Decarbonisation pathways for UK transport

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Have we run out of road?

THE TRANSPORT SECTOR LOOKS SET TO JEOPARDISE UK'S NET ZERO AMBITIONS

While other sectors of the UK economy have made some progress in reducing their greenhouse gas emissions[1] since 1990, the transport sector, taken to include both air and surface modes as well as domestic and international movements from the UK, has yet to do so (figure 1). In 2019, emissions were 11 per cent above 1990 levels compared to the 53 per cent reduction achieved by the rest of the economic sectors.[2] Emissions from transport finally fell below the baseline level in 2020, due to the impacts on travel activity posed by the Covid-19 pandemic, only to bounce back again since. The latest figures (2023) show transport, including international movements, standing at 151 $MtCO_2e$, essentially still at the 1990 baseline.

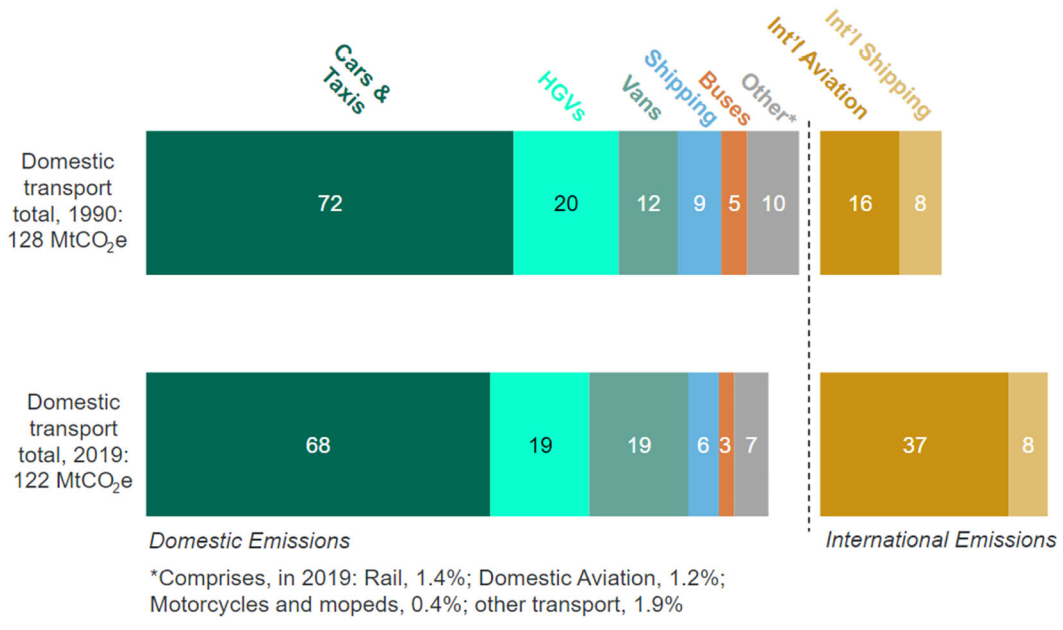
Without some specific policy instruments used over recent decades, the situation would have been even worse. The mandatory CO_2 vehicle emissions performance standards for cars and vans since 2009[4] and the Renewable Transport Fuels Obligation since 2008[5] brought continuous attention to the carbon intensity of the light duty vehicle fleet in use. However, the benefits achieved by these efforts have been more than negated by the cumulative impact of a combination of trends, many of which still prevail today. These include discrepancies between vehicle test-cycle and real-world performance, the growth in the size and weight of new cars, the slow uptake of pure battery electric vehicles, the increase in light goods vehicles (or 'van') traffic, minimal progress in efficiency improvements in heavy goods vehicles, and the immense rise in air passenger demand.

"if transport decarbonisation fails, net zero will also fail"

Thus, any discussion of UK transport decarbonisation pathways must begin with the hard truth that the sector's entire emissions reduction challenge will have to be achieved in less than half the allotted 60-year period set down by the UK Climate Change Act to achieve 'net zero' (1990-2050). In this next phase, the easier wins already secured in the rest of the economy will no longer be available to compensate for transport's failure. Any limited carbon sequestration options that may come online to allow the UK to still emit greenhouse gas emissions in 2050 (as defines the 'net' aspect of the target) are reserved for aviation in this sector; therefore, all surface transport modes must achieve 'absolute zero' emissions.[6]

1 Expressed from this point either as 'emissions', CO_2 or CO_2 equivalents (CO_2e), unless otherwise specified.
2 Department for energy Security and Net Zero [DESNZ] (2024) *Provisional UK greenhouse gas emissions national statistics*, 2023, published 28 March 2024. https://www.gov.uk/government/statistics/provisional-uk-greenhouse-gas-emissions-national-statistics-2023. Domestic transport emissions had fallen 3 per cent compared to the 1990 baseline by 2019, but if international aviation and shipping are added, the sector was 11 per cent above.
4 See: (EC) No 443/2009, (EU) No 510/2011, (EU) 2019/631
5 The RTFO was introduced in 2008 as a result of the EU Renewable Energy Directive I and the Energy Act 2004
6 CCC (2020) *Sixth Carbon Budget*, Climate Change Committee. https://www.theccc.org.uk/publication/sixth-carbon-budget/

Figure 1: UK domestic transport emissions breakdown by mode in 1990 and 2019[31]



Consequently, accounting for 36 per cent of UK emissions in 2023, if transport decarbonisation fails, net zero will also fail. Moreover, 2030 is the year designated by the UK for its legally-binding nationally determined contribution (NDC) towards meeting the UN goal under the Paris Agreement. This requires at least a 68 per cent fall in territorial emissions[7] which translates into a quadrupling of the rate of emissions reductions outside of the power sector.[8] A radically different decarbonisation pathway for transport is now an imperative to start to make deep cuts over the next half a decade. But what might this consist of and is it achievable?

THE INADEQUACY OF THE OFFICIAL PATHWAY

First, we must understand why the official pathway set out by the UK government needs urgent reorientation. UK pathways are set by the Climate Change Committee (CCC) and are responded to in government strategy documents. The response so far to transport's consistent failure to meet its targets has not, however, been to change the approach to achieving them, but to downscale the ambition for the sector.

In July 2021, the Department for Transport (DfT), published its first Transport Decarbonisation Plan (TDP).[9] This presented a set of upper and lower pathways for domestic transport, the most ambitious of which went further than the CCC's 'Balanced Pathway'. Just a few months later, these

7 The UK's NDC does not include international aviation and shipping emissions. The UK reports these emissions separately in its GHG inventory.

8 Mitchell K, Marsden G and Buscher M (2023) *Bridging the Gap: Addressing Challenges in Achieving Net-Zero Mobility*, Stantec. https://www.stantec.com/uk/ideas/content/technical/2023/bridging-the-gap-understanding-uks-transport-decarbonisation-challenges

9 Department for Transport [DfT] (2021) *Decarbonising transport: a better, greener Britain*. https://assets.publishing.service.gov.uk/media/610d63ffe90e0706d92fa282/decarbonising-transport-a-better-greener-britain.pdf

ambitions were downscaled in the Net Zero Strategy (NZS)[10] and reduced even further just 18 months later in the Carbon Budget Delivery Plan (CBDP),[11] by which time 72 per cent of the potential ambition set out in the TDP had disappeared.[12] In May 2024, the CBDP was subject to a legal challenge. This is perhaps no surprise given it was itself the product of a legal challenge to the NZS, which was deemed unlawful on the grounds of not having a robust set of delivery plans and proposals. Another revised plan must now be produced by May 2025 which quantifies and reduces this delivery risk.

"One assessment concluded that transport accounts for 70 per cent of all UK emissions not yet covered by any policy at all"

Transport has been identified as the sector with the largest gap between polices that are firmly in place and the decarbonisation required to meet the CCC's fifth carbon budget (to 2032). One assessment concluded that transport accounts for 70 per cent of all UK emissions not yet covered by any policy at all.[13] This equates to 97 $MtCO_2e$ of cumulative carbon savings between 2024 and 2032, to be achieved through measures not yet in consultation or even suggested as an ambition, whilst also assuming that all of the confirmed policies reach their full potential. In separate analysis, Marsden compared the CBDP and the CCC sixth carbon budget (to 2037) and found a 182MtC cumulative overshoot for the domestic sector alone, even if the ambitious zero-emissions vehicle mandate (ZEV – see below) and some other confirmed small behaviour change initiatives are fully realised.[14] Marsden stresses that this is equivalent to 10 years' worth of road-travel carbon reductions resulting from the activity suppressed during the Covid-19 lockdowns.

Both analyses add to a substantial body of work that has consistently found confirmed policies to be grossly inadequate compared to a carbon budget apportioned to local, regional, sub-national and national UK contexts. It is striking that, despite adopting different methodologies, carbon budget periods, geographical and temporal scales and system boundaries, these studies still arrive at essentially the same unequivocally consistent conclusions: car use will have to be massively reduced even with ambitious electrification. Hopkinson et al's comparison of a set of distinct modelling analyses prior to 2020 found an average total car mileage reduction of at least 20 per cent below ~2019 levels would be necessary by 2030.[15] Given that around half the time has already elapsed since the baseline year used by these studies, but car mileage remains only slightly lower and EV uptake slower than expected,[16] we can assume that this would now translate into at least a 50 per cent drop.

10 Department for Energy Security and Net Zero [DESNZ] and the Department for Business, Energy & Industrial Strategy [BEIS] (2022) *Net Zero Strategy: Build Back Greener*. https://www.gov.uk/government/publications/net-zero-strategy

11 Department for Energy Security and Net Zero [DESNZ] (2023) *Carbon Budget Delivery Plan, HC1269*. https://www.gov.uk/government/publications/carbon-budget-delivery-plan

12 Marsden G (2023) *Reverse gear: The reality and implications of national transport emission reduction policies*, Centre for Research into Energy Demand Solutions. https://www.creds.ac.uk/publications/reverse-gear-the-reality-and-implications-of-national-transport-emission-reduction-policies/

13 O'Connell S (2024) *Net Zero Policy Tracker: March 2024 update*, Green Alliance https://green-alliance.org.uk/publication/net-zero-policy-tracker-march-2024-update/

14 Marsden G (2023) *Reverse gear: The reality and implications of national transport emission reduction policies*, Centre for Research into Energy Demand Solutions. https://www.creds.ac.uk/publications/reverse-gear-the-reality-and-implications-of-national-transport-emission-reduction-policies/

15 Hopkinson L, Anable J, Cairns S, Goodman A, Goodwin P, Hiblin B, Kirkbride A, Newson C and Sloman L (2021) *The last chance saloon: we need to cut car mileage by at least 20%*, Radical Transport Policy Two-Pagers #10, Transport for Quality of Life https://transportforqualityoflife.com/wp-content/uploads/2023/11/211214-the-last-chance-saloon-to-cut-car-mileage.pdf

16 The UK government's zero emission vehicle (ZEV) mandate requires that 22 per cent of each carmaker's sales be pure battery cars in 2024. In August 2024, the Society of Motor Manufacturers and Traders downgraded its forecast to 18.5 per cent. See: https://www.smmt.co.uk/2024/08/two-straight-years-of-growth-for-new-car-market/.

Given this imperative to achieve such dramatic reductions in car CO_2 emissions in the near term, the remainder of this paper considers what a transport decarbonisation pathway would look like if this level of demand reduction was included in the revised UK strategy to be adopted by May 2025.

INCREASING THE SALE OF ELECTRIC VEHICLES IS NOT THE SAME AS REDUCING TOTAL CO_2 FROM THE CAR FLEET

The aggressive favouring of electrification of passenger cars as the central solution is already adopted in UK policy, as in most developed economies. The ZEV, requiring vehicle manufacturers to sell an increasing proportion of electric vehicles (EVs) each year, ratcheting up to 100 per cent by 2035, accounts for 80 per cent (113 MtCO2e) of the domestic transport sector's confirmed policy to 2032.[17] In the first year of application, manufacturers are already requesting more support to help reach their targets. Consequently, the size of the aforementioned policy gap is a likely underestimate as it assumes savings from confirmed policies would be delivered in full on a cumulative basis. Planning for underachievement until such times as the sales of EVs are firmly on the required trajectory would be an application of the precautionary principle that has been absent from the governance of transport decarbonisation, despite its track record of delivery failure.

"SUVs could represent 75 per cent of new registrations in 2027"

Given the ZEV already represents the fastest possible rate of EV uptake deemed commercially, practically and politically achievable,[18] any remaining technological improvements must be secured from the non-battery-electric-vehicle car fleet. Success depends on the rate of new car efficiency improvements between now and when they are banned from sale,[19] as well as the overall scrappage rate. Having reduced slightly year-on-year for over a decade, average tailpipe emissions from petrol, diesel and non-plug-in hybrid vehicles began increasing from around 2017, although petrol variants have recently stabilised.[20] In large part this is due to the increasing size and weight of cars. The SUV ('sports utility vehicle') is now the most popular passenger vehicle, making up 60 per cent of UK new car registrations in 2023. This is up from 'just' 50 per cent in 2021 and, if this trend continues, would mean SUVs could represent 75 per cent of new registrations in 2027.[21] More than four-fifths of these are petrol, diesel, hybrids or plug-in hybrids (PHEVs) which, on average, produce 20 per cent more emissions than an average medium-sized car.

This amounts to significant additional emissions over the next 15 or more years, as these cars remain a high proportion of the fleet, particularly as new cars are being seen to last longer in use.[22] EVs are included in the trend towards increased size and weight, and their larger energy demands may prevent the renewable electricity system from expanding at the pace assumed in many models.[23]

17 O'Connell S (2024) *Net Zero Policy Tracker: March 2024 update*, Green Alliance. https://green-alliance.org.uk/publication/net-zero-policy-tracker-march-2024-update/

18 Department for Transport [DfT] (2023) *Zero Emission Vehicle Mandate and CO_2 Regulations*, Joint Government Response Cost Benefit Analysis, October 2023. https://assets.publishing.service.gov.uk/media/6554be55544aea000dfb2d59/zev-mandate-consultation-final-cost-benefit-analysis.pdf

19 This ban was originally stated as 2030, altered to 2035 in September 2023, and reinstated to 2030 in October 2024. It is so far unclear what this will mean for the ZEV mandate annual targets which set an 80 per cent target for ZEVs (including BEVs and some PHEVs) in 2030.

20 RAC Foundation (2024) *Green Fleet Index*. https://www.racfoundation.org/data/green-fleet-index

21 Transport & Environment (2024) 'Press Release: UK SUV sales have increased by more than a fifth in one year', February 23, 2024 https://www.transportenvironment.org/te-united-kingdom/articles/uk-suv-sales-have-increased-by-more-than-a-fifth-in-one-year

22 RAC Foundation (2024) *Green Fleet Index*. https://www.racfoundation.org/data/green-fleet-index

23 Brand C (2024) Confronting mobesity is vital for the global electrification of transport. *Nature Energy*, *9*(8), pp.909-909. doi.org/10.1038/s41560-024-01559-x

There are also wider material impacts involved in this 'mobesity' epidemic, including land use, health, safety and monetary resources.[24]

So, one clear option on the 'supply side' is to begin restricting the sale of the most carbon-intensive cars immediately. Nowhere has yet to restrict these vehicles from entering a fleet through regulation. However, there are attempts to disincentivise their uptake, such France and Norway's weight-based motoring taxes, or Paris where parking fees for SUVs have recently tripled. The more that the size and weight of cars can be reduced, the less people will have to have their car use constrained through pricing or physical restrictions, although the latter would still be necessary according to modelled scenarios with both of these measures and more.[25] When this trade-off was put to members of the Climate Assembly UK (CAUK), 'quickly stop selling the most polluting cars' gained the most first preference votes – 86 per cent said they were generally in agreement with it, second only to increased investment in public transport.[26]

Unlike the CAUK recommendation to improve public transport, however, a restriction on new car sales has not entered policy discussions. In the first budget of the recently elected Labour government (October 2024), circulation taxes[27] were increased in the first year based on tailpipe emissions, especially for the largest luxury variants.[28] But most significantly, unlike the devolved regions of Scotland and Wales, there is as yet no explicit target to reduce car distance travelled in accordance with carbon budget constraints. Labour's first budget showed little indication that this is being considered, having prolonged a freeze in fuel duty escalations and maintained a five pence per litre reduction, even at a time when fuel costs are relatively low.

INCREASING THE SHARE OF NON-CAR MODES IS NOT THE SAME AS REDUCING CAR USE

All of this is not to say that there is no attention at all on modal shift. DfT's transport decarbonisation plan contained nearly 80 'commitments', including reiteration of targets for buses and active travel (to have 50 per cent of trips in towns and cities walked, wheeled, or cycled by 2030). These are already off track, but have nevertheless been adopted by the new administration. There are, however, two major flaws with the dominant approach to mode shift.

> **"on their own, improvements in public transport patronage, walking and cycling will only substitute for car trips at the very margins of what is required"**

The first is that, on their own, improvements in public transport patronage, walking and cycling will only substitute for car trips at the very margins of what is required. Places with high levels of cycling tend to have low levels of public transport (eg Copenhagen and Amsterdam) and vice versa (eg Vienna, Zurich, Madrid and London).[29] Very strong evidence shows that effective reductions in car travel happen only when improvements to alternatives are coupled with restrictions to car use

24 Ibid

25 Brand C, Marsden G, Anable J, Dixon J and Barrett J (2025) Achieving deep transport energy demand reductions in the United Kingdom, *Renewable and Sustainable Energy Reviews*, *207*, p.114941. doi.org/10.1016/j.rser.2024.114941

26 Climate Assembly UK (2020) *The Path to Net Zero*, Climate Assembly UK Full Report, September 2020. https://www.climateassembly.uk/report/read/final-report.pdf

27 Circulation taxes, also known as vehicle taxes or ownership taxes, are recurring charges levied by governments on vehicles used on public roads.

28 HM Revenue and Customs [HMRC] (2024) *First-year Vehicle Excise Duty rates for cars from 1 April 2025*, policy paper. https://www.gov.uk/government/publications/vehicle-excise-duty-first-year-rates-for-cars-from-1-april-2025/first-year-vehicle-excise-duty-rates-for-cars-from-1-april-2025

29 Metz D (2024) *Travel Behaviour Reconsidered in an Era of Decarbonisation*. London: UCL Press

with pricing, road closures and parking restrictions.[30] The few examples of places that have successfully reduced car use have implemented some form of charging measure, such as a congestion charge, low emissions zone or workplace parking levy.[31] Even where public transport has been made free at the point of use, or fares markedly lowered, car trip substitution has been found to be minimal, with most coming from trips that had been previously walked or cycled.[32]

The second major flaw is the focus on the share of car trips rather than car miles that could theoretically be shifted to alternative modes. In an extensive analysis breaking down the source of emissions from personal transport across different distance bands and modes of transport (including air), Wadud et al present the astounding statistic that only 2.7 per cent of UK personal travel journeys are for long distance travel (>50 miles one-way), but they account for 61.3 per cent of the miles and 69.3 per cent of the CO_2e emissions from passenger travel.[33] Yet, virtually all attention on demand management is on the large proportion of short car trips (eg 53 per cent < four miles). Such statistics are repeated often and with vigour to claim huge opportunity for carbon reductions through mode shift. Wadud et al's analysis, however, shows that even if all the 74 per cent of car trips under eight miles were switched to zero-emissions active modes, this would only reduce emissions from the total transport sector by 9.3 per cent. By contrast, if all the car trips over 50 miles were shifted to rail, representing less than 2 per cent of all trips undertaken, the sector's emissions would reduce by 5.2 per cent.

"The policy focus probably needs to be somewhere between these very short and the longest trips, targeting medium distance trips"

In addition to a lack of concurrent car restraint measures, the above statistics explain why so called 'good practice' largely falls down when examined from a decarbonisation perspective. For instance, 'Dutch levels of cycling' – where alternatives to the car for local journeys, particularly cycling, appear to be the default – are often cited as a key aspiration to contribute to climate objectives. 29 per cent of all trips in the Netherlands are by bicycle, compared to less than 2 per cent in the UK. Yet, average per capita annual car driver mileage in the Netherlands in 2019 was almost double that of England.[34] Consequently, despite the fact that UK residents fly more on average, per capita average carbon emissions from transport are almost equivalent in the two countries (figure 2). Put simply, this is due to a lack of restrictions or disincentives to own and use cars in the Netherlands, coupled with the distances travelled on longer journeys, especially for leisure and business.

On the face of it, it should be possible to target a small percentage of longer car trips much more rapidly than it would be to reach three quarters of them that are short. This would involve a reorientation of focus away from the relatively short distance commute trips, towards discretionary leisure activities and family visits. These are not only more challenging to provide public transport services for, given their fragmented temporal and spatial patterning, but are more politically sensitive. There is also very little evidence on what works in this domain. During the summer of 2022,

30 Kuss P and Nicholas K (2022) 'A dozen effective interventions to reduce car use in European cities: Lessons learned from a meta-analysis and transition management', *Case studies on transport policy*, *10*(3), pp1494-1513. https://doi.org/10.1016/j.cstp.2022.02.001; Xiao C, Van Sluijs E, Ogilvie D, Patterson R and Panter J (2022) 'Shifting towards healthier transport: carrots or sticks? Systematic review and meta-analysis of population-level interventions', *The lancet planetary health*, *6*(11), ppe858-e869. https://doi.org/10.1016/S2542-5196(22)00220-0

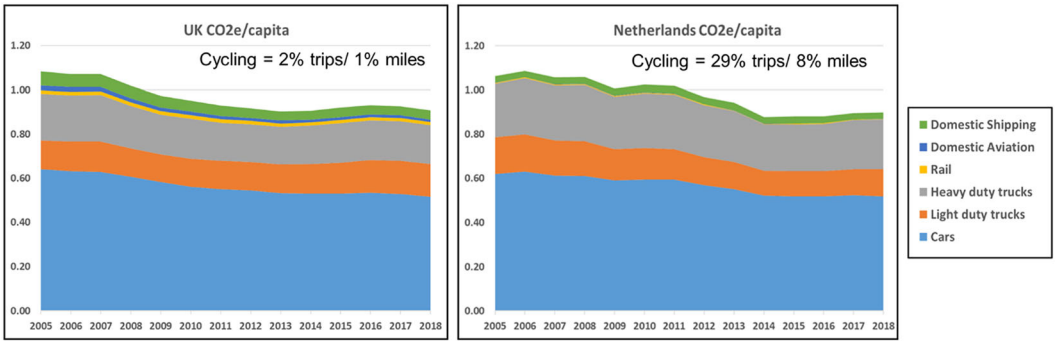
31 Metz D (2024) *Travel Behaviour Reconsidered in an Era of Decarbonisation*, UCL Press

32 UITP (2020) *Full Free Fare Public Transport: Objectives and alternatives*, International Association of Public Transport

33 Wadud Z, Adeel M and Anable J (2024) Understanding the large role of long-distance travel in carbon emissions from passenger travel, *Nature Energy*, pp1-10. https://doi.org/10.1038/s41560-024-01561-3

34 3,198 miles in 2019 in the UK according to UK National Travel Survey table NTS0303. 6,643 miles in 2019 in the Netherlands according to https://opendata.cbs.nl/#/CBS/en/dataset/84710ENG/table

Figure 2: Per capita CO_2 from personal transport in the Netherlands and the UK[351]



unlimited travel on regional rail, trams and buses was offered in Germany for nine euros a month. Almost half the population took up this opportunity and rail patronage was significantly increased, especially in rural areas and at weekends. However, Quinio[36] found that the trips were largely additional rather than substitutions for car use. It is unclear, though, what would have happened if the scheme had been sustained over a longer period, or if it had been coupled with an increase in the price of car use.

The policy focus probably needs to be somewhere between these very short and the longest trips, targeting medium distance trips (between 10 and 30km) that are too long for active travel but are still undertaken on a regular basis.[37] These would require investment in rapid transit systems including trams, express buses and rail. E-bikes could be a new and important mode. Philips et al. use spatial micro-simulation to estimate the maximum capability to reduce emissions by substituting private car travel for e-bike in England.[38] They estimate this capacity would translate into a reduction of 16 $MTCO_2$ over and above conventional walking and cycling, greatest in rural areas and the urban fringe. This would require a shift in investment towards long distance cycle networks and bike sharing schemes, away from urban centres where they tend to be focused today. However, once again the real-world evidence is revealing that, in the absence of strong car-restraint policies, e-bikes may tend to substitute for conventional bike use rather than the car for many journeys, particularly leisure.[39]

"Average car occupancy has fallen over the past decade"

The attempt to alter some of the longer distance trips to become medium or shorter distance trips through destination shifting is also part of the solution, including for leisure trips. As Mitchell et al emphasise: "Long-term development planning cannot solve the carbon problem given the imperative for action before the end of the decade. However, it does have to be ready with projects and

36 Cited in Metz 2024
37 Mitchell K, Marsden G and Buscher M (2023) *Bridging the Gap: Addressing Challenges in Achieving Net-Zero Mobility*, Stantec. https://www.stantec.com/uk/ideas/content/technical/2023/bridging-the-gap-understanding-uks-transport-decarbonisation-challenges
38 Philips I, Anable J and Chatterton T (2022) 'E-bikes and their capability to reduce car CO2 emissions', *Transport Policy*, *116*, pp11-23. https://doi.org/10.1016/j.tranpol.2021.11.019
39 de Haas M, Kroesen M, Chorus C, Hoogendoorn-Lanser S and Hoogendoorn S (2022) 'E-bike user groups and substitution effects: evidence from longitudinal travel data in the Netherlands', *Transportation*, *49*(3), pp815-840. https://doi.org/10.1007/s11116-021-10195-3

proposals which align with the actions which will have been taken to accelerate decarbonisation."[40] Another route to car use reduction, aside from mode switching, is to increase occupancy of cars. Average car occupancy has fallen over the past decade from an average of 1.6 to 1.5 people per vehicle.[41] At the same time, the number of cars per capita has increased, meaning that each car is being utilised less and less.[42] 34 per cent of cars do not go out on any given day and only 14 per cent of all cars in the fleet are on the move during the busiest evening weekday peak hour (pre-Covid-19).[43] Transport policy is delivering neither on its economic nor its environmental promise.

IS A RADICAL NEW PATHWAY EVER GOING TO BE RADICAL ENOUGH?

Despite the transport sector's consistent track record of failing to meet its decarbonisation targets, the approach to the problem remains the same as it has always been: to swap out the fossil fuels in the system with electricity or some form of alternative, including synthetic, liquid fuels. Yet, we are left with little doubt that for transport to pull its weight towards the 2030 nationally binding contribution, and beyond, we need a wholescale shift in what is deemed important to focus on.

On the supply side, the focus on EVs must be rebalanced with a renewed focus on the tailpipe emissions of the approximately eight million new ICE vehicles that will still be sold into the UK market by 2030 and will still be in circulation until well into the 2040s. This requires immediate restrictions on the size and weight of cars that can be sold into the UK car market. Without this, much deeper cuts in car use will be required. The weight of EVs as well as ICEs must also be considered as a target for policy, given the system-wide energy demand implications of the larger battery requirements.

> **"There must be a focus on where the carbon is actually generated and what holds car ownership and use in place"**

On the demand side, almost all attention to 'behaviour change' and mode shift in policy will result in marginal carbon savings at best. There is an urgent need for the dominant thinking about how to reduce car use needs to be turned on its head. Reductions in car use have and will only materialise if improvements to the alternatives are coupled with restrictions in the form of parking, pricing or road space reallocation. There is no alternative to this. The evidence is clear that even making a public transport system free will not make a dent in car use on its own. Secondly, the conventional focus on short, mainly urban trips, often narrowly focused on the commute and the journey to school, will only serve to maintain the status quo if longer distance car trips are not also meaningfully discouraged and catered for by alternative means, including encouraging shorter trips through destination shifting. There must be a focus on where the carbon is actually generated and what holds car ownership and use in place. Therefore, we cannot decarbonise transport without making changes in these predominantly leisure and family-oriented activities. The reality is, there are no good examples of where these longer-range car trips have been shifted to other modes or reconfigured to

40 Mitchell K, Marsden G and Buscher M (2023) *Bridging the Gap: Addressing Challenges in Achieving Net-Zero Mobility, Stantec*, p1. https://www.stantec.com/uk/ideas/content/technical/2023/bridging-the-gap-understanding-uks-transport-decarbonisation-challenges

41 Department for Transport [DfT] (2024) 'Vehicle mileage and occupancy', dataset, accessed 8 October 2024. https://www.gov.uk/government/statistical-data-sets/nts09-vehicle-mileage-and-occupancy

42 Marsden G, Anable J, Bray J, Seagriff E and Spurling N (2019) *Shared Mobility - where now, where next?*, Second Report of the Commission on Travel Demand, Centre for Research into Energy Demand Solutions. https://www.creds.ac.uk/publications/where-now-where-next/

43 Mattioli G, Anable J, and Goodwin P (2019*)* 'A week in the life of a car: a nuanced view of possible EV charging regimes', *European Council for an Energy Efficient Economy (ECEEE)* Summer Study 2019 Proceedings: 1105-1116.https://www.eceee.org/library/conference_proceedings/eceee_Summer_Studies/

become shorter journeys at scale. This is where the new frontier is for transport decarbonisation over the next decade.

Given the scale of this challenge, planning for failure and exploring the synergies between concurrent adaptation and mitigation options, to create both a flexible, resilient as well as lower carbon system, would seem to be the only true meaningful pathway around which to plan a new delivery strategy.

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