

Using the Low Emission Toolkit to support Emission Assessment of Development Sites

Prepared by Green Sphere on behalf of the Low Emission Partnership

Authors: Katherine Stanger and Rob Pilling



Low Emission
Strategies

Building on Good Practice

This report provides a summary of how the methods and data within the Low Emission Toolkit (v1.1) may be used in combination with other tools to support transport emission assessments for development sites.

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1. Introduction

- 1.1. The Low Emission Toolkit (LETv1.1) is a spreadsheet tool, developed by the Low Emission Partnership to calculate emission damage from transport fleets and planning developments¹. It was first published in 2010 and uses datasets current at that time. Emission factors and fleet composition data are equivalent to Defra's Emission Factor Toolkit² (EFTv4.2). Defra has since published several updates to the EFT, the latest, v 6.0.2, released in Dec-14. Work is pending to upgrade the LET to incorporate the most recent EFT data. Due to other Partnership priorities, this will not be completed before mid-2015.
- 1.2. Nevertheless, the LET in its existing form has much to offer in supporting transport emission assessment. This report and accompanying materials summarise how the methods and information may best be used. Relevant accompanying materials include: LET v1.1, plus user guides and supporting information.
- 1.3. The development and use of the LET is linked to ongoing Partnership work, including the Low Emission Hub³, Technical Guidance for Emissions Assessment⁴, Planning Guidance⁵, Planning Policy Appraisal⁶, as well as site-level case studies with York, Sefton and Mid Devon.

Emission assessment using the EFT and damage cost factors

- 1.4. Recent developments in local authority planning policy have brought emission assessment methods to the fore. Notably, guidance for Sussex⁷ uses the EFT to estimate annual emissions of NO_x and PM₁₀ for trips associated with a site. Emissions are multiplied by Defra damage cost factors⁸ to provide an estimate of the baseline damage costs per annum. This is then multiplied by five, to give a five year damage cost.
- 1.5. The basic user inputs required for estimating emissions with the EFT are:
 - (i) Daily trip rate for relevant vehicle types (site specific)
 - (ii) Trip distance (default of 10 km suggested by Sussex Guidance)
 - (iii) Fleet composition (at a basic level, requires % of HGVs; Sussex Guidance example suggests 0%)
 - (iv) Speed (Sussex Guidance example suggests 50 kph)

Potential additional support offered by LET Methods

- 1.6. The methods and data within the existing LET offer a number of complementary method options:
 - (i) **Land-use based trip rates** based on land-use type and size of development, for situations where no site specific data is available
 - (ii) **Land-use based trip distances**, which provide variation in distance based on journey type (as an alternative to using a single estimate of 10 km)
 - (iii) **Refined damage costs**, including a range of PM₁₀ damage cost options based on geographic location, CO₂ damage costs, and Defra/DECC recommended economic treatment incorporating inflation, uplift and discounting.
 - (iv) Methods for **modelling actions** (mitigation options) and **estimating benefits**.

¹ LEP (2011) Low Emission Toolkit v1.1, and accompanying User Guides. www.lowemissionstrategies.org/les_toolkit.html.

LEP (2012) Low Emission Toolkit Method Summary. www.lowemissionstrategies.org/downloads/LET_Method_Summary_Report.pdf.
Expert Review of the LET by Aether and AQC (2012). www.lowemissionstrategies.org/downloads/LET_Review2012.pdf

² Defra Emission Factor Toolkit. laqm.defra.gov.uk/review-and-assessment/tools/emissions.html#eft

³ Low Emission Hub: Central information resource for low emission strategies interventions and impacts: <http://www.lowemissionhub.org/>
Low Emission Hub (2014) Case study drafting guidance: www.lowemissionhub.org/case-study/359/Low-Emission-Hub-Guidance-and-Docs

⁴ LEP (2014) Emission Assessment for Development Site Appraisal: Technical Guidelines. Nov-14. EMA-TG-1.0.
<http://lowemissionstrategies.org/downloads/EMA-TG-v1.pdf>

⁵ LEP (2015) Low Emission Planning Policy Guidance (February 2015): http://lowemissionstrategies.org/tools_and_resources.html

⁶ LEP (2015) Low Emission Planning: Policy Appraisal (February 2015): http://lowemissionstrategies.org/tools_and_resources.html

⁷ Sussex AQ and Emission Guidance (2014): [lowemissionhub.org/case-study/319/Sussex-Planning-document-\(Planning-Policy-Guidance\)](http://lowemissionhub.org/case-study/319/Sussex-Planning-document-(Planning-Policy-Guidance))

⁸ Defra IGCB Damage Cost Factors (last update 10 May 2013): www.gov.uk/air-quality-economic-analysis

2. Baseline Emission Assessment

Trip Rates

- 2.1. The EFT requires a daily trip rate as a basic input. This may be provided within a transport assessment, prepared to support a planning application. However, some transport assessments only provide peak hour trip data, without a break-down by vehicle type. Other sites may not have full transport assessments, or the development proposal may be at a very early stage.
- 2.2. The calculation in the EFT converts daily trips to annual trips by multiplying by 365 days (notes are included in the user guide regarding conversion of g/s/km into annual by multiplying by 3600x8760). Depending on the land use and the trip rate selected, this may represent a significant over-estimate of annual trips (e.g. schools do not operate 365 days of the year).
- 2.3. The LET methods provide:
 - (i) Land use specific trip rates where no site data is available;
 - (ii) Conversion factors to estimate annual trip rates from Peak Hour data;
 - (iii) Methodology to account for varying site operation throughout the year, according to land use

Land Use Specific Trip Rates

- 2.4. The LET uses TRICS data from 2010(a) v6.5.2 Build 14.35⁹, collated into broad land use categories to provide default trip rates for sites with no trip data. The tables are presented in [Appendix A](#). Key points to note:
 - Trip rates are presented for different land-uses, normalised to various scaling units such as GFA.
 - Trip rates are provided separately for cars, bus passengers and HGVs.
 - Trip rates are provided separately for London / not-London.
 - The figures provided are for annual trips. As such, the total trips should be divided by 365 days, to calculate a daily trip rate for entry into the EFT.
 - Two options are available for estimating trips from ‘captive fleets’ (i.e. passenger cars situated at residential sites, and privately owned fleets of LGVs / HGVs): (i) using trip rates calculated from land-use and development size as above; (ii) using an estimate of total vehicles at the development (e.g. for residential sites, from total number of parking places) multiplied by average annual km per vehicle (provided as defaults by the LET – see tables in [Appendix A](#)).
 - The LET also includes a separate module to calculate trips by ‘service vehicles’ (e.g. delivery and refuse collections). This requires the user to estimate the number of weekly LGV and HGV (refuse truck) visits to the site. It then calculates a proportion of the vehicle’s annual average mileage to allocate to the site. Further work is required to reconcile this method with the land-use specific trip rates as listed in [Appendix A](#).

Conversion from Peak Hour Trips

- 2.5. The LET provides conversion factors to estimate annual trip rates from Peak Hour data. (NB annual trip rates would need to be divided by 365 days to calculate a daily trip rate for entry into the EFT.). The conversion table is presented in [Appendix B](#).

Accounting for variation in site operation – Conversion from Daily

- 2.6. The LET takes account of variations in operation of different development sites, using different factors to convert daily trip rates into annual trip rates. (NB annual trip rates would need to be subsequently divided by 365 days to calculate a ‘representative’ daily trip rate for entry into the EFT.). The conversion table and supporting calculation data is presented in [Appendix C](#).

⁹ Ideally, the data would reflect the current version of TRICS. However, the figures are not expected to have changed significantly. Given the current uncertainty over other equally important calculation inputs (e.g. using a default trip distance of 10 km for all journeys), the 2010 TRICS figures are considered a fair approximation.

Trip Distances

- 2.7. The EFT requires an average trip distance as a basic input. Guidance by some local authorities suggests using 10 km for all journeys at all sites. Whilst this provides an easy entry option for users with little site specific data, it is important to note that **emissions and therefore damage costs are as sensitive to trip distance as they are to trip rate**. As such, even a small change to the trip distance (e.g. reduced from 10km to 8 km) has a significant impact on the final outcome (in this instance a 20% reduction in all emissions and damage costs).
- 2.8. The LET provides the option of more refined trip distance estimates, based on location (London / Not London) and by journey purpose (linked to land use) for cars, buses and HGVs. Some of these are less than 10 km, others are more. The values are presented in **Appendix D**.

Inclusion of CO₂

- 2.9. The LET includes CO₂ emissions and damage costs, alongside NO_x and PM₁₀. The LET emission factors were developed from a range of different sources (see LET user guide) and reflect well to wheel emissions. The EFT provides estimates of CO₂ (tailpipe only) for standard vehicle technologies. As such, CO₂ can also be included within an EFT model run to estimate annual CO₂ emissions harm for a site.

Refined Damage Costs

- 2.10. Defra (IGCB, 2013) damage cost factors can be used to calculate annual air quality damage costs. The 'central estimate' for NO_x damage is £955 per tonne. Factors for transport-related PM₁₀ are provided at two levels of precision: (i) as an average for PM transport across the country ('central estimate' of £48,518 per tonne PM₁₀); and (ii) to reflect the geographic location of the development site.
- 2.11. The Defra methodology includes various ways to refine these estimates, which are reflected in the LET. Supporting tables and relevant calculations are presented in **Appendix E**.
- (i) Using PM₁₀ damage cost factors that reflect the geographical location of the development site. The range varies from approximately £15,000 in rural areas to £220,000 in Central London. As such, selection of different factors can significantly affect damage costs.
 - (ii) Inclusion of 'low' (-22%) and 'high' (+14%) estimates for AQ damage from the IGCB as a range for uncertainty
 - (iii) Inclusion of CO₂ damage costs, based on non-traded Carbon values (DECC, 2013)¹⁰. CO₂ emissions, and damage cost factors are significant. Inclusion of CO₂ has various pros and cons (see Planning Policy Appraisal and Planning Guidance for further details.) The decision on whether or not to include CO₂ within site specific emissions assessments is likely to be made on policy rather than technical grounds.
 - (iv) Economic treatment (i.e. future year inflation and discounting) of air quality and CO₂ damage costs, based on Defra and DECC guidance respectively.

¹⁰ DECC (2013) Tables to support the DECC/HM Treasury Green Book Supplementary appraisal guidance on valuing energy use and greenhouse gas emissions (16 Sept 2013). Available online at: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/248604/2013_Appraisal_Guidance_-_Toolkit_Tables_-_FINAL.xlsx

3. On-Site Mitigation

- 3.1. Work by Local Authorities to date has emphasised assessment of base site emissions with less focus on assessing mitigation. The Low Emission Partnership has given attention to this second stage of assessment. The approach is summarised below and example results are provided in the Planning Policy Appraisal report.
- 3.2. Emission impacts for trip reduction measures and conversion to zero (tailpipe) emission vehicles (e.g. electric) can be calculated directly as proportional reductions in the emission harm. Electric vehicles reduce exhaust emissions to zero. Most low carbon vehicles also have regenerative brakes, the more advanced of which can reduce emissions from brake wear to close to zero (operating under normal conditions with a non-aggressive driving)¹¹. Other non-exhaust particulate matter, e.g. from tyre wear and road abrasion, will not be affected.
- 3.3. Estimating the impacts of other on-site technical measures (e.g. newer fleet, or conversion to alternative fuelled vehicles) requires analysis and modification of the fleet composition and vehicle specific emission factors. This is not a straightforward task using the EFT. It involves manual interrogation of default fleet splits, and back calculation of respective traffic flows.
- 3.4. Conversely, estimating the impacts of on-site mitigation is a central function the LET. It has in-built functionality to calculate standard, or user identified mitigation scenarios. The LET also has the advantages of (i) calculating CO₂ emissions (and therefore % reductions) for alternatively fuelled vehicles (not included in the EFT); and (ii) incorporating a wider range of alternative vehicle technologies than the EFT.
- 3.5. As noted above, prior to an LET upgrade, the absolute values from the LET will reflect emission factors from a previous version of the EFT. However, the mitigation functionality in LETv1.1 can be used to calculate relative (%) emission reductions, which can then be applied to the EFT baseline to give an approximation of impact.
- 3.6. The LET includes the following mitigation functionality (user defined mitigation is also available):
 - Vehicle substitution / deployment – e.g. modelling switch (% or absolute) to newer vehicles, or alternative technologies
 - Fleet transformation measures – e.g. Site-based LEZ, Emission based parking allocation
 - Car clubs (using standard or low emission vehicle technologies)
 - Travel plans, including multiple components
 - User based charging – e.g. emission based parking charges, emission based user-charging

4. Additional Information

- 4.1. Further information which may be useful for practitioners is listed in **Appendix F**:
 - Average speeds by location/road type and vehicle type used in the LET

¹¹ TRL (2014) Briefing paper on non-exhaust particulate emissions from road transport. Report for the Low Emission Partnership. December 2014.

Appendix A: Land Use Specific Trip Rates

Table 1: LET land uses

Site	Land use types included within LET defaults	Location	
Housing	<ul style="list-style-type: none"> - Private housing - Non-private housing - Mixed housing - Retirement housing 		
Food retail	<ul style="list-style-type: none"> - Food retail - Discount food - Retail park including food 		
Non-food retail	<ul style="list-style-type: none"> - Non-food retail - Shopping centre - Retail park excluding food - Car showroom 		- Town centre
Education	<ul style="list-style-type: none"> - Nursery - Primary school - Secondary school - College 		- Edge of centre
Health	<ul style="list-style-type: none"> - Hospital - GP Surgery - Nursing home 		- Suburban
Leisure	<ul style="list-style-type: none"> - Hotel - Restaurant - Pub - Fast food - Cinema - Bowling alley - Leisure centre - Swimming pool - Ice rink - Bingo hall - Fitness club - Place of worship - Theatre - Golf course 		- Edge of town
Commercial	<ul style="list-style-type: none"> - Office 		- Free standing
Industrial	<ul style="list-style-type: none"> - Industrial - Warehousing - Civic amenity site 		

Table 2: LET categorisation of journey purposes, land uses (broad) and (narrow)

Journey Purpose	Business	Education escort	Shopping	Social, entmt-holiday	Personal - other escort	All purposes
Land Use (Broad)	Employment	Education	Retail	Leisure	Health	Housing
Land Use (Narrow)	office	nursery	food retail	hotel	hospital	private housing
	industrial	primary	discount food	restaurant	GP Surgery	non-private housing
	warehousing	secondary	non-food retail	pub	nursing home	mixed housing
		college	shopping centre	fast food		retirement housing
			retail park incl food	cinema		
			retail park excl food	bowling alley		
			car showroom	leisure centre		
				swimming pool		
				Ice rink		
				bingo hall		
				fitness club		
				place of worship		
				theatre		
				golf course		
			civic amenity site			

Table 3: Annual Car Trip Rates (Not London)

Land use	Unit	Town centre	Edge of centre	Suburban	Edge of town	Free standing
office	sqm Gross Floor Area (GFA)	25.71	26.77	24.50	31.98	31.98
industrial	sqm Gross Floor Area (GFA)	25.11	25.11	13.81	15.79	15.79
warehousing	sqm Gross Floor Area (GFA)	8.16	8.16	8.16	2.88	2.88
food retail	sqm Gross Floor Area (GFA)	503.28	466.94	521.60	663.07	663.07
discount food	sqm Gross Floor Area (GFA)	268.45	268.45	232.08	426.08	426.08
non-food retail	sqm Gross Floor Area (GFA)	94.50	94.50	235.54	177.95	177.95
shopping centre	sqm Gross Floor Area (GFA)	400.07	400.07	400.07	277.54	277.54
retail park including food	sqm Gross Floor Area (GFA)	266.57	266.57	266.57	242.37	242.37
retail park excluding food	sqm Gross Floor Area (GFA)	130.79	130.79	184.15	180.82	180.82
car showroom	sqm Gross Floor Area (GFA)	71.30	71.30	42.42	33.29	33.29
nursery	students	177.06	177.06	405.99	405.99	405.99
primary school	students	341.25	341.25	341.25	214.50	214.50
secondary school	students	148.59	148.59	148.59	214.70	214.70
college	students	170.24	70.20	141.38	168.68	168.68
hospital	sqm Gross Floor Area (GFA)	51.26	51.26	57.50	51.04	51.04
GP Surgery	sqm Gross Floor Area (GFA)	163.42	163.42	229.10	157.18	157.18
nursing home	sqm Gross Floor Area (GFA)	7.83	7.83	6.82	6.72	6.72
hotel	sqm Gross Floor Area (GFA)	22.17	43.26	29.32	32.62	32.62
restaurant	sqm Gross Floor Area (GFA)	92.69	166.92	225.67	271.75	271.75
pub	sqm Gross Floor Area (GFA)	244.73	257.53	559.56	559.56	559.56
fast food	sqm Gross Floor Area (GFA)	357.70	357.70	357.70	357.70	357.70
cinema	sqm Gross Floor Area (GFA)	191.07	191.07	205.34	109.94	109.94
bowling alley	sqm Gross Floor Area (GFA)	87.63	87.63	65.48	24.42	24.42
leisure centre	hectares	621,010.64	621,010.64	109,374.08	203,698.47	203,698.47
swimming pool	sqm Gross Floor Area (GFA)	107.09	107.09	99.99	161.96	161.96
Ice rink	sqm Gross Floor Area (GFA)	25.27	25.27	25.27	25.27	25.27
bingo hall	seats	71.72	71.72	202.21	202.21	202.21
fitness club	hectares	631,280.14	631,280.14	470,839.05	402,021.22	402,021.22
place of worship	hectares	39,615.00	39,615.00	103,555.28	103,555.28	103,555.28
theatre	seats	115.35	115.35	115.35	115.35	115.35
golf course	hectares	2,048.32	2,048.32	2,048.32	4,871.56	2,466.32
private housing	dwellings	711.39	1,116.24	1,264.19	1,626.38	1,626.38
non-private housing	dwellings	711.39	1,115.78	1,264.19	2,138.54	2,138.54
mixed housing	dwellings	711.39	1,169.17	1,332.29	1,671.66	1,671.66
retirement housing	dwellings	554.80	554.80	443.70	826.36	826.36
civic amenity site	hectares	658,151.78	658,151.78	1,061,542.71	686,402.20	1,094,300.88

Table 4: Annual Car Trip Rates (London)

Land use	Unit	Central	Inner	Outer
office	sqm Gross Floor Area (GFA)	0.30	5.50	3.28
industrial	sqm Gross Floor Area (GFA)	0.38	0.38	1.68
warehousing	sqm Gross Floor Area (GFA)	3.15	3.15	2.98
food retail	sqm Gross Floor Area (GFA)	102.13	173.16	173.39
discount food	sqm Gross Floor Area (GFA)	268.45	268.45	268.45
non-food retail	sqm Gross Floor Area (GFA)	40.92	40.92	46.01
shopping centre	sqm Gross Floor Area (GFA)	20.20	20.20	20.20
retail park including food	sqm Gross Floor Area (GFA)	42.12	42.12	76.78
retail park excluding food	sqm Gross Floor Area (GFA)	42.12	42.12	76.78
car showroom	sqm Gross Floor Area (GFA)	62.97	39.66	16.35
nursery	students	155.00	155.00	265.00
primary school	students	99.45	99.45	144.30
secondary school	students	23.40	23.40	87.75
college	students	7.80	7.80	54.60
hospital	sqm Gross Floor Area (GFA)	2.67	2.67	14.96
GP Surgery	sqm Gross Floor Area (GFA)	44.55	44.55	21.27
nursing home	sqm Gross Floor Area (GFA)	5.99	5.99	5.99
hotel	sqm Gross Floor Area (GFA)	0.80	1.45	4.36
restaurant	sqm Gross Floor Area (GFA)	28.10	57.16	56.31
pub	sqm Gross Floor Area (GFA)	2.63	53.89	101.35
fast food	sqm Gross Floor Area (GFA)	79.22	79.22	258.69
cinema	sqm Gross Floor Area (GFA)	22.42	85.33	549.89
bowling alley	sqm Gross Floor Area (GFA)	15.35	15.35	37.34
leisure centre	hectares	5,640.87	5,640.87	5,640.87
swimming pool	sqm Gross Floor Area (GFA)	84.21	84.21	83.73
Ice rink	sqm Gross Floor Area (GFA)	19.87	19.87	19.87
bingo hall	seats	2,552.62	2,552.62	2,741.88
fitness club	hectares	459.90	2,190.29	2,102.05
place of worship	hectares	429.51	429.51	4,757.97
theatre	seats	82,734.55	82,734.55	82,734.55
golf course	hectares	3,563.27	3,563.27	5,320.92
private housing	dwellings	222.65	459.90	521.95
non-private housing	dwellings	7.30	25.55	660.65
mixed housing	dwellings	222.65	459.90	609.55
retirement housing	dwellings	412.45	412.45	542.83
civic amenity site	hectares	1,961,101.57	1,961,101.57	1,197,656.25

Table 5: Annual Bus Passenger Trip Rates (Not London)

Land use	Unit	Town centre	Edge of centre	Suburban	Edge of town	Free standing
office	sqm Gross Floor Area (GFA)	1.72	1.72	0.56	0.33	0.33
industrial	sqm Gross Floor Area (GFA)	0.44	0.44	0.06	0.24	0.24
warehousing	sqm Gross Floor Area (GFA)	0.04	0.04	0.04	0.02	0.02
food retail	sqm Gross Floor Area (GFA)	44.80	1.23	1.29	4.70	4.70
discount food	sqm Gross Floor Area (GFA)	5.99	5.99	14.62	2.84	2.84
non-food retail	sqm Gross Floor Area (GFA)	4.26	4.26	9.58	9.58	9.58
shopping centre	sqm Gross Floor Area (GFA)	3.85	3.85	3.85	17.60	17.60
retail park including food	sqm Gross Floor Area (GFA)	2.49	2.49	2.49	2.10	2.10
retail park excluding food	sqm Gross Floor Area (GFA)	1.22	1.22	1.72	1.56	1.56
car showroom	sqm Gross Floor Area (GFA)	0.67	0.67	0.40	0.29	0.29
nursery	students	3.54	3.54	8.12	8.12	8.12
primary school	students	6.83	6.83	6.83	4.29	4.29
secondary school	students	2.97	2.97	2.97	4.29	4.29
college	students	3.40	1.40	2.83	3.37	3.37
hospital	sqm Gross Floor Area (GFA)	3.14	3.14	3.53	3.13	3.13
GP Surgery	sqm Gross Floor Area (GFA)	1.81	1.81	2.53	1.74	1.74
nursing home	sqm Gross Floor Area (GFA)	0.09	0.09	0.08	0.08	0.08
hotel	sqm Gross Floor Area (GFA)	1.12	2.18	1.48	1.65	1.65
restaurant	sqm Gross Floor Area (GFA)	41.84	17.25	2.19	0.33	0.33
pub	sqm Gross Floor Area (GFA)	57.83	30.88	67.10	67.10	67.10
fast food	sqm Gross Floor Area (GFA)	161.47	36.97	3.48	0.43	0.43
cinema	sqm Gross Floor Area (GFA)	19.12	19.12	14.24	12.41	12.41
bowling alley	sqm Gross Floor Area (GFA)	7.84	7.84	52.25	19.49	19.49
leisure centre	hectares	2,962.26	2,962.26	521.72	971.65	971.65
swimming pool	sqm Gross Floor Area (GFA)	2.19	2.19	2.05	3.32	3.32
ice rink	sqm Gross Floor Area (GFA)	0.52	0.52	0.52	0.52	0.52
bingo hall	seats	7.18	7.18	14.03	22.82	22.82
fitness club	hectares	75,033.28	75,033.28	1,968.91	1,681.14	1,681.14
place of worship	hectares	5,096.51	5,096.51	13,322.50	13,322.50	13,322.50
theatre	seats	81.65	81.65	81.65	81.65	81.65
golf course	hectares	10.00	10.00	10.00	10.00	10.00
private housing	dwellings	39.25	61.59	94.90	42.20	42.20
non-private housing	dwellings	16.64	26.10	94.90	236.52	236.52
mixed housing	dwellings	35.57	58.47	87.56	93.53	93.53
retirement housing	dwellings	6.44	6.44	62.12	27.01	27.01
civic amenity site	hectares	10.00	10.00	10.00	10.00	10.00

Table 6: Annual Bus Passenger Trip Rates (London)

Land use	Unit	Central	Inner	Outer
office	sqm Gross Floor Area (GFA)	0.70	2.35	1.20
industrial	sqm Gross Floor Area (GFA)	0.98	0.98	0.40
warehousing	sqm Gross Floor Area (GFA)	1.08	1.08	0.38
food retail	sqm Gross Floor Area (GFA)	206.28	120.76	38.57
discount food	sqm Gross Floor Area (GFA)	5.99	5.99	5.99
non-food retail	sqm Gross Floor Area (GFA)	7.42	7.42	3.95
shopping centre	sqm Gross Floor Area (GFA)	53.61	53.61	53.61
retail park including food	sqm Gross Floor Area (GFA)	10.27	10.27	15.84
retail park excluding food	sqm Gross Floor Area (GFA)	10.27	10.27	15.84
car showroom	sqm Gross Floor Area (GFA)	5.60	5.60	3.65
nursery	students	65.00	65.00	25.00
primary school	students	21.45	21.45	13.65
secondary school	students	27.30	27.30	52.65
college	students	7.80	7.80	89.70
hospital	sqm Gross Floor Area (GFA)	0.14	0.14	4.14
GP Surgery	sqm Gross Floor Area (GFA)	2.22	18.74	3.52
nursing home	sqm Gross Floor Area (GFA)	0.92	0.92	0.92
hotel	sqm Gross Floor Area (GFA)	0.83	0.50	0.63
restaurant	sqm Gross Floor Area (GFA)	27.25	22.79	18.18
pub	sqm Gross Floor Area (GFA)	11.46	60.55	57.70
fast food	sqm Gross Floor Area (GFA)	80.00	80.00	84.58
cinema	sqm Gross Floor Area (GFA)	71.94	94.01	199.83
bowling alley	sqm Gross Floor Area (GFA)	10.45	10.45	8.24
leisure centre	hectares	521.91	521.91	521.91
swimming pool	sqm Gross Floor Area (GFA)	2.19	2.19	2.19
Ice rink	sqm Gross Floor Area (GFA)	0.52	0.52	0.52
bingo hall	seats	2,945.91	2,945.91	4,671.42
fitness club	hectares	450.87	409.23	247.86
place of worship	hectares	299.30	299.30	36.50
theatre	seats	81.65	81.65	81.65
golf course	hectares	2,138.77	2,138.77	3,104.54
private housing	dwellings	44.07	91.53	94.92
non-private housing	dwellings	196.62	27.12	64.41
mixed housing	dwellings	94.92	94.92	94.92
retirement housing	dwellings	67.86	67.86	124.74
civic amenity site	hectares	10.00	10.00	10.00

Table 7: Annual HGV Trip Rates (Not London)

Land use	Unit	Town centre	Edge of centre	Suburban	Edge of town	Free standing
office	sqm Gross Floor Area (GFA)	1.16	0.22	0.70	0.39	0.39
industrial	sqm Gross Floor Area (GFA)	1.26	1.26	1.29	1.23	1.23
warehousing	sqm Gross Floor Area (GFA)	3.27	3.27	3.27	0.82	0.82
food retail	sqm Gross Floor Area (GFA)	1.62	1.38	2.08	1.68	1.68
discount food	sqm Gross Floor Area (GFA)	0.57	0.57	0.42	2.63	2.63
non-food retail	sqm Gross Floor Area (GFA)	0.44	0.44	0.17	0.23	0.23
shopping centre	sqm Gross Floor Area (GFA)	4.60	4.60	4.60	3.55	3.55
retail park including food	sqm Gross Floor Area (GFA)	0.53	0.53	0.53	1.00	1.00
retail park excluding food	sqm Gross Floor Area (GFA)	0.51	0.51	0.25	0.31	0.31
car showroom	sqm Gross Floor Area (GFA)	2.42	2.42	0.60	0.62	0.62
nursery	students	3.71	3.71	3.71	3.71	3.71
primary school	students	1.17	1.17	1.17	1.17	1.17
secondary school	students	0.20	0.20	0.20	0.78	0.78
college	students	2.34	0.39	0.39	0.59	0.59
hospital	sqm Gross Floor Area (GFA)	0.62	0.62	0.56	0.47	0.47
GP Surgery	sqm Gross Floor Area (GFA)	0.73	0.73	1.07	1.07	1.07
nursing home	sqm Gross Floor Area (GFA)	0.23	0.23	0.16	0.16	0.16
hotel	sqm Gross Floor Area (GFA)	0.28	0.51	0.36	0.42	0.42
restaurant	sqm Gross Floor Area (GFA)	0.19	0.36	0.48	1.11	1.11
pub	sqm Gross Floor Area (GFA)	2.91	2.91	1.83	1.83	1.83
fast food	sqm Gross Floor Area (GFA)	4.18	4.18	4.18	4.18	4.18
cinema	sqm Gross Floor Area (GFA)	0.19	0.19	0.32	0.32	0.32
bowling alley	sqm Gross Floor Area (GFA)	0.92	0.92	0.92	0.15	0.15
leisure centre	hectares	437.57	437.57	400.01	1,108.51	1,108.51
swimming pool	sqm Gross Floor Area (GFA)	0.19	0.19	0.80	0.72	0.72
Ice rink	sqm Gross Floor Area (GFA)	0.11	0.11	0.11	0.11	0.11
bingo hall	seats	92.39	92.39	92.39	14.60	14.60
fitness club	hectares	845.73	845.73	1,095.50	1,788.80	1,788.80
place of worship	hectares	100.00	100.00	100.00	100.00	100.00
theatre	seats	92.39	92.39	92.39	14.60	14.60
golf course	hectares	14.00	14.00	14.00	30.60	30.60
private housing	dwellings	16.78	16.78	16.24	23.36	23.36
non-private housing	dwellings	29.57	29.57	29.57	29.57	29.57
mixed housing	dwellings	21.81	21.81	15.72	24.33	24.33
retirement housing	dwellings	5.22	5.22	5.22	7.83	7.83
civic amenity site	hectares	10,570.53	10,570.53	10,570.53	10,570.53	10,570.53

Table 8: Annual HGV Trip Rates (London)

Land Use	Unit	Central	Inner	Outer
office	sqm Gross Floor Area (GFA)	0.30	0.13	0.13
industrial	sqm Gross Floor Area (GFA)	1.28	1.28	1.28
warehousing	sqm Gross Floor Area (GFA)	4.68	4.68	4.68
food retail	sqm Gross Floor Area (GFA)	0.41	6.31	6.31
discount food	sqm Gross Floor Area (GFA)	0.41	6.31	6.31
non-food retail	sqm Gross Floor Area (GFA)	1.44	1.44	1.44
shopping centre	sqm Gross Floor Area (GFA)	0.49	0.49	0.49
retail park including food	sqm Gross Floor Area (GFA)	0.53	0.53	0.53
retail park excluding food	sqm Gross Floor Area (GFA)	0.53	0.53	0.53
car showroom	sqm Gross Floor Area (GFA)	1.24	1.24	1.24
nursery	students	2.00	2.00	1.00
primary school	students	2.00	2.00	1.00
secondary school	students	0.39	4.00	1.00
college	students	15.00	2.00	0.00
hospital	sqm Gross Floor Area (GFA)	0.38	0.47	0.37
GP Surgery	sqm Gross Floor Area (GFA)	0.73	0.73	0.73
nursing home	sqm Gross Floor Area (GFA)	0.23	0.23	0.23
hotel	sqm Gross Floor Area (GFA)	0.16	0.08	0.26
restaurant	sqm Gross Floor Area (GFA)	0.19	0.19	0.19
pub	sqm Gross Floor Area (GFA)	0.65	0.65	0.65
fast food	sqm Gross Floor Area (GFA)	29.67	29.67	29.67
cinema	sqm Gross Floor Area (GFA)	4.73	4.73	4.73
bowling alley	sqm Gross Floor Area (GFA)	4.73	4.73	4.73
leisure centre	hectares	1,053.00	1,053.00	1,053.00
swimming pool	sqm Gross Floor Area (GFA)	0.22	0.22	1.12
Ice rink	sqm Gross Floor Area (GFA)	0.22	0.22	1.12
bingo hall	seats	473.00	473.00	473.00
fitness club	hectares	845.73	845.73	845.73
place of worship	hectares	100.00	100.00	100.00
theatre	seats	92.39	92.39	92.39
golf course	hectares	14.00	14.00	14.00
private housing	dwellings	57.00	40.00	234.00
non-private housing	dwellings	57.00	40.00	234.00
mixed housing	dwellings	8.00	2.61	27.00
retirement housing	dwellings	5.22	5.22	5.22
civic amenity site	hectares	15,969.00	15,969.00	15,969.00

Table 9: Average annual km travelled by passenger cars

	Petrol	Diesel	Petrol and diesel cars	All fuel type
London	10,571	14,175	11,086	11,086
Great Britain	12,341	19,646	13,950	13,966
Rest of UK (not London)	12,581	19,867	14,218	14,250

Note: LET uses combined petrol/diesel figure (blue text) for all cars

Table 10: Average annual km travelled by LGVs and HGVs by vehicle type

Rigid HGVs	
Over 3.5 tonnes up to 7.5 tonnes	23,000
Over 7.5 tonnes up to 17 tonnes	28,000
Over 17 tonnes up to 25 tonnes	44,000
Over 25 tonnes	43,000
All rigid HGVs	32,000
Articulated HGVs	
Over 3.5 tonnes up to 33 tonnes	66,000
Over 33 tonnes	93,000
All articulated HGVs	90,000
Rigid and articulated HGVs	
Over 3.5 tonnes up to 25 tonnes	29,000
Over 25 tonnes up to 35 tonnes	48,000
Over 35 tonnes	93,000
All HGVs	48,000
Vans	14,870

Appendix B: Conversion from Peak Hour Trip Rates

Table 11: Factors to convert combined peak hour trip rates to annual trips

Land use	Representative Peak hours	Trip type	Factors to convert combined peak hours to annual trips
Employment	Weekday 08:00-09:00, 17:00-18:00	Commuting	521.54
Education	Weekday 08:00-09:00, 16:00-17:00	Education-education escort	371.32
Retail	Saturday 12:00-13:00, 16:00-17:00	Retail	1,212.82
Leisure	Saturday 12:00-13:00, 19:00-20:00	Leisure	1,400.96
Health	Weekday 08:00-09:00, 17:00-18:00	Health	1,802.05
Notes:			
Factor is for combined peak hours = Two-way AM Peak + Two-way PM Peak			

Appendix C: Accounting for variation in site operation throughout the year

Table 12: Factors to convert daily trip rates to annual trips

Land use	Representative Day	Trip type	Factors to convert daily trips to annual trips
Employment	Weekday	Commuting	123.94
Education	Weekday	Education-education escort	194.97
Retail	Saturday	Retail	234.36
Leisure	Saturday	Leisure	258.00
Health	Weekday	Health	305.88

Table 13: Supporting data – Calculation steps and example data

Calculation Step	Example – relevant assumptions for retail
Calculations supporting default conversion factors in LET for different land uses	
Identify the representative daily trip rate for the land use	Saturday
Assume no. of instances of this day in a year (= level of operation of the site)	52 working weeks each with 1 Saturday = 52 days
Add an allowance for other days of the week <i>The LET uses information from the National Travel Survey (2008, Chart 8.2), which provides proportions of trips made on different days of the week by land use (see Table 14)</i>	NTS (2008): Saturday accounts for 22% of retail trips. Therefore add 78% for weekdays and Sun = $(52/22\%) \times 100\% = 236.36$ days
Minus UK religious holidays (2 per year)	236 days - 2 days = 234.36 days Annual conversion factor = 234.36 days
Calculations made for a retail site, using LET conversion factors	
Multiply daily trip rate (for the representative day) by gross floor area to give daily trips for the site	Saturday trip rate x GFA/100 = daily trips $114.094 \times 94.68 = 10,802.42$ daily trips
Multiply daily trips for the site by land use specific annual conversion factor, to give annual trips	$10,802 \times 234.36 = 2,531,655$ annual trips

Table 14: Supporting data – Average daily trips by day of the week and purpose: 2004 to 2009. Chart 8.2, National Travel Survey (DfT, 2008). Data tables 5-8. Available online at: webarchive.nationalarchives.gov.uk/20091203140650/http://www.dft.gov.uk/pgr/statistics/datatablespublications/personal/mainresults/nts2008/

	Index: average hour = 100						
	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Commuting	120	130	130	130	122	43	25
Education	134	145	143	140	132	4	2
Escort education	131	144	141	143	136	3	2
Shopping	87	87	87	94	108	157	82
Social/entertainment	80	83	88	87	97	137	128
All purposes	100	105	105	107	109	97	77

Table 15: Supporting data – Detail on calculations and land uses selected within LET methodology

LET Land Use Category	TRICS categories used to calculate Combined Peak Hour / Daily ratios (using TRICS: Version 2010(a) v6.5.2 Build 14.35)	Calculation of daily to annual conversion factor
Office	Average TRICS figures from land uses (separate commuting and business figures): <ul style="list-style-type: none"> - 02 Employment A Office - 02 Employment B Business Park 	TR day = week day 48 working weeks (5 working days per week) = 240 Plus 10% for weekends (NTS) = 267 Minus 8 days public holidays = 259 d equiv * factors for commuting and business
Industrial	Average TRICS figures from land uses (separate commuting and business figures): <ul style="list-style-type: none"> - 02 Employment C Industrial Unit - 02 Employment D Industrial Estate 	TR day = week day 52 working weeks (5 working days per week) = 260 Plus 10% for weekends (NTS) = 289 Minus 8 days public holidays = 281 d equiv * factors for commuting and business
Employment	See above	Average of results for Office and Industrial above (separate commuting and business figures)
Education	Average TRICS figures from land uses: <ul style="list-style-type: none"> - 04 Education A Primary - 04 Education B Secondary 	TR day = week day 39 academic weeks (5 working days per week) = 195 Plus 1% for weekends (NTS) = 197 Minus 2 days public holidays = 195 d equiv
Retail	Average TRICS figures from land uses: <ul style="list-style-type: none"> - 01 Retail A Food Superstore - 01 Retail J Retail Park including Food 	TR day = Saturday 52 weeks (1 Saturday per week) = 52 Plus 78% for weekdays and Sundays (NTS) = 236 Minus 2 days public holidays = 234 d equiv
Leisure	Average TRICS figures from land uses: <ul style="list-style-type: none"> - 07 Leisure A Multiplex Cinema - 09 Golf B Private 18 hole courses 	TR day = Saturday 52 weeks (1 Saturday per week) = 52 Plus 80% for weekdays and Sundays (NTS) = 260 Minus 2 days public holidays = 258 d equiv
Health	Average TRICS figures from land uses: <ul style="list-style-type: none"> - 05 Health A General Hospital with Casualty - 05 Health D Private Hospital 	TR day = week day 52 working weeks (5 working days per week) = 260 Plus 15% for weekends (calc using TRICS rates for Sat/Sun, in absence of NTS data for Health) = 306 d equiv

Appendix D: Default Trip Distances

Table 16: Average car trip lengths by journey purpose and region (km)

Region	Commuting	Business	Education-education escort	Shopping	Personal business-other escort	Social, entertainment-holiday	All purposes
London	14.90	24.70	5.00	6.40	8.10	18.80	12.40
Not London	16.10	32.80	6.60	8.50	9.40	18.20	14.00
Great Britain	16.00	32.30	6.50	8.40	9.30	18.20	13.80

Table 17: Average bus trip lengths by journey purpose and region (km)

Region	Commuting	Business	Education-education escort	Shopping	Personal business-other escort	Social, entertainment-holiday	All purposes
London	7.80	6.70	5.40	4.80	5.20	6.00	5.90
Not London	8.90	8.00	8.50	6.70	6.40	8.50	7.80
Great Britain	8.60	7.50	7.70	6.30	6.10	7.80	7.30

Table 18: Average HGV haul length by vehicle type (km)

	Average haul length (kilometres)
Rigid HGVs	
Over 3.5 tonnes up to 17 tonnes	54
Over 17 tonnes up to 25 tonnes	68
Over 25 tonnes	38
All rigid HGVs	45
Articulated HGVs	
Over 3.5 tonnes up to 33 tonnes	112
Over 33 tonnes	121
All articulated HGVs	120
All HGVs	87

Appendix E: Refined Damage Costs

Table 19: Geographical variation on PM₁₀ damage cost factors, and low / high estimates (IGCB, 2013)

IGCB (2013, 2010 prices)		Central Estimate	Low Central Range	High Central Range
NOX	£/t	£955	£744	£1,085
PM transport average	£/t	£48,517	£37,987	£55,133
Central London	£/t	£221,726	£173,601	£251,961
Inner London	£/t	£228,033	£178,540	£259,129
Outer London	£/t	£148,949	£116,621	£169,261
Inner conurbation	£/t	£117,899	£92,309	£133,975
Outer conurbation	£/t	£73,261	£57,362	£83,252
Urban big > 250K population	£/t	£87,332	£68,377	£99,241
Urban large > 100K population	£/t	£70,351	£55,081	£79,944
Urban medium > 25K population	£/t	£55,310	£43,305	£62,853
Urban small > 10K population	£/t	£34,932	£27,351	£39,696
Rural	£/t	£15,041	£11,776	£17,091

Table 20: Non traded Carbon values (DECC, 2013)

2013 (£/t CO ₂ e)	Low	Central	High
2008	27	55	82
2009	28	56	84
2010	28	57	85
2011	29	57	86
2012	29	58	87
2013	30	59	89
2014	30	60	90
2015	30	61	91
2016	31	62	93
2017	31	63	94
2018	32	64	96
2019	32	65	97
2020	33	66	99
2021	33	67	100
2022	34	68	102
2023	34	69	103
2024	35	70	105
2025	36	71	107
2026	36	72	108
2027	37	73	110
2028	37	74	112
2029	38	76	113
2030	38	76	114

Economic Treatment of Air Quality Damage Costs

Damage costs for NO_x and PM₁₀ published by IGCB are in 2010 prices. Defra¹² provides guidance on converting these figures into prices to match the base year of the assessment. An equivalent treatment is applied by the LET (using 2005 prices).

The treatment involves the following steps:

- Calculate NO_x and PM₁₀ damage costs for the impact year
- Recalculate damage costs in the baseline year prices of the appraisal period (by converting values using an assumed inflation rate of 2.5%)
- For emissions reductions in each subsequent year, uplift the damage cost values by 2% per annum. This reflects the assumption that willingness to pay will rise in line with economic growth
- Discount future values back to the baseline year ('present values') at a rate of 3.5% per year (declining after the first 30 years) as set out in the Treasury's Green Book.

Combining those steps means that damage costs for Air Quality are converted to base year values by multiplying by this factor:

$$(1 + \text{inflation} * ((\text{base year}) - 2010)) * (1.02^{((\text{future year}) - (\text{base year}))}) / (1.035^{((\text{future year}) - (\text{base year}))})$$

The impact of these calculations are shown below:

- Multiplication factor increases with subsequent appraisal baseline years (when costs are considered over 1 year):
 - o Base Year = 2010 Future Year = 2010 Multiplication factor = 100%
 - o Base Year = 2011 Future Year = 2011 Multiplication factor = 103%
 - o Base Year = 2012 Future Year = 2012 Multiplication factor = 105%
 - o Base Year = 2013 Future Year = 2013 Multiplication factor = 108%
 - o Base Year = 2014 Future Year = 2014 Multiplication factor = 110%
 - o Base Year = 2015 Future Year = 2015 Multiplication factor = 113%
 - o Base Year = 2016 Future Year = 2016 Multiplication factor = 115%
- Multiplication factor decreases when considering costs over more than one year
 - o Base Year = 2010 Future Year = 2010 Multiplication factor = 100%
 - o Base Year = 2010 Future Year = 2011 Multiplication factor = 99%
 - o Base Year = 2010 Future Year = 2012 Multiplication factor = 97%
 - o Base Year = 2010 Future Year = 2013 Multiplication factor = 96%
 - o Base Year = 2010 Future Year = 2014 Multiplication factor = 94%
 - o Base Year = 2010 Future Year = 2015 Multiplication factor = 93%
 - o Base Year = 2010 Future Year = 2016 Multiplication factor = 92%

¹² Defra (2009) *Defra Local Air Quality Management Practise Guidance: Economic Principles for the Assessment of Local Measures to Improve Air Quality*, February 2009.

Defra (2011) *Air Quality Damage Cost Guidance*, February 2011. Available online at: <https://www.gov.uk/air-quality-economic-analysis>

Economic Treatment of Carbon Damage Costs

Non-traded carbon prices published by DECC are in 2013 prices. A similar treatment is recommended by DECC¹³ to convert the figures into prices to match the base year of the assessment. An equivalent treatment is applied by the LET (using 2009 prices).

The treatment involves the following steps:

- Calculate CO₂e damage costs for the impact year
- Recalculate damage costs in the baseline year prices of the appraisal period (by converting values using an assumed inflation rate of 2.5%)

<<Note, no uplift calculation is included for Carbon Damage Costs>>

- Discount future values back to the baseline year ('present values') at a rate of 3.5% per year (declining after the first 30 years) as set out in the Treasury's Green Book.

Combining those steps means that damage costs for Carbon are converted to base year values by multiplying by this factor:

$$(1+\text{inflation}*((\text{base year})-2013)) / (1.035 ^ ((\text{future year})-(\text{base year})))$$

The effects of changing the timeframes are as follows:

- Multiplication factor increases with subsequent base years (when considered over 1 year):

○ Base Year = 2013	Future Year = 2013	Multiplication factor = 100%
○ Base Year = 2014	Future Year = 2014	Multiplication factor = 103%
○ Base Year = 2015	Future Year = 2015	Multiplication factor = 105%
○ Base Year = 2016	Future Year = 2016	Multiplication factor = 108%
○ Base Year = 2017	Future Year = 2017	Multiplication factor = 110%
- Multiplication factor decreases when considering costs over more than one year

○ Base Year = 2013	Future Year = 2013	Multiplication factor = 100%
○ Base Year = 2013	Future Year = 2014	Multiplication factor = 97%
○ Base Year = 2013	Future Year = 2015	Multiplication factor = 93%
○ Base Year = 2013	Future Year = 2016	Multiplication factor = 90%
○ Base Year = 2013	Future Year = 2017	Multiplication factor = 87%

¹³ DECC (2009b) *A brief guide to the new carbon values and their use in economic appraisal* (July 2009)

Appendix F: Additional Information

Table 21: Average speeds for 'Not London' urban, rural and motorway roads within the LET (kph)

Road type	Cars & LGVs	Rigid HGVs (3.5t – 14t)	Rigid HGVs (>14t) & Articulated HGVs	Buses and Coaches
Urban	48.3	48.3	48.3	48.3
Rural	77.2	74.0	69.2	72.4
Motorway	112.6	98.1	86.9	96.5

Table 22: Average traffic speeds in London (kph)¹⁴

Area	Road type	LDVs	HGVs	Buses
Central London	Major principal roads	16	16	16
Central London	Major trunk roads	24	24	16
Central London	Minor roads	16	16	16
Inner London	Major principal roads	21	21	24
Inner London	Major trunk roads	32	32	24
Inner London	Minor roads	20	20	20
Outer London	Major principal roads	31	31	32
Outer London	Major trunk roads	46	46	32
Outer London	Minor roads	29	29	29
Outer London	Motorways	108	87	87

¹⁴ DfT. Transport Statistics Great Britain (2009) Available online at: <http://www.dft.gov.uk/pgr/statistics/datatablespublications/tsgb/>
DfT confirmed that this data was also valid for 2010.