used to faster bikers, but also because e-bikers don't necessarily 'look like' traditional fast road cyclists:

"[S]o it's a crossroads, yeah and she definitely saw us but she just didn't slow, and she didn't stop ... and basically I realised that if I carried on, ...if I carried on at that pace we were going to have a collision, and so I slammed on the brakes and lost balance, I had to slam the brakes and turn slightly, so lost balance and ended up sort of just holding on, with a car coming the opposite direction directly towards us, who only really just realised what was happening in time. [W]e avoided any major accident but ...that's why I don't trust people as well they just don't seem to, they don't know how fast we go or how slow we go." (E-cyclist 21)

"[O]ne thing that I have been very conscious of is I think a lot of car drivers are not used to e-bikes and so they think that they have enough time to pull out at intersections in front of a bike to get around. They are not used to bikes going at the speed that e-bikes go, so I think there is something about car driver awareness that bikes nowadays can travel faster than you think. A lot of e-bikes look like grandma on a bike kind of things, but actually they are going really fast, ... but they don't think that, so I have had a lot of car drivers pull out in front of me thinking I am not going to get there before I get there." (E-cyclist 23)

"[I]t will be nice once people are used to us more, because we actually for example I don't look super fit, but I can travel at 30kms an hour, 40kms an hour on that bike, and people looking at me predict that I'm going to be really slow and so they'll pull in front of me." (E-cyclist 16)

Worrying about harming pedestrians

Several participants expressed concerns about the possibility that they might accidentally harm a pedestrian when mixing with them on shared paths, especially going downhill on Grafton Gully, or close to town on the Northwestern cycleway:

"Every now and then I wonder as I ride down Grafton Gully cycleway quite fast, I think man what if that pedestrian did just freakishly trip over and walk in front of me, I'm going pretty quick I couldn't stop in time, and I think yeah wow" (E-bike retailer 5)

"Bond St, ...where we're cycling very close to the motorway, and I would say that the cycle way is footpath width, a wide footpath but footpath width, and it's very popular for pedestrians, children going to school, my friend for example rides her bike very slowly with her child on the back because she's taking her to school, cyclists of all different levels because it's quite an urban area, and then e-bikes going at 30kms an hour, and there's not enough room for anyone to pass anyone. Pedestrians feel like they should have the right of way, bikes feel like they should have the right of way, hand written signs have gone up saying, 'please drive slow there's children' but it just, I think the infrastructure could very easily be tweaked to make that a safer location. I didn't cycle much before I had my e-bike right, but I assume that from what I can tell, the non e-bikes that travel at 30kms an hour are usually very fit, very professional looking cyclists, and they're always going to weave in and out, but they're also very good cyclists usually, whereas there's a lot more people going 30kms an hour who are just like me, we're just cycling." (E-cyclist 16)

The cycling policy-makers also tended to be reasonably concerned about the potential for accidents or harm to pedestrians on shared paths:

"So just that extra speed differential giving cause for people to be startled or frightened or actually hit is something that I think will increase with the uptake of e-bikes and is something we need to think about very carefully." (Key informant 6)

Two participants had had accidents involving interacting with pedestrians, although in both cases it was the cyclist who was injured:

"I broke my arm last week coming off my bike and I broke it because someone walked out on the street talking on their cellphone and I avoided them by taking a fall." (E-cyclist 1)

Not all the e-bikers were concerned about this issue, however. Most said they made the effort to slow down around pedestrians:

"I just make sure that when I am going out past a pedestrian I am indicating a little bit beforehand and I am checking over my shoulder to see how far back they are. Because we now have the walking school bus going along that same section and they are all in their little jackets and you don't want to be going past them at a great rate of knots." (E-cyclist 8)

One participant said he felt that he is safer around pedestrians on an e-bike, because throttles, in particular, give e-cyclists the opportunity to get back to speed quickly after passing a pedestrian, removing the need to keep speeds high in order to 'maintain momentum':

"I find that I tend to slow down more on an e-bike than I would if I was on a normal bike just because it is so much easier to regain your momentum afterwards. So if I am on a road bike, if I cast my mind back to when I was fitter; being on a road bike you have managed to get up to the pace, the rhythm that you wanted and then somebody is in the way – there is a great temptation to just get around them with minimal clearance but get around them and not slow down because that way you don't lose your pace. Whereas on an e-bike with a throttle anyway it is not a problem. ...[T]he bikes and pedestrian interactions – where they go wrong it seems to be because the bicycle riders are desperately trying to maintain momentum." (E-cyclist 7)

Bike weight

It was common to have experienced minor accidents associated with getting used to using a heavier bike with a different centre of gravity:

"The first day I rode it back from work, I was at the top of a hill, ... and I just wanted to slow down and think about it, and I forgot that all the weight is in the back and I actually fell into the ditch, but not fell over the whole way. ...It was quite funny, and it's just because I forgot that the weight was in the back, and it just wasn't behaving the way that my other bike [did]." (E-cyclist 16)

"Yeah I have had a few incidents with the weight of it so I am very conscious of how heavy it is and how unwieldy and that is its downside. It is not like carting your bike around." (E-cyclist 22)

The weight was an issue not just when riding, but also when trying to get e-bikes on and off trains and storing or parking your e-bike:

"Getting in and out of some places with a heavy bike is tricky. So mostly the trains are fine, but there are odd places where there are a couple of stairs and there is a tight turn of a car with rails. And [also] getting in and out of our house. Our house has a step that is four inches with a metal door framey thing and then if the car is in the garage, I have to take it in... it is an inconvenience the weight thing. The mid-weight would definitely be easier to manage with those kinds of things, but there will always be that and I know there are some bikes that have a walk function where the power is right off." (E-cyclist 23)

One participant with a cargo bike said that she had an accident because she couldn't find a secure place to park it, it couldn't fit in the lift, and at a friend's suggestion had tried to bring her bike up to her office on the escalator:

"I work on the first floor and I couldn't get it in the lift. Even though interestingly it is only 10cm longer than a normal bike, but it has the appearance of being heaps longer, but is actually isn't. But it doesn't go in the lift by about 3cm. So my colleague told me to bring it up the escalator. And I forgot that I had the paniers full of big paper files; I work with big paper files. So I had probably 10-15 kilos of paper in the back which I forgot about, on top of the bike and the battery which is probably 35 maybe 40 kilos and I was like, I don't think this is a good idea. But he was like yeah – you can do it. And so I did it and I dropped it, pretty much, and it was not a good experience." (E-cyclist 22).

Although one retailer pointed out that he thought bike weight was primarily a problem because we aren't providing suitable infrastructure for heavier bikes:

"Yeah if you had to point to something it would be weight, and even there there's a lot more to the story, so for example a lot of the times when we experience that our bike is too heavy, it is actually infrastructure related, so if you're taking the ferry from Devonport and they're running the wrong ferry, it will be a problem, if they're running the right one it's not a problem, similarly if you have good bicycle infrastructure with nice wide paths, you don't have to manoeuvre your bike in funny ways. Parking obviously is a massive thing, if the building where you work has suitable bicycle parking then the weight doesn't matter. Ditto at home." (E-bike retailer 5)

Concerns about speed and injury

There was considerable variation in the speed people reported travelling at. The majority of the participants reported travelling between 25-35km per hour. Those using the Northwestern cycleway to do longer 10km+ commutes almost always reported needing to cycle at 30km+ for at least part of their trip in order to keep to a realistic time budget for their commute. Most of the e-cyclists were aware that the combination of higher speeds and a heavier bike reduces their stopping time:

"I had to learn very quickly I've gotta slow down 'cause the bike's suddenly heavier and I don't have great brakes. ...[Y]ou could get yourself in a bit of trouble pretty quickly, especially at night now as it's getting busier on the cycle track. You can be in a group of six or eight people all lined up and they could be right up against each other and your stopping power's not quite the same. You've got a bit more weight behind you and you could end up in a real nasty smash." (User13)

One participant had had a dooring accident which he attributed to riding too fast for the conditions, on a heavy bike:

"Yeah look you know I was going far too fast for the conditions, in that environment I should have cut back, because there's just no ability to react when you're in that very tight environment, and that can happen, you know maybe I would have had the same accident on a bike going at that speed, but I doubt the effect would have been the same because of the weight difference with the bike." (E-cyclist 19).

Speed and injury was a particular concern amongst some of the cycling planners/policy makers:

"[T]he faster e-biker, I don't know – maybe 40km/hour – and that is certainly getting into the speed that is going to hurt a lot more when he comes off. So yeah, that speed and collision speed is a concern with faster e-bikes." (Key informant five)

However a number of the key informants and retailers also ride e-bikes, and they noted that not only are they aware of the need to limit their speed for safety reasons, but they are generally not the fastest bikes on the cycleways:

"I never really go that fast, and yeah I mean that does make it a bit easy for me, I'll share paths and that sort of thing because I'm not in too much of a rush, like I'm not a road warrior, and even on the e-bike I still don't go that quick so yeah, I just don't think you can stop in time." (Key informant 1).

"[I]f I think about how I am about the people around me, there's still racing bikes that overtake me so you know, I'm certainly not the fastest on the motorway." (Key informant 4)

"Some people go fast or go slow. I don't actually think the e-bikes are faster than the pedal bikes. I don't think so. Even at 30 kilometres an hour I get overtaken many times, even on my e-bike." (E-bike retailer 2)

The retailers pointed out that maintenance, particularly of brakes was particularly important on e-bikes due to higher weight and speeds. Several retailers pointed out that brake pads

wear out faster on e-bikes because they are generally used more, and one retailer was concerned that e-bikers don't understand this issue well enough:

"That's a bit of a problem, I don't know, but I don't see mine again. That's a little bit of the problem, and that's again where we need to get people to understand that maintenance, as much as with their car, the bike is also important. Cause we do see a lot of people come back with no brakes. Zero brakes. I had two pretty big accidents of bikes that I have sold ... lately, where the police was involved, and luckily we were without guilt, because they hadn't been back. One had done five thousand kilometres, hadn't seen him since, in two years." (E-bike retailer 2)

Concerns about bike path quality

Many of the participants felt that Auckland's bike paths are not necessarily designed, lit, or maintained to the standard needed for fast, heavier e-bikes:

"Yeah, so [the Northwestern cycleway] is great. It is a separated cycleway, but it doesn't get swept and the cyclists don't sweep it. A car would sweep a road in a natural process. So at the moment, the cycleway is really littered with leaves, especially ... where I noticed it a lot this morning was through Sandringham. So that is one aspect. The second one is... (I: You said it is not that well-lit?) Well ...it is kind of lit – you can see where it is, but you can't see enough detail to tell whether that black patch is a puddle, a hole, a manhole... Because I have come off on manholes before and now just have this paranoia. ...and you don't know if it is a pile of leaves on top of a manhole cover which is incredibly slippery." (E-cyclist 5)

"You've got bits of the curb that stand up that high and then you've got pieces of concrete where they join so you get that channel. If your bike tyre gets in that channel, it's gonna take you one way or the other so it's like you're coming down a hill fast, you've got to count every pothole, every bump and you've got to know them." (E-cyclist 19)

"[S]o it is easy to miss a pothole in the dark and if you ride into one on this bike with the small wheels and you didn't know it was there, the crash can be quite disconcerting." (E-cyclist 7)

"I guess you could put that down as a downside - bad road surfaces. [I: Is that an e-bike issue or just a bike issue?] It is an e-bike issue because you tend to be going faster than on a normal bicycle if there is no reason why you shouldn't. Like if I am on a normal bicycle I will be doing 20kms, whereas if I am on my e-bike I will be doing 30kms and that is significantly faster." (E-cyclist 7)

Slippery or bumpy surfaces were considered particularly hazardous for e-bikers:

"[T]he bike's gone out from underneath me because I'm going on a surface that's too slippery, going round a roundabout, going down here on Fort St where you've got pavers, those are really deadly when they get wet because they've got no grip. So the

first time it rained when they put them down, I went round like I would go around a corner normally, and I just kept going.” (E-cyclist 20)

“Then there’s one of the bits that lets pedestrians know there’s a pedestrian crossing coming up. So, that’s that sort of smooth rumble kind of concrete as well. So, I’ve given myself a couple of frights on there just ‘cause the bike.....skidding at the back.” (E-cyclist 13)

Sharp corners in cycleways were also another difficulty for people riding faster bikes. One participant had had an accident trying to negotiate a particularly sharp bend in a cycleway:

“I’ve had quite a few near misses. My first one I suppose was just after I got the bike so I’m just getting used to it. I went around a corner, a very narrow tight corner into a pathway and went to pedal and of course, the bike being an E-bike, yeah so, I went straight off the curb. [Laughter]. But, because I was going slow, no big problem. But, it made me learn don’t pedal when going around a corner.” (E-cyclist 19)

Fear of theft

Many people talked about being worried about having their expensive e-bike stolen. Only a minority of people had secure bike parking facilities at work:

“Yeah, I am worried about it getting nicked, so there is a big foyer on the ground floor but I can’t leave it there – there is nothing to tie it to. I could link it to itself and maybe no one would steal it because it is very heavy.” (E-cyclist 22)

Retailers and policy makers echoed these concerns about theft:

“I know a lot of people are concerned about the cost of them, and then the fear of having them stolen, so they are more expensive generally than another bike, and that, yeah, makes people more concerned about where they then would leave it, so yeah the cost is a big factor for a lot of people.” (Key informant 2)

Biking in bad weather

Some participants reported feeling less safe e-biking in the rain:

“Now one of the reasons I tend not to ride on a wet day is not because I don’t like getting wet – it is mainly because every time it rains, the standard of driver behaviour in cars plummets because they are having to look out through a wet screen, ...but also they are having their workload in terms of making decisions has been increased and they don’t have the margins of attentions to be able to cope with something slightly unexpected like having to get around a cyclist.” (E-cyclist 7)

However, many people were happy to bike in light rain:

"[T]he weather, sure it rains, but I mean if I've got to get out of my car in a car park and walk to the building I've got to go into, I'm going to be in the rain anyway, so if I've got a raincoat I'm ok." (Key informant 1)

Another participant said he felt safer on his e-bike than on a road bike in bad weather, because the weight of his bike meant he got blown around less:

"I can go out in virtually any weather. And, any wind and the others are quite scared and I'm quite happy on my bike." (E-cyclist 2)

Cost

Most of the e-cyclist experienced anxiety around the decision to buy an e-bike, and whether the purchase was 'extravagant', given that it was an unfamiliar technology that they weren't 100% sure that they were going to use:

"[I]t was expensive to buy and outrageously so." (E-cyclist 7)

"Because I probably spent about the same amount of money that I would have on a second-hand car which is quite a chunk of change if you are not sure that it is going to be your permanent mode of transport." (E-cyclist 8)

One retailer said that people who came in to look at bikes were often worried about whether the cost was justified, because they associated bikes with 'exercise', and exercise equipment was something that often ended up unused at the back of the shed:

"That's one of the biggest reservations people have when going to buy a bike, or anything at all actually that has connotations of motivation and fitness, that's what people are scared about when they buy a kayak whatever it is, they're scared that they're not going to use it." (E-bike retailer 5)

Almost all the people in the study had professional employment, or were retired and previously in professional employment, and had medium to high incomes. Several people said that while it was anxiety-provoking even for them to commit to the upfront cost, they were aware that it was only because they were privileged that it was an option at all:

"It is just a bit of a middle-class thing because they are not cheap." (E-cyclist 4)

"I think they're life changers really. It's a shame, it's kind of one of those things, I had the money to go and buy one and they are expensive, it's a shame that people on lower [incomes] don't get that 'cause it would be so much cheaper than petrol. Maybe the prices will come down hopefully." (E-cyclist 9)

"Apart from the cost, that is where it is not democratisation at all. It is completely the purview of rich, white people generally, because \$5,000 for an [electric cargo] bike – I mean if you said that out loud in most communities they would laugh in your face. That is a perfectly serviceable family car and you are buying a bike – that is a joke." (E-cyclist 22)

Several participants and key informants pointed out that lower-income people have the least ability to afford an e-bike, but they are probably the group that would benefit the most from having access to one:

"I used to be a lawyer at a community law service, and the clients that I used to see were beneficiaries and lower socioeconomic people with multiple health problems, constant interactions with WINZ, costs of living in Auckland and all that kind of stuff, and I just thought, ...God, a lot of the clients that I used to see, it would solve their petrol problems. It doesn't cost hardly anything to charge. Most of the people that I used to help as a lawyer didn't have regos or warrants so they'd get traffic infringement fines and that would build onto their cycle of debt and mental health and wellbeing, and I was like, God, can you give every beneficiary an electric bike? It would be not a quick fix for everything but it would be great. That's a pipe dream. I don't know how you'd get that. Unless they come down in price and it's something that's subsidised, that I could see it would be lower economic people really benefitting from it as well as people that can afford to buy them at the moment." (E-cyclist 9)

One of the key informants pointed out that while the cost of e-bikes is coming down slightly, the cheaper bikes were often much less reliable, which wasn't ideal if someone on a low-income was going to use them for their commute. He argued that the more you spend the more reliable your bike is:

"No. Well, most of them [more expensive bikes] have Kevlar like tyres, they'll be puncture resistant. The quality again, a cheaper bike will have a cheaper tyre and that cheaper tyre will puncture easier than a slightly more expensive bike. So, every time you go out ka-ching, ka-ching, ka-ching, you're actually buying performance but you're also buying reliability, you're buying longevity." (Key informant 7)

One of the key informants, who was interviewed because he set up two different types of e-bike schemes in his workplace, said that employees reported that cost was a major barrier to them switching to an e-bike:

"One of the problems we, you know in canvassing people, the cost, the upfront cost of the bike is a serious impediment, you know \$3,000-3,500 or even \$2,000 is more cash than most people have lying around available to spend on things." (Key informant 3)

This key informant made a number of important points about the difficulties employers have attempting to lower the cost of e-bikes for staff. He said that his organization had attempted

to encourage staff to give up car parking by providing employees with an e-bike. However they discovered that the cost would be prohibitive, because while providing parking to staff did not attract fringe benefit tax (because parking is provided as a 'pool'), providing an e-bike would attract additional fringe benefit tax of approximately 40 percent, because under existing tax law bicycles are considered an individual employee benefit (ie. a form of additional income). He said that not only would this significantly increase the cost to his organization, but that fringe benefit tax was also a lot of extra work for payroll, so they had to abandon the idea in favour of paying employees a bonus instead:

"[I]n terms of how can we subsidise bikes or whatever, and FBT [fringe benefit tax] keeps getting in the way of anything that you try to do nice for staff, and ... administering it is an absolute pain, you know for our payroll staff and what have you, FBT is just a, it's a nightmare so we just try not to go there." (Key informant 3)

Range anxiety

Consistent with overseas research, range anxiety, or worrying that you are going to run out of battery and have to push a heavy bike was a universal concern:

"[I]t's kind of like running through mud I think, riding an e-bike with the assistance off. I never want to get caught on one of those with a battery flat." (E-bike key informant 1)

"I charge it every third day. I might be able to stretch it to four to be honest but I don't ever want to find that I'm having to pedal without the assist 'cause it's just so much resistance, it's unpleasant." (E-cyclist 11).

"I mean if worst comes to the worst you just get off and walk or something, you can pedal but like it's pretty hard, it's pretty hard going." (E-cyclist 3)

"I do charge it at work. I charge at both ends. Maybe I shouldn't but that's what I do 'cause I always like to have it full when I go home because it does go down maybe one power by the time I get home and I'm always scared that I'll try to go back and I won't get home. ...That scares me is getting caught out and not being able to charge it. That does scare me a little bit. (E-cyclist 10)

"Well, with the early version that I tried a few times having it run out of battery power half-way up a steep climb. ...Yeah, it just became an anchor, a relatively unpleasant bike to ride." (Key informant 5)

How can we make e-bike use safer and more attractive?

We asked all the participants what they thought we could do to make e-bike use safer and more attractive. The participants pointed to a number of key benefits associated with using an e-bike for everyday travel: particularly making travel more fun and more efficient. They also pointed to a number of key downsides of travel by e-bike: including the high purchase

cost, and concerns about physical safety. We asked participants what we could do address these concerns and get more people riding:

Reduce the up-front cost of e-bikes

As noted anxiety about the upfront cost of purchasing an e-bike was considered a barrier for even middle to high income people. As a number of participants pointed out, it was unlikely that people on low-incomes could afford an e-bike at all, despite the fact that they are a group who more likely to experience both fuel poverty and poor health outcomes, so are potentially the group that have the most to benefit from e-biking. Several participants and key informants identified bringing down the upfront cost, through subsidies, as an important way to increase access to e-bikes:

"[T]here certainly is a problem, a barrier in terms of affordability across the city, so if there was something that we were able to do with the government to address that, it would make them much more accessible. ...It's a lot of money for a lot of people. ...The government certainly could have a hand in subsidising or making them more accessible to more people, and we have seen that work well in other countries so there's good models out there that we could follow." (Key informant 2)

"Make it cheaper, make the e-bikes cheaper please." (E-cyclist 15)

"And also I think that, you know, if they had a discount for people, then more people would buy them. They're quite expensive for people. [A] bike that's going to cost you \$3000, for some people that's way out of their reach. ...So you know if they had them subsidised and really encourage people to buy them." (E-cyclist 18)

"I'm lucky and I get paid a decent amount of money, and buying an e-bike that was a choice I could make without too much pain, but you know somebody else whose sitting there going well, could sit here and I've got my train, and yeah it does cost me \$200 a month, but I can swing that but then kind of forking out \$2500 in one go, although long term I'll end up ahead of the game, I just can't do that at the moment, I can't." (E-cyclist 20)

Several people thought these subsidies could be a particularly efficient way of bringing down transport costs for people in lower-income neighbourhoods, especially in some of the northwestern suburbs and places like Glen Innes where Aucklanders are about to get access to a new cycle highway, but may not be able to afford to buy an e-bike to use on it:

"Yeah so if we look at, you know areas like GI and particularly our areas where you've got a range of demographics, I think that's kind of important as well you know because cycling a \$2,500 E-bike is a hell of a lot cheaper, you know if you're not trying to work crazy hours and three jobs, and night time work and whatever that's certainly an exceedingly affordable way to get to work, and utterly reliable." (Key informant 4)

A number of people pointed out that they thought these subsidies would save money from the health budget:

"I would love to see that [subsidies], you know I just can't help think that the return on investment, from a government point of view would be just enormous, for every person you get out of their car, into an active form of transport, you know the health issues, I've been riding my bike every day since July last year, I haven't had a day sick, I'm so fit it's just stupid, you know even though I'm riding an electric bike." (Key informant 3)

Other important ways to reduce the up-front cost of e-bikes include supporting workplaces to set up salary-sacrifice schemes to enable people to pay off bikes over time, and to do group e-bike purchases on behalf of staff, to bring the cost of bikes down. When Tauranga City Council did a group purchase recently, 52 staff bought bikes through the scheme⁴³. Another important way to support e-bike provision through workplaces is to remove fringe benefit taxes on bicycles. Many countries overseas, including the UK, have made bicycles tax exempt for employees in order to encourage employers to provide staff with bicycles. A scheme similar to the UK Cycle to Work tax exemption should be adopted in New Zealand in order to incentivize employers to provide employees with access to e-bikes. While in the past, additional fringe benefit tax on a \$500 pushbike may not have been a major disincentive to employer provision, it is likely to be a significant disincentive on a \$2500 electric bike.

Providing people with opportunities for try an e-bike for their commute

As both participants and retailers point out, part of the anxiety over purchase cost relates to the lack of personal experience of using an e-bike for everyday travel: a lack of knowledge about how 'realistic' it is that they are going to use this new piece of technology or whether it will become like the 'kayak' gathering dust at the back of the shed. When we sent out an email inviting people to participate in the Auckland Hospital trial, we also received lots of similar responses from staff saying that they had had a chance to try out an e-bike briefly at a bike store, or at a Mercury taster session, but that they felt that this was not enough information to enable them to buy a bike. They wanted the chance to take an e-bike home to try out their actual commute and establish whether it was really realistic for them to do it on an e-bike.

This type of email from a potential participant in the ADHB trial was common:

"I currently live in Pt Chevalier and commute to work via car. I have been interested in an e bike for a while and have test ridden a few but am reluctant to make the investment as I wasn't sure if it might just end up sitting in the garage unused."

Participants who had friends or family who lent them a bike for a few days, or those who bought a bike through a retailer who lent them a bike to test ride for two weeks reported that getting the chance to try out their individual commute in their own time was a really important part of the process of feeling confident that the purchase would not be an extravagant 'waste of money':

"I wouldn't have bought it straight off to be honest, because it was too much money for an unknown, yeah." (E-cyclist 21)

Priority should be given to establishing an e-bike loan scheme that enables people to try out an e-bike for a two-week period. Overseas research suggests that because e-bikes are a fairly novel technology, and have a high 'fun' factor, giving people opportunities to experience e-biking and becoming confident with an e-bike is a critical part of increasing e-bike uptake⁴⁴.

Improvements to cycling infrastructure

More separated cycle paths

People felt much safer on separated cycle paths and want more of them, so that they can use more of the city safely:

"I think to make it more attractive it's really making more cycle paths, opening it up basically to people and making people feel safe, that they're not mingling with traffic. I think that's the big one and coming from now I've got a family and kids and I care about not being dead. A bit younger I wouldn't have cared about the traffic. I'd cycle through central London. I didn't care. I was pretty reckless. Here now I think about when I'm on the roads I make sure I've got my lights and all of those sort of things, where if I know that I'm crossing through traffic I've gotta be seen and visible. I think if you separate the cyclists or the e-bike from the traffic you're going to create an environment where people want to be on their bikes more because they're actually dedicated spaces to be safer." (E-cyclist 13)

"[S]eparated bicycle paths are 1000% better than non-separated paths." (E-cyclist 7)

"And the other thing with the e-bike is the battling along the street that doesn't have a cycle lane. ... I'm okay when I am splitting through lanes of traffic where they have basically stopped because you know there are not going to be any variables as you are going along and especially along Great North Road there are always another couple of cyclists through there and even the motorbikes and mopeds are kind of breaking the line of traffic in front of you if you go through at just the right time. But getting the cycle lanes so you are not sharing space with trucks and buses." (E-cyclist 8).

"One of my favourite cycle ways is that section along Beach Road where you actually have your own little spot in the universe to cycle along and you don't have to worry about the traffic. And it is just a much nicer way to travel than when you are on the main road." (E-cyclist 8)

"I'm not overly confident on the road so I stay away unless they have cycleways." (E-cyclist 10)

"[S]o the thing is that I reckon you could exponentially get people onto E-bikes if the infrastructure, the safety infrastructure for that was there, and that's what people are wanting, we know so many friends who would love to be riding, but they're too scared about it, haven't ridden since they were teenagers. Others who get into it and we've been able to get them onto bikes, so these people they're just too scared about it, but if there was designated cycle lanes they would feel more comfortable trying. They just

need more time in a big open space to re-learn the biking, they've forgotten how to bike but it's about safe cycle spaces, and that's designation and that's what I always say in submissions, is that's going to be the game changer because we're still talking about a small percentage of people on bikes at the moment, but there's room for big change." (E-cyclist 17)

Most people were keen to see cycle lanes on all major arterials, and on any new major roads into new subdivisions:

"But any major road I think there should be a cycle lane, because I can understand why commuters don't want to be forced to go around all the back streets between Dominion Road and Mt Eden Road to get to work. You just want to go there, so I think they should be put everywhere." (E-cyclist 6)

"[S]ome of the big roads do need cycle lanes, yes." (E-cyclist 15)

"I think with the e-bike you can cycle anywhere. No hill puts you off going anywhere. So what? So, people are able to use their bikes to go anywhere. I think at least more cycleways are required. I'd like to see no new road built in New Zealand that doesn't include a cycleway or cycle lane." (E-cyclist 12)

"So we bought our new house in Stonefields for all of these reasons for buying there. They got bloody awards for that development and there is not even one in-out cycle route to that whole sub-division which will have 10,000 people living in there when it is all finished." (E-cyclist 23)

Higher quality cycle paths

The quality of existing cycle paths was also a concern for many of the participants. There was broad consensus that the increasing popularity of e-bikers will require a higher quality of cycle paths, designed to make faster cycling safe: better lit, wider, smooth paths, which avoid sharp corners:

"[We need] good quality paths, so wide, no blind corners I mean it's all stuff that you want anyway, and maybe e-bikes are just a reminder that you're going to have more people riding who don't have a few decades of tolerating bad infrastructure behind them, the experience of how to manage all these problems, they're just going to get on a bike and ride, and they're not going to expect a sudden blind corner, a path that's downhill and allows you to go fairly swiftly but then has a corner that's too tight to really navigate at the speed you would naturally roll, you know. It seems obvious doesn't it but there's so many examples of that, even on quite good infrastructure." (E-bike retailer 5)

"[S]o if you put an e-biker into the sport cyclist class, from a speed point of view because I think that's relevant, you know the radius of corners, the reluctance to stop start stop start stop start, if we think about them in one class and then the riding to school and other sort of recreational riders in another, and the sport cyclist, transport

cyclist, e-biker in a second bucket then I think you start to understand cycling a little bit better, and you need to understand that, you know, something this wide isn't really going to cut it, you know 750mls for each lane is just not good enough, and it's better than nothing but it's certainly not ideal.” (Key informant 3)

“More cycle lanes, more signage, better lighting you know there are some areas that are well used by cyclists, and I think we need to have lighting that just has pedestrians and cyclists more in mind.” (Key informant 4)

“The other thing I really found on the Northwestern cycle way, there's whole portions where they seem to be relying on lights from the motorway to light us up, and I'm like the motorway is 2-3 metres away, and I can't see pedestrians when they're coming to me.” (E-cyclist 16)

“I like the [Northwestern] cycleway. The cycleway is really, really great. There are some areas that are a bit patchy and bumpy, so hopefully they'll look at those because I just find it really, really great.” (E-cyclist 10)

More cycle highways

Like faster sports cyclists, maintaining continuous cycling conditions is particularly critical for e-cyclists: partly because faster heavier bikes have longer stopping distances, and also because it is the additional speed that enables e-bikers to cover longer distances, expanding the active transport radius. However, unlike sports cyclists, e-bikers are often less experienced cyclists who want to be on separated, protected cycleways. For these two reasons e-cyclists particularly benefit from cycle highways. This is potentially evidenced in the higher mode share of e-cyclists on the Northwestern cycleway, which is both protected and largely free-flow, compared to Tamaki Drive, which has a slow, narrow, bumpy cycle path, so is only really free-flow if you ride unprotected on the road.

Both e-bikers and retailers identified the Northwestern cycle 'highway' as a major drawcard for e-bikers. In order to increase e-bike uptake, priority should be to providing everyone within a 15km radius from the CBD and other important employment/educational hubs with access to a protected cycle highway.

Sweeping the cycle paths

Given the earlier comments about debris on the cycleways being a dangerous obstacle for faster cyclists, several e-cyclists requested more regular sweeping of cycle paths, especially after storms:

“I was thinking about that this morning, debris on the road, the gravel and broken glass, sticks and stuff.....gets flung to the side of the road, i.e. the cycleway, you know what I mean? ...So, I was thinking that the council, this is part of promoting, they've gotta maintain, they've gotta clean the whole road ...sweep it.” (E-cyclist 12)

“One of the things that I was thinking of after we had the big floods, there was some massive mud all over the pathways. If they had twice a week to pay someone to literally drive the whole pathway with one of those street sweepers. ...Cos, you get the

Council workers who come and they do the gardening and they just leave it all over the pathway. I had a pinecone the other day, I thought I was going to die. I didn't fall off, it was fine, going down a hill. ...It's like okay the pinecone fell off which is nobody's fault but still. It's like sweep the pathway, ...get rid of the potholes." (E-cyclist 19)

"Where there are cycle lanes there is often broken glass, so if this city is going to invest in joined up cycle lanes eventually, I hope to hell they also invest in a road sweeper going in once a day to bloody sweep them because there is so much broken glass on so many cycle paths that I am on. And it will all be from the night before ...I think I have certainly noticed it on the Grafton Gully – on that one and I have noticed it on Nelson Street. ...And definitely on the Northwestern cycle way and definitely on some of the ones that are around here, like the one that goes towards Sylvia Park." (E-cyclist 23)

A new approach to shared paths

As noted, a number of the participants were concerned about the risk to pedestrians sharing paths with faster e-bikers. There was broad recognition that there is a need to explore what the future of shared paths will look like, including whether and where they are appropriate:

"The speed of cyclists on our shared paths is a problem regardless of the bike. ...I think we're getting increasingly challenged by them, and more and more because of the topography that we're building them in, we have shared paths on a lot of our reasonably steep hills, and that does come with a speed differential even between the person riding up and down the hill, regardless of whether there's someone walking or yeah the potential risk between the person walking and the cyclist, there is also the oncoming slow cyclist if you're going down a hill quickly, so we are being challenged on that. [I]f you're going down the shared path route it has to be wide enough for the volume." (Key informant 2)

More bike parking

Almost everyone thought there is a need for more secure bike parking for e-bikes. People who had secure parking at work were very appreciative of it:

"The joy of here is because [my workplace] is really supportive, we've got two, you know everyone's got car parks, but there's also really good bike lockers, so you know my bike is safely locked away, it's plugged in its recharging. ... I mean you can park probably a couple of hundred bikes and there's lots of plugs so, it is it's really well set up which is brilliant, I think that is important." (Key informant 4)

"My building has E-bike parking which makes a huge difference." (E-cyclist 16)

One of the key informants said they thought that while many workplaces have bike parking, it is often unsuitable for e-bikes:

"There needs to be possibly a change to bicycle parks, particularly in work places. A lot of work places I have seen rely on hooks to hang bikes on and obviously that is not going to work too well especially for people who are older or less strong, and if that is

the reason they got an e-bike then they are not going to be hanging it on a wall any time soon.” (Key informant 5).

Most people would like to see more secure parking for bikes in general in the CBD:

“The thing that I am finding a struggle is when I am using it in the city is where do I park it and lock it safely. Because it’s a little green bike and I’m a little bit cheeky I tend to take it into receptions and ask if I can just pop it inside the door.” (Key informant 7).

“Maybe more places to park them and maybe charge them.” (E-cyclist 10)

“We need to make sure that there’s safe places for people to park their bikes for free.” (E-cyclist 17)

“And there could be a lot more bike parking around. I mean, I think all the Auckland Transport car park buildings, there’s all those dead spaces with the yellow lines could clearly be bike parking and I’m not sure why it’s not.” (E-cyclist 9)

Other biking infrastructure

One participant said it would be useful to have bigger lifts at the Britomart train station:

“One of the lifts at the Britomart train station is almost too small for my bike so I can get my bike in but I have to turn the front wheel around on an angle before I can close the door.” (E-cyclist 23)

Several people also requested charging stations for e-bikes:

“Charging stations. I don’t know, they’ll be quite cool ‘cause if you didn’t have to lug your battery pack around. ‘Cause if they’ve got electric car charging stations starting to come up around the place it would be cool if they focused on that.” (E-cyclist 9)

The right to ride on the footpath when you feel unsafe

Four participants believe it is important to give cyclists the right to ride on the footpath in places where there is no cycleway to keep them safe:

“So I’m a firm believer that you should be able to ride on the footpath when it doesn’t feel safe to ride on the road, and you know in a year and a half I’ve yet to see footpaths that wouldn’t be safe to ride on, and I think if you are very clear that you need to be differential to pedestrians, then I think that would be good.” (Key informant 4)

“All cyclists in NZ are at risk from motor vehicle traffic so riding on foot paths is one alternative as footpaths don’t get a lot of use. [It]’s just what [is] the best protocol when sharing with a pedestrian.” (E-bike retailer 4)

"I guess I just, the biggest thing is having, whether it's E-bike or whether it's an ordinary bike, is actually having bike lanes that are accessible, and you know I suppose I think they're talking about the law change of allowing children to ride on footpaths, there are certain footpaths that I will always ride on, that's just because I don't care if there's a policeman there or not, it wouldn't worry me it's actually too dangerous on the road." (E-cyclist 14)

"And I think that the whole thing of you know like people riding on footpaths, I think that you know we just have to accept that some areas people have to ride on footpaths, because it's easier like I'd never ride along Great North Road, and there's this area where the bike lane finishes, there's an area there but the footpath is so narrow, a friend of mine who bikes that way as well, he's just got a normal bike, he fell off because the rubbish bins were sort of sitting on the you know, so they need to consider all of those things." (E-cyclist 17)

E-Bike training for new users

Key informants were particularly concerned about the need for additional training for e-bikers, especially if they were new to biking, or hadn't ridden in a long time:

*"And if we have got people who weren't bike riding beforehand and have gone straight to an e-bike and used it because of ease and the less physical factor, you could have some people who haven't been sufficiently exposed to cycle skills etc., so they are ripping into e-bikes in traffic. So I think there are some potential issues around there."
" (Key informant 6)*

"Yeah that is a concern, is people who go straight to an e-bike and perhaps don't have the road skills, or cycling skills that someone who has ridden for longer would have, so just the skill level for riding an e-bike, and then the skill level that's required because of the speed people might be travelling at, and their ability to judge speed or stopping distances and things." (Key informant 7)

E-cyclists themselves had mixed feelings about any sort of compulsory training. Some definitely thought it would have been helpful for them:

"Well, I think it would be handy for a new e-cyclist to go out with the person who's ridden e-bikes for a long time just to show them some of the things to be aware of and to remember when they're going fast on a heavy weight bike, they can take a bit of stopping." (E-cyclist 2)

"I think that kind of opportunity for people to do a refresher or a new course on how to deal with traffic situations. And how to approach intersections sometimes when there are cycle lanes. Like there are some tricky intersections when you don't know whether you should be a car or would it be better to be a pedestrian and you don't know if you have to get off your bike and push it across or are you allowed to zip through? So people should know that." (E-cyclist 22).

Others weren't so keen on the idea of a class, but thought some sort of educational materials or online training course would be useful:

"So I don't know whether it would have to be classes or something like that but even educational material about how to signal, stopping, turning left, and turning right and when you need to think about it." (E-cyclist 8)

"Perhaps if there was an online, like a training course. You know, just one of those things – we have them here a lot – we click on stuff and where is the danger – and then you can click and it would show you where the danger was on the road. That is probably useful for anyone coming to cycling or coming to cycle commuting." (E-cyclist 5)

"I think that [an online course] would be really useful. I think that people that ride bikes all the time or who are really enthusiastic about bikes, you know when you've kind of assumed a base level of knowledge that you assume that everyone else has, and I think that a lot of the bike promoters out there have got that base level of knowledge. Whereas when I came, and I was down here, I didn't know the different types of bikes, I didn't know the different types of wheels, I had no idea how to use gears, the fact that you had to go lower to go up a hill which I thought it was the other way around. ...Yeah, literally I had to go on You Tube, and it was like oh, that makes sense now. How to change tyres. There is so much. If it was online it would be great and you could kind of go, oh, I understand that now." (E-cyclist 9)

Driver education

The participants were also just as likely to suggest that there needed to be better training for motorists in how to interact with e-bikes, especially around the speed of e-bikes and time to arrival misjudgements:

"And I can imagine that because they don't necessarily clock that it is an e-bike and therefore you are really travelling faster than a normal bike. But that is where driver education is a little bit... because again sitting behind the cyclist for another 20 seconds doesn't impact on your journey that much. As opposed to the 10 seconds that you save by trying to zip in front of them and completely cut them off." (E-cyclist 22)

"Yeah, so I think there is something about driver education that bikes go faster nowadays than you think." (E-cyclist 23)

"I think it would be more useful to educate the cars, than the e-bike. ...Give space, give them like I think, you know some places you go and it says 1.5 when you're passing any bike, I think the drivers need to be like they're just not considerate in Auckland, or I don't know about anywhere else but, I don't think they're considerate." (E-cyclist 3)

"There is a lot of education that needs to happen with the drivers, with all road users altogether. It's not just about speed, it's about how much space you take up on roads."
(E-bike retailer 3)

Regulation to increase safety?

When asked if they thought there was a need for further regulation of electric bikes, the most common theme was around a compulsory speed-cutout. Key informants, i.e. those responsible for making decisions about cycling infrastructure and regulation, and retailers, had mixed thoughts on whether a cutout was necessary. Several thought the European standard of 25km cutout should be adopted in New Zealand:

"I would certainly support the European style speed cut-out I think that's sensible. ...I think it's there for a very good reason, and the bikes we see that have been adapted, are pretty much motorbikes without the technology that comes with a motorbike, so we'd like to see them retained as bicycles and therefore it's safe on bicycle infrastructure." (Key informant 2)

"Because all the high-end bikes of mine are limited to 25K's an hour, which is the German law. Yeah, so they just stop giving you assistance at 25K an hour. And it makes a lot of sense because that's where the rest of the world is. And when you're on a bicycle there's not really any need to be going any faster than that.I believe they should just follow... it would make so much sense if they followed most of Europe. Europe already has a set of regulations, just adopt them. There's a set of regulations that have been proven and tested by so many years in Europe and they are a helluva lot more into their cycling than we are. Here it is on a plate, just adopt that. And then the bikes that we bring in from Europe are all going to comply." (E-bike retailer 1)

Other retailers, however, particularly those who sell cargo bikes, were not in favour of adopting the European standards, as they felt that they were unsuitable for New Zealand conditions, where cyclists have fewer cycle lanes, so have to do more on road riding, and have to contend with hillier, windier conditions, and therefore are more likely to need faster, higher wattage bikes with a throttle. Two of the e-bike users also commented that they wouldn't like to see a drop in power output, because it would reduce their ability to get up hills:

"Well personally I wouldn't like to see them bring the power down. I wouldn't like to see it go up either, I think they are quite fast enough. The hill climbing is the most important thing for me because of where I live." (E-cyclist 4)

"My e-bike has a 400W motor and I weigh 110 kgs and the 400W motor is enough to get me up some of the steep hills in Auckland at about 20kms. That is fast enough that you are not too much of a nuisance to passing traffic. In Europe there is legislation limited e-bikes to 250W. In Auckland that wouldn't really be enough because although Auckland is not that tall, it is very steep in places." (E-cyclist 7)

One other retailer felt that the current power standards should be maintained, but throttles should be banned:

"I think the current restrictions are the minimum probably that we should have and are probably about right, so I don't think we should have throttle driven e-bikes and I don't think we should let the power go above what it already is. They're reasonably quick. The one I ride to work you can pedal it effortlessly up to 30 kilometres an hour and you can do that up and down and on the flats. So you're going reasonably quick." (E-bike retailer 6).

However, most e-bike users thought that throttles should be retained, because they help them get up to speed quickly at the lights, and 'accelerate out of danger':

"One thing the government might choose to do which would be a shame is that they might choose to follow the European Union and ban throttle controls. The throttle control allows the e-bike user to be much less of a problem to the traffic that they are attempting to navigate through. Because you can accelerate at the rate that car drivers expect you to accelerate and if you are on a normal pushbike what they forget is that you might be able to get up to 50kms but it will take you half a mile." (E-cyclist 7)

Most of the e-cyclists were also resistant to the idea of a European 25km cutout, as they thought it was too slow. Many pointed out that regular push-bikers were going at higher speeds on the Northwestern cycleway than them, making a cutout unfair:

"I do worry I must admit as an e-bike user, I think oh God I hope they're not going to get too carried away with what speeds you can go and things. ...I think they probably should have a cut-out ...mine does about 33....I think that probably feels fast enough, if I think about how I am about the people around me, there's still racing bikes that overtake me so you know, I'm certainly not the fastest on the motorway." (Key informant 4)

"Other regulations I don't know, because I don't know how you can apply them to e-bikes and not regular bikes. I don't think that is fair. Road bikes will go faster than e-bikes. My top speed on a road bike on the way home would definitely be a lot more ...- it would probably take me about the same amount of time but it is just getting there not sweaty that has been the massive advantage. A guy on a road bike will go a lot faster." (E-cyclist 5)

Many participants argued that they thought a 25km/hr cutout was too low, but they would be happy with a maximum speed range in the early to mid-thirties:

"25[km/hr] is a bit low. It is like cutting people [in cars] off at 80km." (E-cyclist 22)

"For instance that would totally mean my bike would be useless to me if that happened [introducing a 25km/hr cutout]. The 30km [cut out on my bike] is just enough and that is really the way home on the causeway with the headwind, I can maintain 30 whereas on my regular bike I would probably be struggling. But on my regular bike I could probably go faster on the way in, much faster on the way in on that section. Yes I would be slower going up the hills, that's the only thing. Top speed is not the issue I don't think because a regular road bike will go much faster." (E-cyclist 5)

"I was frustrated by the 25km thing because I want to go faster than that." (E-cyclist 17)

"I think you probably still need to drive or ride like not too fast, there has to be like there was talk of limiting it to 25km but I wouldn't want that, because I can go over 25km on that, like all along the motorway, you can see the clearway and they've got that beautiful new concreted tar seal, and I was going like 28-30km coming home the other day like no worries you know, just clear in front of you." (E-cyclist 3)

"I think that the limiting of European bikes.....25k cut out is ridiculous and is a big frustration. It's sort of potentially a barrier to entry. ... [B]ecause 25ks an hour... it doesn't have to be much more than that. If there was a 35k an hour cut out, fine. Well, 25k, I think most people on an e-bike would cruise around 30, early 30s, and there's nothing more frustrating than cruising along and then next minute feeling your legs are... you're effectively sort of being halted. ...Well, in certain traffic situations I'm more comfortable...going at a similar speed to the traffic because I am able to get involved in the traffic flow rather than being on the edges if you know what I mean? I'm able to get behind a car in a lane. I'm more visible to the flow of traffic." (E-cyclist 12)

"I think a velocity cut-off does make sense – 30kms, 20 mph – something in that order. That is fair enough I think. ... I mean mine doesn't have a speed limiter on it but I can see that logically that there would be a case for it. 30kms would be okay. 20kms would be too slow because you would be swapping one set of risks for another. ...If you are running along at 20kms, you are making yourself more of a nuisance to the car drivers and I think the consequential ... you end up adding risks as an unintended consequence. But I think 30kms would be alright. Forty kms most of them don't go that fast anyway." (E-cyclist 7)

One participant thought 40km was a better cutout, as it was in line with the speed of existing fast cyclists, sports cyclists:

"Yes, I don't think that e-bikes should be allowed over 40kms/hour. (I:Why?) Why 40kms/hr, because a lot of bike riders ride at 40km/hr." (E-cyclist 2)

Several participants pointed out that the fact that a bike doesn't have a cutout doesn't mean that it can necessarily reach high speeds. They pointed out that motor capacity, gearing, and the weight of the bike and rider mean most people on low to mid-range bikes can't usually go more than about 35km per hour, unless they are going downhill:

"I believe it should have a cut out at 35k. ...But on my bike you can keep going and going and going and then you're not actually pedalling any more and I'm not at 50k an hour. And it's probably a combination of my weight or wind speed or all that sort of stuff." (E-cyclist 12)

"The bike is speed limiting because the e-bikes are so heavy." (E-cyclist 5).

Several people made the case for restrictions on the environment, not bikes:

"I'm not one for limiting the speed a bike should do, because we don't do that to cars, we don't do that to bicycles currently, why should we do it to electric bikes, it doesn't make any sense at all, you know when you're on a good bit of road, you're on the causeway, on the Northwestern go as fast as you like, but if there's 2 people coming in the opposite direction then please slow down thank you. I can't force your bike to do that by limiting its speed or whatever, I have to encourage you to be, you know, not be a dick basically." (Key informant 3)

"Yes. I think e-bikes shouldn't be restricted. I think that we should be restricted in terms of the environments we're riding in. ... So, let me clarify, if I'm driving my car past a school I have to do 40 kilometres, or 25, whatever it is. My car is not restricted to a top speed of 40 kilometres everywhere. It is environment. So, you are restricted by the actual environment, the roading environment, you're not restricted by the vehicle that you are using." (Key informant 7)

"I do think that at some point there may be issues in shared spaces, so on my commute there's a walking bus on the cycle track, and that reduces it down to a very narrow space for people going in both directions on bikes, and there are some people who travel very fast, and it's a definite, you know, it's a space for possible conflict, so I do wonder whether in certain areas, a speed limit might be appropriate, because yeah there's people that shoot past me, absolutely shoot past me, and I'm going faster than the average cyclist, well not the skinny guys in lycra they go faster than me, but your average joe, yeah so I think the speed could potentially become an issue, and I think the only real way of addressing that would be by putting up some shared space speed limits, but that's not about regulations in terms of how the bike is built or anything, that's about how it's used." (E-cyclist 21)

Several retailers felt that additional regulation was going to be difficult to enforce for a number of reasons, including a lack of enforcement resources, and the ease with which users can modify bikes themselves:

"I mean I take a hundred bikes in a container, I've yet to have anybody see what's in them. Which is worrying in one way, but lovely in another way, too. Cause I can just have anything come in, and sort of make it up." (E-bike retailer 2)

"I think there's definitely the issue of them being reconfigured, so they come restricted in some manner. So whilst they're limited in terms of the watts, so the motors are restricted as they come into the country to under 300 watts, but their power or the way that that power is delivered is via some sort of system, some sort of chip or something inside there and so it is possible with all of the ones I've seen to get into the computer of the bike and alter the restriction. So you can have them go faster than they do restricted. So people are doing that and so there is that issue. ...Yeah, in these days Google, you just type in: How do I un-restrict a turbo S and it will come up. It's not hard, so it's not like it used to be." (E-bike retailer 6)

"It's hard to enforce and I can see at the moment it's this situation of there's no one sitting there firstly watching how fast people are going or going, "Actually, your motor is 350 watts not 500 watts or 700 watts," but then it's how big is the battery that makes it go how fast and there's so many variables. How do you enforce that? I don't know. It probably does come down to a speed thing. Somehow there's a way of checking people's speed but that just feels like madness to enforce. Who wants to take that on? Who wants to do what." (E-cyclist 13)

Participants also had mixed views on whether speed restrictions would help or whether they would reduce e-bike use:

"I see it from my case cos its urban, I'm crossing the busiest part of Auckland through the middle of the city almost. It is actually a short trip relatively speaking and it's taking me out of my car. So, even on a short trip, if you thought you could take thousands of people out of your car in central Auckland - which is by the way exactly where they're talking about congestion charges, right? - you definitely don't wanna slow them down because it's actually the speed that is part of the value proposition. ...Yeah. I think because if you have the extra speed you feel more comfortable on the road and you need less of the shared paths in the world. I only use the shared path because actually it is a super highway for bicycles in a way because it is, you know, paralleling that motorway. It has no lights." (E-cyclist 1)

"I know that some people have an issue about the speed thing. I'd be really worried if they sort of lumped it in with the definition of vehicle under the Land Transport Act and stuff like that. I think it's good that it's still considered a bike, not a vehicle, 'cause as soon as you make it more under any kind of regulation I think you'd be limiting people from doing it. I think one of the things about e-bikes is that it's kind of enabled more people like myself to get out there and give it a crack. So, I would be against more regulation I think." (E-cyclist 9)

"I think that they should just encourage more people to ride them, and you know if they start regulating then less people will do it, you know." (E-cyclist 18)

Summary

The participants within this case study research identified a number of key advantages and disadvantages associated with using an e-bike for everyday transport in Auckland. As e-bike 'experts' they also had a number of key recommendations about how to encourage more e-biking, and the role that regulation could play in making e-biking safer and more accessible. Our second study focused on a slightly different group of e-bikers: car commuters who wanted to try out making 'the switch' to an e-bike for commuting for a month. This group of brand-new 'interested but concerned' e-bikers represent an important target group in terms of identifying opportunities to encourage people to move from car to active transport commuting.

Study two: What's it like to switch from car to e-bike for a month? The Auckland Hospital e-bike trial

Introduction: The study

This section provides an overview of data collected as part of a small e-bike trial we ran with five staff from Auckland City Hospital. The trial was designed as a feasibility study to assist the University of Auckland to prepare for a larger e-bike trial based at the hospital. This study involves a different group of commuters than the case study: rather than experienced e-bikers, these participants are motorists who are interested in potentially becoming e-bike users. As well as providing the perspective of potential e-bikers, ie. motorists who are considering making the 'switch', this small study is also workplace-based research, so it provides an overview of some of the opportunities and challenges of promoting e-biking within a workplace.

Methods

We provided the participants with an eZee electric bike (and panniers, lights, lock, rain poncho, helmet) for 4 weeks (mid March to mid April 2018). Bikes were provided by Electric Bike Team, Auckland. We selected participants who lived more than 1km and less than 20km from Auckland City Hospital, and who were NOT currently biking or walking to work. Participants attended a three-hour training session, were given a bike map for their area, and a taxi chit in case of breakdown. They also had an odometer on their bike, which recorded total kms travelled, as well as average and maximum speed. Staff from Electric Bike Team called each participant after one week to check how they were doing with the bike, and provided them with a number to call from 6am to 10pm if they needed assistance or advice. Participants completed an International Physical Activity Questionnaire (IPAQ) at the beginning and end of the trial, and also completed a one hour interview with Dr Wild at the conclusion of the study.

Who took part?

ADHB sent out the invite to an existing list of 415 staff members who reported, in 2016, that they wanted to be kept informed about any potential e-bike trials at ADHB. Forty seven staff contacted the research team to say that they wanted to participate. We selected five eligible people on a first come first served basis, with three men and two women taking part. The participants included three medical staff, and two non-medical staff. All were working at Auckland City Hospital, and one was travelling between Auckland City Hospital and Greenlane Hospital on a regular basis. Four were full-time and one was working three days a week. Two of the participants were Pakeha, one was Pakeha/Maori, one Chinese, and one Indian. Three were aged between 45 – 54, one was aged between 55-64, and one participant was in the 65-74 age bracket. Three participants were living in the western suburbs so were able to do a significant proportion of their commute on the Northwestern protected cycleway. The other two participants were living in the eastern suburbs. One had a mix of protected cycleway and on-road riding, and the other participant was primarily on-road. Commute length varied from 3km to 20km each way.

How realistic is e-bike commuting? Did people use their bikes?

All of the participants used their bike most days to commute, unless it was raining. One participant biked rain or shine, and the other four participants avoided biking if it was raining or forecast to rain when they left for work. The participants covered an average of 333 kms each over the four weeks (Between 165km and 446km). They also all used their bikes to do some recreational riding during the weekends, or after work, as they generally reported finding the bikes 'fun' to use. As well as improving their commuting experience, they also reported enjoying getting the chance to spend more time outdoors, having the chance to explore the city a bit more without having to deal with parking hassles, and using the bike to ride with their families on the weekends:

"So I used the bike pretty much 5 days a week at least, most of the days I commuted to work unless there was heavy rain, and in fact one day even in heavy rain I commuted to work. ... I think I did a lot of recreational cycling too. ... I wanted to get out early in the morning, so I used to go up to Mission Bay or St Heliers. So you actually weren't just commuting to work ...I was doing a bit more, let's say from work and instead of going straight home, I would take a nice ride." (Participant two)

What were the best things about commuting to Auckland City Hospital on an e-bike?

1.Improved mood when you get to work:

- Feeling happier and more 'alert' when you get to work.
- Commuting itself is more 'fun' and enjoyable.
- Reduction in anxiety about being late due to traffic delays or finding a park.

2.Saving time:

- More time at home in the mornings. Not having to 'plan in' extra time for potential traffic delays.
- Saving time on work trips - Quicker than the staff shuttle to get between Auckland and Greenlane Hospitals.

3.Saving money:

- Saving money on petrol and parking at Auckland City Hospital.
- Avoiding the extra parking expenses associated with moving between Auckland City and Greenlane Hospitals.

Saving time

Like many Aucklanders, most of the participants have found themselves leaving earlier and earlier for work in order to avoid traffic delays. The staff in this study reported that getting to spend a bit more time at home in the morning was one of the best things about using an e-bike to commute. They also reported that being able to combine exercising and commuting reduced the length of their day:

"I guess at the moment I've got a little routine, so I leave home at 6:30am to get here, early so I can leave at 4pm, latest 4pm and ... that's primarily to skip traffic, and I've gotten used to that. So, with the bike, I guess the advantage is if I need to stay back for another half an hour, or 5-10 more minutes, then I don't stress out as much, I just go oh well I'll just get on a bike, traffic will be what it is, because I don't have to worry about getting stuck at pinch points and things like that. So that's the, I guess, the plus side. The other plus being normally, when I drive to work I try and go for a run after work, normally I do some exercise after work, whereas cycling I guess that gives me the exercise that I should be doing, and if I cycle both ways then it's, I probably exercise for a longer duration than I normally would." (Participant one)

"It's definitely faster than the car, and it changed my, it would change my work habits a little bit: I've started working quite early and simply because of the need to beat the traffic. That's the benefit, but sometimes it doesn't work because sometimes it means I'm having to, I'm still having to stay late, so I'm just getting very long days and not getting any benefit, all because of having to come early in the morning. Average time coming in, would have been somewhere in the 30 minute (range), whereas years ago when I rode on a bike it was 45 minutes or something. Certainly in a car it's about that in the traffic, yeah so it's faster, definitely." (Participant three)

This particular participant also said using an e-bike saved him time because he needed to travel between Auckland and Greenlane Hospitals, and previously he would have driven in to Auckland City Hospital then caught the shuttle to Greenlane, to avoid paying for parking and spending time looking for parking in both places. On the e-bike he could go freely between sites without having to pay for parking, and the e-bike was quicker than using the staff shuttle:

"I had this opportunity so I actually chose to enjoy the going to Greenlane in the morning on the bike, and then take the bike from Greenlane to Auckland hospital, at one point beating the shuttle, between the hospitals. This was a fantastic feeling, because it's a bit of a joke between me and the bus driver, because off I headed and then we got to the lights and he went on, I went a different way that was safer, and when I got there, there he was still coming along because he'd been stopped at different traffic lights, and he had to stop and pick up passengers on the way. So I literally beat him to Auckland hospital. I did skite about it a bit. Why wouldn't I? (Participant three)

Less parking stress for everyone

In general, people reported having to spend less time looking for a park at work, and they also liked the fact that they could go out and get stuff done in their lunch hour or after work, and not have to worry about the stress of finding a park. One of the medical staff who participated in the study also said he liked the fact that biking freed up car parks for patients, who were also experiencing parking stress:

"[It's] constant. You just need to stand [outside at] 1pm when the afternoon clinics start, outside the car park and you'll know the drama unfolds all the time, and I think

50% of the staff can actually, 30% can cycle I'm sure, or even less, even if it's 10% it's better isn't it, it's so much nicer, yeah I think it could help with other things too." (Participant two)

Feeling happier and more alert when you get to work

Staff noted that the combination of more time spent outdoors, and the 'feel better' effects of exercise made them feel happier and more 'awake' when they arrived at work:

"You feel like you've done some form of exercise, and it clears your head before you start work. And then after work it clears all the cobwebs out, so I don't come home as grumpy." (Participant four).

"The best thing for me, is the buzz that I get from it. ...What is it that they call it, the endorphins, and going at that time of the morning it's like, there's not much traffic and it's quite quiet, and I actually enjoy that quiet time. ... I feel good when I get to work. ... I'm feeling up a lot with it, [it has] improved my mental wellbeing." (Participant five)

Exercise and fitness

Four out of five of the participants felt that the trial had a positive effect on their fitness. Two of the participants stopped going to the gym, as they felt they were getting enough exercise biking, and found e-biking more enjoyable. One participant reported that she had lost weight during the trial. The e-bike was seen as a relatively easy and 'enjoyable' way to get some exercise:

"I think it was the whole fitness thing too. Yeah because my other bike, I did go out on it but it just wasn't enjoyable. [With the e-bike] you still get a bit of fitness in and you still feel good, but they're so easy." (Participant four)

The e-bike was also seen as a good way to increase your fitness because it provided exercise with a 'purpose'. This particular participant was previously going to the gym, but she has stopped, because she says she found it 'boring' in comparison to e-biking:

"Come the second week ... I decided I really needed to start accepting that I'm getting old, and that I shouldn't put my hand up for this sort of stuff, I'm bloody ridiculous, and then suddenly I got my fitness, and oh I just want to keep doing it now. It's great, I'm doing something with a purpose, and yeah a reason for doing it." (Participant five)

Removing the stress of riding uphill in particular was seen as enabling people to take advantage of the enjoyable aspects of cycling, as well as making them feel more 'confident' about their ability to sustain an exercise routine, and work it into their day successfully:

"At first it's a new experience actually, which is quite nice and I think because, what put me off cycling was the hills, and if you could kind of get over that with a little bit of power in the bike. That was really good, and definitely I think you [are] kind of pushed to do a bit more cycling, and kind of you want to do a bit more, and it kind of builds your commuting to work plus your exercising and that's straightaway a bonus ...I think for people who are not that fit too, I think it will be helpful because it gives you that additional thing of saying hey, look, I'm up and about doing something, it's a confidence thing isn't it, it's not just a bike it's a bit more than a bike I think." (Participant two)

"On the hills of course I just smile and wave, up you go, which is amazing." (Participant three)

As one other staff member said, the other important part of successfully incorporating exercise into the day was the way that the e-bike helped her to make sure that she could “actually have a conversation” and avoid “looking like a beetroot” when she arrived somewhere. One of the participants also noted that the e-bike had helped him to increase the amount of exercise he was getting, because he had found other forms of exercise difficult since he injured his back:

"[B]ecause I had a back injury just before the trial, I was kind of going off exercise a little bit, but on the cycle I actually did a lot more. I think that's what it is really, because let's say you had a certain kind of injury which prevents you from walking or running, I think cycling is not a bad option, like swimming really I think it's less, I think it's a more efficient way of working out and I think can lead to less injuries if you're set up properly. ... So actually I did a lot more than what I would have done those particular weeks."
(Participant two)

What were the worst things about commuting to Auckland City Hospital on an e-bike?

- | |
|--|
| <ol style="list-style-type: none">1. Feeling unsafe riding on the road with cars.2. Biking in the rain - Having to think about and plan for changes in the weather.3. Range anxiety – Worrying about running out of battery.4. Wasting money on parking for the days when you ride, if you pay fortnightly for parking. |
|--|

Safety and the experience of e-cycling

There were no significant incidents or crashes during the trial. Three out of four of the participants had experienced a small incident during the initial adjustment period, a pedal banging a shin, tipping over while starting, and banging the front wheel into a wall when turning slowly. This is consistent with our wider e-bike user interviews that show that minor single bicycle incidents are fairly common, while people adjust to the power and weight of the bike:

"[C]oming out of that park at the front of ED, you've got to go up a hill, and I forgot to turn on the, the thing, so I kept biking up and then thought Jesus this is heavy, and it tipped. Yeah, but I didn't hurt myself, and I was more embarrassed that somebody had seen me doing it, so yeah, so now I always check that I've turned on, because that was embarrassing." (Participant four)

One participant did experience a frightening near-miss; however he noted that he felt he was able to handle it safely due to the defensive braking techniques taught during the trial training:

"So there was one where I was, it was night time, I was cycling back from St Heliers, onto the Domain Road, it's a dark road actually, so just near where the ASB kind of stadium was, you turn a left into the Domain and there was a car who came was turning right, and he just cut me across right. Had I not slowed down and stopped he would have hit me. ...I think it's not an e-bike related thing, I think it was a bad driver in the middle of the night, so I think that was what it was, I think it's nothing to do with the e-bike as such, he just didn't see me, or didn't, chose not to see me. I had the full reflectors, I had the lights, I was not invisible and yeah I think it's Auckland, needs a bit of training, the motorists need a bit more training on cyclists. It's nothing to do with the bike. (Participant two)

The final participant, who did the largest amount of on-road riding, including between Grafton and Auckland City Hospitals said he experienced no safety issues at all:

"No, no slide slips, no unusual braking, cars, did anybody come near me? I don't think I can recall a time. Nobody tried to cut me off. It just didn't happen." (Participant three)

Even without experiencing any incidents, however, several of the participants did report finding it stressful when they had to mix with cars in heavy traffic or on narrow roads. One participant from the eastern suburbs had to negotiate one particularly stressful 'merge' point in heavy traffic on his commute and he said he could feel himself 'relax' when he finally got onto the quiet residential streets near his home:

"No for me it's only when I get towards, getting towards my house, that's when you're back on the residential roads. In a sense it's a lot more relaxing. I mean, the suburb I live in is quite quiet, so I know once I get past, like, the [Main] Road, crossing the small roads again, I'm kind of almost 'ok I'm safe now', kind of thing. I've got past all the major heavy traffic roads, and I'm on the residential bits and I kind of lose, you know, my guard goes down, because, you know, there's no constant stream of cars behind you, coming up behind you, you've just got to look out for the odd one, person coming home or coming out of their driveway kind of thing." (Participant one)

The participants who lived in the western suburbs reported really valuing having access to a significant stretch of off-road cycleway:

"I mean I'm doing it because I don't have to drive in the traffic, if I had to drive on the roads, [I] wouldn't be doing it and that's it, end of story." (Participant five)

Although despite there being strong support for the need for more separated cycleways, two of the participants did mention that they felt that using an e-bike improved the safety of on-road riding for them compared to using a push-bike, because their e-bikes gave them the ability to accelerate a bit faster and harmonise their speed with motorists:

"No, St Lukes Road was fine, and once again speed's really good because you're basically keeping up with the flow of traffic really, you're catching them up at the lights, your acceleration is really important, getting away at lights, you're actually across that crossing before that car next to you or behind you has actually accelerated, he can't accelerate as fast as you can actually. ...So you're across and to the left out of harm's way fairly quickly, which I think is really good." (Participant three)

Another participant said he also felt that he was more 'visible' and motorists gave him more 'space' when riding an e-bike compared to the experience of riding a pushbike:

"[Y]ou're taking a bit more of the road space, you're still going faster and I think the cars are watching you a bit more carefully, they don't try and push you off, for some reason I think that's what it is. And I think the power, and the grippiness of the tyres, I think overall gives you much more safety and visibility on the road for some reason." (Participant two).

The weather – riding in the rain

The trial ran from mid-March to mid-April, so while participants felt comfortable biking most of the time, many said they were unsure whether or not they would keep biking through winter. Rain was the most commonly cited barrier to using the e-bike:

"If I did buy one I'd be ...thinking if it rains too much you probably won't end up using it, and I guess some days where I have to go to different places for meetings and things like that, so I probably wouldn't bike in during those times. But yeah no something to factor in for I guess the spring, autumn, summer months, but definitely not something I would think about doing in winter." (Participant one)

"I think the biggest deterrent is of course the weather. If it's bad you can't cycle." (Participant two).

"The weather's a bit, even though that bike's got wider wheels so you're not likely to skid as much, but, yeah it's the visual stuff in the rain is not, like you don't feel as safe as you do in a car when it's raining. So I wouldn't, if it was raining in the morning, I wouldn't bring it" (Participant four)

Having said this, however, several of the participants said they were unsure whether winter weather and rain would be as much of a deterrent as they feared. Two of the participants talked about how they had had experiences cycling home in the rain, and it hadn't been as off-putting as they imagined:

"Yeah look I think I thought it would put me off actually, but I quite enjoyed it because I think these bikes have got the power, and they've got better I think, the tyres are much more grippier, so you don't feel that unsafe in the rain, and you feel like doing it, and there was a day when I kind of cycled for about 10km in the rain actually, which was fine, and I stopped for a few minutes when it was too heavy, but I didn't feel unsafe. ...You get wetter a bit more but I think it was fun, and it's good to have those bags and all that, it was set up nicely because I think with those bags you don't mind throwing a few things in the bag, they're fairly waterproof bags and all that, so I think you know I used it a few times in the rain. I enjoyed it actually." (Participant two)

Another staff member said that when she had ridden a pushbike to work in the past, rain had been very off-putting, but she found it less discouraging on an e-bike:

"So before I used to think oh if it's going to be wet and windy I won't do it, whereas it would have to be quite bad now. ...Well it's because it's easier on the e-bike. A bit of rain doesn't hurt you. It's more wind that's off-putting. Ok wind and rain go together generally, ...and it's more tiring, and you're not tired out on an e-bike. [Also] ...actually I felt on the e-bike a lot more solid, and a lot more safe than if I was on a pushbike, and you're still going to go pretty much the same speed, you might pull it back a little bit to be a bit safer, it's still the same traffic whether it's raining or sunny, you're still stuck in the same dreary old traffic, with the chance of someone having a nose to tail and holding you up for ages on the road anyway, so it makes sense." (Interview three)

Range anxiety – worrying about running out of battery

Consistent with other studies on e-bike use, 'range anxiety' or the fear of running out of battery was seen as a downside of using an e-bike, particularly on days where you might need to add work trips on top of an already decent commute to work and back:

"There's a couple of times when I was just, it just didn't work for me, and the distance I knew I was going to have to travel. ...I wasn't confident that it would do the journey, and I really didn't, because the bike's really heavy, and I really found it a struggle, and I tried a couple of times. ...[D]ownhill is ok, and the flat's very hard, and uphill is almost impossible without any battery power. ...Yeah and that will be my consistent question, and it plays on your mind because you don't feel comfortable, ... that would be the thing that would worry me." (Participant three).

Parking disincentives

One of the participants said that the structure of parking charges at Auckland City Hospital discouraged him from continuing to use an e-bike to commute to work, because he paid by the fortnight, so he was 'wasting money' each day he bought his bike in:

"[T]he car park we get ... it's for the whole time, you can't go, it's not pay as you go kind of thing, so I'd have to work out well is it worth it then if you're getting a car park, ...like for example doing the trial I can't go oh look I don't want a car park for a month or something, because I end up riding in. You can't say that. You have to pay for it all year. ...Well I could decide not to have it, then what happens when it rains, you probably have to pay the normal rate which I think they are, I kind of worked out that the minute I park one day in a week, at normal rates I'm probably better off just paying for the whole week." (Participant one).

Cost

In line with comments from the 'expert' e-bike users, the high relative cost of e-bikes was considered a barrier to purchasing their own e-bike to continue to commute to work:

"I actually think cost is going to be your biggest challenge really. ... It does seem like a lot of money, a lot of outlay. It is fair to say though that in a hospital where professionals are, a lot of people do have the income to support it, you know, but then a lot of people who work here don't as well, and we often forget them, we think oh hospital, nurses, doctors, technicians, but you know it could be cleaning staff, just people who are on a lower wage. A lot of people when you talk to them say, and I'm sure you have heard this before, the price will come, down I'll wait. But while they're waiting they're not commuting, they're sitting in a car while they're waiting." (Interview three)

There was also some further uncertainty and anxiety about a lack of knowledge about what additional ongoing costs might be involved in using and running an e-bike compared to a car.

Needing to have a shower

One participant said that he found having to find extra time to have a shower in the morning at work an inconvenience; however this same staff member also said that overall he thought that biking to work was saving him time because he could leave later, and he didn't need to find additional time after work to exercise:

"I guess the other thing that was slightly inconvenient, I guess is having to shower when you come in. You know because if you drive in, like I drive in the morning I just get to work and I'm good to go, whereas on the bike, you come in have to cool down, go for a shower and then that. Although I get the flexibility, that actually adds to the time. But it's not a big deal. The shower facilities here are decent, they're not terrible, but there's just a time factor. Like if I get in, if I drive in I'm in here 7:05am, I'm pretty much good to go, whereas if I get in here at 7:05am on the bike, then you know it's like I have to get my key, get the clothes, get the towel, go for a shower and that adds, anywhere between 10-15 minutes difference." (Participant one)

How well is Auckland City Hospital set up to encourage mode shift from car to e-bike?

In general the participants felt like ADHB is doing a good job of promoting cycling. All of the participants were happy with the showering situation at ADHB:

"[L]ovely shower facilities for us, we can walk in and change into work greens and all that so, I think work wise ADHB is perfectly positioned for cycling." (Participant two)

Although one participant did wonder if the showering infrastructure would be adequate if you had forty e-bikers wanting to shower and start at a similar time. Four staff members used caged parking, and one was taking his bike into his office. Three were happy with bike parking, and two think that the caged bike parking areas are too full, and there is a need for more bike parking at Auckland City Hospital:

"I see a lot more cyclists and I think especially ADHB I think they're more friendly with cycles, but I think already the cycle parks are full, there's no spaces. It was full but I just parked in the middle of the cycle park really, sometimes I got a slot sometimes I didn't, but just shove it in somewhere. They need another two of them (bike parking areas), I think, it's filling up fast, a lot of interest." (Participant two)

Two participants pointed out that because they start very early that they find it easy to find a park in the caged areas in the morning, but the parks are overly full (no room in the bike stands, bikes piled up against other bikes, making it hard to get bikes out sometimes) when they leave in the afternoon.

How could ADHB encourage more people to switch from car to e-bike?

1. More secure bike parking

2. Help staff to reduce the up-front cost of purchasing an e-bike

Consistent with other research in New Zealand and overseas, the staff who participated in this trial reported that cost is a barrier to buying an e-bike to commute to work. ADHB could explore options to reduce the up-front cost to staff, including through a group purchase, a salary sacrifice scheme, or enabling low-income staff members to put the existing gym membership subsidy towards an e-bike. Several of the participants mentioned the value of exploring some way to bring the cost down for ADHB staff:

"[T]he cost is a factor, I think what people should encourage, like in Australia I think you have the salary sacrifice kind of schemes, where if you can actually use it to buy this thing, or even for a gym membership or to buy a cycle, and make it a pre-tax thing, you probably would, the cost would come down significantly. ...I think those are the kind of things ADHB can do, because if you work in the private world sector, and it's a good

company there are a lot of perks which come with it, whereas in the DHBs the perks are not that much, so these are the kind of little things which hey look, the kind of it's a value thing isn't it, for the nurses and other people, and Dr's tend to be paid a bit more so they probably can afford it, but still if you make it a group thing, and even everybody I think, any staff in the hospital can buy an e-bike through a discounted scheme, it would be such a nice gesture.” (Participant two)

3.Sharing stories of e-bike users, and developing e-bike champions

One participant thought it would be useful to use the staff intranet to share the experiences of staff who participated in the trial:

“[I]f you sold the stories and, you know looked at the group, say that we did it, and ... you sold your story about, you know, the parking, saving on the parking, you've got your exercise, you've got these wonderful bike tracks, and it's a safe way to go to work, people will, and there's lots of ways, you know like on, using like the intranet stuff, because that's how most staff get all their comms. I think, you know, e-bikes are becoming more and more popular too. People always ask you is it an e-bike.” (Participant four)

4.Give more staff the opportunity to try out an e-bike:

Research shows that getting the chance to try an e-bike, because of the high 'novelty' and 'enjoyment' factors, is a strong incentive to purchasing an e-bike. Several staff mentioned that they had others in their team who were keen to participate in a similar trial. On this occasion another 42 ADHB staff contacted us to say that they would also like to try out commuting to work via e-bike if the opportunity were available to them:

“I mean a couple of staff here have had goes on it, so you know one of them is going to go and see if they can get one of the bikes so yeah. I've definitely been selling the e-bikes. I think they're great.” (Participant four)

5.Support separated cycle lanes

The staff involved in the trial reported that more high quality, separated cycle lanes was the key thing that would encourage them, and others they know at work to cycle, or e-cycle more. As a large employer, with a workforce that is valued by the city, ADHB can provide an important voice in support of planned separated cycleways, as well as requesting new cycleways in areas where ADHB staff would use them to commute to work and between ADHB work sites.

Discussion: Comparison with previous studies

There are a number of themes within both studies that are consistent with previous research on the experience of using an e-bike for everyday travel. This research, as with previous studies, suggests that existing e-bike users are more likely to be middle aged or older, and to have higher levels of income and education^{44, 45, 46}. A number of overseas studies however, have shown that younger and lower-income people are just as likely to use an e-bike if they are given an opportunity to do so^{32, 47}, and that cost is therefore the most likely barrier to adoption by a wider demographic. Consistent with overseas studies, the desire to increase cycling ease, through reducing the sweatiness and exhaustion associated with covering long distances^{44, 45, 48}, hill-climbing^{26, 47-49}, poor weather^{44, 50}, and declining physical ability²⁹ were key themes within this research. The desire to reduce travel times^{44, 50}, improve

fitness^{26,29,30,44}, and reduce car use^{26,44,51} were also important motivators, mirrored in other studies of e-bike users. Other motivations that stood out in this study but are not prominent in the literature, include the desire to improve arrival-time reliability, particularly for those with care responsibilities, and the effect that having access to a cycle highway has on e-bike uptake. Increased parking costs also featured more than expected as a reason for e-bike purchase within this Auckland-based research.

As noted, many of the participants reported that they had experienced a convergence of multiple compelling push and pull factors that led to their decision to try or buy an e-bike. This observation is consistent with Jones et. al.'s⁴⁸ research comparing e-bike users in Oxford, UK and the Netherlands. They found that while e-bikers in the Netherlands, where cycling is very normalised, were more likely to be older cyclists motivated to switch to an e-bike, the Oxford e-cyclists were a more diverse group of transport users who had reached a 'critical junction' where several important factors converged and provided a strong impetus to try a novel transport option. The fact that multiple factors are often involved implies that a fairly high level of motivation is required before people buy an e-bike. This is also consistent with the discussion within this study and previous studies about needing a strong motivation to overcome the anxiety around the high perceived cost and relative unfamiliarity of e-bike technology. Participants in this study, even fairly wealthy potential e-bike users, worried about whether they would use the e-bike, or whether it would become an expensive bit of abandoned leisure equipment.

The participants within both our studies talked about a number of key benefits and challenges associated with using an e-bike for everyday travel. These findings were largely consistent with overseas studies. Benefits included making bicycle commuting more practical by making it easier to carry stuff^{26,45,50} reduce sweatiness and turn up looking 'professional'^{26,52}; as well as being able to cover longer distances^{26,44,48}, and save time^{31,48}. Other perceived benefits, also discussed in previous studies include improved commute satisfaction, including the 'fun factor'⁵³ or high levels of intrinsic enjoyment associated with using e-bike technology^{44,45,48,52}, and improvements in mood, fitness, and concentration^{26,30,31} arising from using the e-bike to commute to work. Other previously reported benefits included safety gains associated with increased confidence negotiating intersections and 'taking the lane'^{13,26,44,54}, and being able to harmonise speed with motorists¹³. Being able to choose a safer and/or more enjoyable route^{44 30}, saving money and reducing car use⁴⁴ were other benefits reported by e-bike users.

The exact extent of mode shift from car to e-bike is difficult to assess, as most studies use self-report data⁵⁵. In his review of research on e-bikes and mode shift Kroesen concludes that e-bike use tends to replace a mix of car use AND whatever other alternative modes are most dominant within a city, i.e. cities with higher public transport share see more public transport substitution, and cities with higher levels of cycling or walking see higher levels of substitution of these modes, in addition to a reduction in car use⁵⁵. Hausteiner and Moller argue that variations in the mix of mode substitution are also likely to be due to the fact that different e-bike segments replace different types of modes, with younger e-bike commuters more likely to switch from a car, and older leisure riders more likely to replace walking or public transport use⁴⁵. Overall, most studies show a reduction in car use associated with using an e-bike. A review of European e-bike research by Cairns et al. found 16%-76% of e-bike trips replaced car trips, with at least four European studies showing at least a 50% substitution rate³¹. One

California study asked participants to record their petrol use after purchasing an e-bike. On average participants experienced a thirty percent reduction in fuel use²⁶.

Reports of reduction in car use amongst our study participants and participants within other studies are consistent with the examples they provide about the ways that they are able to undertake more 'car-like' trips on their e-bike, i.e. longer trips, with multiple-stops, picking up things like groceries and/or children. One US study of a mixed bike-share scheme, that used a combination of GIS tracking and self-report data, also provides support for the idea that e-bike use leads to a moderate reduction in car use. This study showed that compared to push-bike users, e-bike users checked out their bikes for longer periods, and made longer trips with more stops. Participants within their study reported that 11% of their e-bike trips replaced a car trip, compared to 0% of the push-bike trips³². Another large Dutch study showed that car owners who own an e-bike were more likely to use their e-bike than other modes (e.g. walking, push-biking, public transport) to replace car trips.⁵⁵

Finally, a recent Swiss study based on an evaluation of a two week 'swap your car keys for an e-bike' scheme found that getting the chance to try an e-bike had a particularly strong and enduring effect on weakening car-based mobility associations, even for participants who did not buy an e-bike at the end of the trial. They noted that this effect was evident even a year post-trial, and was likely related to the high levels of enjoyment reported by e-bike users during the trial. They also noted that these findings contrast with the outcomes of other research on 'swap' schemes, particularly public transport/car swap schemes, which tend to show a declining effect over time⁵³.

Concerns have been expressed about the extent to which e-bikes may be replacing traditional push-bike use, and whether this switch will lead to a decline in physical activity. However, several researchers have pointed out that those who switch from push-bike to e-bike tend to be individuals who are finding it difficult to continue to use their pushbike. Thus, as Jones et al.⁴⁸ argue, e-bikes are likely preventing a shift to car use amongst this group of cyclists⁴⁸. Fyhri's Norwegian e-bike research programme which, like New Zealand, highlighted a high proportion of sports, or 'very fit' cyclists amongst existing cyclists, pointed out that those who already rode were actually the least likely to show an interest in using an e-bike, due to the fact that high levels of exercise was a primary motivator for push-biking. Their research showed that interest in using an e-bike was highest amongst those who did the lowest amounts of existing cycling^{47,49}. Overall, Intelligent Energy Europe argues that the research suggests that e-bike use results in a small but important reduction in car use: they estimate that each e-bike on the road reduces car travel by approximately 900km per year³³.

The potential role that e-bikes can play in increasing women's cycling was an important theme within this study. Our cycle counts on the Northwestern cycleway showed that while women made up around a quarter of cyclists, they were over 40% of e-cyclists. The female participants in our study pointed to some reasons why this may be occurring, including the greater importance of arrival-time-reliability for carers commuting in congested conditions, and the ways that e-bikes can potentially give slower cyclists greater confidence 'taking the lane'. Previous research suggests that e-bikes act as an important 'equalizer', not just in the relationship between motorists and cyclists, but also between cyclists, with women and older people or people with disabilities reporting that their e-bike provides important opportunities for them to ride with slightly stronger or fitter partners, friends and bike social groups⁵⁴. One

overseas e-bike trial showed that when given access to an e-bike women were more likely than men to increase the number of new trips they made by bike⁴⁷. Like our research, previous studies have also pointed to the ways that e-bikes enable people to continue to bike or to pick up biking as a way to maintain fitness and wellbeing as they experience disability or a decline in their physical abilities²⁹. These findings are important, as the largest cycling-related health gains accrue to older cyclists²¹.

Our findings on the negative aspects of using an e-bike are also fairly consistent with overseas studies: bike weight^{29,48}, range anxiety^{26,44,48,54}, fear of theft⁴⁴, and cost^{48,49,54} were the most common concerns. Safety issues, including worries about hurting pedestrians are also common in studies from cycling 'starter cities' that have fewer dedicated cycleways, lower quality paths, and a higher prevalence of shared walking/cycling infrastructure²⁶. Conflicts created by the tendency for motorists to underestimate e-bike speed, or so-called 'time-to-arrival-misjudgements', are another common concern amongst e-cyclists doing a lot of on-road riding⁴⁸, and indeed are the focus of e-cycling safety research in Europe^{56,57}.

Recommendations on how to increase e-bike uptake and make e-cycling safer mirror those from overseas. They include reducing the up-front cost of e-bikes^{29,40,46,58}; providing people with real-life extended opportunities to try an e-bike^{29,45,49,50,53}; improving the prevalence, width, quality and maintenance of cyclepaths^{26,30,40,44,59}; more secure bike parking^{13,60}, and education for motorists and e-cyclists²⁹. There were diverse views about what role increased regulation could play in improving e-bike uptake and safety. In general, the status of New Zealand cities as 'starter' cycling cities, with few protected bike lanes, and a greater need to mix and 'harmonise' with motorized traffic mean that many e-bike users are keen to retain the higher cutout speeds and throttle technology more consistent with a US rather than a European regulatory regime. Throttles were considered to be an important auxiliary safety feature by most riders in our study, and a 30+ speed cutout was seen as important not just to enable harmonisation, but also to make it possible for riders on the northwestern cycleway to cover longer distances in (largely) free-flow conditions.

Conclusion and recommendations: Enhancing the potential for e-bikes to improve efficiency, sustainability and wellbeing within New Zealand's urban transport systems

Across both studies, and all four groups of participants, we found consistent themes: e-bikes are increasing efficiency, sustainability and wellbeing within New Zealand's urban transport systems. E-cyclists themselves report decreased travel times, increased arrival time reliability, and decreased commuting stress as key benefits of using an e-bike for everyday travel in place of other modes (cars and buses especially). The e-cyclists report being happier and more alert when arriving at work, and they enjoy the exercise provided by the commute. All of these factors have been shown to make an important contribution to increasing both workplace productivity and satisfaction with home and family life. Given the higher number of women amongst e-cyclists using the Northwestern cycleway it is likely that e-bikes are also making an important contribution to increasing access to cycling amongst women, the group with the highest levels of both commuting stress and unmet cycling need.

The e-cyclists, retailers and key informants in this study pointed out barriers to e-bike use in Auckland. Concerns about physical safety and the lack of high-quality separated cycleways for fast cyclists were seen to be the most important barriers to greater uptake of e-bikes. There was some variation between the groups in terms of how they understood safety issues around e-bikes. The key informants, or cycling policy makers, tended to focus more on the safety risks associated with e-bikes, particularly increased injury risks, to both cyclists and pedestrians associated with higher speeds. The e-cyclists themselves were also concerned about these issues, however, they also tended emphasize benefits associated with the higher speeds they could achieve on an e-bike, including speed harmonisation, the ability to accelerate out of danger, and the ability to cover longer distances on a bike. Given the range of suggestions made by both expert e-bike users, new e-bike users, retailers and key policy makers about how to make e-bike use safer and more attractive, we make the following recommendations:

Recommendations:

1. **Provide more separated cycle lanes.** Like those riding pushbikes, e-cyclists list more separated cycle lanes as the thing that would be most likely to encourage them to cycle more.
2. **Provide free-flowing, protected cycle highways within the 15km e-bike 'goldilocks zone'.** In order to take advantage of the additional speed provided by pedal assist, e-cyclists need unobstructed routes. It is the additional speed provided by the auxiliary motor that enables e-cyclists to cover longer distances, expanding the active transport radius. As new, sometimes less confident riders, e-cyclists also have a high preference for protected, off-road cycleways. Cycle highways: wide, protected, high quality environments for fast cyclists, provide the best conditions for e-cycling. High priority should be given to investing in cycle highways that enable people within 15km of the CBD, and other key employment/education hubs, to use an e-bike for everyday transport.
3. **Separate pedestrians from cyclists where possible.** E-bikes mean more cyclists, who will tend to ride faster, on heavier bikes, on shared paths. Overseas research suggests that e-cyclists maintain similar speeds to pushbikes when sharing spaces with pedestrians, but in the New Zealand context we believe it is likely that many e-cyclists will need to ride at slightly higher speeds in order to cover longer distances. As a result, shared spaces will likely become less safe for both pedestrians and cyclists as e-bike use rises.
4. **If an e-bike speed cutout is introduced, it is recommended that it be 32km/hr rather than 25km/hr.** The majority of the participants within this study reported riding at speeds between 25km – 35km/hr.

Participants with longer commutes (>10km), were particularly likely to report needing to travel at 30-35km/hr for at least parts of their trip in order to keep commute times within a realistic time budget (under 1hr). Participants who rode on busy roads were also more likely to report travelling over 30km in order to achieve great 'speed harmonisation' with motorists, increasing their sense of confidence with 'taking the lane', and reducing perceived conflict with motorists. International research has also suggested that the ability to achieve 30km speeds amongst e-bikers is important because it provides active transport users with the opportunity to compete on an equal footing with cars in reduced speed, 30km/hr zones. For these reasons it is recommended that if a speed cutout is introduced for safety reasons that New Zealand should adopt the American 32km/hr cutout rather than the 25km/hr European standard.

5. **Reduce the speed limits on more urban roads to 30km/hr.** International research suggests that one of the best ways to increase e-bike use is to make e-bikes more competitive with cars by reducing the speed of all vehicles on urban roads to 30km/hr. Given the safety benefits of speed harmonisation to all road users, but the increased injury risk to cyclists riding above 30km/hr, the new capacity to 'speed bikes up' provided by e-bike technology should be accompanied by a proportionate safety focus on 'slowing cars down'. This recommendation is supported by reports from e-cyclists in this research who said that they felt particularly confident using the road in lower speed environments like the CBD and Wynyard Quarter in Auckland, which have 30km/hr speed limits.
6. **Provide opportunities for people to try out an e-bike for a trial period of 2 weeks.** Many participants, even individuals with fairly high incomes, reported that purchasing an e-bike feels 'extravagant' because they were unsure whether they would use it in their real-life commuting conditions. These findings are consistent with international research that suggests that people struggle with the cost of e-bikes because of cultural associations with bicycles as being a 'low-cost' item in comparison to cars. Participants who bought an e-bike from one particular retailer who provided them with the opportunity to take the bike home and try out their particular commute for two weeks reported that this had been particularly useful to enable them to feel less anxious about whether the price tag was 'worth it'. This experience is also consistent with feedback from potential participants in the e-bike trial we ran at Auckland Hospital, who frequently reported that they had had a chance to try an e-bike for a short ride, but really wanted the chance to try out their own commute to help them make a decision about whether they would actually use the bike, given its substantial price tag.

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7. **Reduce the cost of e-bikes.** Recommendations include removing fringe benefit tax from bicycles and developing a tax exemption scheme like the UK's Cycle to Work scheme to enable employers to provide e-bikes to staff. Current tax rules disincentivize workplace provision of e-bikes. Other recommendations include supporting employers to lower the up-front-cost of e-bikes to staff by encouraging group purchases of e-bikes and salary sacrifice schemes to enable employees to pay off e-bikes over time.
 8. **Create a new 'E-bikes at work' website** to enable employers to access high quality information about how to a) establish a workplace e-bike fleet, and b) assist employees to purchase an e-bike for their commute. This research has highlighted the fact that employers currently have to invest a significant amount of time (and therefore money) in order to figure out how to meet taxation and health and safety regulations surrounding these type of schemes. These challenges mean that workplaces currently developing these schemes generally have strong cycling or e-cycling 'champions' who are willing to take on this significant time commitment. However, the majority of workplaces do not currently have such a champion and are likely to experience this significant investment in compliance research as an undue burden. Sharing stories, research, protocols, and success stories from e-bike friendly workplaces would significantly reduce this compliance research burden and likely increase workplace investment in e-bikes.
 9. **Investigate opportunities to make e-bikes available to low-income people.** Whether through subsidies, employer provision, lease schemes, rent to buy schemes, or bike share schemes, there is a need for further research into how to make e-bikes available to the groups who have the greatest need for the health gains and reduced transport costs associated with having access to an e-bike.
 10. **Provide more secure bike parking, with e-bike charging facilities.** This will reduce levels of anxiety about bike theft and range anxiety - both of which are limiting the generation of new e-bike trips amongst existing e-bike users.

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