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## Article

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# Will Electric vehicles decarbonise drive tourism?

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## ABSTRACT

This study examines the potential impact of the transition to battery operated electric vehicles (EVs) from internal combustion powered passenger vehicles (ICEs) on domestic drive tourism. It asks two core questions: whether EVs will hasten the move to a net zero domestic tourism sector and whether and how EVs will transform domestic tourism. The study, conducted in Queensland, Australia in mid-2023, concludes EVs will have a limited impact on drive tourism in the short to mid-term. Moreover, the substantial desire to continue to use traditional modes of transport or to substitute flying for driving suggests that transition to net zero tourism will remain an aspirational goal and not a realistic outcome of the shift to EVs.

## 1. Introduction

Motor vehicles represent the dominant mode of transport in domestic tourism, accounting for three quarters or more of all tourism activity in the UK (Visit Britain, 2014), Australia (Prideaux & Carson, 2003) and the United States (Christoff, 2022). Their appeal lies in the fact that passenger vehicles provide the greatest flexibility in attraction selection, route choice, time use, freedom of movements and the opportunity to do what one wants to do when one wants to (Bursa, Mailer, & Axhausen, 2022; Zorn & Suni, 2019). Drive tourism also allows tourists to visit destinations that may not be accessible by air, train or boat (Prideaux, 2020).

In spite of these benefits, though, traditional internal combustion engine (ICE) powered vehicles are also a major source of carbon emissions (Becken, 2019; Higham, Font, & Wu, 2022). For example, 11% of Australia's CO<sub>2</sub> emissions (Green Vehicle Guide, 2023) and about 61% of Europe's total transport emissions (EP, 2023) have been attributed to them. Within a tourism context, transport is the major contributor of greenhouse gases (Becken, 2019), with motor vehicles being the second largest carbon source behind only the aviation sector. The best estimate is that cars account for between one-quarter and one-third of all tourism related emissions (Simpson, Gössling, Scott, Hall, & Gladin, 2008; UNWTO / ITO, 2019).

A consensus exists that the global tourism industry must decarbonise in order to move to a more sustainable future (Becken, 2019; Sun, Bischoff, Niu, & Huang, 2020) in order to help us work toward net-zero carbon emissions under the Glasgow Declaration (Sun et al., 2020; UNWTO, 2021). In 2019, for example, the UNWTO / ITO stated

“transforming tourism for climate action requires embracing a low carbon pathway” (UNWTO / ITO, 2019: 49). The mass adoption of electric vehicles (EVs) is one area where fossil fuel consumption can be reduced (He & Zhan, 2018), providing, potentially, the greatest opportunity to reduce drive tourism's carbon footprint (Peeters & Papp, 2023; Scott & Gössling, 2021).

The popularity of EVs is growing rapidly in response to changing public opinion, aggressive government policies and the development of lower cost vehicles (Aultmann-Hall, Seas, Dowds, & Hines, 2012; Koh, 2020). Globally, it is estimated that there were about 16 million EVs on the road in 2021, compared to just two million in 2016 (Evans, 2022). In Australia, demand increased by 65% in 2022 compared to 2021 (Peacock, 2022) with the latest figures for 2023 indicating there were an estimated 130,000 vehicles on the road (EVC, 2023). Sales are expected to quadruple by 2028 (Mordor Intelligence, 2023), with a study reported by the *Australian Financial Review* suggesting market penetration could be complete by 2045, if not earlier (Evans, 2022). However, as impressive as these figures are, EVs still represent <1% of the estimated 15.1 passenger vehicles currently in use in Australia (BITRE, 2022). This figure is comparable to the shares reported in Canada (Statscan, 2023) and the United States (Hawley, 2023; Kane, 2023).

As discussed below, while much hope is held out that EVs could play a key role in the transition to net zero travel (Peeters & Papp, 2023; Scott & Gössling, 2021) at present, EV purchases tend to be made predominantly by the quintessential early adapter segment (Mandys, 2021) and have not reached mainstream penetration as yet. Moreover, given that most Australian households own more than one car (ABS, 2022) and that the average age of the fleet here is 10.4 years (ABS, 2021a), it is unclear

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whether EVs would be the preferred transport option for road tourism, even if more people bought them. This study examines attitudes to the use of EVs for domestic tourism by asking whether or if participants would substitute an EV for their most recent trip, if they had one. The reasons behind the willingness or reluctance to switch were also ascertained. In doing so, the study will determine if EVs could facilitate a more rapid transition to net zero domestic tourism and also examine if they may change the nature of drive tourism. Data for this study were collected from a survey of residents of Southeast Queensland, Australia, in August 2023.

### 1.1. The need to decarbonise tourism

The role of tourism as a significant contributor of greenhouse gases is no longer under debate (Gössling & Higham, 2021; Higham et al., 2022). Fifteen years ago, the United Nations World Tourism Organization (Simpson et al., 2008) estimated that tourism contributed about 5% of total global CO<sub>2</sub> emissions and up to 14% of all emissions when other greenhouse gases were considered. Its share has since been estimated to have grown to 8% pre COVID-19 (Becken, Whittlesea, Loehr, & Scott, 2020). Similarly, there is no longer any debate about the need for tourism to decarbonise, as the UNWTO through the Glasgow Declaration on Climate Action in Tourism endorsed policy actions to cut tourism's emissions in half by 2030 and reach net zero by 2050 (UNWTO, 2021). Transport has been identified as the most urgent priority in advancing the net zero tourism agenda (Higham et al., 2022).

Achieving this lofty goal is a challenge unless the industry reinvents itself through innovation, research and by a massive, ongoing investment in infrastructure and technology (Gössling & Scott, 2018; Scott & Gössling, 2022). Indeed, Becken (2019) feels the likelihood of achieving such change is akin to a 'mission impossible.' Instead, she illustrates that tourism business and government policy remain stuck in a growth paradigm, where technological efficiency takes precedence over behavioural conservation, and where the institutionalisation of interests mitigates against change. Scott (2021) identified the challenge of determining where tourism sits in a net-zero economy, for it is but one component of the global economy. Peeters and Papp (2023) suggest most of the changes will come from outside the tourism sector. They cite the electric car revolution as an example of a non-tourism initiative that benefits the sector.

Becken (2019), Higham et al. (2022), Scott (2021) and Pham, Meng, and Becken (2022) conclude that only radical, systemic changes to disrupt the current system will effect change. Scott (2021) is blunt in his assessment concluding that what we have done in the past has not prepared us for the near future, when action is required, now! Simply relying on technological solutions, without changing behaviour patterns will not achieve desired outcomes. Likewise, policy alone, with its embedded and contested political agenda, coupled with the lack of integration even within government agencies (Becken et al., 2020) may be too little or too late on this pressing matter.

No doubt, the climate crisis is accelerating. Opportunities lie for industry to act faster than the political system can move. One area where change can occur is through the widespread adoption of EVs (Higham et al., 2022). They are readily available, and prices are decreasing. The transformation from ICEs to EVs is well underway. But, the question remains whether tourists are willing to forsake their traditional modes of transport given the ongoing risk/benefit concerns associated with these vehicles (Bryła, Chatterjee, & Ciabiada-Bryła, 2022).

### 1.2. Challenges and Opportunities affecting EV use in domestic tourism

The widespread adoption of EVs in drive tourism faces a number of challenges, albeit while providing a number of opportunities. Some of these issues may be resolved through technical innovation, while others will require a more fundamental change in consumer behaviour. In fact, a number of studies have concluded that EVs are unsuitable for long,

high speed journeys (as summarised by Fitt, 2022), and moreover, some tourists seem unwilling to pay additional premiums to use electric transport options (Raffaelli, Franch, Menapace, & Cerroni, 2022).

The vehicle's limited range is a key issue, as the real range of cars in highway driving situations is often much shorter than the advertised range (Qian & Zhang, 2023). Most range estimates are based on stop and start urban driving (Fitt, 2022; Nogrady, 2023). The actual highway range can deteriorate rapidly, though, depending on speed, weather conditions, the need for air conditioners or heaters, driving habits, hauling a trailer or caravan (Fitt, 2022), and even something as prosaic as passenger and luggage loads (Electric Cars Guide, 2023). Moreover, electric car batteries do not like extreme heat (Najman, 2023; Sun et al., 2020), with some studies suggesting driving in temperatures over 37C (100F) can reduce battery range by up to 31% (Kalmowitz, 2023). This issue is especially relevant in places like Australia, the United States, and parts of Europe where excessively high summer temperatures are becoming the norm rather than the exception.

The European EV Database (2023) (<https://ev-database.org/>) calculates the real range estimates for 215 vehicles currently in the marketplace or about to be launched. The data set presents range estimates for various driving conditions, ranging from city mild weather driving, through to highway cold weather driving (below -10C where heating is required). Typically, real range decreases by about one-third between city and highway driving and up to one half when extreme weather conditions are calculated. Thus, according to the website, for example, the real range for a Tesla Model 3 decreases from 595 km (kms) for city mild weather driving to as low as 290 kms for highway cold weather driving, while the range low cost Dacia Spring Electric 45 declines from 255 kms in mild weather city driving to as little as 110 kms in cold weather highway conditions (EV database, 2023).

Concerns about range, coupled with disturbing stories reported in the media, such as a driver being forced to abandon his car because of the lack of recharging stations (Betz, 2023) or the Chief Executive Officer of Ford finding his pickup truck only charged an extra 20% after 40 min at a slow charging station (Naughton, 2023), have resulted in the common phenomenon of range anxiety (Chen, Liu, Miao, & Yang, 2020; Fitt, 2022; Goel, Sharma, Mathiyazhagan, & Vimal, 2021; Langbroek, Franklin, & Susilo, 2018; Pedrosa & Nobre, 2019; Qian & Zhang, 2023). Range anxiety relates to the need to be overly cautious in estimating the real range of an EV, out of fear of not being able to find charging stations, having a breakdown or other emergency. It is especially prevalent among new car owners (Chen et al., 2020) and among owners of older vehicles where batteries eventually become less efficient (Najman, 2023). To compensate, greater route planning is required (Chen et al., 2020; Fitt, 2022; Langbroek et al., 2018) as people tend to take shorter trips or make more frequent stops to ensure they have sufficient range buffers (Fitt, 2022; Pedrosa & Nobre, 2019). Range anxiety may force some drivers to reduce their speeds (Langbroek et al., 2018) leading to increased travel times, or alternately to turn off heating and air conditioning systems (Daramy-Williams, Anable, & Grant-Muller, 2019), potentially making the trip less pleasant.

Vehicle range is inextricably linked to price. Again, referring to the EV database ([https://ev-database.org](https://ev-database.org/)), cars costing 90,000 euros or more had about twice the highway cold weather driving range as vehicles costing 30,000 euros or less. Regardless, EVs are still more expensive than lower cost ICE options, meaning that they will remain unaffordable for many people (Gore, 2022; Roberts, 2022). Substitution theory, therefore, suggests the opportunity/cost of substituting a conventional vehicle for an EV may be high (Seekamp, Jurjonas, & Bitsura-Meszaros, 2019), as a result, people may choose to retain their conventional cars in the near to medium term to provide them with greater mobility flexibility, especially for longer trips (Pedrosa & Nobre, 2019).

Lack of infrastructure creates a more pragmatic challenge, especially in large countries where the public infrastructure network outside of urban centres is patchy and unreliable (Miller, 2014; Mutavdzija, Kovačić, & Buntak, 2022; Whichcar?, 2023). Consequently, the existing

charging infrastructure may be sparse, slow and inefficient (Tomasi, Zubaryeva, Pizzirani, Dal Col, & Balest, 2021; Westin, Jansson, & Nordlund, 2018) causing long delays in both queuing time and charging time. In some cases, the power grid in rural areas simply is not capable of handling the type of high voltage supply needed for fast chargers (Insan, Rakwichian, Rachapradit, & Thanarak, 2022). As Nogrady (2023) and Page, Fitt, and Moreham (2020) noted in Australia, with vast areas of little to no infrastructure and ageing grids, a great challenge is simply getting access to power. These technical issues may be resolved to some extent if governments invest heavily in power infrastructure (Hitch, 2023). However, the costs of upgrading the power grid may be prohibitive (Prideaux, 2020).

In spite of the above challenges, the increasing popularity of EVs presents a number of opportunities for the tourism sector, especially in the short break market and for stopover or intermediate destinations. The short break market may see increased visitation in response to range anxiety. In addition, tourists may also need to take more frequent stops on longer distance trips (Langbroek et al., 2018; Morrison, 2023), creating opportunities for stopover destinations and local accommodation providers to attract a greater share of visitors (Cortés-Murcia, Afsar, & Prodron, 2023; Nogrady, 2023; Zorn & Suni, 2019). Nogrady (2023), for example, reports that regional Australian communities that used to be bypassed are now attracting more visitors to their central business districts and shopping centres because of the availability of charging facilities. Such investments may be revenue positive and also demonstrate a strong commitment to corporate social responsibility (Qian & Zhang, 2023).

## 2. Method

The authors have been conducting an 'omnibus-style' survey of travel by residents of southeast Queensland in Australia for the past three years. The survey format consists of a set of foundation questions that do not change from year to year (travel experience, importance of travel, travel propensity and behaviour in the past 12 months, demographic profile, etc.) as well as a series of topical issues that vary each year. One of the topical issues addressed in the 2023 survey examined interest in using electric vehicles as a substitute for domestic drive tourism. The target population was those people who had taken a pleasure trip in the previous 12 months and whose main mode of transportation was car, camper van or other motorised vehicle. They were asked to answer two specific questions. The first question, and the one that represents the dependent variable for the study read "If you owned an electric vehicle would you still have driven to the same destination?" Respondents were then given one of four options, including: "would have used the electric vehicle and travelled for the same total trip duration"; "would have used the electric vehicle but would have needed to extend the trip duration by staying overnight along the way to take advantage of slow charging facilities"; "would have used a petrol or hybrid car"; "would have flown or taken other forms of transportation." A follow-up open-ended question asked them to explain their answer. In addition, a number of other questions were included that are germane to this study. As an example, one question asked about mode of transport used by those who travelled for pleasure in the past 12 months, while other questions determined the main destination of the trip, or if there was no main destination (in the case of touring vacations), the furthest destination visited.

The survey was conducted in August 2023, with data collection contracted out to a survey firm used by the authors in previous studies. The use of this survey firm ensures that a representative sample of residents of Southeast Queensland is gathered. The sample was compared to the Australian Bureau of Statistics data base for Greater Brisbane and found to be comparable (ABS, 2021b). A total of 751 people participated in the study, of which 534 (or 71.1%) took an overnight pleasure trip. Of these some 321 travelled by motor vehicle to a domestic destination on their most recent trip. They represent the sample for the study. Data

were entered onto an SPSS spreadsheet for analysis of quantitatively based open- and closed-ended questions. Responses to open-ended questions were subjected to content analysis (Camprubí & Coromina, 2016) a non-obtrusive research methodology used to study a wide range of textual data (Stepchenkova, Kirilenko, & Morrison, 2009) that is capable of capturing rich material that can add depth of understanding to quantitative data. This analytic process consisted of four steps, consistent with the basic tenets of inductive content analysis (Hsieh & Shannon, 2005; Stepchenkova, 2012).

### 2.1. Findings

More than two thirds (68.3%) of the 470 most recent domestic trips reported by respondents were by car, caravan, four wheel drive, or other motorised vehicle, with just over 30% by commercial means, including air (28.6%) and train (2.9%). A further 1% took a cruise, while another 1% identified 'other' modes of transport.

The use of the distance decay method (McKercher, 2018) is the most appropriate technique to display the spatial distribution of domestic drive tourists. Distance decay studies in tourism reveal that demand declines exponentially as distance increases, whether one examines international (McKercher & Mak, 2019) or domestic (McKercher, 2023) tourism. It is predicated on the assumption that if tourists can have their needs met by travelling a relatively short distance, then they need not travel further. Distance decay is modified by the total trip duration, purpose of the trip and composition of the travel party. Fig. 1 compares the share of visitors and mean trip duration by distance travelled. The plot of the volume of visitors follows a classic distance decay curve. Just under 60% of all drive tourism (57.3%) occurred within a 200 km radius of the respondents' home, while another 14% involved trips of between 200 km and 399 km. The share of drive tourists fell rapidly after this distance threshold was passed, with minor secondary peaks noted that correspond with travel to Sydney (New South Wales) and Melbourne (Victoria). A relationship was also noted between distance travelled and total trip duration ( $r = 0.390$ ,  $p < .001$ ). Trips under 400 km were typified by short break holidays, lasting about 3 nights, while the average length of stay increased with distance, peaking at an average of 38 nights for trips in excess of 2400 kms from the person's home. (See Table 1.)

Drive tourists were asked if they had an EV would they use it on the trip reported in the survey. They were given four response options. As shown in Table 1, in total, just over half the sample would have chosen to use an EV if they had one, including 46.3% who would have travelled for the same trip duration and another 7% who felt they needed to extend their trip duration. By contrast, just under half would have used an ICE vehicle (39.8%) or flown (6.8%). They were then asked to explain their answers.

### 2.2. Would substitute an EV if they had one

Proximity to the destination seemed to be the main reason why most people would be happy to use an EV instead of a traditionally powered vehicle. Southeast Queensland is the home of two of Australia's most popular destination regions, the Gold Coast and the Sunshine Coast (Tourism Sentiment Index, 2022). These places are also popular short break destinations for residents of greater Brisbane (Pike, 2007; Wang, Kotsi, Mathmann, Yao, & Pike, 2022). It is not surprising, then, that many people commented that this type of trip was short, being less than a two hour drive away, placing these destinations well within the range of most EVs. "It's less than a two hour drive from home so I think an electric car would have made it", "the return journey is within the range of most new EVs" and "the trip duration was within the capabilities of most EVs" were typical comments. The short distance on well-travelled roads also meant that recharging stations were readily available, obviating most range anxiety concerns, with one person commenting there were "enough charging stations on the highway" to complete the trip.

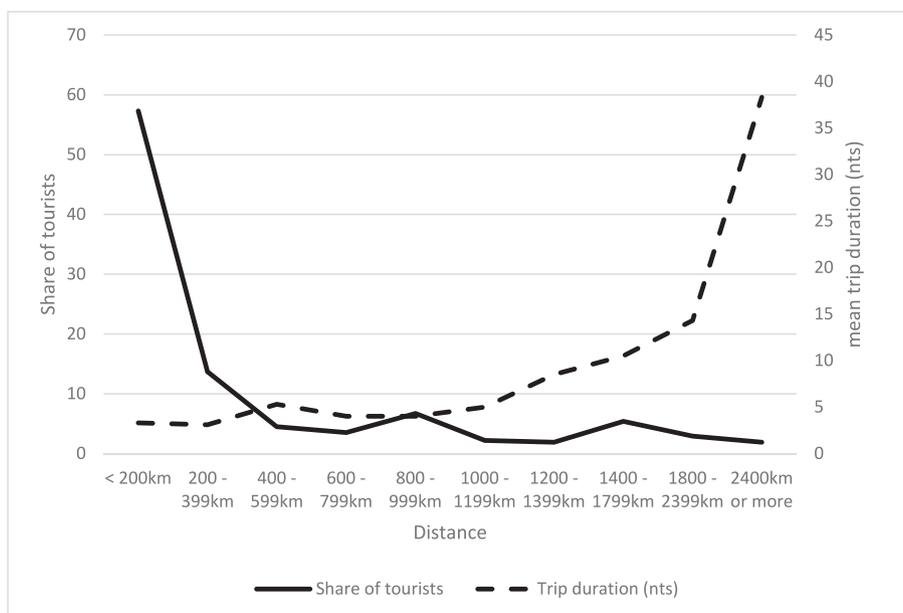


Fig. 1. Share of Visitors and Mean Trip Duration by distance.

Table 1

Would you use an EV on the same trip.

Transport option	Substitute an EV for the same trip	Substitute an EV but would need to extend trip duration	Continue to use petrol or hybrid car	Fly or take other means of transportation
Share of respondents	46.3%	6.8%	39.8%	6.8%
Median distance travelled	< 200 km	200–399 km	200–399 km	1400 km or more
Mean trip duration (nights)	3.6	3.8	6.1	7.8
Type of destination (%)				
Southeast Queensland Capital city (Sydney, Melbourne, Canberra, etc.)	66.7	31.6	44.1	10.0
Regional / rural	2.0	5.2	8.7	35.0
	31.3	63.2	47.2	55.0

A second set of comments related to the willingness to use an EV if they had one. Here, those who did not currently own an EV would have had no problems using such a vehicle if they had one. These comments were typical: “if I owned an electric car, I would use it as much as my presently owned petrol car”, “the type of car doesn’t impact getting to the destination”, and the “destination was set – mode of transport would not have changed the trip”. This last comment echoed the preference of some people to drive, rather than to use commercial transport. They noted that “using a car was easy and convenient” and that when you drive “you can go anywhere you want”.

A small number of respondents commented how EVs were the preferred form of motor vehicle either because they were more environmentally friendly or they felt they were cheaper to drive. Nine individuals identified the environmental theme, given the publicity EVs have had about reducing carbon emissions. Those who did so made such

comments as EVs are “better for the planet” or we “use the electric vehicle so to reduce the emissions for helping save the planet (sic)”. Cost was another option noting it is “far cheaper and easier to travel by electric vehicle” and that “electric cars save on fuel costs”.

2.3. Would substitute an EV if they had one, but would need extend the trip duration

Just under 7% of respondents would have chosen to extend the duration of the trip if they had an EV. The most common reason cited related to the common concerns of range anxiety and distance travelled. Typical comments included “not sure how far you can go on an electric car”, “worried about the distance”, “reduce my battery anxiety” and “it’s a 16 hour journey and we would need to recharge”. Another one added “I would have to make a few stops in rural towns to recharge the car.” As one person said, “outside of Grafton is where I went and the charging facilities would be far and few between”. Another driver commented that recharging “is longer because it is more complex than just quickly stopping for fuel”.

2.4. Would stay with their ICE

By contrast, a large minority of 40% of respondents would have continued to use a petrol car, for their most recent trip even if they owned an EV. The reasons cited related concerns about the reliability of EVs on long trips, the availability of recharging stations and the time involved to recharge, and the range and suitability of current models to tow caravans or go off road. Resistance to substitute EVs for pleasure travel is still evident among a large portion of the population. Some people simply are “not interested in electric cars”, while others “prefer petrol cars” or “prefer the convenience of a petrol vehicle [as] I only have to stop quickly for fuel”. One person noted “because having previously owned an electric car, they are not reliable or practical enough for holidays,” with another stating bluntly “electric vehicles aren’t able to cope with the Australian environment!”

While EVs may be suitable for short trips or those taken along major highways, concerns were raised about the availability of charging facilities in regional and rural areas. Typical comments reflecting this theme included “because there are no charging points in most of remote Australia [making] straight electric vehicles useless outside of large cities”, “this trip was through the outback with little options for charging

an electric car” and “it would have been inconvenient to use an electric vehicle with having to locate, use recharging facilities and even locating them. Also, because the terrain on that trip I would have concerns about the distance an electric vehicle could take me. Because of the distances between towns in this area and how small the towns are I am not sure they have recharge facilities”.

Inconvenient charging time, compared to petrol vehicles is also tied into this theme. The feeling among some respondents was that because “the journey was too far for an electric car to travel without sufficient down time to charge the vehicle” and that they “would not want to waste time to recharge a car on a short trip.” One person commented using an EV “would of (sic) taken longer to get there than normal because would of (sic) had to stop a couple of time to charge the battery along the way”. Australia is a vast country with many nature based destinations available in regional and remote areas. As a result, caravanning and four wheel driving are popular pastimes. A clear consensus emerged that EVs were simply not suitable for this type of vacation. On the one hand it was felt that “electric vehicles are not up to towing a caravan” and instead a heavier duty vehicle is required. On the other hand, four wheel drives worked best in remote areas because “electric vehicles are not so good off road and three hours from town”.

Combined, concerns about the reliability of EVs and questions about recharging resulted in overt expressions of range anxiety, with people afraid that their battery would run out between recharging stations. One person summed their concerns up best when they stated “electric cars don’t have the range/time flexibility. A petrol based car is the only efficient way to travel long distances in Australia”.

2.5. Would switch to flying rather than use an EV

Another 7% would have opted to fly. Concerns related to both the vehicles themselves and the availability of charging infrastructure, especially in remote areas. Two people commented “I do not trust electric cars” and “there are too many problems with electric cars at the moment,” while a third person noted “there are no charging stations in the Kimberleys (in far northwest Australia)”. Distance, was a common theme in other responses, noting it is “too far to drive for an electric [vehicle]” and “it is too long a drive to [the State of] Victoria [although it would be suitable] to drive around the city”. Some noted simply the ease and speed of flying, saying it is “more convenient”.

2.6. Preferred mode of transport as distance increases

As shown in Fig. 2, the preference for using different modes of transport changes significantly with distance travelled ( $F = 26.077, p < .001$ ). More than half of those people travelling 400 kms or less (57.4%) would have been happy to use an EV. However, this figure decreases to less than one-third of people travelling between 400 and 799 kms and falls even further to <20% for longer trips. Almost no one who drove 1800 kms or further on their last holiday would opt for an EV. Instead, they would continue to use their petrol cars or substitute flying for driving.

3. Discussion

3.1. Will EVs help in the transition to net zero domestic tourism?

Drive tourism will continue to dominate domestic tourism into the foreseeable future. This study indicated that about two-thirds of domestic tourists who live in Southeast Queensland travelled by car, camper van or four wheel drive, which is broadly consistent with studies reported elsewhere (Fjelstul & Fyall, 2015; Prideaux, 2011; Sivijs, 2003). However, barely half of respondents would use an EV if they had one, while a near majority would have continued to use an ICE or substitute flying for driving. The reasons cited are manifest and have a much to do with range anxiety, the negative opportunity/cost of time involved in charging cars compared to filling up with petrol and the unavailability or lack of suitable charging infrastructure in regional areas.

The transition to EVs is inevitable as a number of jurisdictions have passed legislation mandating the phasing out of traditionally powered cars by the early to mid-2030s (Scott & Gössling, 2022; Xia, Li, Xia, Wu, & Cheng, 2022). At present, the carbon efficiency of EVs is only as good as the power sources used to charge them, for many jurisdictions still rely on carbon intensive coal fired power stations (Faria, Moura, Delgado, & De Almeida, 2012; Li, Ha, & Li, 2019; Wolfram & Lutsey, 2016; Xia et al., 2022). Nonetheless, even with today’s technology, the cradle-to-grave carbon footprint of EVs is considerably lower than ICEs (Farzaneh & Jung, 2023). And, as the world moves to more renewable energy sources, their net carbon efficiency will increase accordingly.

The tourism industry faces many challenges if it is to move toward its commitments made in the Glasgow Declaration to halve emissions by 2030 and reach net zero by 2050 (UNWTO, 2021). But as both Becken (2019) and Gössling, Balas, Mayer, and Sun (2023) caution, decarbonisation remains a challenge, with Scott and Gössling (2022) adding

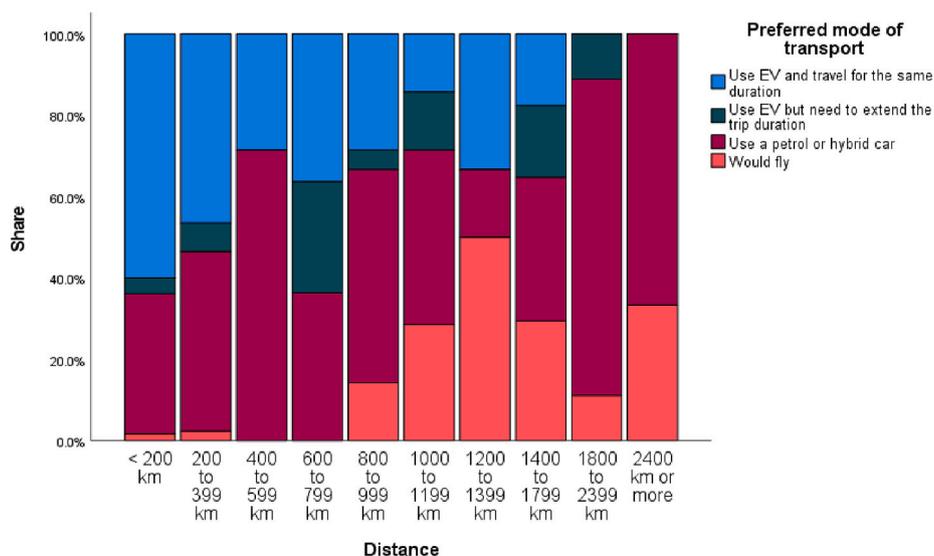


Fig. 2. Preferred Mode of Transport with Distance.

achieving net zero will require tourism to reinvent itself. The increased use of EVs is seen as one ray of hope (Peeters & Papp, 2023; Scott & Gössling, 2022). In principle, therefore, a substantial opportunity exists to achieve close to net zero in drive tourism as full penetration of EVs is achieved (Evans, 2022).

However, this study suggests the goal is more aspirational than realistic, at least in the short to mid-term. Certainly, cutting drive tourism's emission in half by 2030 is a fanciful idea that is not supported by this study if for no other reason than EVs constitute <1% of the vehicles on the road in places like Australia, Canada and the United States. Admittedly, their popularity is growing as sales increase geometrically (EVC, 2023; Hindeleh, 2023). However, in 2023 traditionally powered vehicles still constituted over 90% of new vehicle sales in Australia and will continue to dominate sales for the foreseeable future.

More than that, this study identified significant resistance to switching to EVs for all but the shortest of drive tourism activities. The study suggests the transition will be even slower and more gradual than sales figures suggest, given that Australian households own an average of 1.8 vehicles (ABS, 2022) and that the average age of the passenger vehicle fleet is 10.4 years (ABS, 2021a). Similar figures are found in the United States (average fleet age 11.8 years, 1.88 vehicles per household) and Canada (average fleet age 9.7 years, 1.57 cars per household) (Janssen, 2020; Stasha, 2023; Statscan, 2023). The study revealed that almost half of the respondents will either continue to drive their ICE vehicle or shift from driving to flying. As a result, the substitution rate for EVs in tourism is likely to lag significantly behind their overall adoption rate.

Worryingly, a sizable minority of respondents indicated they would substitute carbon intense flying for medium to long distance trips they are currently taking by car. Thus, an increase in tourism's carbon footprint attributed to medium to long distance domestic tourism may be one of the ironies of the transition to EVs. We say ironic, because reducing one's carbon footprint is an important motive for buying an EV, yet substituting high carbon emission air travel may have the opposite effect. In other words, if more people choose to use EVs to limit carbon emissions, this may open further demand for air travel.

### 3.2. The potential impact of EVs on domestic tourism

The findings of the study suggest EVs will only induce minor changes to drive tourism behaviour in one of four ways. To begin, there may be an increase in short distance, short break holidays. Nearby destinations obviate range anxiety and also permit the use of slow, overnight charging options at accommodation houses using the existing electrical network. As a result, the decaying impact of distance decay on domestic tourism demand may be even more acute than at present.

Second and conversely, the study suggests that, in the short term at least, EVs may not replace the traditional petrol or hybrid car for tourism. Instead, they will be used as a second vehicle for day-to-day commuting. McKercher and Tkaczynski (2023) found that how tourists value transit time coupled with the trip purpose influenced whether or not they were willing to make stopovers. Those who were end-destination focussed as well as those travelling for personal reasons wanted to get to the destination as quickly as possible, and therefore, sought to minimise transit time. Petrol cars provide the best option, obviating the need for multiple, time consuming recharging stops. Considering the perception exists that time it takes to recharge a vehicle represents wasted time, EVs may be considered a deterrent for much domestic travel.

The third impact may be felt in the medium distance trips. Opportunities may exist for intermediate or stopover destinations to increase day or overnight visitation. Tourists with vehicles needing to be recharged may opt to increase their total trip duration to enable them to make needed overnight stops to take advantage of slow trickle and, therefore, lower cost charging options. As a minimum, the opportunity to offer appealing stopover day visits, while vehicles are charging may

exist. As a consequence, accommodations may treat EV stations as the new swimming pools (Jennings, 2022) to attract this specific domestic tourism cohorts. This news report goes on to quote one large private hotelier who stated "when people look at the amenities a place offers, like a swimming pool and Wi-Fi and things like that, they're also now looking at whether or not there's an EV charger available – it's definitely one of the many features people look for (Jennings, 2022)."

The fourth impact, is an ironic one, for the emerging popularity of EVs may actually provide increased opportunities for airlines to capture a greater share of domestic pleasure tourism market. This issue is especially relevant as the growth of low cost airlines makes long distance air travel economically attractive, even though, as Gössling and Higham (2021) note, it is far more carbon intensive.

## 4. Conclusions

This study examined the potential impact of EVs on domestic drive tourism in Australia. Even though EVs currently make up <1% of the country's passenger vehicle fleet, their popularity is growing. Two research questions were posed.

The first question asked if the growth of EVs will facilitate a more rapid transition to net zero domestic tourism? Here the answer is a nuanced and subtle equivocal yes, but with possible unexpected adverse consequences. While EVs are growing in popularity, they still represent a small share of new passenger vehicle sales and an inconsequential share of all passenger vehicles currently on the road. As such, it is going to take a significant amount of time for them to make any impact on the total vehicle population, especially in countries like Australia, the United States and Canada, where demand for ICEs remains strong and where the average age of the car fleet is old. Moreover, a large minority of people would prefer to continue to use their existing ICE vehicle, even if they owned an EV, suggesting the take up rate for drive tourism will lag behind the purchase rate of such vehicles. The net result will be a substantial delay in the reduction of drive tourism's carbon footprint. A further unintended consequence is the finding that a small but important share of current drive tourists would substitute the heavily carbon intensive option of flying for longer trips. Combined, it means the optimism that EVs will result in a reduction of drive tourism's carbon footprint by 50% by the year 2030 and will produce net zero tourism by 2050 may be a fiction, regardless of how much the electricity grid converts to renewables.

The second research question asked whether EV transform the drive tourism sector? The answer is probably not in a meaningful manner. We may see some increase in short break tourism and perhaps some, but limited, opportunities for proximate mid-point destinations to capitalise on the need for overnight stops to recharge batteries. But, these benefits may come at the cost to longer distance stopover points that could now be bypassed as previous drive tourists opt to fly.

The transition to EVs may be inevitable as governments move to ban traditionally powered cars as they seek to decarbonise. And, their indirect carbon footprint will continue to fall as the power grid shifts from coal and gas powered stations to more renewables. However, the impact on drive tourism will not be felt for a long time. It is going to take decades to phase out ICE vehicles even after their sales are restricted. Moreover, many tourists will continue to show a preference for these types of vehicles, given the range of issues identified in this study. Will EVs decarbonise drive tourism? Yes, but not in the short to medium term.

### CRediT authorship contribution statement

**Bob McKercher:** Writing – review & editing, Writing – original draft, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Aaron Tkaczynski:** Writing – review & editing, Writing – original draft, Investigation, Formal analysis.

## Declaration of competing interest

None.

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