1 Introduction

1 In a letter of May 24th 2013, Inspector Vickery requested that we present a paper on carbon emissions to the reconvened Public Inquiry. We have previously submitted a response paper on June 21st 2013.

2 This ADDENDUM to our paper extends the previous computer spreadsheet model of the "a priori" ensemble model to make a more comprehensive comparison on the carbon footprint of the JCS housing distribution vs. the NNTAG proposed housing distribution.

2 Extensions to spreadsheet model

3 Our paper showed that when the higher value NDR carbon footprint figures as per the 2007-2010 figures submitted to Department for Transport are used, the JCS housing distribution creates a much larger carbon footprint than the NNTAG housing distribution in all ensemble runs. No further modelling has been made using this version of the NDR carbon footprint.

4 The paper also showed that where the lower value NDR carbon footprint has been used as per the 2011 Best and Final Business (BAFB) case submitted to Department for Transport, the JCS housing distribution creates a larger carbon footprint that the NNTAG housing distribution in all ensemble runs except one which was fully explainable in terms of an unrealistic modal split being used in the particular JCS ensemble run.

5 However, in the paper, we used different model 'load factors' on some other parameters between the JCS and the NNTAG distributions. These were based on intuitive selection of load factors to reflect different transport traffic flows in the different distributions. However, we are aware that this introduced assumptions into the model.

6 The purpose of this addendum is to remove those assumptions, and model both the JCS and NNTAG housing distributions over a range of "load factors" that are the same. This will give greater confidence in the interpretation of the results.

7 All equations, numerical definitions of the models, mapping of the models remain the same. We are only producing a greater set of ensemble runs over a range of "load factors" that are more equanamous for both distributions.

2.1 Notification of error in previous spreadsheet

8 In preparing this addendum work, we identified a spreadsheet error (formula typo) on one ensemble case in the previous work. This was ensemble run *B50 & AB50 & NEWSW-FBC/MSBC-25* in the NNTAG distribution. Because of the error, this ensemble result was calculated as 323751 tCO2eq instead of 517657 tCO2eq. However, this was on the 2007-2010 figures submitted to Department for Transport where the smallest JCS footprint was 13,398,561 tCO2eq. This error, therefore, has no impact on the conclusions made and is not considered further, but reported here for completeness.

3 New ensemble runs

9 All runs now seed the spreadsheet with the *lower* value NDR carbon footprint as presented in the 2011 Best and Final Business (BAFB) case submitted to Department for Transport.

10 The double counting "load factor" is now applied to the B^{NEGT10} in the JCS distribution, and to B^{NEGT5} and B^{SW2} in the NNTAG distribution at these values: 50%, 70% and 95%.

11 We now apply weighting factors of 10% *and 50%* to the NNTAG model for additionally generated Southern by-pass journeys.

12 The full set of model parameters are shown below with the differences between the original paper modelling and those for this addendum are shown below.

		NNTAG	JCS
	Parameters common to all calculations		
α	Both papers: *Background household transport emissions (modal split) - NEGT*	20%,50%,70%,90%	20%,50%,70%,90%
β	Both papers: *Background household transport emissions (modal split) - SW area*	20%,50%	n/a
γ	Both papers: *Additional southern by-pass traffic (as proportion of relevant NDR emissions)*	25%, 50%	25%, 50%
	Parameters extended in addendum		
δ	Original paper: *DC load factor*	95% * 95%	70%
δ	Addendum: *DC load factor*	(95%, 70%, 50%) * (95%, 70%, 50%)	95%, 70%, 50%
ε	Original paper: *Southern by-pass loading factor*	10%	n/a
ε	Addendum: *Southern by-pass loading factor*	10%, 50%	n/a

13 The top-level equations for the two models JCS Option 1 and NNTAG Options with the model parameters are:

$$C^{JCS} = \delta \,.\, \alpha.\, B^{NEGT10} + (C^{NDR} + C^{PH}) + \gamma.\, C^{NESW(JCS10)}$$

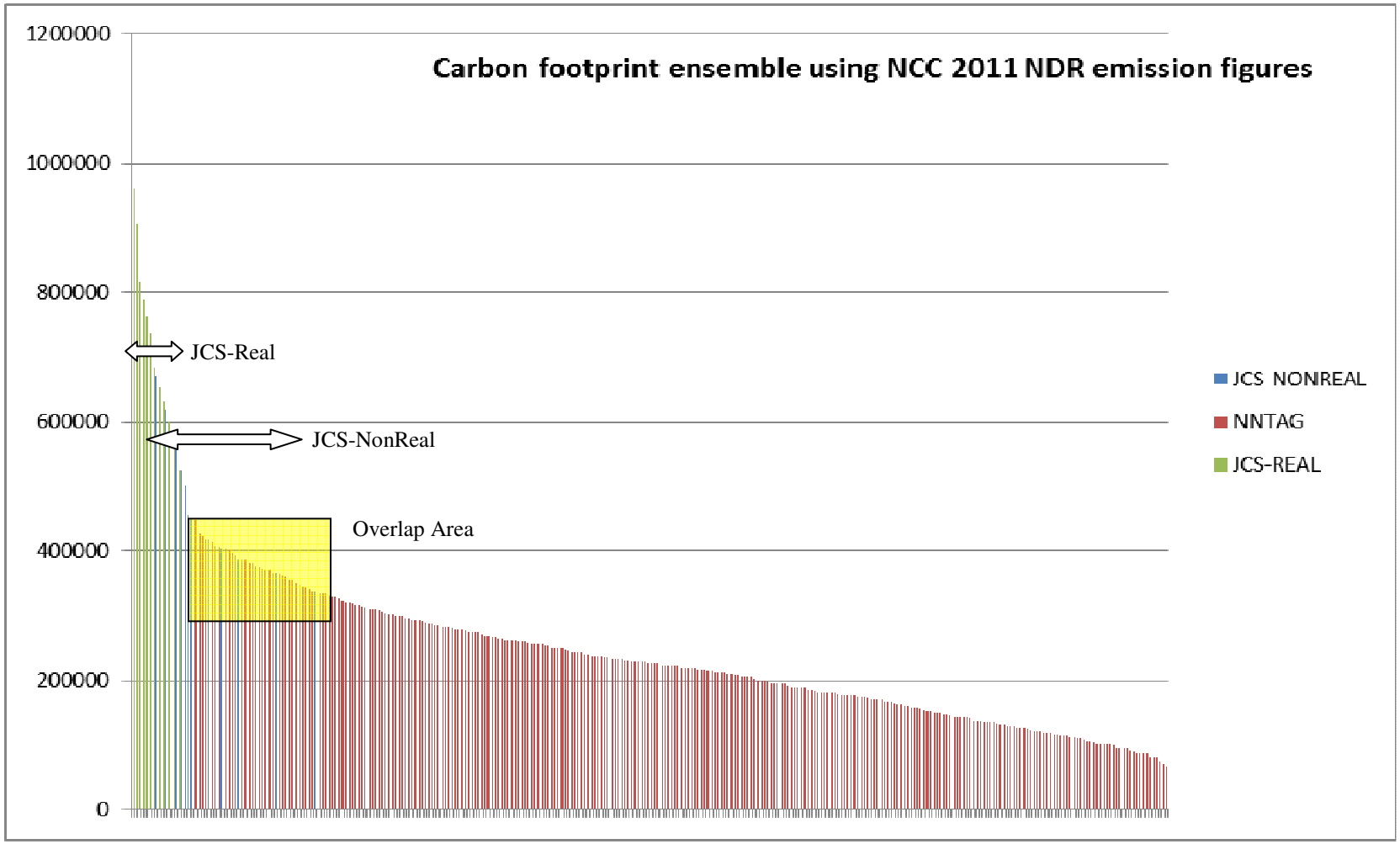
$$C^{NNTAG} = \delta \,.\, \alpha \,.\, B^{NEGT5} + \delta' \,.\, \beta \,.\, B^{SW2} + \varepsilon \,.\, \gamma \,.\, C^{NESW(NNTAG)}$$

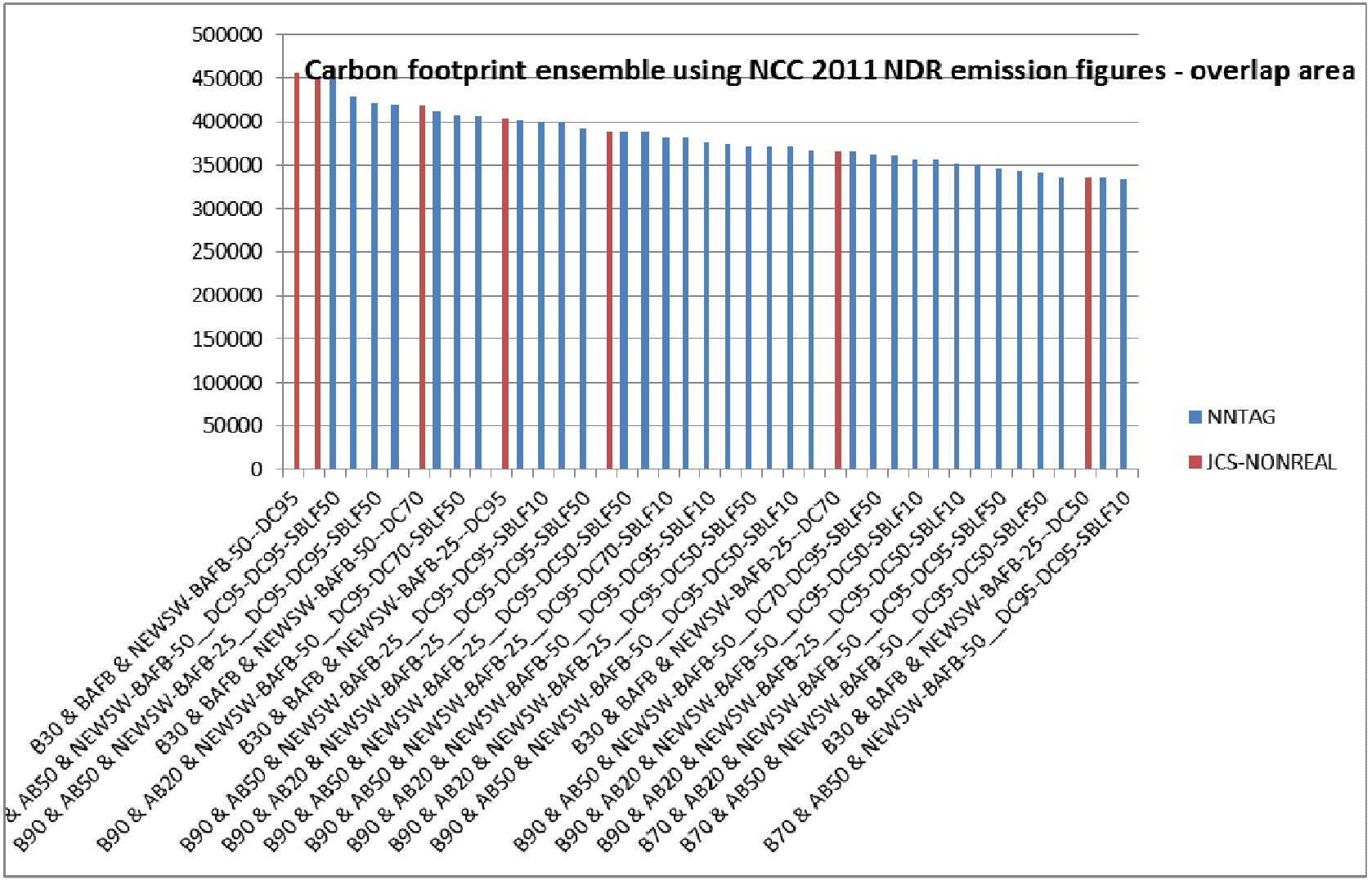
Note, these are the same equations as in the paper, but we have added the spreadsheet parameters (or load factors) for clarity.

14 Full expansion of these equations generates a new set of 24 ensemble runs for the JCS distribution and 288 ensemble runs for the NNTAG distribution.

15 For the purpose of result interpretation, we have identified runs for the JCS model where the modal split is greater than or equal to 70% as "JCS-Real" – this is because the County Council calculate the car/public transport split for this area to be 91% car driver. Runs for the JCS model where the modal split is less than or equal to 50% are identified as "JCS-NonReal".

3.1 Ensemble run results




Carbon footprint ensemble using NCC 2011 NDR emission figures - overlap area
500000
450000
400000
350000
300000
250000
200000
150000
100000
50000
0
NNTAG
JCS-NONREAL
B30 & BAFB & NEWSW-BAFB-50__DC95
B90 & AB50 & NEWSW-BAFB-50__DC95-DC95-SBLF50
B90 & AB50 & NEWSW-BAFB-25__DC95-DC95-SBLF50
B30 & BAFB & NEWSW-BAFB-50__DC70
B90 & AB20 & NEWSW-BAFB-50__DC95-DC70-SBLF50
B30 & BAFB & NEWSW-BAFB-25__DC95
B90 & AB50 & NEWSW-BAFB-25__DC95-DC95-SBLF10
B90 & AB20 & NEWSW-BAFB-25__DC95-DC95-SBLF50
B90 & AB50 & NEWSW-BAFB-50__DC95-DC50-SBLF50
B90 & AB20 & NEWSW-BAFB-50__DC95-DC70-SBLF10
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B90 & AB50 & NEWSW-BAFB-25__DC95-DC50-SBLF10
B30 & BAFB & NEWSW-BAFB-25--DC70
B90 & AB50 & NEWSW-BAFB-50__DC70-DC95-SBLF50
B90 & AB20 & NEWSW-BAFB-50__DC95-DC50-SBLF10
B90 & AB50 & NEWSW-BAFB-25__DC95-DC50-SBLF50
B90 & AB20 & NEWSW-BAFB-50__DC95-DC95-SBLF50
B90 & AB50 & NEWSW-BAFB-50__DC95-DC50-SBLF50
B70 & AB20 & NEWSW-BAFB-25--DC50
B70 & AB50 & NEWSW-BAFB-50__DC95-DC95-SBLF10

3.2 Interpretation of results

16 The first graph shows that the distribution of all 312 runs [12 "JCS-NonReal" in Green, 12 "JCS-Real" in Blue and 288 NNTAG in Red]. As in the original paper, the JCS housing distribution creates a larger carbon footprint that the NNTAG housing distribution in most cases. However, there is an overlap area between footprints of 330,000 tCO2eq and 450,000 tCO2eq where some JCS footprints are smaller than NNTAG ones.

17 Three indicators have been marked on the first graph to aid interpretation.

- The range of the "JCS-Real" model runs. None of these runs occur in the overlap area. The smallest "JCS-Real" carbon footprint is 525375 tCO2eq.
- The range of the "JCS-NonReal" model runs
- The overlap area between "JCS-NonReal" model runs and NNTAG model runs. The largest NNTAG carbon footprint is 447759 tCO2eq.

18 The overall result is that all of the "JCS-Real" runs ie those that use a background household modal split anywhere close to the Council figure are greater than the 288 NNTAG model runs.

19 The second graph expands the overlap area so that the ensemble runs identities may be seen. In each case where the JCS footprint is smaller it is when it is calculated with a 30% loading factor on the B^{NEGT10} variable. This means the background level of traffic flows is calculated with 30% modal shift (B30) in the NEGT area. The County Council calculate the car/public transport split for this area to be 91% car driver. This JCS distribution run assumes 30% car/public transport split, and so is an unrealistic set of input parameters. The results where the JCS carbon footprint appears smaller than an NNTAG one may be discounted because the parameters are unrealistic and not conformant with Council data.

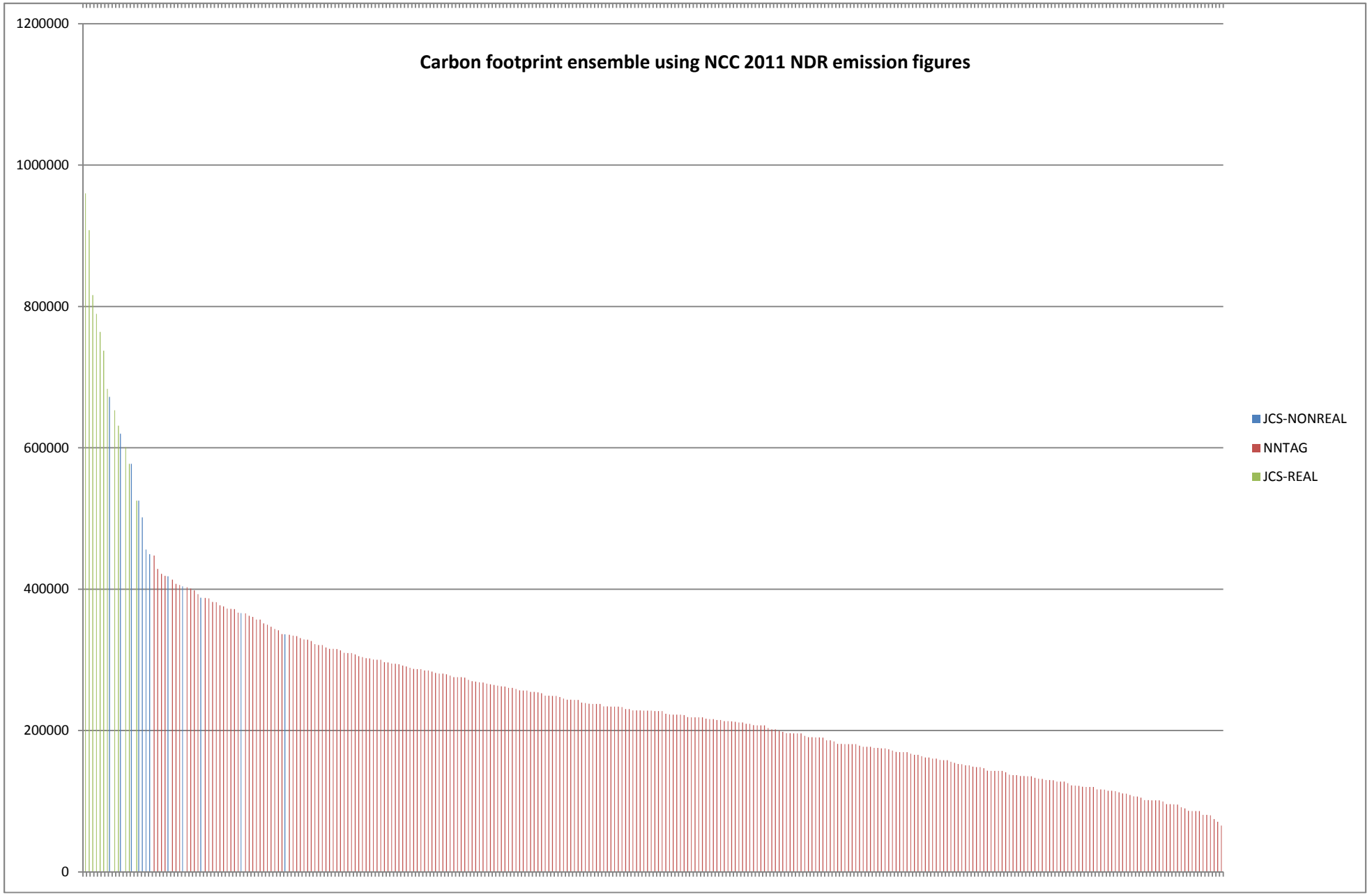
20 In our previous paper, the only JCS footprint that was smaller than NNTAG one was also calculated with 30% modal shift (B30) in the NEGT area. This is the same result. However, in the case of this addendum, we have provide many more cases including greater loading of traffic onto the Southern bypass in the NNTAG case, and we still find that excluding the JCS distributions with 30% modal split, the NNTAG ensembles are always a smaller carbon footprint.

4 Conclusions

21 We have relaxed the constraints on the model ensemble runs so that the JCS and NNTAG distributions are modelled across a wider range of model "load factors". We have also provided greater parity between the load factors for both housing distributions. The results here are based on a greater number of ensemble runs (now over 300) giving a greater statistical sample.

22 Our addendum evidence presented above shows that the NNTAG distribution of housing has a smaller carbon footprint than the JCS distribution when simulated in this wider set of ensemble runs.

Councillor Andrew Boswell
Norwich Green Party
July 9th 2013


Carbon footprint ensemble using NCC 2011 NDR emission figures
1200000
1000000
800000
600000
400000
200000
0
JCS-NONREAL
NNTAG
JCS-REAL