



# DecarboN8

Place-based decarbonisation for transport

## **Carbon accounting for local authorities: A comparative analysis of NAEI estimates and MOT test data based estimates**

### **DecarboN8 working paper 1.1**

**Reference as:**

Walker, R., Morgan, M., Marsden, G. and Anable, J. (2020) Carbon accounting for local authorities: A comparative analysis of NAEI estimates and MOT test data based estimates, DecarboN8 working paper 1.1

 [www.decarbon8.org.uk](http://www.decarbon8.org.uk)



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# Summary

1. The published national statistics for transport carbon emissions by local authority district are the National Atmospheric Emissions Inventory (NAEI).
2. The NAEI uses the United Nations (UNFCCC) approach of attributing emissions to the territory from which they arise. For transport emissions, this means that (for example) the emissions from through traffic on the M6 and M42 as it passes through North Warwickshire district are attributed to North Warwickshire.
3. In response to LAs' complaints about this, a second data set is published for transport emissions, "CO2 emissions estimates within the scope of influence of Local Authorities". For transport, emissions from railways and motorways are omitted, leaving emissions from A-roads and 'minor roads'.
4. This data set leaves strategic road network (SRN- Highways England) roads classified 'A' in the data as 'within the LA scope of influence', even where they are expressways barely distinguishable from motorways in functional terms, eg the A14 in Kettering district.
5. CREDS (ITS Leeds et al) has analysed a completely different data set, the annual mileage recorded at the annual MoT test. This allows a calculation of carbon emissions by all cars with their registered keeper living in a given LA district. (NB: The MoT data set does not at present include vans and lorries.)
6. This paper explores aspects of the two data sets for the most easily available year, 2011.

## Recommendations

7. Although there currently appear to be issues with the MoT data which need to be addressed, it is found that **the MoT data is far more likely to be accepted by LAs as a fairer measure of their transport carbon footprint.**
8. Making the MoT data an official national statistic and publishing it annually alongside the NAEI dataset would be a fairly simple step assisting LAs to review the performance of their transport decarbonisation plans. A further step would be to work out how to add freight vehicles to the data set.
9. The NAEI 'emissions in scope of influence of LAs' dataset should be updated to exclude all Highways England (SRN) roads, not just motorways. SRN emissions should be reported separately as being within the scope of HE's influence and be used as a metric for success of the DfT national Transport Decarbonisation Plan.

# The NAEI and MoT data sources

- The NAEI data is from <https://naei.beis.gov.uk/data/local-authority?view=uk-transport>
  - *Subnational statistics are produced as part of the National Atmospheric Emissions Inventory (NAEI) work programme on fuel consumption from road transport at regional and local authority levels. This is calculated using a bottom-up method by combining fleet-weighted fuel consumption factors (in g fuel/km) for each main vehicle type with traffic activity data provided by the Department for Transport (DfT). The bottom-up calculated fuel consumption derived for each year is expected to vary slightly from the values of petrol and diesel fuel sales reported in the Digest of UK Energy Statistics (DUKES)*
- The MoT data is from Morgan, M. and Chatterton, T. unpublished 2020
  - Data sources: MoT test data on miles driven per car in 2011; address of registered keeper of the car; number of cars by engine type & emissions per mile by engine type from unpublished DfT data that underlies DfT statistics VEH0206
- The NAEI data is for all road vehicles (separated into motorways, A roads and minor roads traffic); the MoT data is for registered cars.

# Top 12 districts, total emissions, NAEI & MoT data

English districts by population, 2011		NAEI total road transport emissions 2011		MoT data: car emissions 2011 (tonnes CO <sub>2</sub> e)	
Top 12 districts	Pop (2011)	Top 12 districts	Tonnes CO <sub>2</sub>	Top 12 Districts	Emissions
Birmingham	1,073,045	Leeds	1,570,912	Birmingham	487,650
Leeds	751,485	Birmingham	1,404,934	Wiltshire	419,743
Sheffield	552,698	Wiltshire	1,170,582	Cornwall	404,337
Cornwall	532,273	Cheshire East	1,079,649	Leeds	397,397
Bradford	522,452	Cornwall	985,292	County Durham	328,935
County Durham	513,242	Cheshire West and Chester	898,901	Cheshire East	286,993
Manchester	503,127	South Gloucestershire	888,374	Sheffield	261,684
Wiltshire	470,981	County Durham	873,285	Cheshire West and Chester	260,931
Liverpool	466,415	Doncaster	802,740	East Riding of Yorkshire	258,000
Bristol, City of	428,234	East Riding of Yorkshire	753,896	Shropshire	254,538
Kirklees	422,458	West Berkshire	722,606	Bradford	252,405
Cheshire East	370,127	Wakefield	707,944	Kirklees	237,607

- Although the absolute level of emissions is the only thing that matters for the climate, what the data mainly shows for top 12 districts by absolute level of emissions, is the most populous districts. This is mainly a fluke of how district boundaries are drawn, not a reliable list of where the most emissions arise.
- The better statistic to use when dealing with districts is **emissions per head of resident population**.

# Top 12 districts, emissions per head, NAEI roads data

The NAEI data is of limited use for calculating per head emissions as it is too sensitive to SRN 'M' & 'A' roads passing through districts of low population. This problem also affects the 'within LA influence' dataset.

Total road transport emissions per head, 2011	
	Total road transport (kt CO2)
<b>Top 12 districts</b>	
North Warwickshire	10,573
Eden	8,496
City of London	8,113
South Bucks	7,051
Daventry	6,349
South Northamptonshire	6,062
Uttlesford	5,890
Bromsgrove	4,878
North West Leicestershire	4,775
Runnymede	4,706
Tandridge	4,699

Road tpt emissions 'within LA influence'/hd, 2011	
	Road tpt 'within LA influence' (kg CO2)
<b>Top 12 districts</b>	
City of London	8,113
Hambleton	3,974
Rutland	3,937
Richmondshire	3,468
Daventry	3,389
Ryedale	3,377
Cotswold	3,284
Eden	3,251
Newark and Sherwood	3,202
South Cambridgeshire	3,186
South Northamptonshire	3,170

Road tpt emissions (motorways) per head, 2011		
	Motorways (kg CO2)	Motorway
<b>Top 12 districts</b>		
North Warwickshire	8,122	M6, M42
South Bucks	5,269	M25, M40
Eden	5,245	M6
Runnymede	3,178	M3, M25
Epping Forest	3,168	M11, M25
Tandridge	3,138	M25
Sevenoaks	3,132	M20, M25
Bolsover	3,100	M1
Uttlesford	3,054	M11
South Staffordshire	2,977	M6, M54
Daventry	2,960	M1
Bromsgrove	2,956	M5, M42

Road tpt emissions (A roads)/head, 2011		
	A roads (kg CO2)	SRN A road
<b>Top 12 districts</b>		
City of London	5,952	
Hambleton	3,215	A1, A19
Rutland	3,199	A1
South Cambridgeshire	2,547	A11, A14
Richmondshire	2,488	A1, A66
Forest Heath	2,474	A11, A14
Daventry	2,455	A5, A14
Newark and Sherwood	2,425	A1, A46
Vale of White Horse	2,417	A34
South Derbyshire	2,390	A38, A50
South Northamptonshire	2,378	A5, A43
Eden	2,325	A66

Emissions (minor roads)/head, 2011	
	Minor roads (kg CO2)
<b>Top 12 districts</b>	
City of London	2,161
West Somerset	1,603
Uttlesford	1,512
Ryedale	1,377
Chichester	1,203
Derbyshire Dales	1,200
Wealden	1,069
New Forest	1,064
Winchester	1,060
Maldon	1,059
West Dorset	1,042
South Norfolk	1,012

# Top 12 districts, per head emissions, MoT data

<b>MoT data car emissions/head 2011</b>	
<b>Top 12 Districts</b>	<b>kg CO<sub>2</sub>e</b>
South Northamptonshire	1,071
Cotswold	1,054
East Hampshire	1,052
Uttlesford	1,047
Forest Heath	1,011
Stratford-on-Avon	1,009
Hart	1,008
South Oxfordshire	996
Mid Suffolk	994
Maldon	986
West Oxfordshire	978
Daventry	976

- The MoT data, calculated as emissions per head of resident population, is better for comparing the relative performance of districts.
- However, the following caveats should be borne in mind:
  - the data is for cars registered to an address in the district, and excludes emissions from vans and lorries
  - the data needs to be inspected for large corporate fleets registered to an address in a given district but which may not be based there
  - the emissions arise anywhere in the country where the car is driven, not solely within the boundaries of the district
  - districts with a small number of residents but large traffic-generating developments will not show up in this data.
- The data looks good for comparing the relative performance of districts but the absolute level of emissions in kg per head does not appear to tally with the NAEI data (see next slide).

# Differences between the MoT mileage and emissions totals and other sources

<b>Data for England, 2011</b>	<b>MoT data</b>	<b>Published data</b>	<b>Data source</b>
Licensed motor vehicles (m)		29.1	DfT VEH0105 (2011)
Licensed cars (m)	19.9	24.2	DfT VEH0105 (2011)
Total mileage driven by cars (bn)	145.3		
Total mileage driven by cars & taxis (bn)		206.5	DfT TRA0106 (2011)
Calculated CO2 emissions cars (m tonnes)	33.9		
CO2 emissions all road transport (m t)		100.0	NAEI 2011 (all road types)

- The NAEI figure for CO2 emissions from all road transport in England is almost 3x the MoT calculated CO2 emissions total from cars registered in English districts (100.0 million tonnes CO2, compared to 33.9m tonnes).
- The discrepancy is surely greater than that which can be explained by the 4.3m fewer cars in the MoT data plus emissions from taxis, buses and freight vehicles, and cars registered outside England.

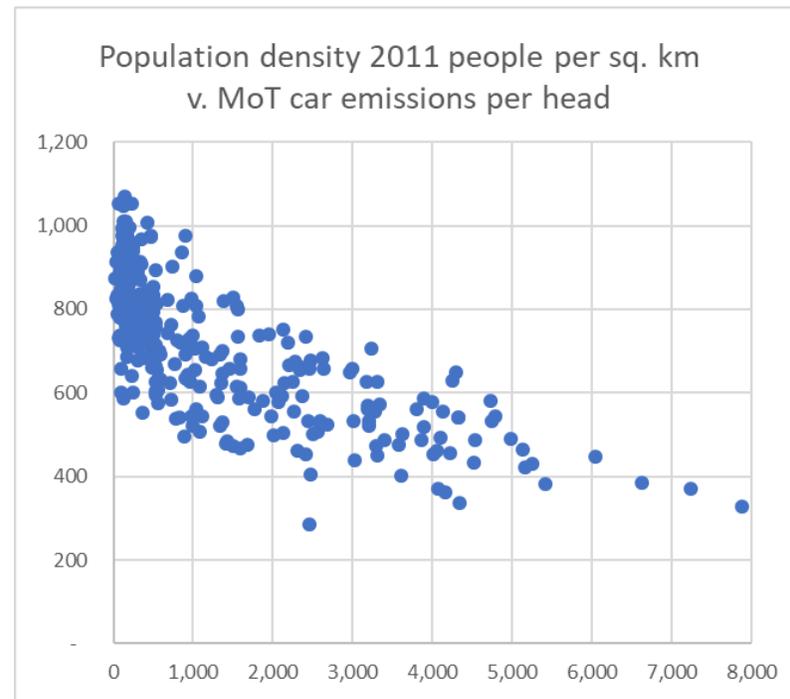
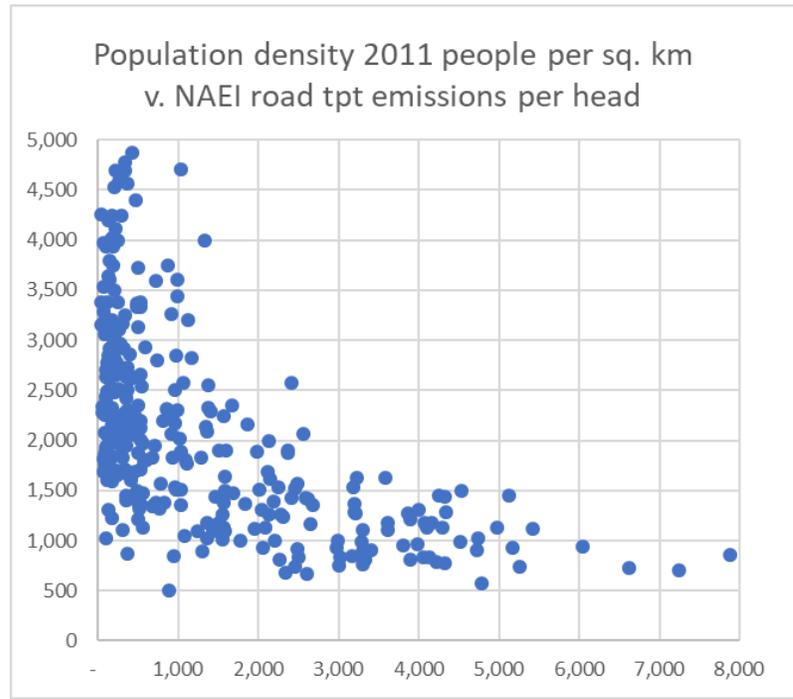
# MoT and NAEI emissions data by LA type

Type of LA	Population (m)	% share pop	MoT data car miles driven (bn)	% miles driven	MOT data car emissions (mt CO2)	% MOT car emissions	NAEI road tpt emissions (mt CO2)	% NAEI road tpt emissions
London Borough	8.17	15.4%	13.32	9.2%	3.30	9.7%	8.15	8.1%
Metropolitan District	11.47	21.6%	26.31	18.1%	5.93	17.5%	18.50	18.5%
Non-metropolitan District	21.25	40.1%	70.98	48.8%	16.65	49.1%	51.36	51.3%
Unitary Authority	12.11	22.8%	34.71	23.9%	8.02	23.6%	22.03	22.0%
England Total	53.01	100.0%	145.32	100.0%	33.90	100.0%	100.04	100.0%

- Although the NAEI figure for total emissions is almost 3x the MoT figure for total emissions, the figures for the share of the total attributable to different types of local authorities is similar. The MoT data looks reliable for relative emissions levels.
- An additional analysis that could be done to check this conclusion would be to compare the miles driven from the MoT data with the published stats on car mileage by local highway authority area in DfT TRA8902.

# Relationship between **population density** and emissions/hd/yr (kg CO2) by LA district: NAEI data compared to MoT data

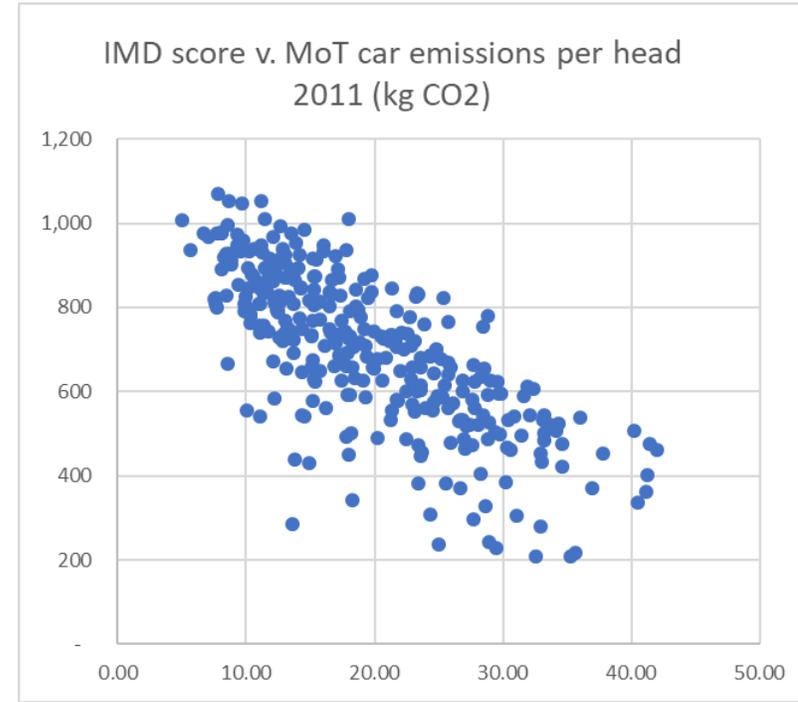
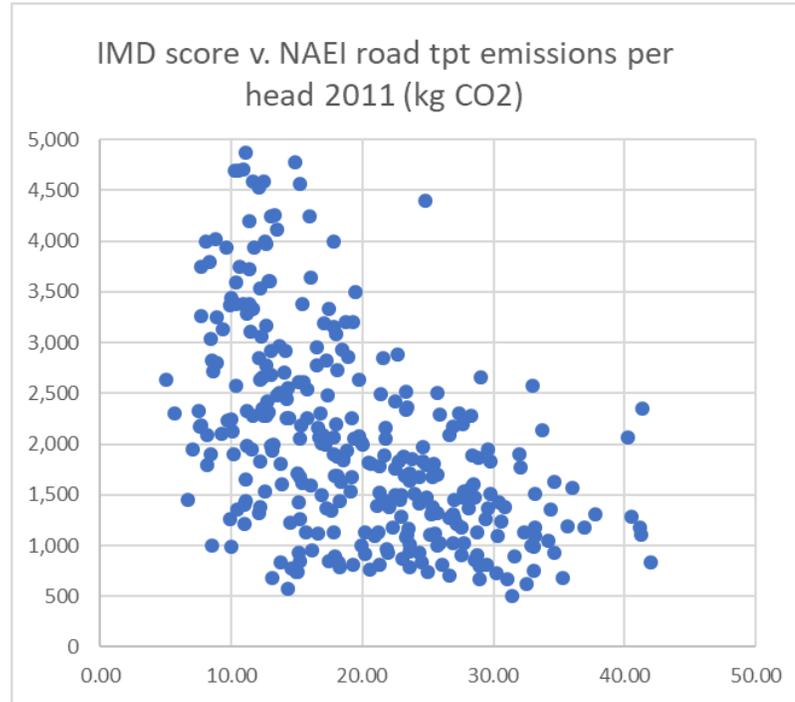
NAEI data chart excludes 7 districts with CO2 emissions/head >5,000kg and 12 London boroughs of pop density >8,000/sq km



- Both the NAEI & MoT data show emissions/head having an inverse relationship to population density.
- The NAEI data shows wide variation among places of low pop density from 500kg/hd (Barrow) to 10,500kg/hd (N Warwickshire), due to including emissions from traffic on roads passing through the district (eg N Warks, M6)
- The MoT data shows a narrower variation, but in some places with a similar pop density emissions still vary by a factor of >2, eg: 500kg/hd (Barrow) to 1,070kg/hd (S Northants)

# Relationship between **multiple deprivation** and emissions/hd/yr (kg CO<sub>2</sub>) by LA district: NAEI data compared to MoT data

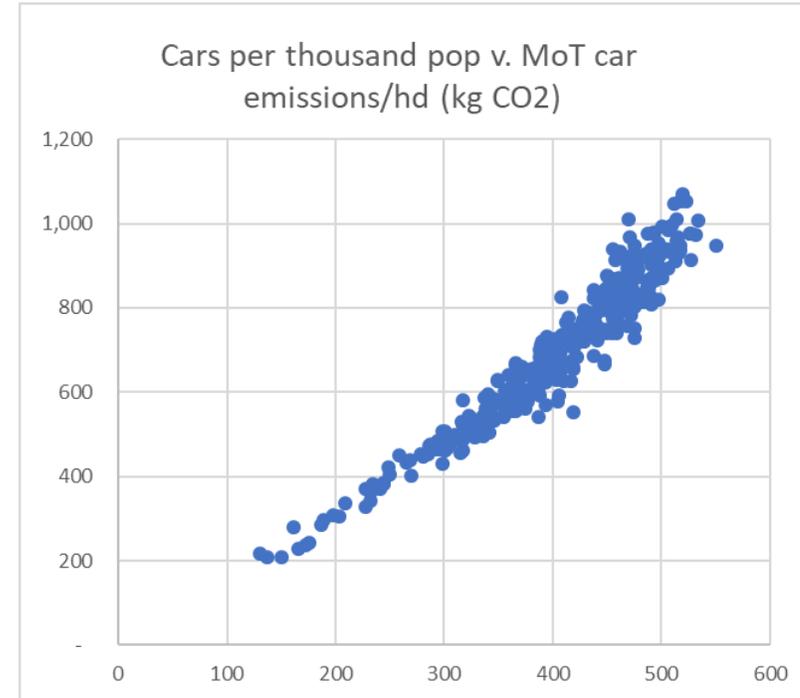
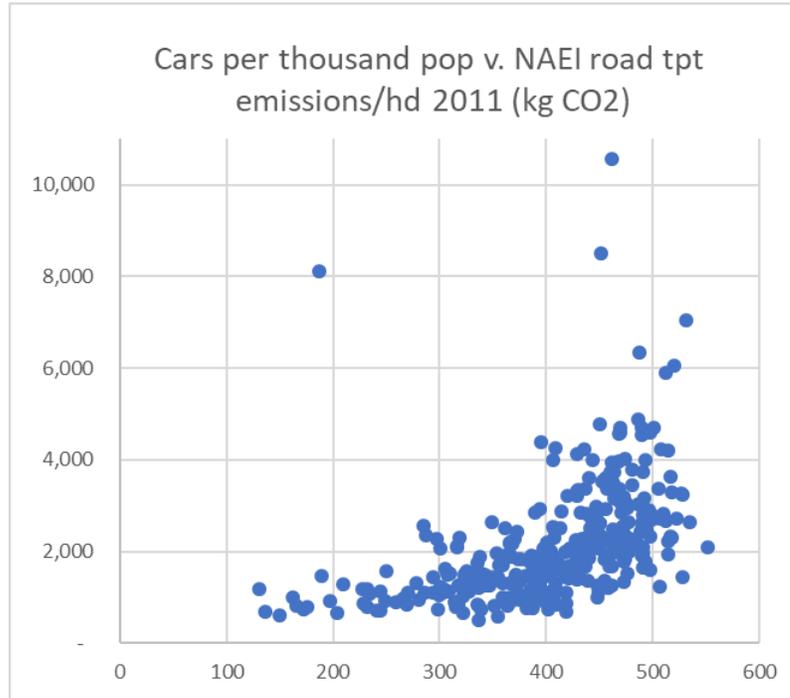
A low index of multiple deprivation (IMD) score indicates low deprivation; a high score high levels of multiple deprivation. NAEI data chart excludes 7 districts with CO<sub>2</sub> emissions/head >5,000kg



- Both the NAEI & MoT data show emissions/head having an inverse relationship to multiple deprivation.
- The NAEI data shows a less clear relationship, due to including emissions from traffic on roads passing through the district
- The MoT data shows a narrower variation, but in some places with a similar level of deprivation, emissions still vary by a factor of >3, eg Lambeth, IMD=28.9, emissions 244kg; East Lindsey, IMD=28.9, emissions 780kg

# Relationship between household car ownership and emissions/hd/yr (kg CO<sub>2</sub>) by LA district: NAEI data compared to MoT data

A low index of multiple deprivation (IMD) score indicates low deprivation; a high score high levels of multiple deprivation. NAEI data chart excludes 7 districts with CO<sub>2</sub> emissions/head >5,000kg



- Both the NAEI & MoT data show emissions/head having a direct relationship to household car ownership level
- The NAEI data shows a less direct relationship, due to including emissions from traffic on roads passing through the district.
- The MoT data shows much narrower variation, but in some places with a similar level of car ownership, emissions vary by 25% or more.

# Conclusions

- CO<sub>2</sub> is not a local air pollutant (unlike NO<sub>x</sub> or particulates) and so the precise location where transport CO<sub>2</sub> emissions arise is not relevant to the atmosphere of the planet. Statistics on emissions by district are only useful as a tool for efforts to reduce emissions.
- Reliable statistics providing an attribution of where transport carbon emissions arise by local authority district are vital for local authorities preparing local transport decarbonisation plans, and for measuring whether places are succeeding or not in reaching their carbon emissions targets/transport decarbonisation pathway.
- Trips have an origin and destination district. They may pass through other districts en route. The NAEI dataset is based on traffic counts and attributes emissions to the district from which they physically arise. Local authorities inevitably do not feel a strong sense of responsibility for emissions from traffic passing through their area.
- The MoT data set tells us where the registered keeper of each car lives, and their annual mileage, and so allows transport carbon to be attributed to every district's residents, which makes the 'per head of resident population' carbon emission figure a meaningful one. In effect, broadly speaking, it attributes transport carbon emissions to trip origin.
- Subject to further work to validate it (including sum total emissions), and some adjustments (for example, to correct for large corporate fleets registered to a single address that may be based elsewhere) the MoT data set makes more sense as a key indicator or metric for local authorities to use for transport decarbonisation plans, and if possible should become an annually published national statistic.
- The MoT data does not currently include freight vehicles, and a key next step would be to work out the best way to include them.
- Making the MoT data the key indicator does not mean the NAEI data has no value, as it does show where in the country the road traffic actually is. For example, a district may permit the development of a major attractor of car trips within its area, generating much carbon emissions, but if the people visiting the development live in other districts, the district's share of the responsibility for the emissions will not show in the data. The NAEI data provides a second way at looking at emissions and a richer overall picture.
- The Highways England Strategic Road Network (SRN) carries about one third of all traffic (vehicle-miles), but has very few trip origins or destinations. A revision to the NAEI dataset to show all emissions from the SRN (motorways and A ('trunk') roads) separately would be a useful improvement. This data could be presented as a calculation of emissions by named road, as opposed to by local authority district. This data could be a key indicator of the success of the DfT's national Transport Decarbonisation Plan.

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