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CLIMATE CHANGE

I am an independent scientist and environmental consultant, working at the intersection of science, policy, and law, particularly relating to ecology and climate change. I work as a consultancy called Climate Emergency Policy and Planning (CEPP).

In so far as the facts in this statement are within my knowledge, they are true. In so far as the facts in this statement are not within my direct knowledge, they are true to the best of my knowledge and belief.

RESUME

I realised recently that my life-scientific goes back over 50 years to when aged 14 I became passionate by the mystery of quantum mechanics. As an undergraduate, I studied for BSc 1977, 1st class honours in Chemistry at Imperial College London. My doctoral work[1], at Oxford University was supervised by Professor R J P Williams, FRS, and was in structural biology, protein binding sites and dynamics (DPhil[2], 1981). I later did an MSc in the then emerging area of "Parallel Computing Systems" at the University of the West of England (1994).

Most of my career has been in scientific computation and modelling. Between 1985 and 1993, I engaged in the software engineering, and testing, of modelling and simulation systems for the high-level design and logic synthesis of Very Large Scale Integrated (VLSI) circuits. These simulation systems were state of the art UK software[3], and in the 1980s and 1990s were at the forefront of formal, mathematical based, methods in the verification of computer systems, both hardware and software, used in applications such as fly-by-wire commercial aircraft. Commercial customers of our products were running software models of microprocessors and Application Specific Integrated Circuits (ASICs), at that time[4], of up to one million transistors.

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[1] My doctoral supervisor was the prolific, much loved and highly missed, British chemist, Napier Royal Society Research Professor R J P Williams, FRS, MBE, [redacted]

[2] DPhil title: "Nuclear Magnetic Resonance Studies of Modified Eukaryotic Cytochrome c"

[3] See references to Electronic Logic Language (ELLA), one of the systems on which I worked, in "The development and deployment of formal methods in the UK", (2020)

[redacted] Cliff Jones and Martyn Thomas, Professor at Gresham College. Professor Thomas was one of my mentors in computing and a superior colleague of mine from 1985-1992 when we both worked at Praxis Systems plc where he was a founding Director.

[4] One million was cutting edge at the time! Transistor counts now exceed two trillion on a single chip

[redacted]

Between 1995 and 2006, I ran the high-performance computer service at the University of East Anglia (UEA), and I supported the university's scientific research community in running models, across a range of sciences, on a small supercomputer which I developed and manged. I have a wide understanding of the principles and practice of modelling complex systems which I bring to my current work.

I provided consultancy across the science faculties at UEA on computer modelling. This ranged from advising several generations of PhD and post-doctoral research students on modelling issues including detailed program coding issues; advising professors and research leaders on system and architectural issues of modelling, and in many cases programming solutions for them; testing and debugging extremely complex modelling systems for scientists who did not have the relevant IT skills in forensic fault finding; systems administration of servers and several iterations of high-performance computers; and running training courses of parallel computing and scientific computing languages across the campus. Supporting scientists running climate models in UEA's esteemed Environmental Science department was a significant part of my work too.

Due to the climate crisis, from 2005 I have been involved in campaigning and politics, and have also been a Green Party Councillor on Norfolk County Council for 12 years. The severity of the climate emergency is clear through science and has been for several decades, and my work through CEPP now is to promote the necessary rapid response to the Climate Emergency in mainstream institutions, such as local authorities and government, through the lenses of science, policy, and law. I am an Expert contributor to the proposed UK Climate and Ecological Emergency Bill[5], drafted by scientists, legal experts, ecological economists, and environmentalists, and designed specifically to reverse the climate and ecological breakdown that we are facing. The Bill recently had a second reading in the House of Commons.

I have been awarded a fellowship for 2022 from the Foundation for Integrated Transport[6] to study "*Exposing the flaws in carbon assessment and transport modelling for road schemes*".

[5] [redacted]

[6] [redacted]

Contents

RESUME 1
Contents 3
1 INTRODUCTION 4
1.1 Scope 4
1.2 Acronyms 4
1.3 Recent changes to relevant policy 5
1.4 Relevant documents from other DCO schemes 5
1.5 Definitions 7
1.6 Overview of statement 7
2 LACK OF TRANSPARENCY OF DATA AND COMPUTER MODELLING 8
3 OUTSTANDING ISSUE - CARBON PRICING – ASSESSING MONETARY VALUE UNDER DfT APPRAISAL CRITERIA 9
3.1 Background to carbon pricing for appraisal 9
3.2 Background to new carbon pricing guidance 9
3.3 Further issues with the economic valuation of carbon 11
4 CHANGES IN LOCAL AND NATIONAL POLICY 12
4.1 Net Zero Strategy in context of the Planning System, and this DCO application 12
4.2 Net Zero Strategy in context of the NN NPS 13
4.3 Surface transport decarbonisation targets in the Net Zero Strategy and the Transport Decarbonisation Plan 13
5 THE EIA REGULATIONS 15
5.1 The EIA Regulations and the NPS NN 15
6 REQUEST FOR FURTHER INFORMATION FROM THE APPLICANT ON THE CUMULATIVE ASSESSMENT OF CLIMATE IMPACTS 17
6.1 Assessment of Cumulative Effects of Greenhouse Gas Emissions from the Scheme with other Existing and/or Approved Projects 18
6.2 Assessment of Cumulative Effects – PINS Advice Note 17 22
6.3 The Appropriate Geographical Scale of Assessment of Greenhouse Gas Emissions 23
6.4 How the Assessment Complies with Various Carbon Budgets and Wider Carbon Policies 25
6.5 How an Assessment was Undertaken to Evaluate the Impacts of the Scheme Including Consideration of Likely Significance Effects 25
6.6 TDP Factor test – data issues 28
6.7 Data and algorithmic transparency issues 28
6.8 Potential double counting 29
6.9 All the data is based on solus, not cumulative, quantification and assessment 30
6.10 How the Assessment Presented for the Scheme Complies with the Environmental Impact Assessment Regulations 30
7 CONCLUSIONS 31
8 SIGNED 31
9 APPENDIX A: BEIS CARBON PRICING POLICY PAPER 32
10 APPENDIX B: DATA AND ALGORITHMIC TRANSPARENCY 44
10.1 The Algorithmic Transparency Standard 44

1 INTRODUCTION

1 I have not previous submitted information on the A303 Stonehenge scheme. However, during the last year, I have contributed submissions on a number of NSIP DCO examinations on carbon quantification and assessment, and also provided expert witness statements to the DfT consultations on the A38 Derby scheme.

2 I believe that my evidence will be helpful to the A303 Re-determination, especially as comments on the Secretary of State's **invitation** the Applicant to update section 4 of their response to the Statement of Matters on carbon and its assessment of the cumulative effects of Greenhouse Gas emissions from the scheme with other existing and/or approved projects on a local, regional and national level on a consistent geographical scale.

1.1 Scope

3 I refer to these documents from the PINS website for the A303 Stonehenge scheme:

Reference in document	
BP3-RESP	Applicant's response to Bullet Point Three. Document reference: Redetermination-1.3
ANTICIP-RESP	The **anticipated** response from the applicant to the SoS's invitation to the applicant to update section 4 of their response to the Statement of Matters – "2. Update to the Environmental Information".
DERBY-EXP-REP-1	My first expert report on the A38 Derby scheme, referenced on the PINS A38 Derby website as "Derby Climate Coalition, Response to the Secretary of State's Consultation of 23 September 2021 - Expert Report of Dr Boswell, published 27/10/2021".
[APP-292]	A303 Stonehenge "7.1 Case for the Scheme and NPS Accordance".

1.2 Acronyms

AST	Appraisal Summary Table
NDC	Nationally Determined Contribution
NZS	Net Zero Strategy
TDP	Transport Decarbonisation Plan

1.3 Recent changes to relevant policy

(a) The Government's Transport Decarbonisation Plan[7] (TDP) and Net Zero Strategy[8] (NZS) were released last year. **The A303 Stonehenge scheme should be assessed against the NZS** which is discussed in more detail in a later section.

(b) New carbon pricing data from the HM Treasury Green Book supplement on quantifying and valuing emissions of GHGs[9], as transposed into an updated version of the DfT's WebTAG guidance[10] and TAG data book (TAG Data Book November 2021 v1.17 (Table A3.4)). **The BCR for the A303 Stonehenge scheme needs to be recalculated**, not just on the basis of new carbon price data, but on to correct problems with the existing BCR calculation which I outline in a later section.

1.4 Relevant documents from other DCO schemes

4 I draw the ExA's attention to these recent consultations by the SoS on the following schemes:

A. A1 in Northumberland – Morpeth to Ellingham [TR010059] (Secretary of State Consultation 3, 22nd December 2021 requiring response by January 19th 2022)

B. M25 junction 10/A3 Wisley interchange improvement [TR010030] (Secretary of State Consultation 8, 22nd December 2021 requiring response by January 19th 2022)

C. M25 junction 28 improvements [TR010029] (Secretary of State Consultation 3, 22nd December 2021 requiring response by January 19th 2022)

D. A38 Derby Junctions [TR010022] (Secretary of State Consultation 3, 22nd December 2021 requiring response by February 4th 2022, and further consultation requiring responses by March 23rd 2022)

5 Each of these consultations requires additional information from the Applicant on the cumulative assessment of climate impacts, and specifically asks for:

> *"The Secretary of State invites the Applicant to update its response of [date] to provide (or, to the extent that it has already been provided, identify)* ***its assessment of the cumulative effects of Greenhouse Gas emissions from the scheme with other***

[7] https://www.gov.uk/government/speeches/transport-decarbonisation-plan

[8] https://www.gov.uk/government/publications/net-zero-strategy

[9] "Valuation of energy use and greenhouse gas: Supplementary guidance to the HM Treasury Green Book on Appraisal and Evaluation in Central Government" https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1024054/1.Valuation_of_energy_use_and_greenhouse_gas_emissions_for_appraisal_CLEAN.pdf

[10] https://www.gov.uk/government/publications/tag-data-book

> ***existing and/or approved projects on a local, regional and national level*** *on a consistent geographical scale (for example an assessment of the cumulative effects of the Roads Investment Strategy RIS 1 and RIS 2 at a national level).*
>
> *This should: take account of both construction and operational effects; identify the baseline used at* ***each local, regional and national level****; and identify* ***any relevant local, regional or national targets/budgets*** *where they exist and how the assessment complies with these (including the carbon budgets, the 2050 zero target under the Climate Change Act 2008, and the UK's Nationally Determined Contribution under the Paris Agreement). It should be accompanied by reasoning to explain the methodology adopted, any likely significant effects identified, any difficulties encountered in compiling the information, and how the assessment complies with the Environmental Impact Assessment Regulations.*
>
> *The Secretary of State would also welcome confirmation that the response to all parts of this question has been prepared by a competent expert. Please can links be provided to any documents referenced and their relevance fully explained."*
>
> **(my emphasis)**

6 The same wording is used in the Secretary of State's letter of February 24th under "2. Update to the Environmental Information" for the A303 Stonehenge scheme.

7 It is clear that the SoS is required to have significant regard, in decision making on road infrastructure, including A303 Stonehenge, to:

A. cumulative carbon emissions assessment
B. local, regional and national assessment
C. UK's national and international obligations on Climate Change
D. EIA Regulations compliance

8 I have examined the responses to the above schemes, and submitted a second expert witness report on the A38 Derby Scheme (available on the PINS A38 Derby Junctions website under the reference "Richard Buxton Solicitors on behalf of Mair Bain", published 29th March 2022).

9 The responses are canonical in that the same answers have been given on each scheme with variations just to the actual numerical data presented relevant for each scheme, and other minor but non-significant differences. **I, therefore, anticipate that a similar response will be given to the Secretary of State's letter of February 24th under "2. Update to the Environmental Information".** I refer to this as ANTICIP-RESP in my response below. I will respond to the anticipated response on the substantive matters which I expect to pertain.

1.5 Definitions

10 For scientific precision, I use the following additional definitions:

- **Absolute emissions** – *carbon emissions which are expressed in terms of **an absolute quantity** of emissions. The value of the absolute emissions, as released into the atmosphere, quantifies the real measure of the impact of greenhouse gases as an environmental factor (or receptor).*

- **Differential emissions** – *carbon emissions, with an associated value which has been **derived by differentiation of absolute emissions**. The differentiation is usually performed by the difference between two traffic scenarios, one with a transport intervention and one without. Differential values derived this way do not quantify the real impact of atmospheric greenhouse gases by the transport intervention within its transport system, and therefore do not represent the real global heating impact.*

1.6 Overview of statement

11 There is a lack of transparency of the data and computer modelling throughout the Environmental Statement and the anticipated new data, and new methodology[11], in ANTICIP-RESP. This is addressed through the document with specific information being requested in places. Section 2 provides an overview of this issue.

12 Section 3 gives background on the further quantification of the economic cost of carbon required for the case for the scheme in the Environmental Statement.

13 Section 4 provides background on the Net Zero Strategy (NZS) which is the most up-to-date delivery mechanism, and policy, for the Climate Change Act (CCA) and a legally binding document, but which has been ignored by the applicant.

14 Section 5 describes the requirement for the assessment of both solus[12] and cumulative carbon emissions under the EIA Regulations, and how this is fully supported by the NN NPS.

15 Sections 6 responds to the anticipated ANTICIP-RESP.

[11] Referred to by the applicant as "TDP Sensitivity test"
[12] Solus means, here, "alone; separate" as in the first definition in the Collins on-line dictionary

2 LACK OF TRANSPARENCY OF DATA AND COMPUTER MODELLING

16 The Application, Environmental Statement, and the applicant's subsequent submissions contain very considerable data on traffic modelling, and calculations of carbon emissions, and assessments.

17 In the anticipated response from the Applicant, ANITICIP-RESP, I expect that there will be a new data set derived by applying a nationally conglomerated "rate of improvement" based on TDP, Figure 2 (referred to by the applicant as "the TDP Sensitivity test").

18 This is on top of other previous sets of data for operational emissions from the Environmental Statement, and from BP3-RESP.

19 In all cases, the full details of the assumptions, data and computer modelling leading to these data changes has not been provided. Further, the modelling behind TDP, Figure 2 has not been published. Consequently, the nationally conglomerated "rate of improvement" based on it, and as applied to the anticipated data figures in ANTICIP-RESP, have been applied as a black-box calculation. (More details on this are explained in later sections).

20 The lack of transparent information and data about the traffic models from which operational carbon emissions are calculated **places severe limitations on any independent review and scrutiny** of the high-level figures published in the Environmental Statement, BP3-RESP, and ANTICIP-RESP. It is, therefore, not possible to fully respond to the current consultation, without publication of the full details of the assumptions, data and computer modelling involved. **The applicant must provide the additional information required so that the SoS can, then, hold a further consultation round.**

21 The Government recently announced an "Algorithmic Transparency Standard" at https://www.gov.uk/government/collections/algorithmic-transparency-standard under the Central Digital and Data Office in the Cabinet Office. Under the new approach, government departments and public sector bodies will be required to explain where an algorithm was used, why it was used and whether it achieved its aim. There will also be an obligation to reveal the architecture behind the algorithm. Although, currently being piloted, it indicates the direction of travel for transparency on data, algorithms and modelling architectures. The current presentation of material falls far short of any standard of transparency. More details are provided at Appendix B.

3 OUTSTANDING ISSUE - CARBON PRICING – ASSESSING MONETARY VALUE UNDER DfT APPRAISAL CRITERIA

3.1 Background to carbon pricing for appraisal

22 The applicant has not recalculated the costs and benefits of carbon, using the new carbon pricing data, for the BCR and economic appraisal of the scheme. This recalculation is not just required for the applicant's own investment decisions, but it is important information for the decision on planning consent.

23 The new carbon price data has changed the application of the DfT's WebTAG guidance and required a re-issuing of TAG Data Book now at v1.17 released in November 2021 with the new carbon price data[13]. In order to demonstrate value for money, and to meet the scheme objectives in the ES, the revised DfT criteria should be tested with new calculations of the BCR as described in a later section. The SoS cannot consider the case for the scheme to be legitimate for determining the DCO, or consistent with its own objectives, until this has been done

3.2 Background to new carbon pricing guidance

24 This section gives a very brief overview of the relevant methodology. The new guidance and carbon pricing values for appraisal were published by the Government in September and October 2021, followed by an update of the DfT WebTAG guidance and TAG data book. The BEIS Carbon Pricing Policy Paper "Valuation of greenhouse gas emissions: for policy appraisal and evaluation" (published 2 September 2021) is given **in Appendix A**.

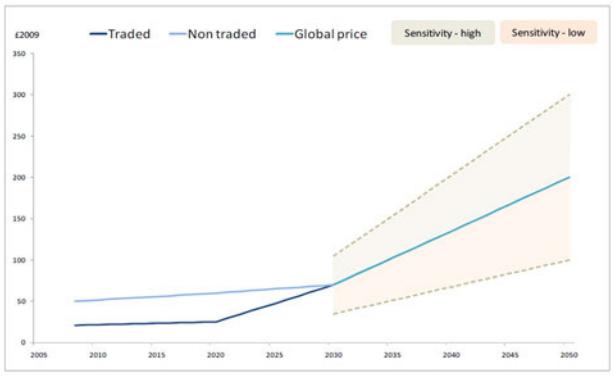
25 In 2011, the previous approach (before the policy changes outlined above and reflected in the Application) of working towards a fully working carbon market was outlined by BEIS' predecessor department DECC[14].

> *"In the short term (up to 2030), different targets in the Traded (ETS) and Non-Traded (non–ETS) sectors imply that emissions in the two sectors are essentially different commodities and the approach to valuing carbon needs to reflect this reality. Therefore, traded and non-traded carbon values will be used over the 2008-2030 period (Chart 1). Beyond 2030, a fully working global carbon market is assumed implying a single carbon value for economic appraisal over the 2031-2050 period ...*

[13] https://www.gov.uk/government/publications/tag-data-book

[14] DECC publication, 2011, "*Guidance on estimating carbon values beyond 2050: an interim approach*", https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/48108/1_20100120165619_e___carbonvaluesbeyond2050.pdf

Chart 1: Traded and Non Traded carbon values (2008-2050)



”

26 The latest Green Book supplement updates the method to recent Government policy on climate change, and the UK Emissions Trading Scheme, and “to give equal weight to emissions from the traded and non-traded sectors”[15]. This means that from 2020 traded and non-traded emissions are equally valued, as shown in the graph below, in the latest carbon pricing figures are shown below graphically as clipped from the policy paper guidance (reproduced in Appendix A).

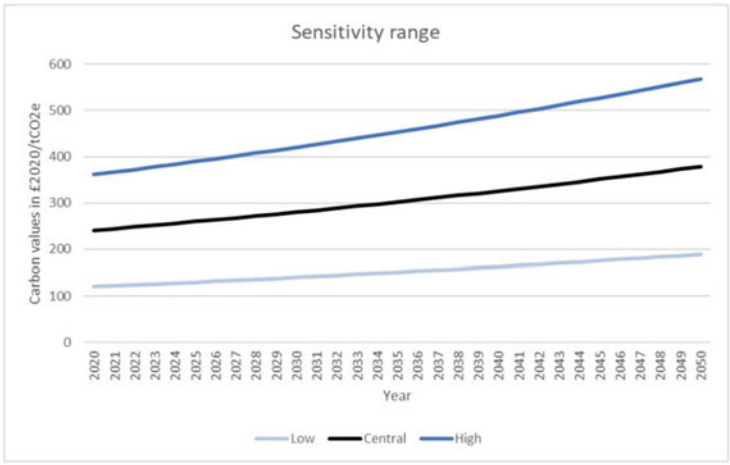


Figure 3: Sensitivity range of the updated carbon values.

27 Note that previously 60-year appraisals of road schemes have split the carbon emissions into the traded and non-traded sectors, with fossil fuel vehicles being non-traded and electric vehicles being traded. The fossil fuel vehicle / non-traded sector has been the numerically predominant sector in the appraisal data.

28 It can be seen that the new carbon prices are significantly greater than the previous ones. For example, for the predominant non-traded sector, the 2020 carbon price in the new

[15] See “*Traded and non-traded carbon*” under “*Valuation of greenhouse gas emissions: for policy appraisal and evaluation*”, September 2nd 2021 at https://www.gov.uk/government/publications/valuing-greenhouse-gas-emissions-in-policy-appraisal/valuation-of-greenhouse-gas-emissions-for-policy-appraisal-and-evaluation

policy data is c. £240/tCO_2e compared to of c. £60/tCO_2e on the previous data (ie 4 times greater).

29 The rationale for the change in carbon price is given in the policy paper, from Department of Business, Energy and Industrial Strategy (BEIS) "*Valuation of greenhouse gas emissions: for policy appraisal and evaluation*", published 2 September 2021 and provided **in Appendix A**. BEIS has conducted a review and update of the carbon values because several factors have changed since the last review, the most significant of which are the following:

i. Changes in international climate change targets, especially the Paris Agreement of 2015 and the new temperature target to limit global overheating to 1.5ºC.

ii. Changes in national targets including the UK 2050 net-zero target.

iii. The introduction of a UK Emissions Trading Scheme (UK ETS) in January 2021 following Brexit.

3.3 Further issues with the economic valuation of carbon

30 The changes in carbon pricing outlined above require a revision of the BCR and the case for the Scheme. However, there are further issues which also need addressing in the required recalculation as follows.

31 The applicant's latest traffic model should be used with the updates enumerated including the Emission Factor Toolkit (EFT) (version 11).

32 **Construction emissions** should be included on the cost side of the BCR.

33 A **solus differential quantity of carbon emissions** should be calculated as specified by this document's Table 2, as shown in a later section, ie: based on the environmental impacts of adding the road to the existing environmental baseline.

34 A quantification of the [full] **cumulative carbon emissions** should be calculated as specified by this document's Table 3, later in this document.

35 For the full economic cost of the greenhouse gases associated with the road requires that the quantification of **cumulative carbon emissions** is also taken forward into the calculations. (ie the full **cumulative carbon emissions**).

36 In summary, the economic case for the road remains completely flawed, and unreliable for a safe determination of the Application, until it is updated for:

A. The new carbon pricing data
B. The new traffic model with EFT v11
C. Construction emissions (on cost side)
D. The full cumulative carbon emissions calculated in compliance with the EIA Regulations

4 CHANGES IN LOCAL AND NATIONAL POLICY

37 There have been significant changes to national policy on Climate Change and carbon reduction targets which the applicant has not yet addressed in its documents to date.

4.1 Net Zero Strategy in context of the Planning System, and this DCO application

38 The NZS is the most up-to-date delivery mechanism for the Climate Change Act (CCA). As such it is a legally binding policy document. CCA Section 13 imposes a duty of the Secretary of State to prepare such a document, and the NZS is the document of proposals and policies that the Secretary of State has prepared, and laid before Parliament under CCA Section 14, to meet the UK carbon budgets and targets.

39 The relevant budgets and targets include:

A. The UK Nationally Determined Contribution under the Paris Agreement of 68% reduction of carbon emissions by 2030

B. The target of 78% carbon emissions reduction by 2035 under the 6th Carbon Budget

C. The 4th, 5th and 6th carbon budgets

D. The net-zero target of net-zero carbon emissions by 2050

40 The planning system is required to take account of the NZS, as the NPPF 152 states that the planning system should "*help to: shape places in ways that contribute to radical reductions in greenhouse gas emissions*" whilst NPPF 153 states:

> *"Plans should take a proactive approach to mitigating and adapting to climate change, taking into account the long-term implications for flood risk, coastal change, water supply, biodiversity and landscapes, and the risk of overheating from rising temperatures <footnote 53>."*

Where footnote 53 says "*In line with the objectives and provisions of the Climate Change Act 2008.*"

41 The NZS is the most up-to-date policy document which provides Parliament's proposals and policies to meet the objectives and provisions of the Climate Change Act, and therefore, it is of material weight in planning decisions.

42 Further the NZS itself at page 252 says:

> *"19 We will make sure that the reformed planning system supports our efforts to combat climate change and help bring greenhouse gas emissions to net zero by 2050. For example, as part of our programme of planning reform we intend to review the National Planning Policy Framework to make sure it contributes to climate change mitigation and adaptation as fully as possible."*

43 This indicates that further strengthening of the NPPF can be expected on top of the already very clear alignment of the planning system to the Climate Change Act via the extant NPPF, and to the NZS as the delivery mechanism for the CCA.

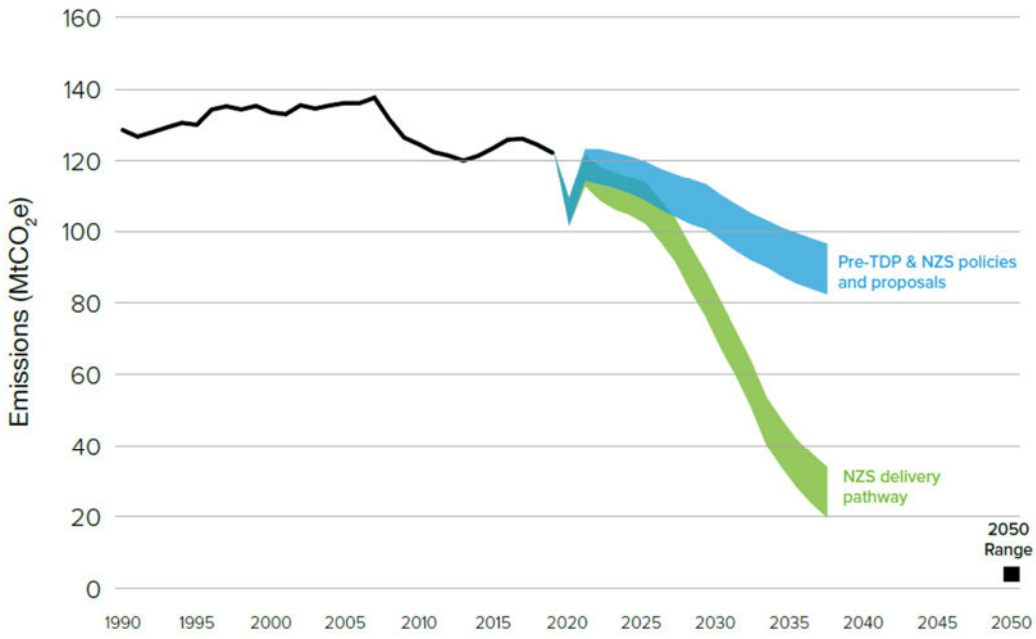
4.2 Net Zero Strategy in context of the NN NPS

44 The NN NPS 5.16- 5.18 provides guidance on carbon emissions, the legally binding framework under the Climate Change Act, the Applicant's assessment, and decision making. The document refers to the eleven-year-old Carbon Plan (2011), as the plan for meeting carbon budgets. Footnote 69 states that "successor documents" should be applied. The NZS is the most up-to-date successor document under section 13 of the Climate Change Act. Therefore, the NZS and TDP are government policies to which the SoS must give weight in determining this DCO Application. Currently, the applicant's Environmental Statement, and responses to the SoS' consultations, are not aligned to the NZS or the TDP. I will explain this in later sections.

4.3 Surface transport decarbonisation targets in the Net Zero Strategy and the Transport Decarbonisation Plan

45 I anticipate that the applicant reproduces Figure 2 of the TDP in ANTICIP-RESP. It should be noted that Figure 21 of the NZS, reproduced below, is a refined version of the same figure. The NZS also provides numerical lower and upper bounds for the emission reductions in the indicative domestic transport emissions pathway to 2037 in the narrative for Figure 21. These are a fall in residual emissions from domestic transport emissions (excluding aviation and shipping) by around 34-45% by 2030 and 65-76% by 2035, **relative to 2019 levels.**

Figure 21: Indicative domestic transport emissions pathway to 2037



Source: BEIS analysis

46 The applicant has not demonstrated that the scheme contributes to the required fall in residual emissions from domestic transport emissions (excluding aviation and shipping) by around 34-45% by 2030 and 65-76% by 2035, **relative to 2019 levels.**

5 THE EIA REGULATIONS

47 Section 1.4 notes that the SoS is required to have significant regard, in decision making on road infrastructure, to a number of issues including EIA Regulation compliance in relation to all matters, including carbon impacts, and cumulative carbon emissions assessment. This section lays out the relationship between the EIA Regulations and the NPS NN, and particularly in relation to cumulative carbon emissions assessment.

48 The NPS NN section 4.15 invokes the EIA Regs and states that the Directive as transposed into UK law *"specifically requires an environmental impact assessment to identify, describe and assess effects on … climate …"*. The EIA Regs Schedule 4 is invoked which requires "*the likely significant effects of the proposed project on the environment, covering the* ***direct effects*** *and any indirect, secondary,* ***cumulative****,* ***short, medium and long-term****, permanent and temporary, positive and negative effects of the project*" to be described in the EIA.

The second highlighted section from NPS NN 4.15 above is directly "cut and paste" from the wording in the EIA Regs themselves, indicating it was the DfT's intention in the NPS NN that significant effects, impacts or benefits as described are included in the Environmental Statement.

49 Again the EIA Regs are invoked for the assessment of carbon emissions at NPS NN 5.17 which states "*any Environmental Statement will need to describe an assessment of any likely significant climate factors in accordance with the requirements in the EIA Directive.*"

50 The Applicant's assessment in the Environmental Statement has not met these requirements of the NPS NN, and has not demonstrated the assessment of ***cumulative impacts.***

5.1 The EIA Regulations and the NPS NN

51 In considering compliance with the EIA Regulations, the Applicant's standard response at other recent DCO applications and examinations is to pitch the NPS NN as somehow legally eclipsing the EIA Regulations. However, this ignores the very clear requirement **in the EIA Regulations** for cumulative assessment which the NPS NN cannot remove.

52 The matter here is not about **either** the EIA Regulations "winning over" the NPS NN, **or** the reverse of the NPS NN winning over the EIA Regulations. The ExA and SoS are required to take account of, and apply, both pieces of legislation (ie it is an **and-and** situation).

53 The NPS NN **directly invokes** the EIA Regulations at NPS NN 4.15 and 4.16. The NPSNN, therefore, fully accepts that the EIA process must be followed in full. The

NPSNN cannot, as a matter of law[16], in any way limit or constrain what is required by the EIA process; a full assessment of a proposed DCO's environmental effects and their significance must be undertaken through the EIA process. This point is, in fact, recognised in the NPSNN at para 4.15 et seq. That section of the NPSNN even states, in relation to cumulative assessments that (at 4.17):

> "*The Examining Authority should consider how significant cumulative effects and the interrelationship between effects might as a whole affect the environment, even though they may be acceptable when considered on an individual basis with mitigation measures in place.*"

54 Moreover, irrespective of what NPSNN policy might say as to how certain environmental effects should be considered, or weighed, in the decision-making process, the independent application of the EIA regime to the DCO process is designed to ensure that all significant environmental effects are both identified and assessed. Following this process, it is entirely permissible for the SoS to weigh a project's significant environmental effects (as part of the adverse impact of the project) into his assessment of the balancing exercise required under section 104(7) of the Planning Act 2008 (see **R (oao ClientEarth) v SSBEIS [2021] EWCA Civ 43** at [95]).

55 Further, for the EIA Regulations, it is necessary to clearly distinguish solus and cumulative assessment. Solus[17] being the impacts of the scheme in isolation. Solus and cumulative impacts in the context of EIA assessment are clarified in *Pearce v BEIS [2021] EWHC 326 (Admin)*.

56 There are two fundamental questions (KQ-1 and KQ-2) which the ExA and SoS need to consider, **through the lenses of both** the EIA Regulations and the NPS NN:

> (KQ-1) How will the Scheme's emissions be quantified?
>
> (KQ-2) Against which "target(s)" or "budget(s)" should the Scheme's emissions be contextualised for assessment?

57 The EIA Regulations are clear that two types of assessments (KQ-2), are required: solus and cumulative. A pre-requisite of this is that two types of quantifications (KQ-1), solus and cumulative, are also required. **The Applicant's traffic model configurations do not provide for the full extent of traffic model configurations to meet the full range of solus, and cumulative quantification and assessment of carbon impacts required.**

58 This is expanded in the next section.

[16] I am grateful to the recent legal submission to A38 Derby Junctions scheme [TR010022], of 27th October 2021, here, https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/TR010022/TR010022-001491-Lewis%20Hadler%20-%20Derby%20Climate%20Coalition.pdf

[17] Solus means, here, "alone; separate" as in the first definition in the Collins on-line dictionary

6 REQUEST FOR FURTHER INFORMATION FROM THE APPLICANT ON THE CUMULATIVE ASSESSMENT OF CLIMATE IMPACTS

59 The SoS in his letter of February 24th 2022:

> *"… **invites** the Applicant to update section 4 of their response to the Statement of Matters on carbon to provide (or, to the extent that it has already been provided, identify) its assessment of the cumulative effects of Greenhouse Gas emissions from the scheme with other existing and/or approved projects on a local, regional and national level on a consistent geographical scale (for example an assessment of the cumulative effects of the Road Investment Strategy ('RIS') 1 and RIS 2 at a national level)."*

60 I anticipate that the applicant will have failed to respond to this invitation in ANTICIP-RESP:

A. It will not have **identified** how it has already provided an assessment of the cumulative effects of Greenhouse Gas emissions from the scheme. As explained below, it has only identified how a quantification and assessment of the **solus** effects of Greenhouse Gas emissions from the scheme has been provided. (Note, this is also wrong solus quantification and assessment, which as explained below is a severe underestimate of the real solus effects).

B. By way of **update(s)** to its response BP3-RESP (in ANTICIP-RESP), it will not have provided an assessment of the **cumulative** effects of Greenhouse Gas emissions from the scheme. The anticipated update is expected to update the numerical CO_2e data in the context of the original quantification and assessment of the **solus** effects of Greenhouse Gas emissions from the scheme.

   Any new data provided in ANTICIP-RESP is expected to include applying a nationally conglomerated "rate of improvement" based on TDP Figure 2 (referred to by the applicant as "the TDP Sensitivity test"). This new set of data is still based on the same traffic modelling as the Environmental Statement and BP3-RESP, which are **solus** only quantifications.

61 The applicant has, therefore, failed to provide the Secretary of State with the information requested. I now provide the evidence for this in detail which I break down below reflecting the anticipated response, as supplied on the other schemes listed in section 1.4.

6.1 Assessment of Cumulative Effects of Greenhouse Gas Emissions from the Scheme with other Existing and/or Approved Projects

62 In responses on other schemes, the applicant describes their traffic model as being "inherently cumulative" because it contains data about:

> *"1) The Proposed Development and adjoining Strategic Road Network and local road network;*
>
> *2) Other Proposed Developments promoted by National Highways in the near vicinity of the Proposed Development with high certainty that they are to be progressed i.e. progressed beyond preferred route announcement stage;*
>
> *3) Foreseeable developments promoted by third parties likely (based on discussions with the relevant planning authorities) to be developed in a similar timeline to the proposed National Highways' scheme. Knowing where the proposed third party development is to be sited, the extents and types of development, and the timescales of when it is to be constructed and completed are requirements to ensure that the third party developments can be reasonably described in the traffic model; and*
>
> *4) National government regional growth rates which include a representation of likely growth rates excluding known planning developments already included in the traffic model. This is represented by DfT's NTEM/TEMPRO growth factors for car usage, and growth in freight is derived from DfT's National Transport Model."*

63 I do not dispute that the applicant's traffic model contains all these elements.

64 The problem in the applicant's position is how it then quantifies and assesses the carbon for the scheme via its selection, and extraction, of data from the different possible configurations of the traffic model. The applicant essentially posits the following notion:

> **'If** the traffic model contains all known road and land developments in the study, **then** it follows that any combination of data, and any differentiation of that data (eg DS-DM), extracted from the traffic model must also be "inherently cumulative".'

This is a defective notion as the latter does not universally follow the former, as I will demonstrate below.

65 Having configured a traffic model for the scheme with all the elements listed above within it, the applicant is then anticipated to describe how they quantify the carbon for the scheme as follows:

> *"In terms of operational carbon, the Applicant has evaluated the changes in CO2e emissions of the proposed Scheme by comparing changes in the road traffic on the Strategic Road Network and local road network between the 'without scheme scenario' and the 'with scheme scenario'."*

66 The applicant, here, identifies a single calculation of "the changes in CO_2e emissions of the proposed Scheme" from the many possible calculations available. By the applicant's own advocacy, this is the only calculation which they perform in the Environmental Statement and subsequent documents, and the only calculation which they are saying is required.

67 However, this calculation produces a differential quantity of carbon emissions for the scheme which is the difference (DS-DM), **solely**, of the all the elements of the network [ie: 1) to 4) above] as the DS case, and all the elements of the network except the scheme as the DM case. This is a **solus** quantification. Notwithstanding that it is the wrong solus calculation, it is also not the only quantification required; the EIA Regulations also require a cumulative quantification, and the SoS has invited the applicant to provide it.

68 This illustrates the calculation made.

	Performance oriented	
Model configuration name	DM (Perf, baseline)	DS (Perf, all)
Baseline Highway network (1)	✓	✓
A303 Stonehenge scheme (1)	×	✓
Other schemes promoted by National Highways (2)	✓	✓
Foreseeable developments promoted by third parties (3)	✓	✓
National government regional growth rates (4)	✓	✓

Table 1

69 The red ellipse indicates the only change in the configuration between the DM and DS scenarios is the presence, or not, of the A303 Stonehenge scheme in the modelling, as the applicant identifies in the quoted statement above.

70 The important point is that although the DS and DM traffic models in this case may be described as "inherently cumulative", **the quantification produced by the differentiation (DS-DM) is "solus" in the sense described by Mr Justice Holgate in in Pearce v BEIS [2021] EWHC 326 (Admin)**. For the EIA Regulations, it is necessary to clearly distinguish solus and cumulative assessment, as Mr Justice Holgate does: solus[18] being the impacts of a scheme in isolation. In the Pearce case, Mr Justice Holgate ruled that the evaluation of (onshore) environmental impacts was required **both** for the windfarm in question (under DCO planning application) in isolation (**ie solus**), and also the windfarm in combination with another windfarm which was undergoing a parallel DCO planning application (**ie cumulative**).

[18] Solus means, here, "alone; separate" as in the first definition in the Collins on-line dictionary

71 The applicant is anticipated to continue:

> *"This takes into account the assessment of the Proposed Development and all other developments likely to have an influence on the Proposed Development and on the area the Proposed Development is likely to influence."*

72 It is a truism that the presence of all elements of data in the traffic model has an influence on its outputs, but it is not a particularly helpful truism in understanding the carbon impacts of the scheme and how to extract them from the model meaningfully. There are two key issues here:

A. Fundamentally, the "influence" of all other developments **is not the same** as **quantifying** their environmental impact, in this case on the EIA receptor of global GHG emissions, which is what the EIA Regulations require. The presence of their influence on the data output is not the same as quantifying their environmental impact, as measured in tCO_2e, and is no substitute for it.

B. The nature and quantification of the "influence" is not addressed. This can be understood by considering another possible **solus** quantification based also on a (DS-DM) differentiation but from different configurations of the traffic model, as shown below.

	EIA Regs compliance-oriented (eg: for impact assessment of GHGs)	
Model configuration name	*DM (GHG, baseline)*	*DS (GHG, scheme)*
Baseline Highway network (1)	✓	✓
A303 Stonehenge scheme (1)	×	✓
Other schemes promoted by National Highways (2)	×	×
Foreseeable developments promoted by third parties (3)	×	×
National government regional growth rates (4)	✓	✓

Table 2

73 Here, the quantification is made by considering the scheme when it is added, in isolation or solus, to the current environmental baseline. In this case, there is no influence from other developments which may follow after the scheme's implementation. This model provides a more accurate description of the journey trips which are attributable to the scheme itself as it quantifies the impact of building out the scheme into the current environmental baseline.

In the applicant's solus calculation (ie as specified by this document's Table 1 above) journey trips attributable to the scheme may actually be accounted for in the DM case. This raises the quantum of the DM, and reduces the DS-DM differential, making it an underestimate of the real solus impacts of the scheme. This shows how the effects of the other developments have an influence which distorts even the solus quantification. Further, the quantification of the tCO_2e associated with the other developments, required for the cumulative assessment, has not been made.

74 This shows that the by-far preferrable way to understand the carbon emissions of the scheme, in isolation, is to perform the solus quantification against the current environmental baseline (ie as specified by this document's Table 2 above), and then perform the applicant's version (ie as specified by this document's Table 1 above) as a sensitivity test on the "influence" that results from considering the other development.

75 Returning to the requirements of the EIA regulations, and the fundamental requirement, for **quantifying** the environmental impacts of the scheme with all other developments for cumulative carbon assessment. This may be done as illustrated below. The required calculation is *DS (GHG, all) – DM (GHG, baseline)* in my nomenclature which has been fully explained in my first expert report on the A38 Derby scheme [DERBY-EXP-REP-1]. Arrows have been added below the Table 3 to make the intended meaning of the two different solus carbon quantifications described above, and the cumulative carbon quantification, required by the EIA Regulations, entirely clear.

	Performance oriented (ie as in APP-254)		EIA Regs compliance oriented (for impact assessment of GHGs)		
Model configuration name	*DM (Perf, baseline)*	*DS (Perf, all)*	*DM (GHG, baseline)*	*DS (GHG, scheme)*	*DS (GHG, all)*
Baseline Highway network (1)	✓	✓	✓	✓	✓
A303 Stonehenge scheme (1)	×	✓	×	✓	✓
Other schemes promoted by National Highways (2)	✓	✓	×	×	✓
Foreseeable developments promoted by third parties (3)	✓	✓	×	×	✓
National government regional growth rates (4)	✓	✓	✓	✓	✓

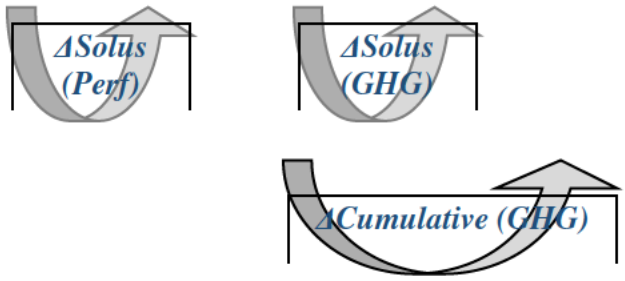


Table 3

76 In summary:

i. The applicant has identified that it has performed a single quantification of carbon. It is a **solus** quantification, and any assessment based on comparing it to benchmarks (such as the NZS and TDP delivery pathways, or carbon budgets) is consequently also only a **solus** assessment.

ii. The solus quantification is the wrong solus quantification. The carbon emissions of the scheme against the existing environmental baseline needs to be quantified, assessed and understood first (DS-DM as specified by this document's Table 2 above). The applicant's DS-DM (ie as specified by this document's Table 1

above) could be an interesting sensitivity test, but it should not be considered as the primary solus quantification (and assessment).

iii. The SoS has invited the applicant to identify its cumulative quantification and assessment of the carbon impacts of the schemes. If I am correct in anticipating their response as above, the applicant has been unable to do so. Therefore, the Environmental Statement remains non-compliant with the EIA Regulations, and further work is still required by the applicant: a cumulative quantification of the carbon impacts of the scheme should be made, and an assessment based upon that. This would be based upon running the traffic model configurations, and calculating *DS (GHG, all) – DM (GHG, baseline)* as specified by this document's Table 3 above.

77 For absolute clarity, the narrative above applies to all data sets that have been provided by the applicant for the operational road-user emissions: that is, the original Environmental Statement, BP3-RESP, and the anticipated new data in ANTICIP-RESP. Each of these use the same traffic model configuration for the DS-DM quantification ie as specified by this document's Table 1 above. Each of the four data sets is a solus only quantification (the wrong solus quantification), and therefore only a solus assessment of the impacts of the scheme has been provided in each case.

6.2 Assessment of Cumulative Effects – PINS Advice Note 17

78 I anticipate that the applicant will refer to PINS Advice Note 17 along the lines:

> *'In essence, as both with and without scheme scenarios already include all likely developments and traffic growth factors, the assessment is inherently cumulative as regards operational carbon emissions. This is recognised in general terms in paragraph 3.4.4 of the Planning Inspectorate's Advice Note 17 ("Cumulative effects assessment relevant to nationally significant infrastructure projects"), the first two sentences of which state that:*
>
> > *"Certain assessments, such as transport and associated operational assessments of vehicular emissions (including air and noise) may inherently be cumulative assessments. This is because they may incorporate modelled traffic data growth for future traffic flows. Where these assessments are comprehensive and include a worst case within the defined assessment parameters, no additional cumulative assessment of these aspects is required (separate consideration may be required of the accumulation or inter-relationship of these effects on an individual set of receptors e.g. as part of a socio economic assessment)."'*

79 The first sentence is false. As demonstrated above, the quantification and assessment made by the applicant of carbon emissions in the Environmental Statement is simply and purely **a solus one**. I have shown above that it is a defective notion that including all

likely developments and traffic growth factors in the traffic model, necessarily generates a cumulative quantification and assessment of carbon impacts.

80 PINS Advice note 17 does not address cumulative carbon assessment. There is no reference to it in the quoted section, but furthermore there is no reference to cumulative carbon assessment in the entire document[19]. Whilst the PINS Advice note 17 is part of a suite of general, and often helpful, advice provided by the Planning Inspectorate, it has no statutory status as the website states.

81 The writers of PINS Advice Note 17 used the word "may" in the first sentence of paragraph 3.4.4 indicating that they understood that it was not universally true that assessments would be "inherently cumulative" just on the basis of the traffic model including traffic data growth for future traffic flows.

82 I have unambiguously shown that the distinguishing feature on the applicant's approach is that it is based on calculating differential emissions, that is DS-DM where DS and DM are absolute carbon emission values output from the traffic model. The quantification and assessment are not inherently cumulative when differential emissions are calculated based on just "with scheme" and "without scheme" models (the inclusion of the scheme, or not, being the only element of difference). The reason is that even if planned changes to the highway network and foreseeable third-party developments are included in each model (input to the calculation), their effects ("influence") on carbon emissions are cancelled out by the subtraction process. This is also clear by considering Tables 1, 2 and 3 above.

83 The applicant appears to have taken this PINS Advice note which does not consider the issue of cumulative carbon assessment, and holds no statutory status and tried to apply it to their case. In referring to its relevance "*in general terms",* the reality is that the note offers no support for the applicant's case.

84 I conclude that Planning Inspectorate's Advice Note 17 gives no support to the applicant's claims, and accordingly the Secretary of State should also inevitably conclude that no weight can be applied to the note in this context.

6.3 The Appropriate Geographical Scale of Assessment of Greenhouse Gas Emissions

85 I anticipate that the applicant will fail to identify that the NZS now provides a sector specific target for surface transport under UK Climate Change legislation, and will have failed to withdraw its repeated assertion that there is no sector specific target for transport.

86 I anticipate that the applicant will state:

> *"Neither Parliament nor Government has identified any sectoral targets for carbon reductions related to transport, or any other sector. There is no requirement in the*

[19] https://infrastructure.planninginspectorate.gov.uk/legislation-and-advice/advice-notes/advice-note-17/, accessed 18th March 2022

CCA 2008, or in Government policy, for carbon emissions for all road transport to become net zero."

and will refer to *R(Transport Action Network) v Secretary of State for Transport [2021] EWHC 2095 (Admin)* ("the TAN case"). However, the TAN case judgement was in July 2021 whilst the Net Zero Strategy was published in October 2021. The Net Zero Strategy has been laid before Parliament under section 13 and 14 of the Climate Change Act, and provides the up-to-date legal and policy framework to be considered within the context of the NPS NN.

87 The Net Zero Strategy (NZS) and the Transport Decarbonisation Plan (TDP) update the policy framework since the TAN case. Both documents provide the same sector specific decarbonisation pathway, and implied targets, for the surface transport sector, and the NZS is legally binding policy under section 13 of the Climate Change Act 2008 (CCA).

88 The NZS delivery pathway, related to road transport, in the Figure below corresponds to a fall in residual emissions from domestic transport emissions (excluding aviation and shipping) by around 34-45% by 2030 and 65-76% by 2035, **relative to 2019 levels** (see Figure 21 from the NZS reproduced above).

89 Figure 21 of the NZS, reproduced in an earlier section, is a refined version of the Figure 2 of the TDP (which I anticipate will be reproduced by the applicant in ANTICIP-RESP), and shows the linkage between the TDP and the NZS. Essentially the same indicative delivery pathway for domestic transport has been carried forward from the TDP to the NZS.

90 The applicant has claimed that there is no sector specific target under UK Climate Change legislation. However, the NZS (and TDP) which is the delivery policy document for achieving the CCA targets and budgets has clearly laid out an indicative delivery pathway for surface transport as one of the 11 sectors under the Climate Change Act budgets. **This is a sector specific target for surface transport under UK Climate Change legislation.**

91 Despite the very clear material relevance of the NZS to appraisal of carbon in road schemes under the NN NPS, as outlined above, the applicant has failed to mention the NZS targets, indicative delivery pathways, for surface transport.

92 As described in the NZS section above, with the NZS, the Climate Change Act is a material consideration for this scheme, and this is supported by NPPF 153, footnote 53, and NN NPS, footnote 69.

6.4 How the Assessment Complies with Various Carbon Budgets and Wider Carbon Policies

93 I anticipate that the applicant will fail to identify that the NZS now provides a sector specific target for surface transport under UK Climate Change legislation. It has also failed to withdraw its repeated assertion that there is no sector specific target for transport.

94 Despite the very clear material relevance of the NZS to appraisal of carbon in road schemes, as outlined above, the applicant has failed to mention the NZS (and TDP) targets, indicative delivery pathways, for surface transport. As described in the NZS section above, with the NZS, the Climate Change Act is a material consideration for this scheme, and this is supported by NPPF 153, footnote 53, and NN NPS footnote 69, as explained in previous sections.

6.5 How an Assessment was Undertaken to Evaluate the Impacts of the Scheme Including Consideration of Likely Significance Effects

95 In previous recent responses on carbon emissions, the applicant has stated that they have been advised by the DfT that "a sensitivity test based on the impact of the policy measures set out in TDP can now be undertaken for schemes", and that "the DfT has approved a sensitivity test based on the rate of improvement shown in Figure 2 of the TDP which can be applied to CO_2e emissions calculated for the Scheme assessment". I anticipate that the applicant will provide numbers which they refer to as a "TDP Sensitivity test" in ANTICIP-RESP.

96 I first raise two issues with the overall method which the applicant refers to as the "TDP Sensitivity test".

97 The **first** is that what has been performed - applying the TDP Figure 2 rate of improvement to CO_2e emissions calculated for the Scheme – is not what is normally understood as a sensitivity test. Sensitivity analysis is the study of how the uncertainty in the output of a mathematical or computer model can be understood and proportioned statistically to different sources of uncertainty in its inputs. In terms of traffic modelling, I have already described how the solus quantification of carbon emissions for the scheme, as specified by this document's Table 1 above (and that performed by the applicant), can be a sensitivity test of the preferrable, and more accurate, solus quantification of carbon emissions for the scheme, as specified by this document's Table 2 above (and that has not been performed by the applicant). This is an example of sensitivity analysis, in this case, testing the influence of adding other known developments to the traffic modelling on the differential carbon emissions associated with the scheme.

98 The anticipated method described in ANTICIP-RESP, by contrast, applies a graph of some desirable, future outcome (ie the TDP Figure 2) to existing data. This makes **no** test of how the carbon emission outputs change depending on inputs to the modelling. Further, the "rate of improvement" represented by TDP, Figure 2 is conglomeration of national data, and therefore, takes no account of the specific, and local, conditions which determine the carbon emissions in the traffic model study area.

99 The method is falsely called a "TDP Sensitivity test". It would be more accurately described as applying a "<u>TDP policy factor</u>", and I will use that descriptor from now on.

100 The **<u>second</u>** is that even **<u>if</u>** applying a TDP Policy factor was technically sound and reliable, and I don't agree that it is without the full publication and scrutiny of the method, **then** it could only be justified where the case for the scheme fully aligned with the TDP, and NZS, policies.

101 However, the case for the A303 Stonehenge scheme was developed many years in advance of the TDP and NZS, and did not even foresee these key policy documents of the current legal framework, let alone attempt to align with them.

102 [APP-292] is titled "7.1 Case for the Scheme and NPS Accordance". And section 2.8.2, it outlines specific scheme objectives including:

> *"Transport – To create a high quality reliable route between the South East and the South West that meets the future needs of traffic."*

103 This objective, based on the needs of traffic and future traffic growth, is not easily aligned with the policies in the NZS and TDP. For example, page 156 of the NZS states:

> *"We cannot simply rely on the electrification of road transport, or believe that zero emission cars and lorries will solve all our problems.* ***As we build back better from the pandemic, it will be essential to avoid a car-led recovery.*** *Alongside road vehicle decarbonisation, we must increase the share of trips taken by public transport, cycling and walking. We want to make these modes the natural first choice for all who can take them. As more journeys are cycled or walked, and taken by public transport, the carbon, air quality, noise and congestion benefits will be complemented by significant improvements in public health and wellbeing."*

104 Whilst page 6 of the TDP says:

> *"Road traffic, even on pre-pandemic trends, was predicted to grow by 22 percent from 2015 to 2035 much of it in cities, where new roadbuilding is physically difficult and disadvantages communities.–*
> *We cannot pile ever more cars, delivery vans and taxis on to the same congested urban roads. That would be difficult for the roads, let alone the planet, to tolerate.* ***As we build back better from the pandemic, it will be essential to avoid a car-led recovery.****"*

105 The scheme is predicated on increasing capacity of the strategic road network in response to the future needs of traffic. Just at the policy level, the TDP and NZS do not support unbridled increase of capacity and provide policy support against a car-led recovery from the pandemic.

106 When this discrepancy is taken to the numerical level of quantifying carbon emissions, as I anticipate it will be in the applicant's ANTICIP-RESP, it is clear that the different data being applied is not internally consistent. First, there are the traffic models of the scheme which as enumerated contain the Baseline Highway network, the scheme itself, other schemes promoted by the applicant, foreseeable developments promoted by third parties, and national government regional growth rates. And second, the TDP policies which require avoiding a car-led recovery, a significant modal shift to non-motorised journeys, and a contraction of the overall need for vehicle movements. The different elements within the traffic model expand vehicles using the network and with the express intent of expanding capacity, and model the effects of this to produce a carbon quantification. The TDP Policy factor applies numbers based on very different, and in some cases quite opposing, policy directions to the carbon quantification output from the models. **The approach is simply incoherent.**

107 The **genuine TDP Sensitivity test** would be to apply the individual TDP policies in the local context of the study area in the traffic models themselves. For example, the "foreseeable developments promoted by third parties" could be remodelled to align with the policies in the TDP for modal shift in new developments[20]. This would give a clear indication of the effect of remodelling land-based developments for TDP compliant modal shift against the approach incorporated in the traffic model which is based on unconstrained traffic growth, and car-based development, as conceived quite a few years ago. This has not been attempted by the applicant, despite the TDP, and NZS, now being part of the policy and legal framework.

108 In summary, "TDP Sensitivity test" is a misnomer for the new data anticipated in the applicant's ANTICIP-RESP, and it is nothing more than a non-project specific TDP Policy factor that has actually been applied. However, the TDP policies - the basis for the TDP Policy factor - do not align with the assumptions in the existing traffic model. The result is an incoherent method which produces numbers to which no value, nor weight, can be given in determination of the DCO.

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[20] See TDP, page 8 "We must also do better at joining up our transport, decarbonisation, and planning goals in both urban and rural areas. Too many new developments – not just by housebuilders, but by public-sector bodies – are difficult to reach without a car. But if we do development in a greener way, and if we join it to existing places, we can make it lower-carbon, lower-emission and lower-traffic – and more acceptable to local communities. We will also support local areas to decarbonise by linking local infrastructure funding to solutions that cut emissions – aligning billions of pounds of investment to our net zero mission.", and

TDP, page 156 "**We will embed transport decarbonisation principles in spatial planning and across transport policymaking**", and "The government wants walking, cycling or public transport to be the natural first choice for journeys. Where developments are located, how they are designed and how well public transport services are integrated has a huge impact on whether people's natural first choice for short journeys is on foot or by cycle, by public transport or by private car. The planning system has an important role to play in encouraging development that promotes a shift towards sustainable transport networks and the achievement of net zero transport systems. Traffic issues have often caused opposition to housebuilding. There is a legacy of developments that give people few alternatives to driving, are difficult to serve efficiently by public transport and are laid out in ways which discourage walking and cycling. Developments which are planned to minimise car use, promote sustainable transport choices, and are properly connected to existing public transport could help make new building more publicly acceptable."

6.6 TDP Factor test – data issues

109 I anticipate that there will be two further fundamental problems with new data in ANTICIP-RESP:

i. No explanation as to the assumptions and modelling used to generate TDP Figure 2 has been provided, either in ANTICIP-RESP, or elsewhere since the TDP was published. The same is true for NZS Figure 21 which is a refinement of TDP Table 2. This is despite various Freedom of Information requests[21] and a parliamentary question[22] being raised. Therefore, the anticipated application of a TDP Policy factor based on the rate of improvement shown in TDP Figure 2, will presented as a black-box calculation, and algorithmically untransparent. I present further questions on this below.

ii. Despite the new data anticipated as being in ANTICIP-RESP, I anticipate that **no assessment or conclusions will be made** from the data. The anticipated presentation relating to the new data is therefore expected to fail to achieve what it sets out to do which is to describe "how an assessment ..." was undertaken.

110 On point i, I draw attention to my statement above on "Lack of Transparency of Data and Computer Modelling" and the Algorithmic Transparency Standard (see Appendix B). If as anticipated, the applicant has applied figures for a nationally conglomerated "rate of improvement" based on TDP, Figure 2 to figures derived directly from traffic modelling without explaining how the TDP figures are derived, then **for data and algorithmic transparency, a full explanation of how these figures are derived is required.** The anticipated introduction of this new material, and the lack of transparent information and data relating to it will place severe limitations on the independent review by interested parties and other such as myself. A further consultation round following full data transparency is required as enumerated next.

6.7 Data and algorithmic transparency issues

111 If as I anticipate, the applicant has **applied** a black box approach which it describes as "a sensitivity test based on the rate of improvement shown in Figure 2 of the TDP which can be applied to CO_2e emissions calculated for the Scheme assessment". All TDP policies are assumed to be working as a conglomerate mass, based on a model at the national level, the details of which have not been made public.

112 The approach of applying a nationally conglomerated "rate of improvement" to carbon quantities which are derived from a specific traffic model for a specific study makes no account of:

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[21] For example, by the New Scientist "UK refuses to release document showing Net Zero Strategy CO2 savings", 1 December 2021, [redacted]

[22] Kerry McCarthy, MP, 18th October 2021 to Trudy Harrison, MP [redacted]

A. **which** TDP policies are having an effect, and

B. **how, and by how much,** they are having an effect on the transport carbon emissions associated with the scheme in the study area

113 As such, applying the TDP Policy factor is a blunt tool which eliminates the gathering of useful information rather than generating it.

114 **The applicant must provide a complete breakdown of the calculations behind TDP Figure 2**, showing for each policy how it has been modelled and what its contribution towards the decarbonisation path in TDP Figure 2 is. The applicant must provide any analysis, if there is any, on how each potential TDP policy may impact and apply **to the particular situation in the study area** of the scheme.

115 **The applicant must also make available a wide range of data involved in the traffic modelling.** For the study area, the highway and public transport matrices, changes in walking and cycling modelled, and automatic TUBA outputs for each of the three traffic models (rows A, B and C in Table 4 above). These will also be useful in analysing how each potential TDP policy, for example those on modal shift in new developments, impacts the study area. Further, the 60-year appraisal spreadsheets for GHGs should be provided for each of these traffic models. The Economics Table and new BCRs should also be calculated, including the new appraisal carbon pricing data from Government.

116 **If the applicant has produced a 60-year appraisal GHGs spreadsheets for its "TDP Sensitivity test"** set of data, then they should provide this.

6.8 Potential double counting

117 Further, I have concerns that there may be **double counting** between emission reductions in the EFT v11 and the application of the TDP sensitivity test. Data from EFT v11 traffic model runs will already have emissions outputs for the years 2031-2050 with updated fleet and engine efficiency adjustment factors. The DEFRA EFT webpage states "the 'Output CO2 Summary' sheet provides a summary of direct CO2 emissions from tailpipe and indirect CO_2e emissions associated with the charging of the batteries of electric and plug-in hybrid cars and LGVs, in tonnes/annum"[23].

118 As significant policies in the TDP relate to electric vehicle (eg "A zero emission fleet of cars, vans, motorcycles, and scooters", and "Zero emission buses and coaches" in the "Summary of commitments", TDP, Part 2a, for "Decarbonising all forms of transport"), decarbonisation from electric vehicles can be expected to be part of the nationally conglomerated "rate of improvement" implied by TDP Figure 2".

[23] https://laqm.defra.gov.uk/air-quality/air-quality-assessment/emissions-factors-toolkit/, "Emissions Factors Toolkit", accessed Mar 18th 2022,

119 This risk of double counting may extend to other policies too, such as modal shift: electric vehicles is just the most obvious example.

120 **The Applicant must provide a breakdown of all the adjustments for carbon reduction values made in the EFT v11 and the TDP Figure 2, and demonstrate that there is a clear demarcation of which contribute to the EFT v11 and which to the emission reductions implied by the TDP Policy factor.** There should also be a clear demonstration that DEFRA and DfT are working to ensure that this demarcation and apportionment of emissions reduction effects between versions of the EFT and the TDP modelling is fully understood. The resolution of this issue may require work between DEFRA and the DfT.

121 If as anticipated, the applicant presents carbon emission quantities calculated from model runs by first introducing the EFT v11 and second by the application of the TDP Policy factor, then **the applicant must provide a very clear explanation of, and demarcation between, the effects contributing to each of the reduction effects on their data.**

6.9 All the data is based on solus, not cumulative, quantification and assessment

122 All of the data presented from different traffic model runs (with different EFT versions, and with the TDP Policy factor) for operation emissions data are **only solus** quantifications, and the **wrong solus** quantifications, as described earlier.

123 No assessment is possible of the cumulative carbon impacts of the scheme with other developments, as these cumulative impacts have not been quantified as explained earlier. **The applicant has still not made the application EIA compliant**.

6.10 How the Assessment Presented for the Scheme Complies with the Environmental Impact Assessment Regulations

124 I have shown in previous sections that the Applicant has not quantified, nor assessed, the cumulative impacts of the development proposed together with those from other "existing and/or approved projects".

125 The applicant claims that it "can only assess the change in CO_2e emissions from the Scheme in absolute terms". However, the quantifications that the applicant calculates are differential in nature, being differences (DS-DM) of configurations of the traffic model. The differential emission quantities do not reflect the scale of the absolute emissions in the study area with the scheme. The absolute emissions value is the realistic quantification of the transport emissions for the study area, as part of local, regional or national carbon budgets.

7 CONCLUSIONS

126 No cumulative carbon assessment has been provided for the A303 Stonehenge scheme, despite the SoS requesting twice. The Environmental Statement does not comply with the EIA Regulations requirement for cumulative carbon assessment.

127 The Environmental Statement is therefore not legitimate under the current policy and legislation.

128 The scheme should be refused consent.

8 SIGNED

Dr Andrew Boswell,
Climate Emergency Policy and Planning, April 4th, 2022

9 APPENDIX A: BEIS CARBON PRICING POLICY PAPER

Policy paper, Department of Business, Energy and Industrial Strategy (BEIS)
"Valuation of greenhouse gas emissions: for policy appraisal and evaluation"
Published 2 September 2021

GOV.UK

Policy paper

Valuation of greenhouse gas emissions: for policy appraisal and evaluation

Published 2 September 2021

Contents

Introduction
Methodology
Application
Annex 1: Carbon values in £2020 prices per tonne of CO2

Introduction

This document sets out a revised approach to valuing greenhouse gas (GHG) emissions in policy appraisal, following a cross-government review during 2020 and 2021. It replaces the previous guidance on carbon valuation (https://www.gov.uk/government/publications/carbon-valuation-in-uk-policy-appraisal-a-revised-approach).

What are carbon values?

Greenhouse gas emissions values ("carbon values") are used across government for valuing impacts on GHG emissions resulting from policy interventions. They represent a monetary value that society places on one tonne of carbon dioxide equivalent (£/tCO2e). They differ from carbon prices, which represent the observed price of carbon in a relevant market (such as the UK Emissions Trading Scheme).

The government uses these values to estimate a monetary value of the greenhouse gas impact of policy proposals during policy design, and also after delivery.

Why value GHG emissions in policy appraisal?

The fundamental purpose of assigning a value to the GHG emissions impacts that arise from potential government policies is to allow for an objective, consistent and evidence-based approach to determining whether such policies should be implemented. Carbon values are used in the framework of broader cost-benefit analysis to assess whether, taking into account all relevant costs and benefits (including impacts on climate change and the environment), a particular policy may be expected to improve or reduce the overall welfare of society.

To reach net zero in 2050 and meet our 5-yearly carbon budgets (https://www.gov.uk/government/publications/carbon-valuation-in-uk-policy-appraisal-a-revised-approach), a robust approach to valuing emissions is vital to ensure that government takes full account of climate change impacts in appraising and evaluating public policies and projects, whether those policies are intended to reduce emissions or are likely to have the effect of increasing emissions. Such policy decisions often involve making choices between competing policy objectives.

Assigning a value to carbon helps to ensure that such choices are made in a transparent fashion and in a way that seeks to be cost-effective for UK society as a whole.

Valuing emissions impacts explicitly when making policy decisions helps to:

- ensure the climate impacts of policies are fully accounted for
- ensure consistency in decision making across policies
- improve transparency and scrutiny of decision making

Valuing emissions impacts robustly is important, however it is often the case that some of the most strategically important benefits of climate policy cannot always be quantified. For example; strengthening of decarbonisation supply chains; or increases in the UK's resilience to deal with extreme climate events. As a result, quantified benefits of carbon saving policies can underestimate the true benefits. Therefore, policy makers and decision makers should consider all qualitative and quantitative evidence in the round as set out in the Green Book, even if a project has a low estimated benefit-cost ratio.

Greenhouse gas emissions should be valued for all policies that may have an impact on emissions, whether these impacts are positive or negative. This includes policies whose primary objective is not related to progressing the net zero target, but where there are indirect impacts on emissions.

It should be stressed that the carbon values discussed in this paper apply to all types of policy, providing there is some impact on emissions. It is not the aim of this document to discuss how these policies should be designed but rather to provide carbon values to be used in the economic appraisal or evaluation of these policies. Detailed practical guidance for analysts on how to apply the carbon values in appraising policies is available in the Green Book Supplementary Guidance: Valuation of Energy Use and Greenhouse Gas Emissions for appraisal (https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal).

Rationale for reviewing and updating carbon values

BEIS's current approach to carbon valuation for appraisal purposes was set out in the 2009 publication Carbon Valuation in UK Policy Appraisal: A Revised Approach (https://www.gov.uk/government/publications/carbon-valuation-in-uk-policy-appraisal-a-revised-approach).

Since 2009, a 'target consistent' approach has been used to estimate the values, where these are calculated as the marginal abatement cost of meeting targets.

BEIS has conducted a review and update of the carbon values because several factors have changed since the last review, the most significant of which are the following.

Changes in international targets

The UK signed the Paris Agreement in 2016, which sets out a more ambitious goal - to keep global temperature rise well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5°C.

Changes in domestic targets

In June 2019, the UK adopted in law the recommendations of the Climate Change Committee, to achieve net zero GHG emissions by 2050 (compared to the previous target of an 80% reduction by 2050 on 1990 levels).

EU Exit

The UK has left the EU Emissions Trading System (EU ETS) and from January 2021 introduced a UK Emissions Trading Scheme (UK ETS).

New understanding of technology costs and availability

Some of the key technologies for decarbonisation such as renewable power generation and batteries have seen larger-than-predicted price reductions over the last 10 years which should reduce abatement costs in relevant sectors.

Previous reviews of the value of carbon

In 2009 the government conducted a review of the approach taken to developing carbon values. The conclusion of the review was to move to a "target-consistent" or "abatement cost" approach to carbon valuation rather than a "social cost of carbon" (SCC) approach. The main rationale for moving away from the SCC is further outlined in the 2009 publication of Carbon Valuation in UK Policy Appraisal: A Revised Approach (https://www.gov.uk/government/publications/carbon-valuation-in-uk-policy-appraisal-a-revised-approach).

Under the target consistent approach, the appraisal of individual policies is based on target-consistent values of carbon. Previously these were be based on a "traded value of carbon" for appraising policies that affected emissions in sectors covered by the EU ETS and, in the short term, a "non-traded value of carbon" for appraising policies that affected emissions in sectors not covered by the EU ETS. In the long term (post-2030), a single series of carbon values was used covering emissions across the economy based on global abatement cost estimates.

Since 2009, the government has ensured that the values remain fit-for-purpose, by taking the following actions:

- the values were updated annually to update the real terms price base year and also reflect developments within the EU ETS
- policy analysis used high and low ranges as part of sensitivity analysis to account for uncertainties
- in 2011, BEIS produced guidance on valuing emissions post-2050. This ensured that policies with a longer time horizon correctly accounted for their emissions impact during the appraisal stage

Methodology

Aproach taken to updating the values

We have given due consideration to the following criteria while updating the current values:

- consistent: the new values must be consistent with the UK's national and international climate commitments
- simple and transparent: the series should be intuitive, resistant to modelling artefacts, easily understandable and replicable
- evidence-based: the values should be supported by the latest evidence available
- pragmatic: the series should be stable, and allow effective decision-making in its application, and represent a reasonable balance of the factors above

The new carbon values are based on a Marginal Abatement Cost (MAC) or "target-consistent" valuation approach. This involves setting the value of carbon at the level that is consistent with the level of marginal abatement costs required to reach the targets that the UK has adopted at a UK and international level. This is illustrated, in simplified form, below in Figure 1 which illustrates how a "target-consistent" carbon value would be set. From our understanding of emissions projections and abatement options, we can determine the effort level, A*, that is required in order to meet the UK's targets. Reading across from the abatement curve produces the corresponding carbon value level.

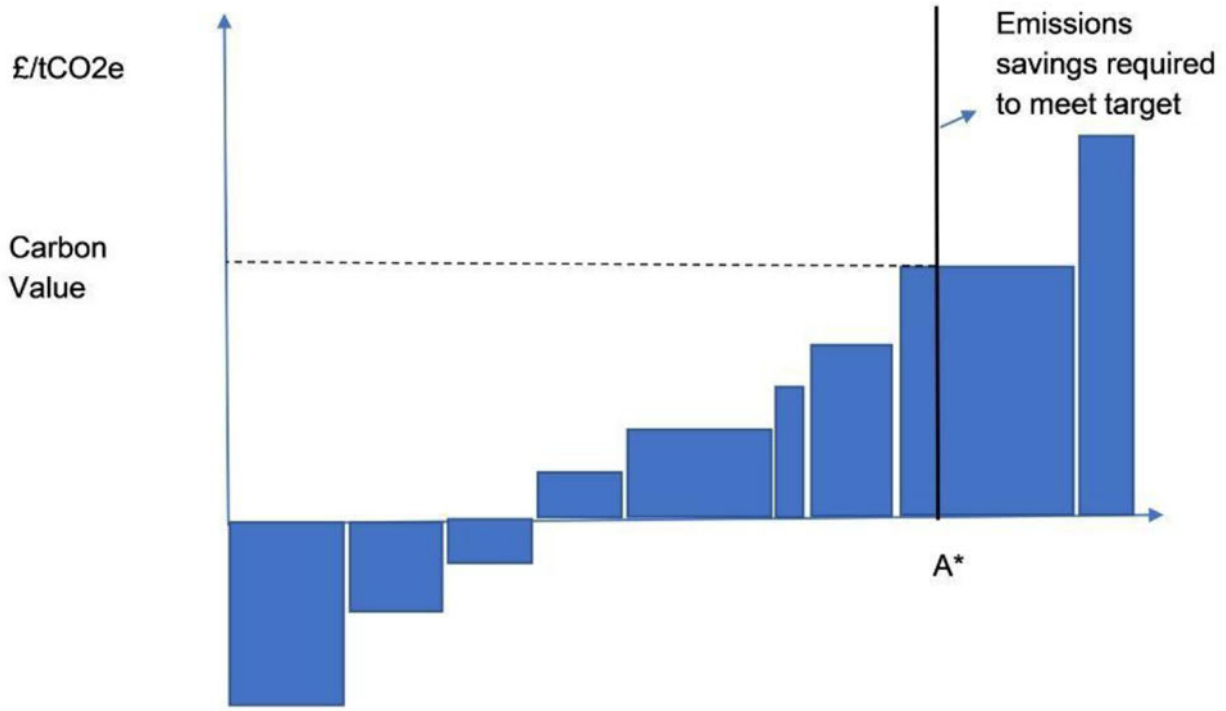

Figure 1: illustrative MAC curve

BEIS has consulted academics and commissioned a literature review, which confirmed that the SCC approach is not recommended for use and that the target-consistent approach remains the best option. The target-consistent approach is preferred in two main areas. First, it is more credible as the methodology is more transparent and relies less on unobserved factors and uncertain estimates about damages caused by GHG emissions. Second, the approach is well-aligned with the net zero target, which represents the UK's primary legal obligation.

BEIS has taken the following steps to produces the carbon value series:

- identifying appropriate targets
- selecting the modelling approach
- translating the range of modelling outputs into a single series
- defining an appropriate uncertainty range

Climate targets

The UK has both domestic and international climate targets. The updated carbon values presented in this publication are intended to be consistent with both targets.

Internationally, the UK has committed to climate targets under the Paris Agreement. The Paris Agreement provides for the international community to keep the increase in global average temperature to well below 2°C above pre-industrial levels, and to pursue efforts to limit the temperature increase to 1.5°C. The government has a clearly stated focus on 1.5°C, with well below 2°C being inconsistent with its climate leadership intentions.

Domestically, the UK government has legal targets committing us to reaching net zero emissions by 2050, along with a series of interim carbon budgets (each covering a 5-year period) paving the trajectory towards the net zero target. Recently, the UK announced the Sixth Carbon Budget level (2033-37) (https://www.gov.uk/government/news/uk-enshrines-new-target-in-law-to-slash-emissions-by-78-by-2035), equivalent to reducing emissions around 78% by 2035 compared with 1990 levels. This is consistent with a pathway through our 2030 Nationally Determined Contribution (NDC) under the Paris agreement (which is more ambitious than the legislated 5th Carbon Budget).

The domestic targets are the UK's chosen implementation of our international commitments and represent a more ambitious end point and more front-loaded pathway than previous targets.

Modelling approach

The carbon values review has taken a range of evidence on abatement costs into consideration. It has been informed by internal BEIS modelling as well as international evidence from the Intergovernmental Panel on Climate Change (IPCC). The evidence base has been used by both the government and the Climate Change Committee in its advice and decisions on carbon budgets and net zero.

Evidence base

Global carbon prices from IPCC Modelling

The scientific and economic modelling literature underpinning the IPCC assessment reports provides a broad consensus on the global technological and emission trajectory changes that are needed to maintain climate change below 2°C of warming, but there is no consensus on the carbon price signals needed to trigger such transformations, with the exception of prices increasing throughout the end of the century[footnote 1]. Consistent with the 2009 values, the revised carbon values are anchored on long-run global abatement costs rather than UK costs, but as discussed later the trajectory over time reflects the UK's relatively front-loaded domestic targets.

There is a significant range of uncertainty in the carbon price trajectories deriving from the application of Integrated Assessment Models (IAM)[footnote 2]. The differences in carbon price trajectories are often driven by either structural differences in modelling approaches (that is, optimisation models v. dynamic recursive models) or by differences in underlying scenario assumptions on the future evolution of socioeconomic factors (that is, population or GDP forecasts). This means that there is no true or unique carbon price trajectory that is perfectly aligned with a given global temperature target. The trajectory will depend on the future uncertain evolution of socioeconomic factors and implementation of mitigation actions[footnote 3].

IPCC values, produced by a suite of IAMs, are freely available (https://data.ene.iiasa.ac.at/iamc-1.5c-explorer/#/workspaces). In this case the modelled carbon prices and emissions projections were sourced from the 1.5°C low overshoot pathway class of modelling scenarios (including a constraint on Kyoto gas emissions in 2010 being sufficiently close to observed values) following the IPCC approach outlined in Chapter 2 of IPCC Special Report 1.5 and also followed by the CCC in their analyses. The median carbon price was calculated from the range of carbon prices and converted from USD2010 to GBP2020.

GloCaF – BEIS Global Carbon Finance Model

GloCaF models an idealised carbon market. A global emission trajectory is set and by means of 100% free trade with no friction, each region mitigates up to the same marginal cost to meet the global target. Trade is modelled across 25 specified regions, giving global coverage, including International Bunkers (International Aviation and Maritime sectors). Trade is allowed across all 24 sectors of the model, giving economy-wide coverage. The result is the most cost-effective carbon price, by which the abatement target equivalent to the emissions target, might be achieved.

In setting the emissions target for the modelling of necessary abatement we used the median value of the range of IPCC climate model outputs for the 1.5°C target to limit global temperature increase to 1.5°C by 2100, allowing for a temporary marginal exceedance (low overshoot) prior to 2100 ("1.5LowOS"). In modelling of 2030 and 2040 abatement necessary to achieve emissions that correspond to the median emissions projected for 1.5LowOS, GloCaF carbon prices are within the interquartile range of carbon prices included in the IPCC model set. The 2030 value is marginally lower than the IPCC median (£147 vs £163) and the 2040 value higher than the corresponding IPCC median (£576 vs £326), while still within the interquartile range of IPCC carbon values.

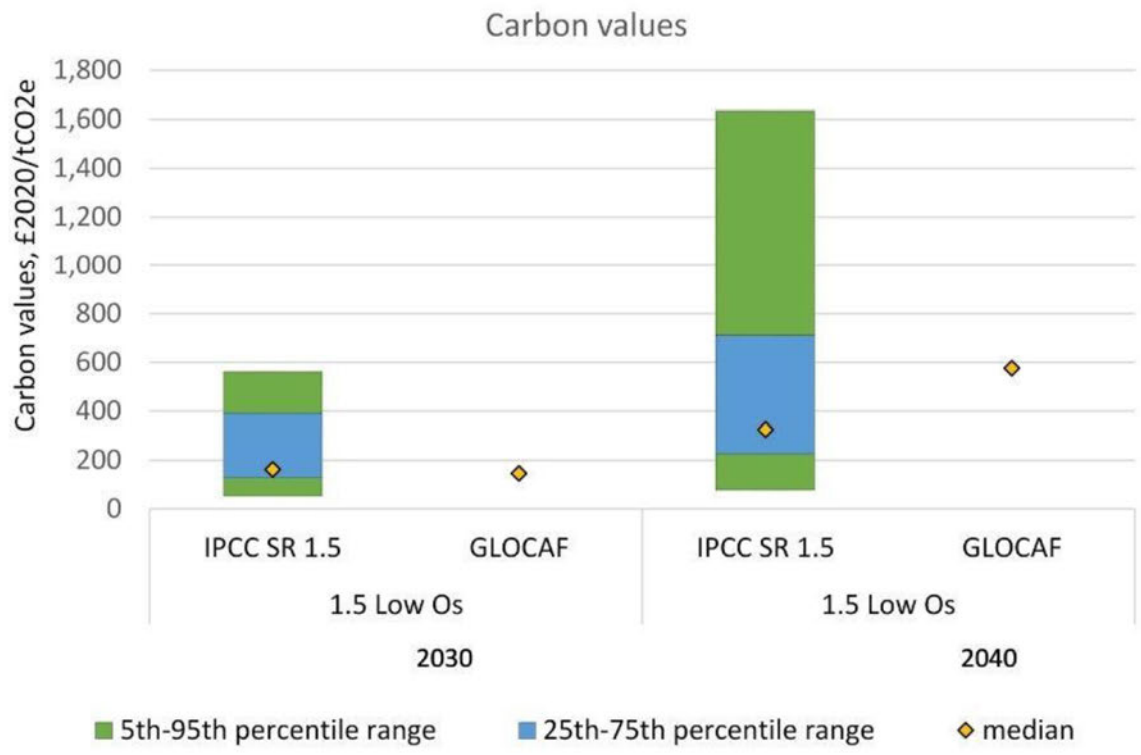

Figure 2: comparison of GloCaF modelled carbon values and IPCC median carbon value and carbon value range for 2030 and 2040, for IPCC 1.5 Low overshoot scenario

Each of the modelling approaches set out above has advantages and disadvantages. On the basis of the relative merits, BEIS has adopted the IPCC's evidence base as the starting point for constructing a series of values. The main advantages of the IPCC evidence is that it has been widely peer-reviewed and builds on a broad range of modelling and available evidence. Furthermore, it is a source independent to UK government and considered authoritative internationally.

Anchor points

Marginal abatement costs can be subject to large fluctuations between years modelled. This can be due to a number of factors, not least:

- assumptions about technology costs and availability
- emissions pathways within the modelling
- interdependency with modelling outcomes in other years

Therefore, the full series derived by models can have counterintuitive annual fluctuations, which are not practical for appraisal purposes. We therefore use a single point estimate in 2040 (anchor point) around which we apply a constant growth rate to derive annual values.

There is considerable uncertainty around technologies and corresponding abatement costs far into the future (beyond 2040) at these ambitious levels of domestic and global climate mitigation. Future technological advancements are most likely to happen at the higher cost end of current known technologies (reflecting that they are typically in earlier stages of development), on which marginal cost estimates depend. As a result, anchoring the value on 2050 is particularly uncertain as all models rely on indicative stopgap technologies, or extrapolated cost estimates that far in the future.

Choosing an anchor point in the very near future risks underestimating the cost of abatement as the level of action required in the future will place us further up the marginal abatement cost curve.

Growth rate

Marginal costs are not constant over time, and are influenced largely by 2 primary driving forces:

- increased emissions reductions ambitions, requiring more expensive technologies to be adopted
- reductions in technology costs through innovation and deployment

Currently, there is no academic consensus on how these two factors interplay, and consequently what the precise optimal trajectory for carbon values is – although there is general consensus that they should rise over time. For simplicity and pragmatic application, we have adopted a constant growth rate to construct the carbon value series around the 2040 IPCC anchor point.

Relative to global trajectories for emissions, our domestic emissions reduction targets are relatively front-loaded, which implies that a flatter trajectory for carbon values is more appropriate as additional UK efforts should be made in the near-term. In the 2020s and 2030s the evidence is clear that the UK needs to implement many policies and technologies that have relatively high upfront investment costs and long lead times. In this case, early action will contribute to innovation in the clean technology space and thus encourage future cost advantages. Based on our assessment of the evidence base, including the CCC's estimates of UK abatement costs in their advice on the 6th Carbon Budget, we have concluded that an indicative 1.5% annual real growth rate around the 2040 anchor point is appropriate.

Uncertainty range

There is a significant range of uncertainty in the carbon values derived from any modelling. The differences in carbon price trajectories are often driven by either structural differences in modelling approaches or by differences in underlying scenario assumptions on future evolution of socioeconomic factors (for example, population or GDP forecasts).

To capture the full range of uncertainty, a plus or minus 50% sensitivity range has been deemed appropriate around the central series. This is consistent with the previous range used.

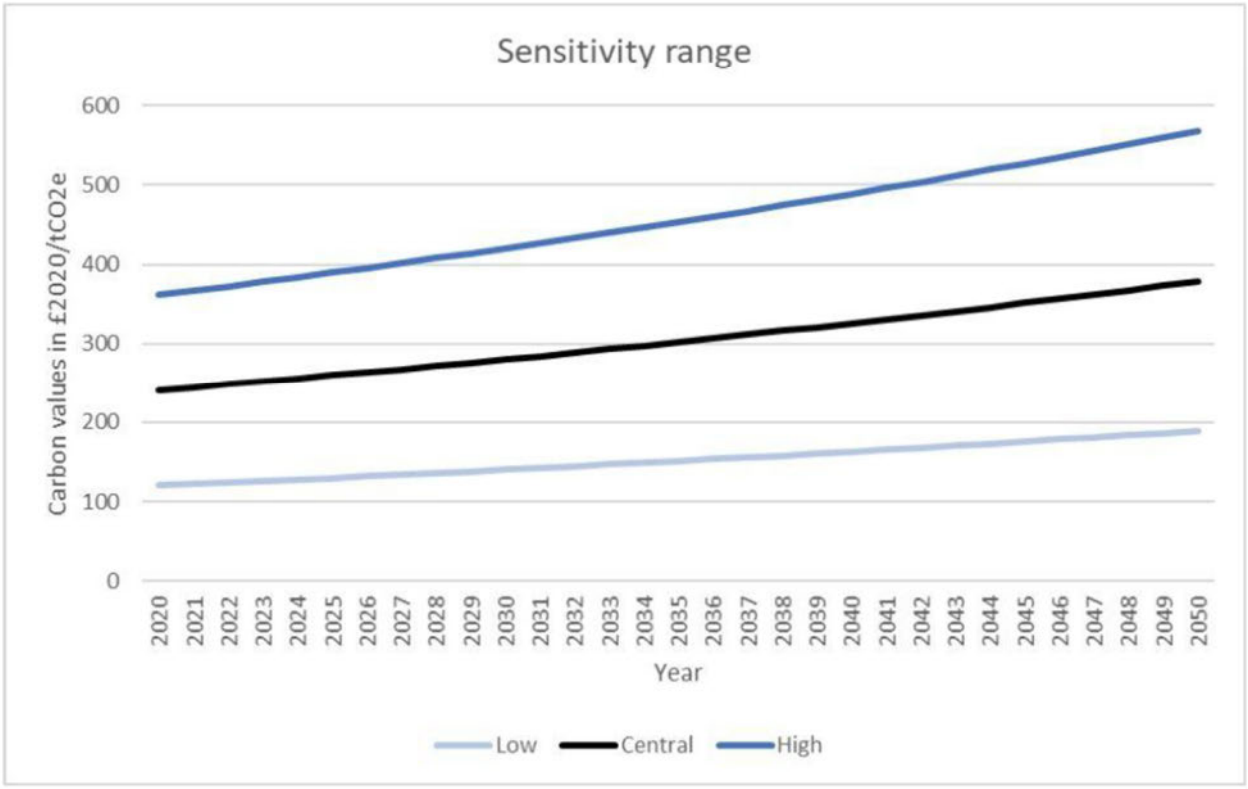

Figure 3: Sensitivity range of the updated carbon values.

Traded and non-traded carbon

Traded emissions capture those that come from installations covered by the UK Emissions Trading Scheme (https://www.gov.uk/government/publications/participating-in-the-uk-ets/participating-in-the-uk-ets) (ETS), whereas non-traded emissions are those which do not fall within scope of the UK ETS.

Currently, the UK ETS covers power generation, energy-intensive industries, and domestic aviation. To achieve the economy-wide decarbonisation required to meet our net zero goals in a cost-effective way, it is important that our decarbonisation strategy gives equal weight to emissions from the traded and non-traded sectors.

The UK ETS caps the total level of greenhouse gas emissions within the sectors in scope and allows firms with low emissions to sell their emissions allowances to higher emitters.

Previously this trade could occur between the UK and other countries in the EU ETS and this was reflected in accounting towards the UK's emissions targets.

The UK ETS is an important mechanism to achieve the UK's climate goals. However, it is likely that additional measures in the sectors covered by the UK ETS will need to be taken to reach net zero. Therefore, any emissions increases or savings resulting from policies (either traded or non-traded) should be considered and valued during appraisal. For emissions in the traded sector, appropriate adjustments should be made to account for any existing carbon pricing in the market prices of goods or services. For example, if a policy increases the production of a good where the price of that good already reflects a carbon price then this needs to be taken into account in order to avoid double counting some of the carbon costs.

Post-2050 values

The carbon series published in this report only extends to 2050. The main challenge in modelling carbon values beyond 2050 is that any analysis looking over such a long timescale is subject to significant uncertainty from a range of sources. Many of the input assumptions that are required to estimate future carbon prices – such as GDP growth and its sectoral composition, fossil and non-fossil fuel prices, and the costs and availability of different technologies – are extremely uncertain. Moreover, the way in which these variables interact over time in the complex, dynamic global climate, economic and social system is both uncertain and, in some areas, unknown. For these reasons, projections of future carbon prices based on modelling outputs can be highly sensitive to modelling methodology and assumptions and must therefore be seen and used in this context of uncertainty.

Nevertheless, some policy proposals will have long term impacts reaching beyond 2050. It is therefore necessary that any carbon impacts from such proposals are captured during policy appraisal. To obtain values post-2050, it is advisable to apply a real annual growth rate of 1.5% starting at the most recently published value for 2050.

Approach to future updates

The government is committed to using the best available evidence to inform the value placed on greenhouse gas emissions during appraisal. However, there is a trade-off to be struck between three factors:

- having the most up-to-date carbon valuation estimates
- avoiding spurious updates that do not reflect the high level of uncertainty
- ensuring stability in application to allow long-term policy decision-making to occur

A situation where the carbon values used in appraisal changed too often would be undesirable, as this would mean that policy options were being assessed against different criteria. Therefore, the carbon values will be reviewed every 5 years in line with setting the UK's carbon budgets. The review will take into account a broad evidence base. Under exceptional circumstances, reviews outside the 5-yearly cycle may be necessary if changes affecting the evidence or policy regime are significant enough in order to warrant a review.

Application

How to apply carbon values during policy appraisal

Incorporating a value of carbon into the appraisal of projects and policies ensures proper account of greenhouse gas emissions across government. By comprehensively and systematically using carbon valuation across appraisal in a consistent manner, it is intended that government should seek out cost-effective opportunities for reducing emissions across policies and projects – not only in areas such as energy and transport policies where emissions reductions are of primary or secondary importance, but also where this is not the case. Having consistent values across government also provides transparency and consistency for business.

A policy or project that increases or decreases GHG emissions domestically or internationally relative to a "business as usual" scenario is required to quantify the change in emissions, and then apply the carbon values. This calculation feeds into the overall cost benefit analysis to be considered alongside other quantitative and qualitative evidence in the overall policy appraisal. The values should be considered as a guide to the carbon cost-effectiveness of policies but account should be taken of the inherent uncertainty involved in estimating future abatement costs and unquantified costs and benefits.

Carbon valuation is not a policy instrument in itself. It is a £-value applied in appraisal in order to guide government decision-making, and further signal the level of ambition that should be factored into those policies. Unless it is translated into a tangible incentive (and the incentive may exceed the carbon value in order to overcome barriers), it will not act upon private economic agents, whether individuals or business.

Alongside setting the right carbon appraisal value, the selection of instruments to tap potential emissions reduction is key. A mix of carbon pricing (through taxes/trading), regulatory instruments, innovation support and information policies are likely to be required to address the multiple market failures and barriers which exist.

When carrying out a policy appraisal it is also necessary to take into account the impacts on the wider environment also known as natural capital. To help with this Defra has developed an online resource called Enabling a Natural Capital Approach (https://www.gov.uk/guidance/enabling-a-natural-capital-approach-enca) (ENCA) . This provides guidance on natural capital, economic values, references on reports and data sources along with over 70 case studies.

Presenting the monetised change in greenhouse gas emissions

To appropriately quantify greenhouse gas emissions, analysts should consider the key drivers of emissions affected by a policy proposal or intervention. All assessments should include a baseline or Business as Usual (BaU) emissions against which the policy is assessed. There is no standardised or straightforward methodology for measuring the baseline, so this must be done on a case-by-case basis. Historical trends and statistically supported projections are the most commonly used, but historical trends are not effective

at taking changing circumstances into consideration (i.e. non-linearity). The annually updated Energy and Emissions Projections (https://www.gov.uk/government/publications/updated-energy-and-emissions-projections-2019) published by BEIS provide projections of greenhouse gas and energy demand to 2040 by sector and are a useful starting point.

Policies or projects can impact emissions in a number of different ways, either directly or indirectly. Analysts should refer to the Green Book Supplementary Guidance (https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal) for how to calculate cost effectiveness indicators, including NPVs and £/tCO2.

Annex 1: Carbon values in £2020 prices per tonne of CO2

Year	Low series	Central Series	High Series
2020	120	241	361
2021	122	245	367
2022	124	248	373
2023	126	252	378
2024	128	256	384
2025	130	260	390
2026	132	264	396
2027	134	268	402
2028	136	272	408
2029	138	276	414
2030	140	280	420
2031	142	285	427
2032	144	289	433
2033	147	293	440
2034	149	298	447
2035	151	302	453
2036	153	307	460
2037	156	312	467
2038	158	316	474
2039	161	321	482
2040	163	326	489
2041	165	331	496
2042	168	336	504
2043	170	341	511
2044	173	346	519
2045	176	351	527
2046	178	356	535
2047	181	362	543
2048	184	367	551

Year	Low series	Central Series	High Series
2049	186	373	559
2050	189	378	568

1. World Bank, Report of the High-Level Commission on Carbon Prices, May 2017.
2. IAMs are the most widespread tool for assessing long-term emission trajectories in the context of global warming scenarios and they are the underlying modelling tool used to derive the pathways presented by the IPCC.
3. To narrow the scope of our analysis we focused on the median IPCC scenario to inform our global emissions abatement targets. As part of the validation of our Business-as-Usual trajectory we concluded that it was more aligned with the SSP1 and SSP2 scenarios, representing respectively the Sustainable Development and Middle of the Road scenarios in the IPCC classification.

10 APPENDIX B: DATA AND ALGORITHMIC TRANSPARENCY

10.1 The Algorithmic Transparency Standard

129 The Government recently announced an "Algorithmic Transparency Standard" at https://www.gov.uk/government/collections/algorithmic-transparency-standard under the Central Digital and Data Office in the Cabinet Office. Under the new approach, government departments and public sector bodies will be required to explain where an algorithm was used, why it was used and whether it achieved its aim. There will also be an obligation to reveal the architecture behind the algorithm.

130 This follows from the debate on computing, AI and data in public bodies where decision may be made by computer or based on computer outputs. It also applies to decision making and one of the scopes is software that "has a potential legal, economic, or similar impact on individuals or populations" which includes transport models used for decision making of carbon in planning.

131 The need for such transparency was foreseen by Supreme Court judge Lord Sales in a 2019 speech[24] "Algorithms, Artificial Intelligence and the Law" which includes the key paragraph:

> "*The question then arises, how should we provide for ex ante review of code in the public interest? If, say, a government department is going to deploy an algorithmic program, it should conduct an impact assessment, much as it does now in relation to the environmental impacts and equality impacts in relation to the introduction of policy. …*
>
> *Therefore, t**here seems to be a strong argument that a new agency for scrutiny of programs in light of the public interest should be established, which would constitute a public resource for government, Parliament, the courts and the public generally**. It would be an expert commission staffed by coding technicians, with lawyers and ethicists to assist them."*

132 Whilst the Algorithmic Transparency Standard is at a pilot stage and being currently tested by several government departments and public sector bodies, it will be reviewed again and formally launched later in the year. It is a standard that the Applicant as a public body, or publicly owned company, will be required to comply with in the future.

[24] [redacted]