The HIF1 road proposal:

Is this plan compatible with Oxfordshire's climate goals?

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Ng Chien Xen for Oxford Friends of the Earth

Friends of the Earth Oxford

This document sets out issues and concerns relating to the proposal by Oxfordshire County Council to build a major new road scheme funded in part by the UK Housing Infrastructure Fund (HIF) scheme. It would be a 9 mile road from the A34 at Milton to the Oxford Road (B4015) near Nuneham Courtenay. The development includes a major new bridge over the Thames near Culham.

Executive summary

The transport sector in Oxfordshire will consume its remaining carbon budget under the UN Paris agreement in three and a half years unless there are steep and immediate cuts to emissions. However, at this critical time, the proposed HIF1 scheme is likely to increase rather than decrease emissions and car use.

While an analysis by Oxfordshire County Council's consultants concluded that there will be no significant climate impact, there are significant flaws in their analysis. When these are accounted for, we estimate the scheme will consume around 8% of Oxfordshire's remaining transport carbon budget. This will be greater than the potential carbon savings from hitting Oxfordshire's cycling targets. Compared to district-level targets, the scheme will consume 19% of South Oxfordshire and the Vale of White Horse's transport carbon budget.

We recommend that the county puts a freeze on the scheme in order to further assess its climate impact, and consider more sustainable ways to support growth in Oxfordshire.

Oxfordshire has committed to delivering a net-zero transport system. In its Local Transport and Connectivity Plan (LTCP), the Oxfordshire County Council's (OCC) targets are to replace or remove 1 out of every 4 current car trips by 2030 and 1 out of every 3 trips by 2040. These targets recognise that while electric vehicles will be an essential part of decarbonising transport, they do not reduce emissions fast enough to limit global warming to less than 1.5°C. To deliver this, the LTCP sets out a number of policies, one of which requires the carbon emissions from potential transport schemes to be quantified and compared against Oxfordshire's carbon budget.

Based on research by the Tyndall Centre at the University of Manchester, the fair share of the carbon budget for transport (i.e. one in which transport's share of emissions does not increase) is 6.2MtCO2. If annual transport emissions return to 2019 levels (which appears will be the case), this carbon budget will be used up in around three and a half years. Therefore, rapid and immediate cuts in emissions are required.

It is within this context that we need to assess whether HIF1 ('the Scheme'), a £296m project adding significant road capacity, of which £56m will come from local funding sources, is aligned with policy goals. HIF1 is a project that was proposed before the pandemic, Brexit and when climate ambitions were lower. Since then, there has been greater recognition that the right policies can help deliver transport decarbonisation, and local councils have a critical role to play in this.

AECOM, OCC's consultants, have estimated the Scheme's emissions to support its planning application. They estimate that while there will be some emissions from construction of the Scheme, there will be lower emissions from road users due to lower congestion. Moreover, they calculate that emissions only account for less than 0.04% of the UK's *national* transport carbon budget, and conclude that "no significant effects are expected to occur to the scheme in respect of climate change."

However, their analysis is based on a number of flawed assumptions.

- The Scheme's emissions are compared against national rather than local carbon budgets, as required by the LTCP. This inevitably leads to the conclusion that the Scheme's emissions are immaterial as national emissions are inherently several order of magnitudes larger than local projects. However, when compared to Oxfordshire's transport carbon budget, the Scheme's emissions are significant, as will be discussed in the paragraphs below.
- They have assumed, with agreement from OCC, that traffic and emissions growth will be the same whether or not the Scheme is built. This is not a credible assumption: adding new road capacity leads to extra traffic, known as 'induced demand'. This is a significant source of emissions; we estimate that it could be around 2.3x larger than the emissions from constructing the scheme. Therefore, AECOM has significantly underestimated the Scheme's emissions;

- They assume that people will travel the same amount regardless of the level of congestion. In fact, people travel less when there is high congestion, and more when there is lower congestion. This means they overestimate the level of congestion without the Scheme, and overestimate the improvement in congestion with the Scheme. Therefore, they overestimate the potential carbon savings from reduced congestion.

When we account for these issues,[1] we find the Scheme could emit around 514ktCO2 in the period up to 2050, which on its own consumes around 8% of Oxfordshire's remaining transport carbon budget. This figure takes into account expected improvements in vehicle efficiency and electric vehicles uptake in the 'Core scenario' of the Department for Transport's National Road Traffic Projections 2022, which includes firm and funded government policies. Even if we assume there is a rapid uptake of electric vehicles, the Scheme could still emit around 287ktCO2, or 5% of Oxfordshire's transport carbon budget.

These emissions are greater than the carbon savings from Oxfordshire's managing to reach cycling targets set in the LTCP (to increase cycling trips from 600,000 to 1 million by 2030).

In addition, district councils have set decarbonisation targets—South Oxfordshire District Council aims for carbon neutrality by 2030, and the Vale of White Horse aims for a 75% reduction in emissions by 2030. Going forward with the Scheme will make these targets significantly more difficult to hit: we estimate that around 19% of their transport carbon budget will be consumed by the Scheme alone.

In principle, the Scheme's emissions could be acceptable if it is possible to find equivalent carbon reductions elsewhere. However, these compensating trade-offs have not been identified, and could be difficult to identify, given the challenging speed of decarbonisation needed.

Therefore, we recommend that the OCC follows the example of the Welsh government, which has implemented a freeze on new road building, to review the planned road investments and assess whether these are aligned with its climate ambitions. This review should not only consider each proposed road project in isolation, but needs to assess their impact in collectively enabling car-dependent lifestyles.

The OCC should then assess how to support connectivity for new developments while decarbonising transport and reducing car use. The experience of other successful European

[1] We do so by employing a high-level methodology in which we assume the carbon intensity of the HIF1 scheme is similar to historically implemented road schemes. This gives us an estimate of the potential emissions from the scheme to compare against carbon budgets. For further details, see section 4.

cities suggests measures that both discourage car use and encourage sustainable transport modes will be needed to engender a shift away from car use.

Ng Chien Xen is an economist with significant experience working in the transport sector. He works as a consultant at Oxera, an economics and finance consultancy. He has provided analysis on a number of high-profile cases before courts, regulators and governments in the UK and the EU, and advised companies on developing carbon accounting frameworks. His experience includes contributing economic analysis to Lord Tony Berkeley's dissenting report on HS2, presenting before an All-Party Parliamentary Group on connectivity to remote UK communities, and presenting analysis of the impacts of the EU's climate package on the aviation sector at the European Transport Conference.

1. Introduction

1.1 The Housing Infrastructure Fund (HIF1) scheme (henceforth 'the Scheme') consists of four separate but interdependent highway schemes. Its aim is to support anticipated growth in the Science Vale area, which is spread across the South Oxfordshire and Vale of White Horse districts.

1.2 The Scheme is estimated to cost around £296m. Of this, around £56m comes from local sources, including a £30m loan by the OCC.[2] These figures exclude any recurring interest payments. The Scheme therefore represents a significant expense at a time of high inflation, where cuts to spending are needed.[3] These funds could be used instead for the necessary investment in sustainable transport needed to decarbonise transport in Oxfordshire.[4]

1.3 The purpose of this report is to assess whether the Scheme is compliant with Oxfordshire's policy goals to decarbonise its transport network.

1.4 The report is set out as follows.

- Section 2 sets out Oxfordshire's climate targets, and considers the remaining carbon budget for transport in Oxfordshire.
- Section 3 reviews AECOM's (OCC's consultants) analysis on the Scheme's emissions.
- Section 4 estimates the Scheme's emissions and compares it to Oxfordshire's remaining transport carbon budget.
- Section 5 provides recommendations and conclusions.

[2] The £56m comes from a £30m loan + £9.7m underwritten under S106 + £6.7m S106 held by the OCC + £10m from OxLEP. See Table 1, https://mycouncil.oxfordshire.gov.uk/documents/s60987/CA_JUN2122R17%20HIF1%20Grant%20Determination%20Agreement.pdf (accessed 4 January 2023).

[3] The OCC is currently consulting on its 2023/24 budget proposals, where it faces a funding shortfall of £44 million in 2023/24. A total of £27 million of this shortfall relates to inflationary costs. Oxfordshire County Council (2022), 'County council asks for views on its 2023/24 budget proposals', https://news.oxfordshire.gov.uk/budget-consult/#:~:text=Oxfordshire%20County%20Council%20estimates%20a,shortfall%20relates%20to%20inflationary%20costs. (accessed 4 January 2023).

[4] Research by the Environmental Change Institute at the University of Oxford estimates that significant levels of investment will be needed to stay on the path to net-zero. Environmental Change Institute (2021), 'Pathways to a zero carbon Oxfordshire', section 4.3, https://www.eci.ox.ac.uk/publications/downloads/PazCo-final.pdf (accessed 4 January 2023).

2. Meeting climate targets in Oxfordshire

Climate targets in Oxfordshire

2.1 In its Local Transport and Connectivity Plan (LTCP), OCC has set a target to deliver a net-zero transport network by 2040. The LTCP also targets a reduction in car use, aiming to replace or remove one out of every four current car trips in Oxfordshire by 2030, and one out of every three by 2040.[5] These targets recognise that adopting electric vehicles, while necessary, will not lead to fast enough reductions in emissions, and a reduction in vehicle miles travelled is also necessary.[6]

2.2 To achieve these targets, the LTCP has set out guidance on how carbon emissions from potential transport schemes should be assessed. Specifically, it states that the OCC will "consider [the Scheme's] contribution to Oxfordshire's carbon budget and delivery of a net zero transport network by 2040, taking into account embodied, operational and user net emissions."[7]

2.3 This means assessing the emissions from the materials used in constructing the Scheme (embodied emissions), the day-to-day running of the road, such as maintenance and street lighting (operational emissions), and changes in traffic as a result of the scheme (user emissions). These emissions should then be compared with Oxfordshire's carbon budget.

2.4 Decarbonisation targets have also been set at the district level. South Oxfordshire District Council aims to be a carbon neutral district by 2030[8] and the Vale of White Horse

[5] Oxfordshire County Council (2022), 'Local Transport and Connectivity Plan 2022 – 2050', July. https://www.oxfordshire.gov.uk/sites/default/files/file/roads-and-transport-connecting-oxfordshire/LocalTransportandConnectivityPlan.pdf (accessed 4 January 2023).
[6] The need to focus on reducing car mileage is well-established and has been noted by many different groups and experts. For example, see written evidence submitted by Anable. J., Lyons. G., Marsden. G. and Parkhurst. G. to Parliament, February 2021. https://committees.parliament.uk/writtenevidence/22828/pdf/ (accessed 4 January 2023); Friends of Earth and Transport for Quality of Life (2019), 'More than electric cars', 1 February, shorturl.at/klptz (accessed 4 January 2023).
[7] Oxfordshire County Council (2022), 'Local Transport and Connectivity Plan 2022 – 2050', July, p.88-90. https://www.oxfordshire.gov.uk/sites/default/files/file/roads-and-transport-connecting-oxfordshire/LocalTransportandConnectivityPlan.pdf (accessed 4 January 2023).
[8] South Oxfordshire District Council (2022), 'Climate Action Plan for South Oxfordshire District Council 2022-2024', p.3, https://www.southoxon.gov.uk/wp-content/uploads/sites/2/2022/02/South-Climate-Action-plan-2022-2024.pdf (accessed 4 January 2023).

Council aims for a 75% reduction in district emissions by 2030, and carbon neutrality by 2045.[9]

2.5 These are challenging targets: South Oxfordshire's ambitions exceeds that of the Paris agreement while the Vale of White Horse are in line with the Paris agreement.[10] Therefore, we assess whether it is possible to still meet these ambitions by comparing the Scheme's impact against district-level carbon budgets.

Oxfordshire's carbon budget

2.6 The OCC defines Oxfordshire's carbon budget as "the local share of the carbon emissions that can still be emitted while staying below 2 degrees of global heating, as stated in the Paris agreement."

2.7 Carbon budgets for each local authority are available from the Tyndall Carbon Budget tool, developed by the Tyndall Centre for Climate Change Research at the University of Manchester.[11] Further information on the tool is provided in the box below.

Box 2.1 Carbon budgets and the Tyndall Carbon Budget tool

Why set carbon budgets?

Setting a target year by which emissions will be zero (e.g. the OCC's target of net zero transport by 2040) is important. However, as carbon dioxide accumulates in the atmosphere over time, it is the total amount of emissions which matters.[12] Therefore, to stay within 2 degrees of global heating, local councils should set a carbon budget, which is the cumulative amount of CO2 permitted for councils to play their role in contributing to the Paris agreement.

What is the Tyndall Carbon Budget tool?

The tool, developed by the University of Manchester, calculates science-based carbon budgets based on the remaining carbon that can be emitted to be consistent with the

[9] Vale of White Horse District Council (2022), 'Climate Action Plan for Value of White Horse District Council 2022-2024', https://www.whitehorsedc.gov.uk/wp-content/uploads/sites/3/2022/02/Vale-Climate-Action-plan-2022-2024.pdf (accessed 4 January 2023).
[10] Based on the Tyndall Centre Carbon budget tool – see the next section.
[11] Tyndall Centre, 'Tyndall Carbon Budget Reports – quantifying the implications of the United Nations Paris Agreement for local areas', https://carbonbudget.manchester.ac.uk/ (accessed 4 January 2023).
[12] CREDS (2020), 'Decarbonising transport: getting carbon ambition right', https://www.creds.ac.uk/publications/decarbonising-transport-getting-carbon-ambition-right/#3 (accessed 4 January 2023).

Paris agreement.[13] At least 27 local authorities, including Manchester, Sheffield and Leeds, have used the tool to set climate goals.[14]

The tool's basis is a global carbon budget of 900 GtCO2, taken from the Intergovernmental Panel on Climate Change (IPCC) Special Report on 1.5ºC. The UK is allocated a proportion of this budget following UNFCC[15] principles of common but differentiated responsibility, where developing countries are allocated a greater share of the carbon budget to support their development.[16] The UK's carbon budget is then apportioned to different local authorities.

It is possible that we overshoot our climate targets, i.e. that we emit too much carbon, leading to temperatures rising to levels outside of the Paris agreement.[17] However, even in this case, cuts to emissions will still have highly beneficial impacts as each degree of additional warming will lead to increasingly severe consequences.[18]

2.8 Based on this, the remaining carbon budget for Oxfordshire is 17.2MtCO2.[19] For the transport sector to contribute its fair share, so that it does not take up an increasing share of all emissions in Oxfordshire, transport's carbon budget is 6.2MtCO2.[20]

[13] The tool excludes aviation and shipping, non-CO2 emissions and land use, land use change and forestry emissions.
[14] Tyndall Centre, 'Tyndall carbon targeter helps local authorities respond to their climate emergency', https://tyndall.ac.uk/news/tyndall-carbon-targeter-helps-local-authorities-respond-their-climate-emergency/#:~:text=Tyndall%20Manchester%20is%20using%20science,for%20all%20UK%20Local%20Authorities. (accessed 4 January 2023).
[15] United Nations Framework Convention on Climate Change.
[16] Specifically, it is assumed that emissions for developing countries to peak in 2025, and then follow a path towards zero emissions by around 2050. The UK receives a proportion of the remaining carbon budget, which is then further sub-divided to local authorities. This is done through 'grandfathering', which allocates carbon budgets in proportion to recent emissions.
[17] For example, The Economist (2022), 'The world is going to miss the totemic 1.5ºC climate target', https://www.economist.com/interactive/briefing/2022/11/05/the-world-is-going-to-miss-the-totemic-1-5c-climate-target (accessed 4 January 2023)
[18] This is set out in Mark Lynas' book, 'Six Degrees: our future on a hotter planet'.
[19] This is the carbon budget for the period 2023-2100. This figure can be calculated using creating going to https://carbonbudget.manchester.ac.uk/reports/combined/, which calculates carbon budgets for county councils. Once the local authorities in Oxfordshire are selected, the carbon budget for 2023-211 can be calculated from Table 1 of the generated report.
[20] The share of transport emissions in Oxfordshire is 36%. The transport carbon budget is calculated by multiplying the share of transport emissions by the overall carbon budget (17.2MtCO2 * 36% = 6.2MtCO2). The source for transport's share of Oxfordshire's emissions is Oxfordshire County Council (2022), 'Local Transport and Connectivity Plan 2022 – 2050', July, p.24. https://www.oxfordshire.gov.uk/sites/default/files/file/roads-and-transport-connecting-oxfordshire/LocalTransportandConnectivityPlan.pdf (accessed 4 January 2023).

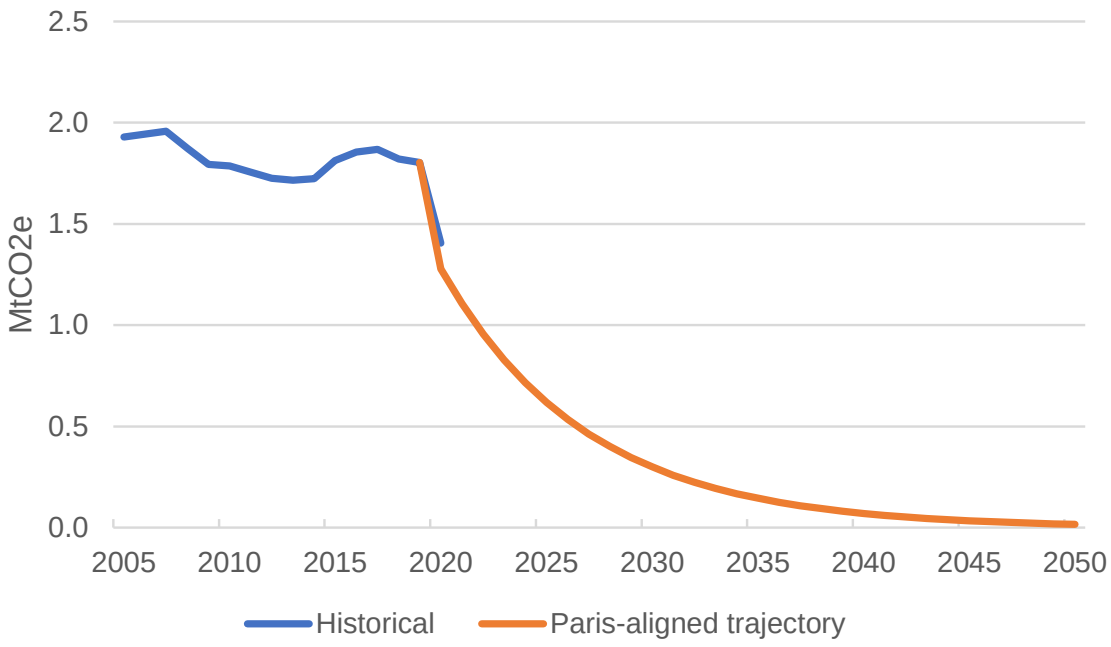
2.9 Therefore, based on the guidance set out in the LTCP, it should be considered whether it is still possible to limit Oxfordshire's transport carbon emissions (through to 2100) to 6.2MtCO2 if the Scheme were allowed to go ahead.

2.10 Using the same methodology, transport's carbon budget in South Oxfordshire and the Vale of White Horse is 2.8MtCO2. If the transport sector emits more than 2.8MtCO2, then the maximum amount of emissions in other sectors and other Oxfordshire districts must be reduced to stay on track with the Paris agreement.

A step change is needed

2.11 These targets and carbon budgets mean that emissions in Oxfordshire need to be reduced immediately and rapidly.[21] Figure 2.1 below shows historic emissions and the trajectory of transport emissions needed to meet to be consistent with the Paris agreement. The two lines overlap in 2020 as both historic data and projections from the Tyndall Centre are available for that year.

Figure 2.1 Oxfordshire's transport carbon budget against historic transport emissions



[21] For further details on carbon budgets and the level of ambition that is required, see CREDS (2020), 'Decarbonising transport: getting carbon ambition right', September, https://www.creds.ac.uk/publications/decarbonising-transport-getting-carbon-ambition-right/ (accessed 4 January 2023).

Source: Tyndall Centre Carbon Budget Reports and BEIS (2022), 'UK local authority and regional greenhouse gas emissions national statistics, 2005 to 2020', https://www.gov.uk/government/statistics/uk-local-authority-and-regional-greenhouse-gas-emissions-national-statistics-2005-to-2020 (accessed 4 January 2023).

2.12 The figure shows that transport emissions have historically remained high. In fact, emissions have risen by 5.0% between 2013 and 2019. This increase occurred despite improvements in vehicle efficiency and is driven by an increase in car use in Oxfordshire.[22] Compared to other sectors, transport is the only sector where emissions have remained high.[23] This rise in emissions occurred in spite of the policies in LTP4, which aimed to reduce car travel.[24]

2.13 We do not have a significant carbon budget remaining because we have left it so late to act. If Oxfordshire's transport emissions return to 2019 levels, which is around 1.8MtCO2 per year (travel is returning to pre-pandemic levels),[25] we will use up our remaining carbon budget in around three and a half years.

2.14 By comparison, emissions following a Paris-aligned trajectory need to decrease significantly by around 13.5% every year, as shown by the orange line in the figure above. To achieve this, significant changes in behaviour are needed. This is illustrated by the fact that the decrease in emissions in 2020 due to the pandemic follows the Paris-aligned trajectory, and additional emissions reductions of 13.5% every year after this will be needed.

2.15 Furthermore, the proposed road investments take place in districts where there is a high level of car use. Research by the Centre for Research into Energy Demand Solutions (CREDS) shows that emissions by private vehicles per person are 53% higher in South Oxfordshire compared to the average in England, and 33% higher in the Vale of White Horse. This is driven by high levels of car ownership in each district: there are 0.6 and 0.55 cars per person in South Oxfordshire and the Vale of White Horse compared to 0.49 across England.

[22] Department for Transport (2022), 'Road traffic statistics – local authority Oxfordshire', https://roadtraffic.dft.gov.uk/local-authorities/142 (accessed 4 January 2023).
[23] Environmental Change Institute (2021), 'Pathways to a zero carbon Oxfordshire', p.27m https://www.eci.ox.ac.uk/publications/downloads/PazCo-final.pdf (accessed 4 January 2023),
[24] Oxfordshire County Council (2022), 'Local Transport and Connectivity Plan 2022 – 2050', July, LTP4 review, p.21. https://www.oxfordshire.gov.uk/sites/default/files/file/roads-and-transport-connecting-oxfordshire/LocalTransportandConnectivityPlan.pdf (accessed 4 January 2022)
[25] Oxfordshire County Council (2022), 'Local Transport and Connectivity Plan – Baseline Report', p.3, https://www.oxfordshire.gov.uk/sites/default/files/file/roads-and-transport-connecting-oxfordshire/LTCPBaselineReport.pdf (accessed 4 January 2023).

2.16 It is within this context that we need to consider whether HIF1 is consistent with Oxfordshire's policy ambitions, or whether it will risk delivery of what are already highly challenging decarbonisation goals and serve to further increase car use.

3. Review of AECOM's assessment of HIF1's emissions

3.1 In this section, we review AECOM's assessment of the Scheme's emissions.

AECOM's assessment of emissions

3.2 AECOM estimated the Scheme's emissions and compared this against the UK's national carbon budget. Their main results are summarised in Table 3.1 below.

Table 3.1 AECOM's assessment of net emissions against relevant carbon budgets

Years	Construction (tCO2)	Operation (tCO2)	% of UK carbon budget	% of UK domestic transport budget
4th carbon budget: 2023-2027	154,842	-4,601	0.0077%	0.03804%
5th carbon budget: 2028-2032	-	-5,752	-0.00033%	-0.00177%
6th carbon budget: 2033-2037	-	-5,752	-0.00060%	-0.00324%

Source: AECOM (2021),'Didcot Garden Town HIF1 Scheme. Environmental Statement. Volume 1. Chapter 15 - Climate', https://myeplanning.oxfordshire.gov.uk/Document/Download?module=PLA&recordNumber=10449&planId=58651&imageId=65&isPlan=False&fileName=Didcot%20HIF1%20ES%20Chapter%2015%20Climate.pdf, Table 15.15, (accessed 4 January 2023)

3.3 They estimate that the Scheme is likely to lead to construction emissions of around 154,842MtCO2. This is based on estimates of the volume of materials needed (e.g. stone, asphalt, steel) and other emissions from construction activity. For operation emissions, they estimate that the Scheme would lead to a decrease in emissions of around 1,074-1,226tCO2 due to a reduction in congestion and journey times resulting from improvements to the road network. In our view, the conclusion that the Scheme will lead to a reduction in operational emissions is surprising and counter-intuitive, and will be discussed further below.

3.4 These emissions are then compared to the UK's overall carbon budget and for the UK transport sector (rather than Oxfordshire's carbon budget, as is required under the LTCP). They find that the emissions are likely to take up a very small proportion of the

UK's carbon budget, and conclude that "no significant effects are expected to occur to the scheme in respect of climate change."[26]

Issues with the AECOM's assessment of HIF1's carbon

3.5 There are at least three major issues with AECOM's assessment of carbon.

<u>The Scheme's emissions are misleadingly compared to the UK national carbon budget instead of Oxfordshire's carbon budget, as required by the LTCP</u>

3.6 AECOM's analysis compares emissions to the UK national carbon budget, instead of against Oxfordshire's carbon budget, as required by the LTCP. The emissions of the whole UK economy is inherently a number that is several orders of magnitude larger than the emissions arising from any individual scheme. Therefore, the comparison of HIF1 against the UK national carbon budget leads to the misleading conclusion that the carbon emissions from HIF1 are insignificant (only 0.0077% of the overall UK carbon budget, according to AECOM's analysis).

3.7 There is also an inconsistency in that, unlike carbon emissions, the benefits of HIF1 are not compared to 'whole economy' figures'.[27] For example, it is claimed that the scheme will 'unlock and support the delivery of c.18,000 new homes in the area',[28] but there is (rightly) no comparison of this number against the annual number of new homes needed in the UK overall and an accompanying conclusion that this scheme is unlikely to materially meet the UK's housing needs. This inconsistency in comparison has the effect of diminishing the importance of carbon emissions relative to the benefits of the scheme.

3.8 In fact, even comparing the emissions of a single scheme against Oxfordshire's overall transport budget could distort decision-making. For example, there is also a proposed scheme ('HIF2') that enhances the A40 dual carriageway between Witney and Eynsham.

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[26] AECOM (2021),'Didcot Garden Town HIF1 Scheme. Environmental Statement. Volume 1. Chapter 15 - Climate', paragraph 15.10.2, https://myeplanning.oxfordshire.gov.uk/Document/Download?module=PLA&recordNumber=10449&planId=58651&imageId=65&isPlan=False&fileName=Didcot%20HIF1%20ES%20Chapter%2015%20Climate.pdf, Table 15.15, (accessed 4 January 2023)

[27] This point was also made by Professor Phil Goodwin in written evidence submitted to Parliament. See Goodwin. P. (2021), 'Written evidence submitted by Professor Phil Goodwin (MTP0052)', January, https://committees.parliament.uk/writtenevidence/21473/pdf/ (accessed 4 January 2023).

[28] AECOM (2021), 'Didcot Garden Town HIF1 Scheme. Environmental Statement. Volume I. Chapter 2 – The Scheme', paragraph 2.1.6, https://myeplanning.oxfordshire.gov.uk/Document/Download?module=PLA&recordNumber=10449&planId=58638&imageId=52&isPlan=False&fileName=Didcot%20HIF1%20ES%20Chapter%202%20The%20Scheme.pdf (accessed 4 January 2023).

Even if it were found that HIF1, HIF2 or any other road schemes were individually not inconsistent with the LTCP (which is not the case since, as will be shown below in section 4, HIF1 has significant emissions), they could collectively lead to unacceptable levels of emissions. The broader point is that proposed transport schemes cannot be assessed in isolation: their overall carbon impact, and their potential in long-term effects in collectively enabling car-dependent lifestyles needs to be considered when assessing these schemes.

AECOM's traffic modelling assumes the Scheme will not generate any additional traffic compared to a scenario without the Scheme, leading to a significant underestimate of carbon emissions

3.9 The construction of new roads usually generates induced traffic, which is traffic that would have not otherwise occurred but for the road scheme. This occurs because additional road capacity leads to a reduction in congestion and an improvement in travel times. Over the longer term, constructing new roads leads to induced demand by encouraging more car-dependent urban developments. This in turn reduces the attractiveness of other sustainable modes of travel, such as walking and cycling (as busier streets are less pleasant and more dangerous) and taking the bus (since congestion reduces the attractiveness of bus travel). This increased car use leads to an increase in carbon emissions.

3.10 However, AECOM has not assessed the impact of induced traffic that is likely to result. In their Environmental Statement, they state that there are:

> "existing plans for urban development in the area [that] present methodological challenges for the traffic model when considering the 2034 emissions. As a result, after consultation with OCC and Wood Group UK Limited, it has been accepted that the **2034 emissions under the 'Do Minimum' scenario have been estimated by assuming that they will increase from 2025 in the same ratio as the 2025 to 2034 increase for the 'Do Something' scenario**." [emphasis added]

In other words, traffic growth with and without the HIF1 scheme is assumed to be the same, rather than the outcome of an evidence-based assessment.

3.11 This assumption is particularly inappropriate in the case of the proposed Scheme. Research shows that adding road capacity in areas where there is a high-level of congestion and suppressed demand are likely to lead to higher levels of induced traffic. The Scheme is also linked to supporting new urban developments that could come to rely on automobiles for connectivity. Therefore, the AECOM is likely to have significantly underestimated the Scheme's emissions.

3.12 Induced traffic also leads to additional congestion which offsets the initial benefits of the scheme. This means that the benefits may not be as large as initially anticipated. A widely cited report by SACTRA (1994) concluded that "the economic value of a scheme can be overestimated even by the omission of even a small amount of induced traffic."[29] This finding has been borne out by more recent studies. For example, a recent study on the widening of the M25 motorway showed that there was no increase in speed of travel (driven by higher-than-expected travel volumes) beyond the first year, despite forecasts of faster traffic speeds underpinning the economic model upon which it was concluded the project had 'high value for money'.[30] Therefore, it is likely that the reduction in congestion and improvement in speeds and journey times of HIF1 will be lower than anticipated, leading to lower economic benefits. Broadly, this is the maxim that "you cannot build your way out of congestion"[31] as an increase in road capacity will be either partially or fully offset by an increase in congestion.[32] This is acknowledged in the LTCP:[33]

[29] The Standing Advisory Committee on Trunk Road Assessment (1994), 'Trunk roads and the generation of traffic', p.iii, https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/TR010044/TR010044-001678-sactra-1994-trunk-roads-traffic-report-unlocked.pdf (accessed 4 January 2023).
[30] Metz, D. (2021), 'Economic benefits of road widening: Discrepancy between outturn and forecast', *Transportation research part A: policy and practice*, *147*, 312-319; and Metz, D. (2021), 'Written evidence submitted by Dr David Metz, honorary professor, Centre for Transport Studies, University College London, formerly Chief Scientist, Department for Transport (in a personal capacity) (RSM0041)', https://committees.parliament.uk/writtenevidence/25361/pdf/ (accessed 4 January 2023).
[31] For further details, see Metz, D. (2009), 'Memorandum for Dr David Metz, University College London (MRN 14), paragraph 14, https://publications.parliament.uk/pa/cm200910/cmselect/cmtran/505/505we16.htm (accessed 4 January 2023).
[32] Long-run elasticities of induced demand, i.e. the percentage change in traffic (vehicle kilometres travelled) with respect to an increase in capacity, ranges from 0.16 to 1.39 (a value greater than 1 indicates that traffic increases by more than the increase in capacity). Department for Transport (2018), 'Latest evidence on induced travel demand: an evidence review', p.22, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/762976/latest-evidence-on-induced-travel-demand-an-evidence-review.pdf (accessed 4 January 2023).
[33] Oxfordshire County Council (2022), 'Local Transport and Connectivity Plan 2022 – 2050', July, p.96. https://www.oxfordshire.gov.uk/sites/default/files/file/roads-and-transport-connecting-oxfordshire/LocalTransportandConnectivityPlan.pdf (accessed 4 January 2023).

> "However, we have found that road schemes often generate new demand and quickly reach capacity again. It is therefore not a sustainable long term solution for Oxfordshire's transport network."

AECOM does not realistically model travel behaviour, and therefore overestimates the potential carbon savings from any congestion relief arising from the scheme

3.13 The Scheme could, in principle, lead to a reduction in emissions by increasing vehicle speeds. Average speeds are currently around 23-24mph,[34] lower than optimal speeds of 45-50mph for car fuel use.[35] AECOM's modelling predicts that congestion is expected to increase significantly in the future, with speeds falling to 7-10mph by 2034 in a scenario without HIF1. Therefore, by reducing congestion and increasing speeds, less fuel could potentially be consumed.

3.14 However, there are a number of issues with AECOM's analysis, leading it to overestimate congestion if HIF1 were not built, and overstate the reduction in congestion that HIF1 would bring about.

3.15 This is because the model used by AECOM does not realistically represent passenger behaviour. This can be seen in the modelling outputs presented in its transport assessment. For example, AECOM modelled journey times on a 4.5mile road on the A415 that connects to the A4074. The model predicts that without HIF1 in 2034, it would take an implausible 15 hours to complete the journey road due to a gridlocked network.[36] This is about ten times slower than an average person's walking speed.[37]

3.16 More generally, AECOM predicts that the "2034 without HIF scenario shows a significant reduction in average speed across the network, due to the gridlock situation that develops in the model."[38] However, congestion tends to be self-limiting as people decide

[34] AECOM (2021), 'Didcot garden town. Housing Infrastructure Fund (HIF1). Transport Assessment', paragraph 6.10.2, Figure 6.29 and Table 6.30, https://mycouncil.oxfordshire.gov.uk/documents/s61364/Didcot%20HIF1%20Transport%20Assessment%20Part%201.pdf (accessed 4 January 2023)
[35] RAC (2022), 'How to save fuel – the ultimate guide', https://www.rac.co.uk/drive/advice/how-to/fuel-saving-tips/ (accessed 4 January 2023).
[36] AECOM (2021), 'Didcot garden town. Housing Infrastructure Fund (HIF1). Transport Assessment', paragraph 6.10.2, Figure 6.27 and Table 6.41 (Eastbound route from West of Tollgate Road to Berinsfield), https://mycouncil.oxfordshire.gov.uk/documents/s61364/Didcot%20HIF1%20Transport%20Assessment%20Part%201.pdf (accessed 4 January 2023)
[37] British Heart Foundation, https://www.bhf.org.uk/how-you-can-help/events/training-zone/walking-training-zone/walking-faqs (accessed 4 January 2023).
[38] AECOM (2021), 'Didcot garden town. Housing Infrastructure Fund (HIF1). Transport Assessment', paragraph 6.11.2,

whether to travel based on how much congestion there is. For example, if there is a high level of congestion, those making trips which are not time-sensitive (e.g. shopping trips) may choose to travel at other times instead. Furthermore, post-pandemic, more people have the option to work from home, which means that some trips can either be avoided or shifted to other times. When these trips are replaced or removed, the congestion on the network alleviates.[39] Similarly, if there is less congestion (e.g. due to additional road capacity being added), more people will choose to travel, leading to more congestion.

3.17 However, this behaviour is not modelled by AECOM. Instead, the model takes as given that there are a specific number of travellers seeking to travel between two fixed places, regardless of the level of congestion.[40] The only response passengers have is the choice of route travelled for the scenarios with and without HIF1.[41] For example, if someone is leaving their home to go shopping at 10AM in a store that is 5 miles away, they will always make this trip regardless of whether HIF1 is constructed and the level of congestion of the road. This results in the model predicting gridlock in the absence of the HIF1 scheme, which may not necessarily arise, particularly if there is appropriate investment in public transport, good urban planning and digital connectivity.

3.18 Furthermore, even if there were an improvement in speeds, this effect may be short-lived: as induced traffic increases, congestion rises, which reduces speeds.

3.19 Therefore, the level of congestion in the scenario without HIF1 may not be as bad as predicted by AECOM's modelling, and the improvement in congestion as a result of HIF1 could be smaller than expected (as explained in the section on induced demand). This means benefits of HIF1 are likely overestimated, with carbon emissions being underestimated.

https://mycouncil.oxfordshire.gov.uk/documents/s61364/Didcot%20HIF1%20Transport%20Assessment%20Part%201.pdf (accessed 4 January 2023)

[39] This logic also applies in reverse: when there is additional capacity, people may choose to travel more during peak times, leading to additional congestion. This is the issue of induced demand as described above.

[40] AECOM (2021), 'Didcot garden town. Housing Infrastructure Fund (HIF1). Transport Assessment', figure 5.2, https://mycouncil.oxfordshire.gov.uk/documents/s61364/Didcot%20HIF1%20Transport%20Assessment%20Part%201.pdf (accessed 4 January 2023)

[41] This point is also noted by Professor Phil Goodwin in his submission to the Oxford City Council. Goodwin, P. (2022), 'Outline comments on HIF forecasts and appraisal', https://mycouncil.oxfordshire.gov.uk/documents/b21005/Addenda%20Tuesday%2021-Jun-2022%2014.00%20Cabinet.pdf?T=9 (accessed 4 January 2023).

4. Estimating HIF1's carbon emissions

4.1 In this section, we provide high-level estimates of the Scheme's carbon emissions. Accurately estimating carbon emissions is a difficult and complex exercise—as explained in the previous section, it requires us to understand how travel behaviour will change with and without the Scheme. Even sophisticated transport models that exist today are not effective at estimating traffic and emissions impacts resulting from road projects. Instead, our aim is to provide high-level estimates and to compare these to Oxfordshire's carbon budget.

4.2 There are three main sources of emissions that could result from the Scheme:

- embodied carbon, which are emissions from the construction and materials used;
- operational carbon from changes in speed, which are changes in emissions as a result of changes in vehicle speed and congestion;
- emissions from induced demand, which are emissions from the additional road users.

4.3 These are considered in turn in the following sections.

Embodied carbon

4.4 We have carried out cross-checks to AECOM's embodied carbon estimates by applying estimates of average embodied carbon emissions per £m of capital expenditure of proposed road schemes over RIS2 (the road regulatory period running from 2020/21 to 2024/25)[42] and UK national statistics.[43] The resulting estimates ranged between 135–205ktCO2, compared to AECOM's estimate of 155ktCO2. Therefore, with the information currently available to us, AECOM's estimate of embodied carbon emissions appears to fall within the right range.

[42] Transport for Quality of Life (2020), 'The carbon impact of the national roads programme', July, https://www.transportforqualityoflife.com/u/files/The%20carbon%20impact%20of%20the%20national%20roads%20programme%20FINAL.pdf (accessed 4 January 2023)
[43] Scott, K., Giesekam, J., Owen, A. and Barrett, J. (2015), 'Embodied greenhouse gas emissions of the UK National Infrastructure Pipeline (NIP)', May, https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/TR010034/TR010034-001078-CPRE%20PDSY%20-%20comments%20on%20submissions%20for%20Deadlines%203%20and%204.pdf (accessed 4 January 2023).

Emissions from changes in speed

4.5 As explained in section 3, the Scheme could reduce emissions if it is effective in increasing speeds and reducing congestion. However, AECOM's analysis likely overstates the Scheme's effectiveness in reducing congestion, and so their claim that operational emissions will be reduced is not credible.

4.6 It is difficult to obtain reliable estimates of this source of emissions. This is because applying estimates based on averages of other road schemes does not take into account the current speeds of the HIF1 scheme. For example, if other schemes are implemented in areas where average speeds are higher, further increasing speed would lead to higher emissions. But as average speeds are low in the case of HIF1, relying on data from other schemes may not be appropriate. This could lead to an over-estimate of HIF1's emissions.

4.7 Therefore, in the absence of more robust evidence, we have not included these emissions for comparison against carbon budgets.

Emissions from induced demand

4.8 The Scheme is likely to generate significant additional traffic (i.e. induced demand) for reasons set out in section 3. To estimate emissions from induced demand, we draw on research by Transport for Quality of Life (TfQL), which developed a methodology to assess the carbon emissions of RIS2. Based on an analysis of previously completed road schemes, they estimated emissions from induced traffic for each £m of expenditure.[44]

4.9 Induced traffic tends to increase over time. As it takes some time for people to adjust their behaviour to the added road capacity, induced traffic may not be as large in the scheme's opening year compared to later in the future. However, future emissions per km travelled will be lower due to improvements in vehicle efficiency and uptake of electric vehicles. To account for this, we adjust emissions estimates based on scenarios set out in the Department for Transport's national road traffic projections 2022. We use

[44] Specifically, following TfQL, we assume that induced traffic would be zero in the year the scheme was completed, 2% of opening traffic in the year after the scheme was completed, and rising by 2% per year to 24% of opening year traffic 12 years after scheme completion. TfQL also found that on average, opening year emissions were around 613tCO2 for each £1m of expenditure (based on an analysis of 87 road schemes). For further details, see Transport for Quality of Life (2020), 'The carbon impact of the national roads programme', July, https://www.transportforqualityoflife.com/u/files/The%20carbon%20impact%20of%20the%20national%20roads%20programme%20FINAL.pdf (accessed 4 January 2023)

the ‘Core Scenario’, which includes the government’s latest projections for GDP, employment, households, and fuel efficiency. It also includes ‘firm and funded’ government policies. We also use an alternative scenario (‘Vehicle-led Decarbonisation’) where there is a high and fast uptake of electric vehicles, where vehicle fleet electrification approaches 99% by 2050.[45]

4.10 Based on the above, we estimate that under the ‘Core Scenario’, the Scheme could lead to around 359ktCO2 of emissions by 2050, and 132ktCO2 under the ‘Vehicle-led Decarbonisation Scenario’.

Compatibility of carbon emissions with carbon budgets

4.11 Table 4.1 below summarises the analysis on the Scheme’s emissions, and compares it against Oxfordshire’s transport carbon budget. We also compare emissions to carbon budgets for South Oxfordshire and the Vale of White Horse to assess whether these district’s decarbonisation ambitions if the Scheme were to go ahead.

Table 4.1 Estimated HIF1 carbon emissions, ktCO2

	Scenario	
	Core	**Rapid EVs uptake**
Embodied carbon emissions	155	
Emissions from induced demand	359	132
Total emissions	**514**	**287**
Oxfordshire's transport carbon budget	**6,192**	
% of Oxfordshire's carbon budget consumed by HIF1	8%	5%
South Oxfordshire and Vale of White Horse transport carbon budget	**2766**	
% of South Oxfordshire and Vale of White Horse's carbon budget consumed by HIF1	19%	10%

[45] Department for Transport (2022), ‘National road traffic projections 2022’, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1123542/national-road-traffic-projections-2022.pdf (accessed 4 January 2023).

4.12 We estimate that the Scheme could emit around 514ktCO2 due to embodied carbon emissions and emissions from induced demand. By comparison, the transport sector can only emit a maximum of 6,192ktCO2 to stay in line with the Paris agreement. The additional carbon could therefore use up 8% of Oxfordshire's remaining carbon budget in a crucial period in which emissions need to be rapidly reduced.[46]

4.13 Even if there is a rapid uptake of electric vehicles, the carbon emitted would be 287ktCO2, or 5% of the transport carbon budget.

4.14 The OCC has also set a target to increase the number of cycling trips in Oxfordshire from 600,000 to 1 million trips per week. If we assume that all of these trips displace car miles (which is an optimistic assumption as the increase in cycling trips could be new trips, or replacement of walking and public transport trips), the estimated carbon savings from now until 2050 would be around 298ktCO2 under the 'Core' scenario.[47,48] Therefore, the Scheme's are 1.7x larger than the potential savings from increased cycling, and will be greater than the carbon savings from hitting OCC's cycling targets.

4.15 The Scheme's emissions means that it will be more challenging to meet district-level decarbonisation targets. Transport in South Oxfordshire and the Vale of White Horse is only allowed to emit 2,677MtCO2—the Scheme would therefore use up 19% of the remaining carbon budget.

[46] We note that the carbon budgets calculated by the Tyndall Centre do not include emissions from concrete production and carbon sequestered by land-use, e.g. forests and land-use. Including these would make the carbon budget larger, and so the Scheme will not represent as large a proportion of the carbon budget. However, these are relatively small factors: concrete represents only 1.5% of the UK's emissions, and the net carbon sequestered from land-use is only around 2% of Oxford's emissions. Furthermore, we have not included non-CO2 impacts from vehicle use, such as from methane and nitrogen oxides. These represent a small part of the warming impact of vehicles, and so we have likely under-estimated the warming impacts of the Scheme, all else equal. Therefore, on balance, these factors are unlikely to affect our conclusions. Source for magnitude of concrete emissions: Institute of Civil Engineers (2022), 'Construction sector could more than halve emissions from concrete by 2035 – industry task force', shorturl.at/hkvEK (accessed 4 January 2023); source for land-use carbon sequestration: BEIS (2022), 'UK local authority and regional greenhouse gas emissions national statistics, 2005 to 2020', https://www.gov.uk/government/statistics/uk-local-authority-and-regional-greenhouse-gas-emissions-national-statistics-2005-to-2020 (accessed 4 January 2023).

[47] And 156ktCO2 under the 'Rapid EVs uptake' scenario.

[48] In calculating this figure, we assume that the increase in cycling trips will increase linearly through to 2030, and stay at this level until 2050.To convert the trips into distance travelled, we apply the average distance travelled for each cycling trip based on data from the National Travel Survey. We then assume that this leads to an equal reduction in car miles travelled, and convert this into an estimate of carbon savings using the National Road Traffic Projections 2022. Department for Transport (2022), 'National Travel Survey 2021: Active travel', https://www.gov.uk/government/statistics/national-travel-survey-2021/national-travel-survey-2021-active-travel#:~:text=Trends%20in%20cycling%20trips,-Chart%2013%3A%20Average&text=There%20has%20been%20a%20general,to%2055%20miles%20per%20person. (accessed 4 January 2023).

4.16 The idea of a carbon budget is that if there are additional emissions from one area, there needs to be an equivalent reduction of emissions in another area to stay within the budget. Therefore, whether or not we can afford to undertake HIF1 also depends on whether we are able to use other policies to stay within the carbon budget. In principle, this means that we can use the remaining carbon budget we have for the most effective purposes. However, in practice, the OCC acknowledges that "the means of achieving [the targets in the LTCP] have yet to be comprehensively identified" and are currently undertaking further work through a LTCP 'part 2' to understand how these targets can be achieved.[49,50] While it is right to carefully plan how the targets should be delivered, carrying out major new road investments in the meantime risks delivery of these targets by locking in valuable resources that could be spent elsewhere, and by failing to encourage the behaviour change needed to deliver the targets.

4.17 In conclusion, this analysis suggests that the Scheme is incompatible with the policies in the LTCP, and the OCC's aim to reach net zero.

[49] Oxfordshire County Council (2022), 'Implementing 'Decide and Provide': Requirements for Transport Assessments', September, paragraph 2.5.1, https://mycouncil.oxfordshire.gov.uk/documents/s62102/CA_SEP2022R12%20Annex%201_Implementing%20Decide%20and%20Provide%20-%20TA%20Requirements.pdf (accessed 4 January 2023)
[50] Oxfordshire County Council (2022), 'Local Transport and Connectivity Plan 2022 – 2050', July, p.33. https://www.oxfordshire.gov.uk/sites/default/files/file/roads-and-transport-connecting-oxfordshire/LocalTransportandConnectivityPlan.pdf (accessed 4 January 2023).

5. Conclusion and recommendations

5.1 There needs to be both a rapid uptake of electric vehicles and a significant and immediate reduction in car mileage for Oxfordshire's transport sector to be aligned with the Paris agreement. At current emission levels, transport in Oxfordshire is likely to use up its share of the carbon budget in the next three and a half years.

5.2 However, the Scheme is a legacy project that was proposed before the LTCP was developed and when the level of climate ambition was lower. The analysis in this report suggests that HIF1 will lead to significant carbon emissions, much more than estimated in its Environmental Statement. Furthermore, HIF1 has not been assessed in a way that is compliant with the LTCP, as it has failed to assess the impact of the scheme relative to Oxfordshire's carbon budget, and the level of induced traffic that it would generate.

5.3 In light of the serious issues with the climate assessment of HIF1, we recommend that the OCC follows the example of the Welsh government, which has implemented a freeze on new road building in order to review the pipeline of road investments and assess whether it is aligned with its climate ambitions.[51]

5.4 The OCC needs to consider how future growth in Oxfordshire can be supported in a way that is consistent with its goal of reducing car use. The most successful cities in Europe have managed to grow whilst reducing car use by using both 'carrot' and 'stick' measures. These include incentives to encourage more sustainable travel choices, including public transport, cycling and walking, while discouraging travel by private vehicle.[52] Adding new road capacity is not a sustainable long-term solution as it often generates new demand and reaches capacity again (a point acknowledged by the LTCP).[53] Instead, as others have argued, we should treat the existing road network as a mature system, focusing on how to improve the operational efficiency of existing roads rather than undertake additional major civil engineering works.[54]

[51] Welsh Government (2022), 'Wales Road Review: initial panel report', https://www.gov.wales/wales-roads-review-initial-panel-report-html (accessed 4 January 2023).
[52] Kuss, P., & Nicholas, K. A. (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*.
[53] Oxfordshire County Council (2022), 'Local Transport and Connectivity Plan 2022 – 2050', July, p.96. https://www.oxfordshire.gov.uk/sites/default/files/file/roads-and-transport-connecting-oxfordshire/LocalTransportandConnectivityPlan.pdf (accessed 4 January 2023).
[54] Metz, D. (2022), 'Five overarching issues that should be tackled before work starts on RIS3 roads plan', https://elements.lttmagazine.co.uk/ltt842c-metz.php (accessed 3 January 2022)