

Greenhouse Gases Workbook

TAG Reference

TAG Unit A3 - Environmental Impact Appraisal

Notes

This tool helps valuing the impact arising from the change in CO₂e emissions, in conjunction with guidance in TAG Unit A3.

To use this tool, the following are required:

- 1 Year of appraisal
- 2 Opening year of the analysed scheme/policy
- 3 Annual CO₂e emissions (tonnes), split by traded and non-traded sector, both for the 'without-scheme' and 'with-scheme' forecasts.

Cells requiring user inputs on the 'inputs' sheet are shaded light green. The user inputs required are:

- 1 Scheme name
- 2 Scheme opening year
- 3 Scheme type (road, rail or road/rail)
- 4 Current year - the year the appraisal is undertaken to ensure the correct profile of discount rates
- 5 Without scheme emissions in the non-traded sector
- 6 With scheme emissions in the non-traded sector
- 7 Without scheme emissions in the traded sector
- 8 With scheme emissions in the traded sector

The other standard inputs are taken from the TAG data book / guidance:

- 1 Non-traded carbon values
- 2 Standard 60-year appraisal period
- 3 Standard DfT base year for present values and prices
- 4 HMT profile of discount rates
- 5 GDP deflator series from TAG data book (if results are required for a different base year)

The 'outputs' sheet produces 'Worksheet 1' as described in TAG Unit A3.

Note: The value of traded emissions should be internalised in the fuel/energy prices used in the appraisal. Therefore this spreadsheet calculates changes in both traded and non-traded emissions for reporting purposes but monetary values are only applied to non-traded emissions.

Cells highlighted in yellow show the results

Version Control

<u>Date</u>	<u>Description</u>
Dec-17	Updated carbon values and GDP deflator forecasts
Aug-17	Updated carbon values and GDP deflator forecasts
Mar-17	Updated carbon values and GDP deflator forecasts
Jul-16	Updated carbon values and GDP deflator forecasts
Dec-15	Updated carbon values and GDP deflator forecasts
Mar-15	Revised workbook structure released as forthcoming change
Nov-14	Updated non-traded carbon values in line with the 2014 DECC / Supp. Green Book guidance on energy and GHGs
Spring 2014	Updated non-traded carbon values in line with IAG 2013 guidance
Jan-14	Definitive release
17/10/2013	Release of restructured guidance

Contact

Transport Appraisal and Strategic Modelling (TASM) Division
Department for Transport
Zone 2/25 Great Minster House
33 Horseferry Road
London
SW1P 4DR
tasm@dft.gsi.gov.uk

Greenhouse Gases Workbook - Inputs

Scheme details

Scheme name	<input type="text" value="EGPH SIDs & STARS"/>	<i>Scheme_name</i>
Opening year	<input type="text" value="2019"/>	<i>Opening_year_in</i>
Scheme type (select from list)	<input type="text" value="road/rail"/>	<i>Scheme_type</i>
Current year	<input type="text" value="2018"/>	<i>Current_year_in</i>

Emissions (tCO2e per year)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Non-traded sector																
Road without scheme										0	0	0	0	0	0	0
Road with scheme										-5507	-5591	-5674	-5758	-5841	-5925	-6008
Rail without scheme																
Rail with scheme																

Traded sector

Road without scheme																
Road with scheme										-25434	-25819	-26204	-26590	-26975	-27360	-27746
Rail without scheme																
Rail with scheme																

Emission values

Non-traded values (£/tCO2e)

price base year	<input type="text" value="2010"/>	<i>CO2e_value_price_base_in</i>															
price base year		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Low		26.2	26.5	26.9	27.3	27.8	28.2	28.6	29.0	29.5	29.9	30.3	30.9	31.4	31.9	32.4	32.9
Central		52.3	53.1	53.9	54.7	55.5	56.3	57.2	58.0	58.9	59.8	60.7	61.7	62.7	63.7	64.7	65.8
High		78.5	79.6	80.8	82.0	83.3	84.5	85.8	87.1	88.4	89.7	91.0	92.6	94.1	95.6	97.1	98.6

source: TAG data book v1.10 (May 2018). Table A3.4.

Traded values (£/tCO2e)

price base year	<input type="text" value="2010"/>	<i>CO2e_value_price_base_in</i>															
price base year		2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Low		12.3	11.1	5.8	3.6	4.5	5.1	4.0	0.0	0.0	0.0	0.0	3.5	7.1	10.5	14.0	17.5
Central		12.3	11.1	5.8	3.6	4.5	5.1	4.0	3.7	3.7	3.9	4.1	10.7	17.4	24.1	30.7	37.4
High		12.3	11.1	5.8	3.6	4.5	5.1	4.0	4.3	5.8	7.1	8.8	18.5	28.3	38.0	47.7	57.5

source:

TAG data book v1.10 (May 2018). 'GHG' tab.

Appraisal period and discounting

Appraisal period (years)	60	<i>Appraisal_period_length_in</i>
PV base year	2010	<i>PV_base_year_in</i>
Outputs price year	2010	<i>Price_base_outputs_in</i>
Discount period 1	30	<i>Discount_period_1_in</i>
Discount period 2	75	<i>Discount_period_2_in</i>
Discount period 3	125	<i>Discount_period_3_in</i>
Discount rate 1	3.5%	<i>Discount_rate_1_in</i>
Discount rate 2	3.0%	<i>Discount_rate_2_in</i>
Discount rate 3	2.5%	<i>Discount_rate_3_in</i>

source:

TAG data book v1.10 (May 2018). Table A1.1.1

Carbon budget 1 start	2008	<i>Carbon_budget_1_start_in</i>
Carbon budget 1 end	2012	<i>Carbon_budget_1_end_in</i>
Carbon budget 2 start	2013	<i>Carbon_budget_2_start_in</i>
Carbon budget 2 end	2017	<i>Carbon_budget_2_end_in</i>
Carbon budget 3 start	2018	<i>Carbon_budget_3_start_in</i>
Carbon budget 3 end	2022	<i>Carbon_budget_3_end_in</i>
Carbon budget 4 start	2023	<i>Carbon_budget_4_start_in</i>
Carbon budget 4 end	2027	<i>Carbon_budget_4_end_in</i>

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
GDP deflator	100.0	102.0	103.6	105.6	107.4	107.9	110.0	112.2	113.9	115.7	117.6	119.6	121.7	124.4	127.2	130.0

source:

TAG data book v1.10 (May 2018). Annual parameters tab.



2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046

0	0	0	0																	
-6092	-6175	-6259	-6342																	



-28131	-28516	-28902	-29287																	



2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046

33.4	33.9	34.4	34.9	35.4	38.7	42.0	45.3	48.6	51.8	55.1	58.4	61.7	65.0	68.3	71.6	74.9	78.1	81.4	84.7	88.0
66.8	67.8	68.8	69.8	70.8	77.4	84.0	90.5	97.1	103.7	110.3	116.8	123.4	130.0	136.6	143.1	149.7	156.3	162.9	169.4	176.0
100.2	101.7	103.2	104.7	106.2	116.1	125.9	135.8	145.7	155.5	165.4	175.3	185.1	195.0	204.9	214.7	224.6	234.4	244.3	254.2	264.0



2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040 2041 2042 2043 2044 2045 2046

20.9	24.3	27.7	31.1	35.4	38.7	42.0	45.3	48.6	51.8	55.1	58.4	61.7	65.0	68.3	71.6	74.9	78.1	81.4	84.7	88.0
44.0	50.6	57.2	63.9	70.8	77.4	84.0	90.5	97.1	103.7	110.3	116.8	123.4	130.0	136.6	143.1	149.7	156.3	162.9	169.4	176.0
67.2	77.0	86.7	96.5	106.2	116.1	125.9	135.8	145.7	155.5	165.4	175.3	185.1	195.0	204.9	214.7	224.6	234.4	244.3	254.2	264.0



2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046
132.8	135.7	138.7	141.8	144.9	148.1	151.3	154.7	158.1	161.6	165.1	168.7	172.5	176.2	180.1	184.1	188.1	192.3	196.5	200.8	205.2



2047 2048 2049 2050 2051 2052 2053 2054 2055 2056 2057 2058 2059 2060 2061 2062 2063 2064 2065 2066 2067





2047 2048 2049 2050 2051 2052 2053 2054 2055 2056 2057 2058 2059 2060 2061 2062 2063 2064 2065 2066 2067

91.3	94.6	97.9	101.2	103.7	106.0	108.3	110.6	112.6	114.6	116.4	118.1	119.7	121.1	122.0	122.7	123.2	123.5	123.6	123.7	123.4
182.6	189.2	195.7	202.3	209.5	216.4	223.4	230.3	237.1	243.9	250.4	256.8	263.1	269.2	274.0	278.9	283.2	287.3	290.9	294.5	297.5
273.9	283.8	293.6	303.5	315.3	326.8	338.4	350.1	361.6	373.1	384.4	395.5	406.4	417.2	426.1	435.0	443.2	451.1	458.2	465.3	471.5



2047 2048 2049 2050 2051 2052 2053 2054 2055 2056 2057 2058 2059 2060 2061 2062 2063 2064 2065 2066 2067

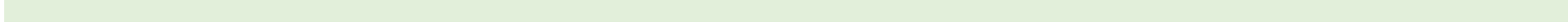
91.3	94.6	97.9	101.2	103.7	106.0	108.3	110.6	112.6	114.6	116.4	118.1	119.7	121.1	122.0	122.7	123.2	123.5	123.6	123.7	123.4
182.6	189.2	195.7	202.3	209.5	216.4	223.4	230.3	237.1	243.9	250.4	256.8	263.1	269.2	274.0	278.9	283.2	287.3	290.9	294.5	297.5
273.9	283.8	293.6	303.5	315.3	326.8	338.4	350.1	361.6	373.1	384.4	395.5	406.4	417.2	426.1	435.0	443.2	451.1	458.2	465.3	471.5



2047	2048	2049	2050	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067
209.8	214.4	219.1	223.9	228.8	233.9	239.0	244.3	249.6	255.1	260.8	266.5	272.4	278.3	284.5	290.7	297.1	303.7	310.3	317.2	324.1



2068 2069 2070 2071 2072 2073 2074 2075 2076 2077 2078 2079 2080 2081 2082 2083 2084 2085 2086 2087 2088





2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088
123.1	122.5	121.8	121.0	120.2	119.1	117.9	116.7	115.2	113.6	112.0	110.2	108.2	106.6	104.9	103.0	101.1	99.2	97.2	95.1	93.0
300.2	302.5	304.5	306.4	308.1	309.5	310.3	311.2	311.3	311.4	311.0	310.4	309.3	309.1	308.4	307.5	306.4	305.4	303.8	301.9	300.1
477.3	482.5	487.2	491.8	496.0	499.8	502.7	505.7	507.3	509.1	510.0	510.6	510.3	511.6	512.0	512.0	511.6	511.5	510.3	508.8	507.1



2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088
123.1	122.5	121.8	121.0	120.2	119.1	117.9	116.7	115.2	113.6	112.0	110.2	108.2	106.6	104.9	103.0	101.1	99.2	97.2	95.1	93.0
300.2	302.5	304.5	306.4	308.1	309.5	310.3	311.2	311.3	311.4	311.0	310.4	309.3	309.1	308.4	307.5	306.4	305.4	303.8	301.9	300.1
477.3	482.5	487.2	491.8	496.0	499.8	502.7	505.7	507.3	509.1	510.0	510.6	510.3	511.6	512.0	512.0	511.6	511.5	510.3	508.8	507.1



2068	2069	2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085	2086	2087	2088
331.3	338.6	346.0	353.6	361.4	369.4	377.5	385.8	394.3	402.9	411.8	420.9	430.1	439.6	449.3	459.2	469.3	479.6	490.1	500.9	511.9

2089 2090 2091 2092 2093 2094 2095 2096 2097 2098 2099 2100 year_in

													<i>Non_traded_emissions_road_without_scheme_in</i>
													<i>Non_traded_emissions_road_with_scheme_in</i>
													<i>Non_traded_emissions_rail_without_scheme_in</i>
													<i>Non_traded_emissions_rail_with_scheme_in</i>

													<i>Traded_emissions_road_without_scheme_in</i>
													<i>Traded_emissions_road_with_scheme_in</i>
													<i>Traded_emissions_rail_without_scheme_in</i>
													<i>Traded_emissions_rail_with_scheme_in</i>

2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100	
90.9	88.7	86.7	84.7	82.5	80.4	78.3	76.2	74.1	71.9	69.9	67.8	<i>CO2e_values_low_in</i>
297.9	295.7	293.9	292.0	289.6	287.2	284.7	282.1	279.6	276.7	274.0	271.1	<i>CO2e_values_central_in</i>
505.0	502.7	501.1	499.3	496.7	494.0	491.1	488.0	485.1	481.4	478.2	474.4	<i>CO2e_values_high_in</i>

2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100	
90.9	88.7	86.7	84.7	82.5	80.4	78.3	76.2	74.1	71.9	69.9	67.8	<i>CO2e_values_low_in_non_traded</i>
297.9	295.7	293.9	292.0	289.6	287.2	284.7	282.1	279.6	276.7	274.0	271.1	<i>CO2e_values_central_in_non_traded</i>
505.0	502.7	501.1	499.3	496.7	494.0	491.1	488.0	485.1	481.4	478.2	474.4	<i>CO2e_values_high_in_non_traded</i>



2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100	
523.2	534.7	546.5	558.5	570.8	583.3	596.2	609.3	622.7	636.4	650.4	664.7	<i>GDP_deflator_in</i>

Greenhouse Gases Workbook - Calculations

2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021

Appraisal period

Opening year	2019	<i>Opening_year</i>										
Opening year	0	0	0	0	0	0	0	0	0	1	0	0
Appraisal period length (years)	60	<i>Appraisal_period_length</i>										
Appraisal period	0	0	0	0	0	0	0	0	0	1	1	1
Check	TRUE											

Emissions (tCO2e)

Non-traded sector

Road without scheme	0	0	0	0	0	0	0	0	0	0	0	0
Road with scheme	0	0	0	0	0	0	0	0	0	-5507.498	-5590.9444	-5674.3908
Road - change in emissions	0	0	0	0	0	0	0	0	0	-5507.498	-5590.9444	-5674.3908
Rail without scheme	0	0	0	0	0	0	0	0	0	0	0	0
Rail with scheme	0	0	0	0	0	0	0	0	0	0	0	0
Rail - change in emissions	0	0	0	0	0	0	0	0	0	0	0	0
Total change in non-traded emissions	0	0	0	0	0	0	0	0	0	-5507.498	-5590.9444	-5674.3908
Change over 60 years (tCO2e)												<i>-65172 Non_traded_emissions_change_60years</i>

Traded sector

Road without scheme	0	0	0	0	0	0	0	0	0	0	0	0
Road with scheme	0	0	0	0	0	0	0	0	0	-25433.502	-25818.8556	-26204.2092
Road - change in emissions	0	0	0	0	0	0	0	0	0	-25433.502	-25818.8556	-26204.2092
Rail without scheme	0	0	0	0	0	0	0	0	0	0	0	0
Rail with scheme	0	0	0	0	0	0	0	0	0	0	0	0
Rail - change in emissions	0	0	0	0	0	0	0	0	0	0	0	0
Total change in traded emissions	0	0	0	0	0	0	0	0	0	-25433.502	-25818.8556	-26204.2092
Change over 60 years (tCO2e)												<i>-300963 Traded_emissions_change_60years</i>

Total change in CO2e emissions **0** **0** **0** **0** **0** **0** **0** **0** **0** **-30941** **-31409.8** **-31878.6**

Change over 60 years (tCO2e) *-366135 TOTAL_emissions_change_60years*
 Change in opening year (tCO2e) *-30941 TOTAL_emissions_change_opening_year*

Carbon budget periods

Carbon budget 1 start	2008 <i>Carbon_budget_1_start</i>
Carbon budget 1 end	2012 <i>Carbon_budget_1_end</i>
Carbon budget 2 start	2013 <i>Carbon_budget_2_start</i>
Carbon budget 2 end	2017 <i>Carbon_budget_2_end</i>
Carbon budget 3 start	2018 <i>Carbon_budget_3_start</i>
Carbon budget 3 end	2022 <i>Carbon_budget_3_end</i>
Carbon budget 4 start	2023 <i>Carbon_budget_4_start</i>
Carbon budget 4 end	2027 <i>Carbon_budget_4_end</i>

Masks

Carbon Budget 1	1	1	1	0	0	0	0	0	0	0	0	0	0
Carbon Budget 2	0	0	0	1	1	1	1	1	0	0	0	0	0
Carbon Budget 3	0	0	0	0	0	0	0	0	1	1	1	1	1
Carbon Budget 4	0	0	0	0	0	0	0	0	0	0	0	0	0

Change in traded emissions (tCO₂e)

Carbon Budget 1	0 <i>Traded_emissions_change_Budget_1</i>
Carbon Budget 2	0 <i>Traded_emissions_change_Budget_2</i>
Carbon Budget 3	-104046 <i>Traded_emissions_change_Budget_3</i>
Carbon Budget 4	-138728 <i>Traded_emissions_change_Budget_4</i>

Change in non-traded emissions (tCO₂e)

Carbon Budget 1	0 <i>Non_traded_emissions_change_Budget_1</i>
Carbon Budget 2	0 <i>Non_traded_emissions_change_Budget_2</i>
Carbon Budget 3	-22530.7 <i>Non_traded_emissions_change_Budget_3</i>
Carbon Budget 4	-30040.9 <i>Non_traded_emissions_change_Budget_4</i>

Emission valuations

Price adjustment

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
GDP deflator	100.0	102.0	103.6	105.6	107.4	107.9	110.0	112.2	113.9	115.7	117.6	119.6
CO ₂ e values price base	2010 <i>CO2e_value_price_base</i>											
GDP deflator index - base	100 <i>GDP_deflator_base</i>											
Price base for outputs	2010 <i>Price_base_outputs</i>											
GDP deflator index - for outputs	100 <i>GDP_deflator_outputs</i>											
Price base adjustment	1.00 <i>Price_adjustment</i>											
Carbon values in 2010 prices												
low (£/tCO ₂ e)	26.2	26.5	26.9	27.3	27.8	28.2	28.6	29.0	29.5	29.9	30.3	30.9
central (£/tCO ₂ e)	52.3	53.1	53.9	54.7	55.5	56.3	57.2	58.0	58.9	59.8	60.7	61.7
high (£/tCO ₂ e)	78.5	79.6	80.8	82.0	83.3	84.5	85.8	87.1	88.4	89.7	91.0	92.6

Valuing changes in emissions (non-traded) (£)

positive values represent a benefit - a reduction in GHG emissions

Low (£)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	164674.6	169677.2	175079.9
Central (£)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	329349.2	339354.4	350159.7
High (£)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	494023.9	509031.7	525239.6

Discounting and present values

Discount period

Current year	2018	<i>Current_year</i>
PV base year	2010	<i>PV_base_year</i>
discount period 1	30	<i>Discount_period_1</i>
discount period 2	75	<i>Discount_period_2</i>
discount period 3	125	<i>Discount_period_3</i>

Masks

Discount period 1	0	1	1	1	1	1	1	1	1	1	1	1	1
Discount period 2	0	0	0	0	0	0	0	0	0	0	0	0	0
Discount period 3	0	0	0	0	0	0	0	0	0	0	0	0	0

Discount rates and factors

discount rate 1	3.5%	<i>Discount_rate_1</i>
discount rate 2	3.0%	<i>Discount_rate_2</i>
discount rate 3	2.5%	<i>Discount_rate_3</i>

Discount rate profile		0.0%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%
Discount factor	1	1.00	1.04	1.07	1.11	1.15	1.19	1.23	1.27	1.32	1.36	1.41	1.46

Discounted GHG benefits

Low (£)	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	120826.9	120287.4	119920.2
Central (£)	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	241653.7	240574.7	239840.4
High (£)	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	362480.6	360862.1	359760.6

Present values

Low (£)	1,300,845	<i>NPV_low</i>
Central (£)	2,601,691	<i>NPV_central</i>
High (£)	3,902,536	<i>NPV_high</i>

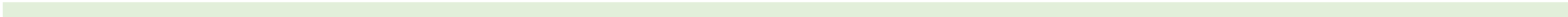


2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037



0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1



0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

-5757.8372 -5841.2836 -5924.73 -6008.1764 -6091.6228 -6175.0692 -6258.5156 -6341.962 0 0 0 0 0 0 0 0

-5757.8372 -5841.2836 -5924.73 -6008.1764 -6091.6228 -6175.0692 -6258.5156 -6341.962 0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

-5757.8372 -5841.2836 -5924.73 -6008.1764 -6091.6228 -6175.0692 -6258.5156 -6341.962 0 0 0 0 0 0 0 0



0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

-26589.5628 -26974.9164 -27360.27 -27745.6236 -28130.9772 -28516.3308 -28901.6844 -29287.038 0 0 0 0 0 0 0 0

-26589.5628 -26974.9164 -27360.27 -27745.6236 -28130.9772 -28516.3308 -28901.6844 -29287.038 0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

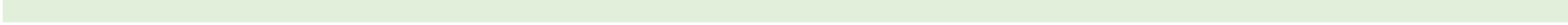
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

-26589.5628 -26974.9164 -27360.27 -27745.6236 -28130.9772 -28516.3308 -28901.6844 -29287.038 0 0 0 0 0 0 0 0

-32347.4 -32816.2 -33285 -33753.8 -34222.6 -34691.4 -35160.2 -35629 0 0 0 0 0 0 0 0



0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0



2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
121.7	124.4	127.2	130.0	132.8	135.7	138.7	141.8	144.9	148.1	151.3	154.7	158.1	161.6	165.1	168.7

31.4	31.9	32.4	32.9	33.4	33.9	34.4	34.9	35.4	38.7	42.0	45.3	48.6	51.8	55.1	58.4
62.7	63.7	64.7	65.8	66.8	67.8	68.8	69.8	70.8	77.4	84.0	90.5	97.1	103.7	110.3	116.8
94.1	95.6	97.1	98.6	100.2	101.7	103.2	104.7	106.2	116.1	125.9	135.8	145.7	155.5	165.4	175.3



2038 2039 2040 2041 2042 2043 2044 2045 2046 2047 2048 2049 2050 2051 2052 2053



0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1



0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0



0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

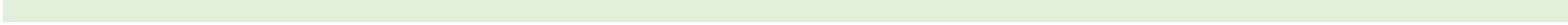
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0



0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0



0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051	2052	2053
172.5	176.2	180.1	184.1	188.1	192.3	196.5	200.8	205.2	209.8	214.4	219.1	223.9	228.8	233.9	239.0

61.7	65.0	68.3	71.6	74.9	78.1	81.4	84.7	88.0	91.3	94.6	97.9	101.2	103.7	106.0	108.3
123.4	130.0	136.6	143.1	149.7	156.3	162.9	169.4	176.0	182.6	189.2	195.7	202.3	209.5	216.4	223.4
185.1	195.0	204.9	214.7	224.6	234.4	244.3	254.2	264.0	273.9	283.8	293.6	303.5	315.3	326.8	338.4



2054 2055 2056 2057 2058 2059 2060 2061 2062 2063 2064 2065 2066 2067 2068 2069



0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1



0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0



0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

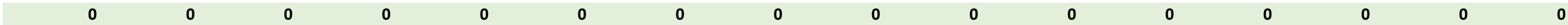
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

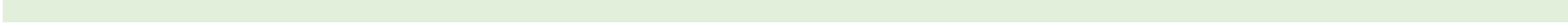
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0



0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0



0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



2054	2055	2056	2057	2058	2059	2060	2061	2062	2063	2064	2065	2066	2067	2068	2069
244.3	249.6	255.1	260.8	266.5	272.4	278.3	284.5	290.7	297.1	303.7	310.3	317.2	324.1	331.3	338.6

110.6	112.6	114.6	116.4	118.1	119.7	121.1	122.0	122.7	123.2	123.5	123.6	123.7	123.4	123.1	122.5
230.3	237.1	243.9	250.4	256.8	263.1	269.2	274.0	278.9	283.2	287.3	290.9	294.5	297.5	300.2	302.5
350.1	361.6	373.1	384.4	395.5	406.4	417.2	426.1	435.0	443.2	451.1	458.2	465.3	471.5	477.3	482.5

0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

3.0% 3.0% 3.0% 3.0% 3.0% 3.0% 3.0% 3.0% 3.0% 3.0% 3.0% 3.0% 3.0% 3.0% 3.0% 3.0%
4.41 4.55 4.68 4.82 4.97 5.12 5.27 5.43 5.59 5.76 5.93 6.11 6.29 6.48 6.68 6.88

0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0



2070 2071 2072 2073 2074 2075 2076 2077 2078 2079 2080 2081 2082 2083 2084 2085



0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

1 1 1 1 1 1 1 1 1 0 0 0 0 0 0 0



0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0



0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

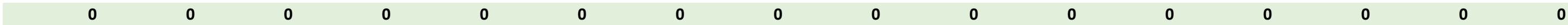
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0



0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0



0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

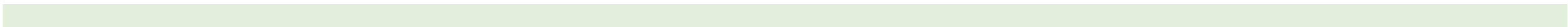


2070	2071	2072	2073	2074	2075	2076	2077	2078	2079	2080	2081	2082	2083	2084	2085
346.0	353.6	361.4	369.4	377.5	385.8	394.3	402.9	411.8	420.9	430.1	439.6	449.3	459.2	469.3	479.6

121.8	121.0	120.2	119.1	117.9	116.7	115.2	113.6	112.0	110.2	108.2	106.6	104.9	103.0	101.1	99.2
304.5	306.4	308.1	309.5	310.3	311.2	311.3	311.4	311.0	310.4	309.3	309.1	308.4	307.5	306.4	305.4
487.2	491.8	496.0	499.8	502.7	505.7	507.3	509.1	510.0	510.6	510.3	511.6	512.0	512.0	511.6	511.5



0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0



2086	2087	2088	2089	2090	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100
490.1	500.9	511.9	523.2	534.7	546.5	558.5	570.8	583.3	596.2	609.3	622.7	636.4	650.4	664.7

97.2	95.1	93.0	90.9	88.7	86.7	84.7	82.5	80.4	78.3	76.2	74.1	71.9	69.9	67.8
303.8	301.9	300.1	297.9	295.7	293.9	292.0	289.6	287.2	284.7	282.1	279.6	276.7	274.0	271.1
510.3	508.8	507.1	505.0	502.7	501.1	499.3	496.7	494.0	491.1	488.0	485.1	481.4	478.2	474.4





year



Opening_year_mask

Appraisal_period



Non_traded_emissions_road_without_scheme

Non_traded_emissions_road_with_scheme


Non_traded_emissions_road_change

Non_traded_emissions_rail_without_scheme

Non_traded_emissions_rail_with_scheme

Non_traded_emissions_rail_change

Non_traded_emissions_TOTAL_change



Traded_emissions_road_without_scheme

Traded_emissions_road_with_scheme

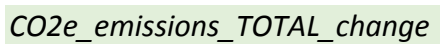
Traded_emissions_road_change

Traded_emissions_rail_without_scheme

Traded_emissions_rail_with_scheme

Traded_emissions_rail_change

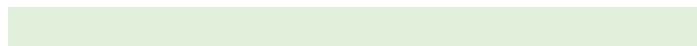
Traded_emissions_TOTAL_change




CO2e_emissions_TOTAL_change





Carbon_budget_1_mask
Carbon_budget_2_mask
Carbon_budget_3_mask
Carbon_budget_4_mask




CO2e_values_low
CO2e_values_central
CO2e_values_high



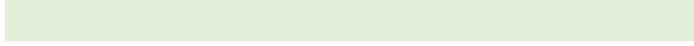
CO2e_benefits_undiscounted_low
CO2e_benefits_undiscounted_central
CO2e_benefits_undiscounted_high



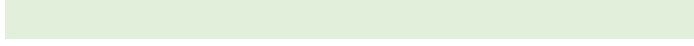
Discount_period_1_mask
Discount_period_2_mask
Discount_period_3_mask



Discount_rate_profile
Discount_factor



CO2e_benefits_discounted_low
CO2e_benefits_discounted_central
CO2e_benefits_discounted_high



Greenhouse Gases Workbook - Calculations

2010 2011 2012

Appraisal period

Opening year	2019 <i>Opening_year</i>			
Opening year	0	0	0	0
Appraisal period length (years)	60 <i>Appraisal_period_length</i>			
Appraisal period	0	0	0	0
Check	TRUE			

Emissions (tCO2e)

Non-traded sector

Road without scheme	0	0	0	0
Road with scheme	0	0	0	0
Road - change in emissions	0	0	0	0
Rail without scheme	0	0	0	0
Rail with scheme	0	0	0	0
Rail - change in emissions	0	0	0	0
Total change in non-traded emissions	0	0	0	0
Change over 60 years (tCO2e)	-65172 <i>Non_traded_emissions_change_60years</i>			

Traded sector

Road without scheme	0	0	0	0
Road with scheme	0	0	0	0
Road - change in emissions	0	0	0	0
Rail without scheme	0	0	0	0
Rail with scheme	0	0	0	0
Rail - change in emissions	0	0	0	0
Total change in traded emissions	0	0	0	0
Change over 60 years (tCO2e)	-300963 <i>Traded_emissions_change_60years</i>			

Total change in CO2e emissions 0 0 0

Change over 60 years (tCO2e)	-366135 <i>TOTAL_emissions_change_60years</i>			
Change in opening year (tCO2e)	-30941 <i>TOTAL_emissions_change_opening_year</i>			

Carbon budget periods

Carbon budget 1 start	2008	<i>Carbon_budget_1_start</i>
Carbon budget 1 end	2012	<i>Carbon_budget_1_end</i>
Carbon budget 2 start	2013	<i>Carbon_budget_2_start</i>
Carbon budget 2 end	2017	<i>Carbon_budget_2_end</i>
Carbon budget 3 start	2018	<i>Carbon_budget_3_start</i>
Carbon budget 3 end	2022	<i>Carbon_budget_3_end</i>
Carbon budget 4 start	2023	<i>Carbon_budget_4_start</i>
Carbon budget 4 end	2027	<i>Carbon_budget_4_end</i>

Masks

Carbon Budget 1	1	1	1
Carbon Budget 2	0	0	0
Carbon Budget 3	0	0	0
Carbon Budget 4	0	0	0

Change in traded emissions (tCO₂e)

Carbon Budget 1	0	<i>Traded_emissions_change_Budget_1</i>
Carbon Budget 2	0	<i>Traded_emissions_change_Budget_2</i>
Carbon Budget 3	-104046	<i>Traded_emissions_change_Budget_3</i>
Carbon Budget 4	-138728	<i>Traded_emissions_change_Budget_4</i>

Change in non-traded emissions (tCO₂e)

Carbon Budget 1	0	<i>Non_traded_emissions_change_Budget_1</i>
Carbon Budget 2	0	<i>Non_traded_emissions_change_Budget_2</i>
Carbon Budget 3	-22530.7	<i>Non_traded_emissions_change_Budget_3</i>
Carbon Budget 4	-30040.9	<i>Non_traded_emissions_change_Budget_4</i>

Emission valuations

Price adjustment

	2010	2011	2012
GDP deflator	100.0	102.0	103.6
CO ₂ e values price base	2010	<i>CO2e_value_price_base</i>	
GDP deflator index - base	100	<i>GDP_deflator_base</i>	
Price base for outputs	2010	<i>Price_base_outputs</i>	
GDP deflator index - for outputs	100	<i>GDP_deflator_outputs</i>	
Price base adjustment	1.00	<i>Price_adjustment</i>	
Carbon values in 2010 prices			
low (£/tCO ₂ e)	12.3	11.1	5.8
central (£/tCO ₂ e)	12.3	11.1	5.8
high (£/tCO ₂ e)	12.3	11.1	5.8

Valuing changes in emissions (traded) (£)

positive values represent a benefit - a reduction in GHG emissions

Low (£)	0.0	0.0	0.0
Central (£)	0.0	0.0	0.0
High (£)	0.0	0.0	0.0

Discounting and present values

Discount period

Current year	2018	<i>Current_year</i>
PV base year	2010	<i>PV_base_year</i>
discount period 1	30	<i>Discount_period_1</i>
discount period 2	75	<i>Discount_period_2</i>
discount period 3	125	<i>Discount_period_3</i>

Masks

Discount period 1	0	1	1
Discount period 2	0	0	0
Discount period 3	0	0	0

Discount rates and factors

discount rate 1	3.5%	<i>Discount_rate_1</i>
discount rate 2	3.0%	<i>Discount_rate_2</i>
discount rate 3	2.5%	<i>Discount_rate_3</i>

Discount rate profile	0.0%	3.5%	3.5%	
Discount factor	1	1.00	1.04	1.07

Discounted GHG benefits

Low (£)	0	0.0	0.0
Central (£)	0	0.0	0.0
High (£)	0	0.0	0.0

Present values

Low (£)	2,527,971	<i>NPV_low</i>
Central (£)	5,580,158	<i>NPV_central</i>
High (£)	8,669,391	<i>NPV_high</i>



2013 2014 2015 2016 2017 2018 2019



0 0 0 0 0 0 1

0 0 0 0 0 0 1



0 0 0 0 0 0 0

0 0 0 0 0 0 -5507.498

0 0 0 0 0 0 -5507.498

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 -5507.498



0 0 0 0 0 0 0

0 0 0 0 0 0 -25433.502

0 0 0 0 0 0 -25433.502

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 -25433.502



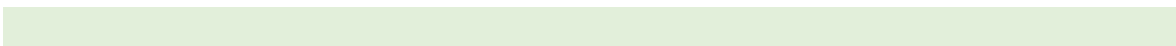
0 0 0 0 0 0 -30941



0	0	0	0	0	0	0
1	1	1	1	1	0	0
0	0	0	0	0	1	1
0	0	0	0	0	0	0



- 1
- 2
- 3
- 4



2013	2014	2015	2016	2017	2018	2019
105.6	107.4	107.9	110.0	112.2	113.9	115.7

3.6	4.5	5.1	4.0	0.0	0.0	0.0
3.6	4.5	5.1	4.0	3.7	3.7	3.9
3.6	4.5	5.1	4.0	4.3	5.8	7.1

0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	99117.1
0.0	0.0	0.0	0.0	0.0	0.0	179566.6

1	1	1	1	1	1	1
0	0	0	0	0	0	0
0	0	0	0	0	0	0

3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%
1.11	1.15	1.19	1.23	1.27	1.32	1.36

0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	72725.3
0.0	0.0	0.0	0.0	0.0	0.0	131753.6



2020 2021 2022 2023 2024 2025 2026



0 0 0 0 0 0 0

1 1 1 1 1 1 1



0 0 0 0 0 0 0

-5590.9444 -5674.3908 -5757.8372 -5841.2836 -5924.73 -6008.1764 -6091.6228

-5590.9444 -5674.3908 -5757.8372 -5841.2836 -5924.73 -6008.1764 -6091.6228

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

-5590.9444 -5674.3908 -5757.8372 -5841.2836 -5924.73 -6008.1764 -6091.6228



0 0 0 0 0 0 0

-25818.8556 -26204.2092 -26589.5628 -26974.9164 -27360.27 -27745.6236 -28130.9772

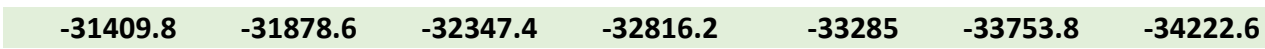
-25818.8556 -26204.2092 -26589.5628 -26974.9164 -27360.27 -27745.6236 -28130.9772

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

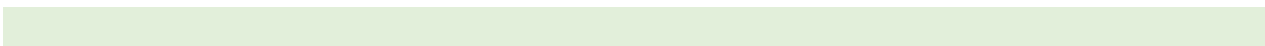
-25818.8556 -26204.2092 -26589.5628 -26974.9164 -27360.27 -27745.6236 -28130.9772



-31409.8 -31878.6 -32347.4 -32816.2 -33285 -33753.8 -34222.6



0	0	0	0	0	0	0
0	0	0	0	0	0	0
1	1	1	0	0	0	0
0	0	0	1	1	1	1



2020	2021	2022	2023	2024	2025	2026
117.6	119.6	121.7	124.4	127.2	130.0	132.8

0.0	3.5	7.1	10.5	14.0	17.5	20.9
4.1	10.7	17.4	24.1	30.7	37.4	44.0
8.8	18.5	28.3	38.0	47.7	57.5	67.2

0.0 92780.4 187617.1 284549.2 383612.6 484840.5 588263.3
105042.2 281509.8 462858.3 649103.0 840257.9 1036336.1 1237349.5
226286.7 485038.9 751302.0 1025076.1 1306361.2 1595157.3 1891464.3

1 1 1 1 1 1 1
0 0 0 0 0 0 0
0 0 0 0 0 0 0

3.5% 3.5% 3.5% 3.5% 3.5% 3.5% 3.5%
1.41 1.46 1.51 1.56 1.62 1.68 1.73

0.0 63549.5 124161.9 181942.0 236988.9 289396.7 339254.9
74466.4 192818.9 306311.9 415039.1 519096.0 618579.3 713586.8
160418.9 332225.3 497199.1 655437.9 807046.2 952134.4 1090818.7



2027 2028 2029 2030 2031 2032 2033



0 0 0 0 0 0 0

1 1 1 1 1 1 1



0 0 0 0 0 0 0

-6175.0692 -6258.5156 -6341.962 0 0 0 0

-6175.0692 -6258.5156 -6341.962 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

-6175.0692 -6258.5156 -6341.962 0 0 0 0



0 0 0 0 0 0 0

-28516.3308 -28901.6844 -29287.038 0 0 0 0

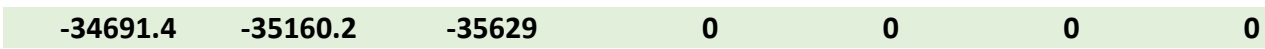
-28516.3308 -28901.6844 -29287.038 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

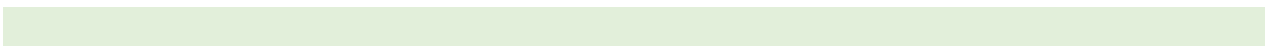
-28516.3308 -28901.6844 -29287.038 0 0 0 0



-34691.4 -35160.2 -35629 0 0 0 0



0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
1	0	0	0	0	0	0



2027	2028	2029	2030	2031	2032	2033
135.7	138.7	141.8	144.9	148.1	151.3	154.7

24.3	27.7	31.1	35.4	38.7	42.0	45.3
50.6	57.2	63.9	70.8	77.4	84.0	90.5
77.0	86.7	96.5	106.2	116.1	125.9	135.8

693909.3	801804.3	911972.2	0.0	0.0	0.0	0.0
1443309.0	1654225.0	1870106.5	0.0	0.0	0.0	0.0
2195282.4	2506611.4	2825451.3	0.0	0.0	0.0	0.0

1	1	1	1	1	1	1
0	0	0	0	0	0	0
0	0	0	0	0	0	0

3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%
1.79	1.86	1.92	1.99	2.06	2.13	2.21

386648.9	431660.3	474367.6	0.0	0.0	0.0	0.0
804217.3	890570.4	972746.5	0.0	0.0	0.0	0.0
1223219.6	1349462.1	1469674.6	0.0	0.0	0.0	0.0



2034 2035 2036 2037 2038 2039 2040



0 0 0 0 0 0 0

1 1 1 1 1 1 1



0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0



0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0



0 0 0 0 0 0 0



0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0



2034	2035	2036	2037	2038	2039	2040
158.1	161.6	165.1	168.7	172.5	176.2	180.1

48.6	51.8	55.1	58.4	61.7	65.0	68.3
97.1	103.7	110.3	116.8	123.4	130.0	136.6
145.7	155.5	165.4	175.3	185.1	195.0	204.9

0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0 0.0

1 1 1 1 1 1 1
0 0 0 0 0 0 0
0 0 0 0 0 0 0

3.5% 3.5% 3.5% 3.5% 3.5% 3.5% 3.5%
2.28 2.36 2.45 2.53 2.62 2.71 2.81

0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0 0.0



2041 2042 2043 2044 2045 2046 2047



0 0 0 0 0 0 0

1 1 1 1 1 1 1



0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0



0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0



0 0 0 0 0 0 0



0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0



2041	2042	2043	2044	2045	2046	2047
184.1	188.1	192.3	196.5	200.8	205.2	209.8

71.6	74.9	78.1	81.4	84.7	88.0	91.3
143.1	149.7	156.3	162.9	169.4	176.0	182.6
214.7	224.6	234.4	244.3	254.2	264.0	273.9

0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0

1	1	1	1	1	1	1
0	0	0	0	0	0	0
0	0	0	0	0	0	0

3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%
2.91	3.01	3.11	3.22	3.33	3.45	3.57

0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0



2048 2049 2050 2051 2052 2053 2054



0 0 0 0 0 0 0

1 1 1 1 1 1 1



0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0



0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

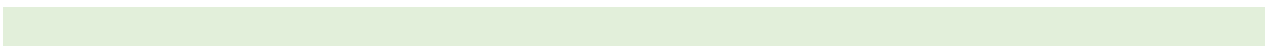
0 0 0 0 0 0 0



0 0 0 0 0 0 0



0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0



2048	2049	2050	2051	2052	2053	2054
214.4	219.1	223.9	228.8	233.9	239.0	244.3

94.6	97.9	101.2	103.7	106.0	108.3	110.6
189.2	195.7	202.3	209.5	216.4	223.4	230.3
283.8	293.6	303.5	315.3	326.8	338.4	350.1

0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0

1	0	0	0	0	0	0
0	1	1	1	1	1	1
0	0	0	0	0	0	0

3.5%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%
3.70	3.81	3.92	4.04	4.16	4.28	4.41

0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0



2055 2056 2057 2058 2059 2060 2061



0 0 0 0 0 0 0

1 1 1 1 1 1 1



0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0



0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0



0 0 0 0 0 0 0



0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0



2055	2056	2057	2058	2059	2060	2061
249.6	255.1	260.8	266.5	272.4	278.3	284.5

112.6	114.6	116.4	118.1	119.7	121.1	122.0
237.1	243.9	250.4	256.8	263.1	269.2	274.0
361.6	373.1	384.4	395.5	406.4	417.2	426.1

0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0 0.0

0 0 0 0 0 0 0
1 1 1 1 1 1 1
0 0 0 0 0 0 0

3.0% 3.0% 3.0% 3.0% 3.0% 3.0% 3.0%
4.55 4.68 4.82 4.97 5.12 5.27 5.43

0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0 0.0



2062 2063 2064 2065 2066 2067 2068



0 0 0 0 0 0 0

1 1 1 1 1 1 1



0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0



0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

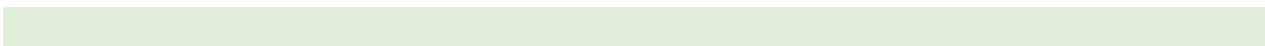
0 0 0 0 0 0 0



0 0 0 0 0 0 0



0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0



2062	2063	2064	2065	2066	2067	2068
290.7	297.1	303.7	310.3	317.2	324.1	331.3

122.7	123.2	123.5	123.6	123.7	123.4	123.1
278.9	283.2	287.3	290.9	294.5	297.5	300.2
435.0	443.2	451.1	458.2	465.3	471.5	477.3

0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0

0	0	0	0	0	0	0
1	1	1	1	1	1	1
0	0	0	0	0	0	0

3.0%	3.0%	3.0%	3.0%	3.0%	3.0%	3.0%
5.59	5.76	5.93	6.11	6.29	6.48	6.68

0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0	0.0



2069 2070 2071 2072 2073 2074 2075



0 0 0 0 0 0 0

1 1 1 1 1 1 1



0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0



0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0



0 0 0 0 0 0 0



0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0



2069	2070	2071	2072	2073	2074	2075
338.6	346.0	353.6	361.4	369.4	377.5	385.8

122.5	121.8	121.0	120.2	119.1	117.9	116.7
302.5	304.5	306.4	308.1	309.5	310.3	311.2
482.5	487.2	491.8	496.0	499.8	502.7	505.7

0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0 0.0

0 0 0 0 0 0 0
1 1 1 1 1 1 1
0 0 0 0 0 0 0

3.0% 3.0% 3.0% 3.0% 3.0% 3.0% 3.0%
6.88 7.08 7.29 7.51 7.74 7.97 8.21

0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0 0.0



2076 2077 2078 2079 2080 2081 2082



0 0 0 0 0 0 0

1 1 1 0 0 0 0



0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0



0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

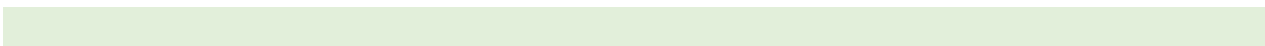
0 0 0 0 0 0 0



0 0 0 0 0 0 0



0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0



2076	2077	2078	2079	2080	2081	2082
394.3	402.9	411.8	420.9	430.1	439.6	449.3

115.2	113.6	112.0	110.2	108.2	106.6	104.9
311.3	311.4	311.0	310.4	309.3	309.1	308.4
507.3	509.1	510.0	510.6	510.3	511.6	512.0

0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0 0.0

0 0 0 0 0 0 0
1 1 1 1 1 1 1
0 0 0 0 0 0 0

3.0% 3.0% 3.0% 3.0% 3.0% 3.0% 3.0%
8.46 8.71 8.97 9.24 9.52 9.80 10.10

0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0 0.0



2083 2084 2085 2086 2087 2088 2089



0 0 0 0 0 0 0

0 0 0 0 0 0 0



0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0



0 0 0 0 0 0 0

0 0 0 0 0 0 0

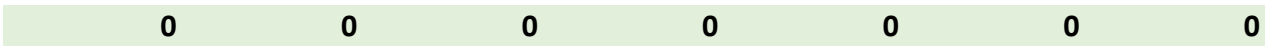
0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0



0 0 0 0 0 0 0



0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0



2083	2084	2085	2086	2087	2088	2089
459.2	469.3	479.6	490.1	500.9	511.9	523.2

103.0	101.1	99.2	97.2	95.1	93.0	90.9
307.5	306.4	305.4	303.8	301.9	300.1	297.9
512.0	511.6	511.5	510.3	508.8	507.1	505.0

0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0 0.0

0 0 0 0 0 0 0
1 1 1 1 1 1 1
0 0 0 0 0 0 0

3.0% 3.0% 3.0% 3.0% 3.0% 3.0% 3.0%
10.40 10.71 11.03 11.36 11.71 12.06 12.42

0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0 0.0



2090 2091 2092 2093 2094 2095 2096



0 0 0 0 0 0 0

0 0 0 0 0 0 0



0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0



0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0

0 0 0 0 0 0 0



0 0 0 0 0 0 0



0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0



2090	2091	2092	2093	2094	2095	2096
534.7	546.5	558.5	570.8	583.3	596.2	609.3

88.7	86.7	84.7	82.5	80.4	78.3	76.2
295.7	293.9	292.0	289.6	287.2	284.7	282.1
502.7	501.1	499.3	496.7	494.0	491.1	488.0

0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0 0.0

0 0 0 0 0 0 0
1 1 1 1 0 0 0
0 0 0 0 1 1 1

3.0% 3.0% 3.0% 3.0% 2.5% 2.5% 2.5%
12.79 13.17 13.57 13.98 14.33 14.68 15.05

0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0 0.0
0.0 0.0 0.0 0.0 0.0 0.0 0.0



2097 2098 2099 2100



0 0 0 0

0 0 0 0



0 0 0 0

0 0 0 0

0 0 0 0

0 0 0 0

0 0 0 0

0 0 0 0

0 0 0 0



0 0 0 0

0 0 0 0

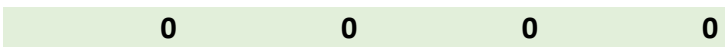
0 0 0 0

0 0 0 0

0 0 0 0

0 0 0 0

0 0 0 0



0 0 0 0



0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0



2097	2098	2099	2100
622.7	636.4	650.4	664.7

74.1	71.9	69.9	67.8
279.6	276.7	274.0	271.1
485.1	481.4	478.2	474.4



0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0



0	0	0	0
0	0	0	0
1	1	1	1



2.5%	2.5%	2.5%	2.5%
15.43	15.81	16.21	16.61



0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0



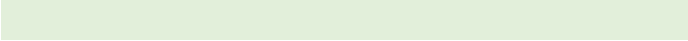



year



Opening_year_mask

Appraisal_period



Non_traded_emissions_road_without_scheme

Non_traded_emissions_road_with_scheme

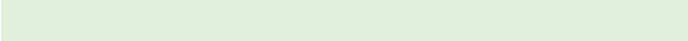
Non_traded_emissions_road_change

Non_traded_emissions_rail_without_scheme

Non_traded_emissions_rail_with_scheme

Non_traded_emissions_rail_change

Non_traded_emissions_TOTAL_change



Traded_emissions_road_without_scheme

Traded_emissions_road_with_scheme

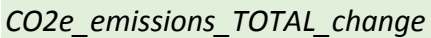
Traded_emissions_road_change

Traded_emissions_rail_without_scheme

Traded_emissions_rail_with_scheme

Traded_emissions_rail_change

Traded_emissions_TOTAL_change



CO2e_emissions_TOTAL_change

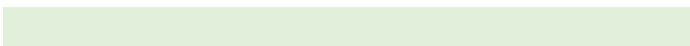


Carbon_budget_1_mask

Carbon_budget_2_mask

Carbon_budget_3_mask


Carbon_budget_4_mask





CO2e_values_low

CO2e_values_central


CO2e_values_high




CO2e_benefits_undiscounted_low
CO2e_benefits_undiscounted_central
CO2e_benefits_undiscounted_high




Discount_period_1_mask
Discount_period_2_mask
Discount_period_3_mask



Discount_rate_profile
Discount_factor



CO2e_benefits_discounted_low
CO2e_benefits_discounted_central
CO2e_benefits_discounted_high



Greenhouse Gases Workbook - Worksheet 1

Scheme Name: EGPH SIDs & STARs

Present Value Base Year

Current Year

Proposal Opening year:

Project (Road/Rail or Road and Rail):

Overall Assessment Score:

Net Present Value of carbon dioxide equivalent emissions of proposal (£):

*positive value reflects a net benefit (i.e. CO2E emissions reduction)

Quantitative Assessment:

Change in carbon dioxide equivalent emissions over 10 year appraisal period (tonnes):
(between 'with scheme' and 'without scheme' scenarios)

Of which Traded

Change in carbon dioxide equivalent emissions in opening year (tonnes):
(between 'with scheme' and 'without scheme' scenarios)

Net Present Value of traded sector carbon dioxide equivalent emissions of proposal (£):

(N.B. this is not additional to the appraisal value in cell I17, as the cost of traded sector emissions is assumed to be internalised into market prices. See TAG Unit A3 for further details)

*positive value reflects a net benefit (i.e. CO2 emissions reduction)

Change in carbon dioxide equivalent emissions by carbon budget period:

	Carbon Budget 1	Carbon Budget 2	Carbon Budget 3	Carbon Budget 4
Traded sector	0	0	-104046.1296	-138728.118
Non-traded sector	0	0	-22530.6704	-30040.882

Qualitative Comments:

The proportion of intra-EU flights is 82.2% hence this proportion of the CO2 is classed as traded sector.

The proportion of flights who's origin/destination is outside the EU is 17.8% hence this proportion of the CO2 is classed as non-traded sector.

Sensitivity Analysis:

Upper Estimate Net Present Value of Carbon dioxide Emissions of Proposal (£):

Lower Estimate Net Present Value of Carbon dioxide Emissions of Proposal (£):

Data Sources:

