Adran yr Economi a'r Seilwaith
Department for Economy and Infrastructure

Llywodraeth Cymru
Welsh Government

The M4 Motorway (Junction 23 (East of Magor) to West of Junction 29 (Castleton) and Connecting Roads) and The M48 Motorway (Junction 23 (East of Magor) Connecting Road) Scheme 201-

The M4 Motorway (Junction 23 (East of Magor) to West of Junction 29 (Castleton) and Connecting Roads) and The M48 Motorway (Junction 23 (East of Magor) Connecting Road) (Amendment) Scheme 201-

The London to Fishguard Trunk Road (East of Magor to Castleton) Order 201-

The M4 Motorway (West of Magor to East of Castleton) and the A48(M) Motorway (West of Castleton to St Mellons)(Variation of Various Schemes) Scheme 201-

The M4 Motorway (Junction 23 (East of Magor) to West of Junction 29 (Castleton) and Connecting Roads) and the M48 Motorway (Junction 23 (East of Magor) Connecting Road) and The London to Fishguard Trunk Road (east of Magor to Castleton) (Side Roads) Order 201-

The Welsh Ministers (The M4 Motorway (Junction 23 (East of Magor) to West of Junction 29 (Castleton) and Connecting Roads) and the M48 Motorway (Junction 23 (East of Magor) Connecting Road) and the London to Fishguard Trunk Road (East of Magor to Castleton)) Compulsory Purchase Order 201-

The M4 Motorway (Junction 23 (East Of Magor) to West of Junction 29 (Castleton) and Connecting Roads) and The M48 Motorway (Junction 23 (East Of Magor) Connecting Road) (Supplementary) Scheme 201-

The Welsh Ministers (The M4 Motorway (Junction 23 (East Of Magor) to West of Junction 29 (Castleton) and Connecting Roads) and The M48 Motorway (Junction 23 (East Of Magor) Connecting Road) and The London to Fishguard Trunk Road (East of Magor to Castleton)) Supplementary Compulsory Purchase Order 201-

Proof of Evidence

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Proof of Evidence – Carbon

Document Reference: WG 1.13.1

Contents

1. Author

1.1 Personal Profile and Qualifications

1.1.1 I am a professional civil engineer. I hold degrees in Civil Engineering and Soil Mechanics. I hold Chartered Engineer status in both the UK and Ireland and am a Fellow of the Institution of Civil Engineers and of the Institution of Engineers of Ireland. I am also a member of the British Geotechnical Association, the British Tunnelling Society and the Geotechnical Society of Ireland. I am registered with the Register of Geotechnical Engineering Professionals (RoGEP) as an “Adviser”, its highest category.

1.1.2 In 2014, I was elected to the Royal Academy of Engineering, the UK’s national academy for engineering, as a Fellow. I am now a member of its Policy Committee.

1.1.3 I have been employed by Arup since September 1987 and became a director in December 2004. I became leader of Arup’s London-based geotechnical and tunnelling group in November 2006. Since August 2011, I have been leader of the Infrastructure London Group, comprising all the design skills for major economic infrastructure and sit on Arup’s UK Infrastructure Sector Executive.

1.1.4 I led the Institution of Civil Engineers’ report on a trajectory for low carbon infrastructure (2011) for which I won the Presidential Medal of the Institution of Civil Engineers also in 2011. In October 2016, I was appointed to the National Infrastructure Commission’s Technical Expert Advisory Group.

1.1.5 Since 2015, I have been a member of the UK’s Green Construction Board (GCB). The GCB is a consultative forum for government and the UK design, construction, property and infrastructure industry. The GCB is the sustainability work stream of the Construction Leadership Council. The role of the GCB is to provide leadership and action to enable the whole value chain (clients, contractors, product manufacturers and suppliers) to become more environmentally sustainable, more productive and better placed to exploit the

growing global market.

1.1.6 I am also active on the GCB's infrastructure working group, of which I have been a member since 2012, which is establishing the necessary framework of client leadership so that infrastructure projects can be made lower carbon. I was a steering group member for the UK Government's Infrastructure Carbon Review (2013) and was the Arup director responsible for the world's first standard for the reduction of carbon in infrastructure PAS 2080:2016, produced jointly with colleagues from Mott MacDonald.

1.2 Relevant experience

1.2.1 I have worked on a wide range of building and infrastructure projects ranging from the very small to the very large.

1.2.2 A detailed summary of relevant experience is included in my CV in Appendix A to this report.

1.3 Personal Role on the Scheme

1.3.1 I am the Carbon Reviewer for the Scheme, providing assessment and advice on the Whole Life Carbon emissions associated with the Scheme.

1.3.2 I am using Carbon as a shorthand for Greenhouse Gas Emissions (GHG) across the whole of the Proof of Evidence.

1.3.3 I first became involved in the project in October 2015.

1.4 Declaration of truth

1.4.1 This Proof of Evidence represents my true and professional opinion and is given in accordance with the Institution of Civil Engineers Code of Professional Conduct[1].

[1] https://www.ice.org.uk/ICEDevelopmentWebPortal/media/Documents/About%20Us/ice-code-of-professional-conduct.pdf

2. Scope of Evidence

2.1 My Proof of Evidence will address the Whole Life Carbon emissions aspects for the Scheme and the associated impact on climate change.

2.2 My Proof of Evidence is presented in the following structure:

1. Author
2. Scope of Evidence
3. The Scheme
4. General Proof of Evidence related to the carbon emissions of the Scheme
5. Objections related to the carbon emissions of the Scheme

2.3 This Proof of Evidence responds to issues raised on Whole Life Carbon emissions for the Scheme. It thus refers to Capital Carbon ($CapCO_2$), Operational Carbon ($OpCO_2$) and User Carbon ($UseCO_2$) as defined by PAS2080:2016[Document 8.2.10] and presented in the Environmental Statement (ES) [Document 2.3.2, Vol.3, Appendix 2.4 Carbon Report].

3. The Scheme

3.1 The main objectives of the Scheme are set out in the Transport Planning Objectives (TPOs) [Document 4.5.7] and include improved connectivity and more reliable journeys. TPO 10 requires “reduced greenhouse gas emissions per vehicle and/or person kilometre”.

3.2 The Scheme provides an important transport link that is essentially carbon neutral (see 4.1.3), compared to the Do-Minimum alternative.

3.3 Compared to the Do-Minimum scenario, the current Scheme has a number of advantages for carbon reduction that offset an increase in traffic:

a) The route is 2.8km shorter so that vehicles have less far to travel between Junctions 23 and Junctions 30 of the existing M4 corridor.

b) Congestion is much reduced so that vehicles can travel more efficiently.

3.4 The upshot is the Scheme overall achieves Whole Life Carbon neutrality for a greater throughput of vehicles compared to the Do-Minimum scenario.

3.5 Mr Ben Sibert's Design Proof of Evidence and Mr Barry Woodman's Construction Proof of Evidence show that Capital Carbon reduction was actively considered in the development of the Scheme, so that Capital Carbon has been reduced.

4. General Proof of Evidence related to the carbon emissions of the Scheme

4.1 Assessment of Whole Life Carbon of infrastructure

4.1.1 An in-depth understanding of the Whole Life Carbon impact of infrastructure started in about 2008 following the excellent book written by Professor David Mackay "Sustainable energy without the hot air" and the then Innovation and Growth challenge to the Construction industry from Government (Department of Business, Innovation and Skills, 2010). In 2011 the Low Carbon Infrastructure Trajectory - 2050 that I chaired for the Institution of Civil Engineers (ICE) crystallised much of that thinking. A methodology for the overall quantification of the carbon impacts for UK infrastructure was first published in 2013 with the Infrastructure Carbon Review report [Document 8.3.2] produced by the Green Construction Board (GCB), of which I'm a member. I was also a member of the Steering Group for the production of that report. GCB then instigated the production of the first ever Standard on Carbon Management in Infrastructure, PAS2080:2016 [Document 8.2.10], which was published by the British Standards Institution (BSI) in May 2016, jointly written by Arup and Mott MacDonald. I was the Arup Project Director for the production of this standard.

4.1.2 The assessment of impact to climate change of an infrastructure project should take into account the carbon emitted during the life of the project, from

beginning of construction and throughout its operational life. The Whole Life Carbon of a project is the sum of three distinct components of Capital, Operational and User carbon, as defined in PAS2080. The Carbon Report in Appendix 2.4 of the ES provides a detailed explanation of what each carbon component consists. Generally, the Operational component of any highway project is very small compared to the other two and generally the User Carbon becomes dominant over time.

4.1.3 An infrastructure project can be considered to be net carbon neutral when the Capital Carbon expended during its construction is equal to the cumulative Operational and User Carbon saved from the introduction of the project. Whole Life Carbon neutrality on a highway project may be achieved after several years or decades of operation as a result of relieving congestion from the existing alignment and the associated wider network around it, thereby reducing the User Carbon until it offsets the Capital Carbon in its creation.

4.2 Overall Welsh carbon emissions and transport

4.2.1 The latest Greenhouse Gas Inventory [Document 8.3.4] suggests the transport sector in Wales contributed 5.7Mt CO_2e, around 11% of total Welsh emissions in 2014. Generally, road transport emissions in the UK are approximately 67% of the UK transport emissions [Document 8.3.5]. Almost the entirety (98%) of the road transport emissions are due to the User Carbon UseCO_2 (also referred to as tailpipe emissions), with the Capital and Operational Carbon emissions consisting of the remaining 2% [Document 8.3.2].The majority of the UK transport user emissions are attributed to cars (52%), whereas 11% is from road freight transport. Details are set out in Figure 1 below.

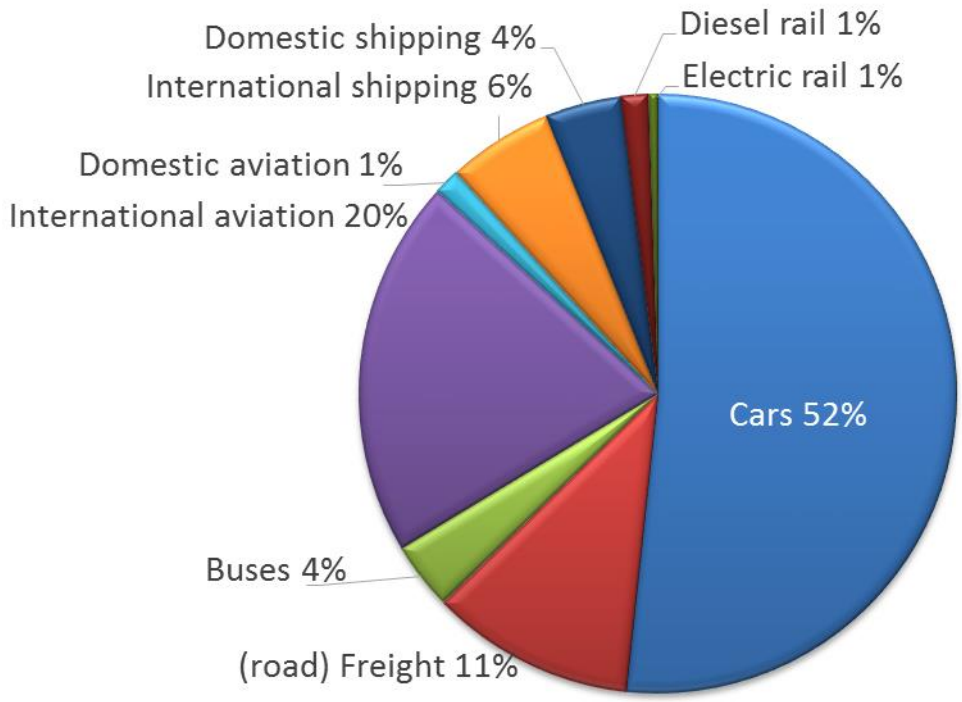

Figure 1 UK transport emissions split

4.2.2 The Welsh Government published the Climate Change Strategy for Wales [Document 5.1.9] in 2010, setting out key climate change targets. These included a commitment to reduce greenhouse gases by 3% year-on-year from 2011 in devolved areas, and to achieve at least 40% reduction in total greenhouse gas emissions by 2020.

4.2.3 The new Environment (Wales) Act 2016 [Document 3.1.16] has changed Wales' approach to tackling emissions, progressing from the annual (non-statutory) target of 3% year-on-year reduction to instead setting an emissions reduction target for the year 2050 (at least 80% of the baseline emissions, similar or more stringent than the UK Climate Change Act 2008) and with interim targets for 2020, 2030 and 2040. The Act states that the Welsh Government must set the maximum emissions for each interim target year, by the end of 2018.

4.2.4 The recent introduction of the Environment (Wales) Act 2016 requires an overall reduction in carbon emissions to be made. As with any overall

reduction in spending, it is not managed effectively by just applying that same reduction to every item of spending – rather it requires a whole new approach in how that rationed commodity is to be spent, which may even allow spending on some items to be increased, offset by bigger cuts elsewhere. Therefore, the legislation does not require a reduction in carbon in this specific Scheme, or indeed any specific scheme.

4.2.5 The carbon analyses and interpretation for this Scheme, using PAS 2080: 2016, should allow its carbon effects to be much better recognised than would typically be the case for equivalent schemes promoted before PAS2080.

4.3 The carbon emissions of the Scheme

4.3.1 The Environmental Statement (ES) of a highway scheme has to comply with the Design Manual for Roads and Bridges (DMRB) methodology. Following the DMRB methodology [Document 8.2.5], the carbon assessment was undertaken using the DMRB-compliant program SATURN and reported in the ES issued in March 2016. SATURN is a strategic traffic model that covers a wide area of south Wales using average speeds and average flows. The DfT Tempro 6.2 input traffic data were used in this model. The assessment of the carbon emissions associated with the Scheme is presented in detail in the Carbon Report in Appendix 2.4 of Volume 3 of the Environmental Statement. The figures, when that report was written in March 2016, were based on Tempro 6.2 and were correct – since then, there have been some minor changes in the analysed figures, updated in this Proof of Evidence, but that report's conclusions remain valid.

4.3.2 Changes in the traffic input data introduced by DfT (referred to as Tempro 7.1 Interim for Wales) led to the production of an updated traffic SATURN model, from which revised carbon data were derived in December 2016, which were reported in the ES Supplement [Document 2.4.4].

4.3.3 The overall Scheme carbon data for the original (March 2016) and updated (December 2016) SATURN models are shown in Table 1 below.

Table 1 Comparison of original and updated SATURN analyses for the wider South Wales road network

(tCO_2e/yr)	2014	2022		2037	
SATURN	**Baseline**	**DM**	**DS**	**DM**	**DS**
Tempro 6.2 (03.2016)	2,259,088	2,303,805	2,291,091	2,496,659	2,489,142
Tempro 7.1 (12.2016)	2,351,628	2,288,503	2,285,852	2,520,208	2,511,434

Where: DM: Do-Minimum; DS: Do-Something (the Scheme)

4.3.4 The use of the Tempro 7.1 SATURN model gives similar results to the Tempro 6.2 model, concluding that the Scheme has a positive (albeit small) effect on annual User Carbon emissions, using the assumptions inherent in those models.

4.3.5 However, for a complex project, particularly one that is prone to congestion with start-stop traffic, such as the M4CaN, User Carbon can be more accurately assessed with a traffic model like VISSIM and emissions model PHEM [2], which provide more detail and appropriate clarity on the impact of relieving congestion and speed variation of individual vehicle performance. VISSIM is a micro-simulation model that takes into account the high levels of acceleration and deceleration present in heavily congested traffic conditions, more characteristic of real conditions than the average flows that SATURN uses. PHEM is an instantaneous emissions model that relates emissions to specific vehicle speed-time profiles. The DMRB guidance recognises the benefit of carrying out more detailed 'instantaneous' emissions modelling, and makes specific reference to the use of VISSIM-PHEM (DMRB, Vol.11, Section 3, Part 1HA207/07, Annex E).

4.3.6 To the best of my knowledge, the M4 was one of the first large scale highway projects in 2008 that employed detailed micro-simulation VISSIM modelling to explore the User Carbon impact of the Scheme. This was one of the case

[2] It stands for: 'Passenger car and Heavy duty Emissions Model' and was developed by the Graz University of Technology.

studies reviewed in Lynsay Hughes' PhD research at Cambridge University published in 2012 [Document 8.3.6], for which I was a reviewer.

4.3.7 A VISSIM/PHEM model - considering the existing M4 corridor between Junctions 23 and 30, together with the proposed Scheme - has been produced to inform the Carbon Evidence, as described in Mr Bryan Whittaker's traffic Proof of Evidence. Due to its computationally demanding nature, the VISSIM model boundaries are localised to the specific route corridor (existing M4 plus the proposed Scheme) rather than the whole South Wales network that the SATURN model considered. The VISSIM model output has been post-processed using the program PHEM to compute the emissions of vehicles using the modelled network, taking account of local conditions and the effects of congestion that VISSIM produced.

4.3.8 The VISSIM & PHEM Analysis Report (included as Appendix to Mr Bryan Whittaker's Proof of Evidence), describes the traffic model used and its results. Mr Bryan Whittaker's Proof of Evidence notes that the VISSIM model has been calibrated and validated against actual traffic data and uses more detailed methodologies for modelling the traffic in congested and free-flowing conditions.

4.3.9 The VISSIM model has been updated for the Tempro 7.1 Interim for Wales changes. I have presented the results of the updated VISSIM model here.

4.3.10 Table 2 below compares the Tempro 7.1 VISSIM results with a sub-set of the Tempro 7.1 SATURN results that corresponds to only the study area covered by the VISSIM model, to enable comparison. The Tempro 7.1 VISSIM assessment shows a very small improvement of tailpipe emissions due to the Scheme: in 2022 the provision of the Scheme is forecast to reduce emissions by 4,324 tCO_2e /year on the highway network covered by the model, and by 2037 would reduce emissions by 13,416 tCO_2e/ year. However, these annual emission values are different to the SATURN ones in Table 1, because of the different boundaries the models use.

Table 2 Comparison of the VISSIM results with the SATURN subset that corresponds to the VISSIM modelled area.

	Tempro 7.1 SATURN (sub-set)			Tempro 7.1 VISSIM				
tCO_2e/yr	**Base**	**DM**	**DS**	**Base**	**DM**	**DS**	**Difference Δ**	
2014	276,722			421,291				
2022		277,916	282,632		443,620	439,296	4,324	1%
2037		322,593	324,549		456,385	442,969	13,416	3%

4.3.11 The SATURN subset results in Table 2 show the emissions marginally increasing as a result of increased traffic growth with the Scheme in this narrow study area; the small User Carbon reduction in the wider SATURN area (Table 1) indicates that the Scheme therefore results in relief of the surrounding road network. The equivalent VISSIM results for the study area in Table 2 show a small decrease of User Carbon as a result of the Scheme, indicating an actual benefit on this corridor too, once the effects of congestion relief have been modelled.

4.3.12 There therefore seems to be a small User Carbon reduction in the wider South Wales road network, excluding these core routes, based on these results. However, the more detailed and appropriate VISSIM model shows a carbon reduction on the core routes too. Accordingly, I consider that these calculations show that there will be a small reduction in overall User Carbon as a result of the Scheme.

4.3.13 The Capital Carbon for the Scheme has been assessed to be 522,516 tCO_2e, as described in detail in the Carbon Report in Appendix 2.4 of Volume 3 of the Environmental Statement. I understand that there will be further efforts to control and reduce this estimate. Some examples of these efforts are provided in Mr Barry Woodman's Proof of Evidence.

4.3.14 The Operational Carbon for the Scheme has been assessed to be 1,587 tCO_2e/ annum, as presented in the Carbon Report. As with most highway schemes, this is a very small component of the whole life carbon, with negligible contribution to the net carbon emissions for the Scheme.

4.3.15 As explained in Section 4.1.3, given that there is a net reduction in User Carbon emissions along the corridor, one can devise the concept of carbon neutrality for the Scheme over time – a date by which the Capital Carbon expended in building the road is finally balanced by the annual savings in User and Operational Carbon emissions (although Operational Carbon emissions are not significant compared to the other two larger figures).

4.3.16 The Capital and Operational carbon impacts are such that, on a scheme assessment basis, carbon neutrality may be achieved by the year 2066.

4.3.17 However, future User Carbon emissions are difficult to project beyond 2030, due to uncertainties in the future technology improvements in the vehicle fleet or the energy generation and fuel mix. The input traffic data in SATURN gives the standard approach to future vehicle emissions efficiencies, but stops giving further improvements beyond 2030, given the speculative nature of such long-range predictions.

4.3.18 All assumptions beyond say 2030 are increasingly speculative about vehicle mix and states of decarbonisation of electricity and electrification of transport, and this could cause the date by which carbon neutrality of the Scheme is achieved to be delayed beyond 2066. However, it is worth highlighting that this carbon neutrality date will only drift out to a later date if decarbonisation of transport is more successful than currently assumed, in which case overall emissions will be reduced, which would be good news. Poor achievement in decarbonising transport will lead to an earlier date for neutrality.

4.3.19 Therefore, on the basis of the assessments, the Scheme does play a minor role in reducing Welsh emissions, not hindering the longer-term targets that are to be set by 2018 under the Environment (Wales) Act 2016.

4.3.20 Of the Transport Planning Objectives, TPO10 is the objective relating to carbon and that objective will be met through a combination of technological improvements in energy efficiency of vehicles, more stringent vehicle

emission standards[3] and decarbonisation of the national energy generation, as well as relief of congestion on the shorter M4 corridor.

5. Objections related to the carbon emissions of the Scheme

5.1 Tyndall Centre

5.1.1 Some objectors (eg OBJ 0018, 0074 *)* quote the specific issues on carbon emissions raised in the Tyndall Centre report:

a) The Carbon Report '*makes no direct reference to the degree of induced* [travel] *demand that is considered and how it was derived*'

b) The scope of the two scenarios is very limited…what would the impact of carbon emissions be if a proportion of the £1.1bn budget were to be spent on … public transport, cycling and walking?

c) '*…how can this potential development be reconciled with the Welsh Government's commitments enshrined in the Paris Agreement. …investing over £1 billion in a scheme that may or may not be carbon neutral, at a time where unprecedented reductions in carbon are required is highly misguided'*

5.1.2 The objection a) to the effect that the carbon report makes no direct reference to induced demand relates to the traffic modelling. I understand that the traffic modelling does acknowledge and includes increased trips due to induced demand. The outputs of the traffic model have been used for the carbon assessment, and accordingly the carbon assessment does include induced demand. Questions surrounding the extent of induced demand included in the traffic model will be dealt with by Mr Bryan Whittaker.

5.1.3 Objections b) and c) are essentially suggesting that modal shift is likely to have a bigger carbon reduction impact than the Scheme and that the carbon neutrality that the Scheme offers is not good enough. However, a legislative or policy requirement to reduce Carbon does not target each individual scheme,

[3] As an example, please see EU CO2 standards for passenger cars and light commercial vehicles (2014.01.17): http://www.theicct.org/eu-co2-standards-passenger-cars-and-lcvs

but must be achieved as an overall balance with some rising, but many more falling Carbon emissions.

5.2 Friends of the Earth

5.2.1 The Friends of the Earth Cymru (FoE) submission additionally objects on the carbon emissions. A response to the objections is presented below:

Para §	Their objection	My response
9 - Table	They refer to the Transport Planning Objective (TPO) 10 '*Reduced greenhouse gas emission vehicle and/ or person kilometre*' and comment that it is '*a false objective. The objective should be an absolute reduction in greenhouse gas emissions'*	The TPO is a relevant objective, as well as absolute reduction of emissions as a whole. I note that this assessment indicates that the Scheme results in an absolute reduction in Whole Life Carbon emissions after 2066, albeit I acknowledge that there are difficulties in forecasting beyond 2030, as explained above, which could mean Whole Life Carbon neutrality is achieved by an earlier or later date.
[11]	With reference to TPO11, they comment that *'Reliable travel is elevated several-fold more important than greenhouse gas emissions'*	This is a policy consideration and addressed in Mr Matt Jones' Proof of Evidence. Reliable travel is correlated with lack of congestion, one of the prime causes of reduction in User Carbon emissions due to the Scheme, so I don't consider that there is necessarily a tension between the two objectives of enhancing journey reliability and reducing carbon emissions.
[57]	They quote from Clause 7.8.18 of the Regional Air Quality (AQ) Assessment presented in Chapter 7 of the Environmental Statement [Document 2.3.2]: "*However, an increase in CO2 is predicted in the future year likely due to the increase in capacity leading to more vehicles on the road in the future year"*	The CO_2 figures in the regional Air Quality Assessment are based on the Affected Road Network (ARN) as required for compliance with the DMRB. The figures in this carbon assessment are based on the change in emissions from the entire road network and are therefore more relevant for the climate change impact assessment.
[97]	*From 2038 onwards, the 'do something' scenario produces more carbon emissions than the 'do minimum' alternative. The climate is impacted by*	I believe this assertion to be factually incorrect. The Carbon Report and the information presented in earlier sections of this Proof of Evidence, set out the carbon

Para §	Their objection	My response
	total emissions. This scheme is therefore ultimately more climate-damaging than the 'do minimum' alternative	emissions of the Scheme, which do not support this assertion.
[126]	*Carbon emissions will ultimately be higher as a result of the scheme, than they would with the 'do minimum' option.*	I believe this assertion to be factually incorrect. The Carbon Report and the information presented in earlier sections of this Proof of Evidence, set out the carbon emissions of the Scheme which will reach carbon neutrality in the future.
[Appendix 58]	*Emissions are reduced as a result of congestion, where it brings average speeds down as low as 45mph*	Actual vehicle speeds and congestion have been modelled. Congestion does not result in smooth flowing traffic at 45mph; instead, it causes a stop-start traffic behaviour with increased User Carbon intensity.
[Appendix - 62]	*We might reasonably expect the increased CO2 emissions associated with traffic using this motorway to be at least the equivalent of 28 miles of new carriageway, or a minimum 24,556 tonnes CO2 extra per annum.*	The extra traffic has been modelled and is included in the Proof of Evidence of Mr Bryan Whitaker. My Proof of Evidence takes account of the total traffic on the two parallel routes, current and new roads, within the corridor.

6. Summary and conclusions

6.1 My Proof of Evidence relates to the Whole Life Carbon aspects of the Scheme (as defined in PAS 2080) – relating to Carbon (as shorthand for overall Greenhouse Gas) emissions as a contributor to Climate Change.

6.2 Whilst various pieces of legislation require UK and Welsh Governments to make large overall savings in carbon, they should still spend carbon in ways that are beneficial for their citizens – those mandated reductions are not also required at an individual project level. It is, of course, important for every project that carbon is invested deliberately and wisely, hence the production of the analysis in the Carbon Report (in the ES) to inform decision making.

6.3 Analysis of the traffic flows on the wider network (both on the existing M4 and new section of motorway) shows that, even with forecast traffic increases, the Scheme is effectively Whole Life Carbon neutral, with calculations showing a

small saving overall. This is because of a combination of the new route being some 2.8km shorter and also it having significant congestion alleviation benefits over the “Do Minimum” scenario on the existing M4.

6.4 Modelling shows that overall, the Scheme would result in a User Carbon saving of some 4,324 tonnes per year emitted initially, with increasing savings into the future. This would mean that the Capital Carbon of around 522,516 tonnes invested in building the Scheme would be repaid after around 45 years of operation, so by 2066. At this point, the Scheme would achieve Whole Life Carbon neutrality.

6.5 Transport Planning Objective 10 relates to Carbon (“reduced greenhouse gas emissions per vehicle and/or person kilometre”) and is met by the Scheme proposals.