



## Greenhouse Gases Workbook

### TAG Reference

TAG Unit A3 - Environmental Impact Appraisal

### Notes

This tool helps valuing the impact arising from the change in CO<sub>2</sub>e emissions, in conjunction with

To use this tool, the following are required:

- 1 Year of appraisal
- 2 Opening year of the analysed scheme/policy
- 3 Annual CO<sub>2</sub>e emissions (tonnes), split by traded and non-traded sector, both for t

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

- 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
- 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

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 use changes in both traded and non-traded emissions for reporting purposes but mon  
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
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

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h guidance in TAG Unit A3.

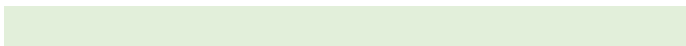
he 'without-scheme' and 'with-scheme' forecasts.

are:

discount rates

se year)

ed in the appraisal. Therefore this spreadsheet calculates  
etary values are only applied to non-traded emissions.



rk guidance on energy and GHGs



# Greenhouse Gases Workbook - Inputs

## Scheme details

Scheme name	EGD323 - with new routes	<i>Scheme_name</i>
Opening year	2019	<i>Opening_year_in</i>
Scheme type (select from list)	road/rail	<i>Scheme_type</i>
Current year	2018	<i>Current_year_in</i>

## Emissions (tCO<sub>2</sub>e per year)

	2010	2011	2012	2013	2014
<b>Non-traded sector</b>					
Road without scheme					
Road with scheme					
Rail without scheme					
Rail with scheme					

## Traded sector

Road without scheme					
Road with scheme					
Rail without scheme					
Rail with scheme					

## Emission values

### Non-traded values (£/tCO<sub>2</sub>e)

price base year	2010	<i>CO<sub>2</sub>e_value_price_base_in</i>			
price base year					
	2010	2011	2012	2013	2014
Low	26.2	26.5	26.9	27.3	27.8
Central	52.3	53.1	53.9	54.7	55.5
High	78.5	79.6	80.8	82.0	83.3

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

### Traded values (£/tCO<sub>2</sub>e)

price base year	2010	<i>CO<sub>2</sub>e_value_price_base_in</i>			
price base year					
	2010	2011	2012	2013	2014
Low	12.3	11.1	5.8	3.6	4.5
Central	12.3	11.1	5.8	3.6	4.5
High	12.3	11.1	5.8	3.6	4.5

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
GDP deflator	100.0	102.0	103.6	105.6	107.4

source:

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

ime

2015 2016 2017 2018 2019 2020 2021 2022 2023

				3499	3547	3595	3643	3691

				1416	1435	1454	1474	1493

2015 2016 2017 2018 2019 2020 2021 2022 2023

28.2	28.6	29.0	29.5	29.9	30.3	30.9	31.4	31.9
56.3	57.2	58.0	58.9	59.8	60.7	61.7	62.7	63.7
84.5	85.8	87.1	88.4	89.7	91.0	92.6	94.1	95.6

2015 2016 2017 2018 2019 2020 2021 2022 2023

5.1	4.0	0.0	0.0	0.0	0.0	3.5	7.1	10.5
5.1	4.0	3.7	3.7	3.9	4.1	10.7	17.4	24.1
5.1	4.0	4.3	5.8	7.1	8.8	18.5	28.3	38.0



2015	2016	2017	2018	2019	2020	2021	2022	2023
107.9	110.0	112.2	113.9	115.7	117.6	119.6	121.7	124.4

4.





2024 2025 2026 2027 2028 2029 2030 2031 2032

3739	3787	3835	3883	3931	3979			

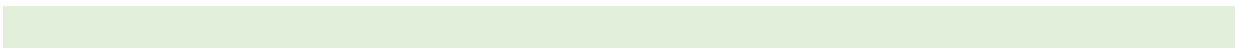


1513	1532	1551	1571	1590	1610			



2024 2025 2026 2027 2028 2029 2030 2031 2032

32.4	32.9	33.4	33.9	34.4	34.9	35.4	38.7	42.0
64.7	65.8	66.8	67.8	68.8	69.8	70.8	77.4	84.0
97.1	98.6	100.2	101.7	103.2	104.7	106.2	116.1	125.9



2024 2025 2026 2027 2028 2029 2030 2031 2032

14.0	17.5	20.9	24.3	27.7	31.1	35.4	38.7	42.0
30.7	37.4	44.0	50.6	57.2	63.9	70.8	77.4	84.0
47.7	57.5	67.2	77.0	86.7	96.5	106.2	116.1	125.9



2024	2025	2026	2027	2028	2029	2030	2031	2032
127.2	130.0	132.8	135.7	138.7	141.8	144.9	148.1	151.3



2033 2034 2035 2036 2037 2038 2039 2040 2041



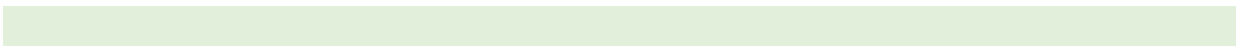






2033 2034 2035 2036 2037 2038 2039 2040 2041

45.3	48.6	51.8	55.1	58.4	61.7	65.0	68.3	71.6
90.5	97.1	103.7	110.3	116.8	123.4	130.0	136.6	143.1
135.8	145.7	155.5	165.4	175.3	185.1	195.0	204.9	214.7



2033 2034 2035 2036 2037 2038 2039 2040 2041

45.3	48.6	51.8	55.1	58.4	61.7	65.0	68.3	71.6
90.5	97.1	103.7	110.3	116.8	123.4	130.0	136.6	143.1
135.8	145.7	155.5	165.4	175.3	185.1	195.0	204.9	214.7



2033	2034	2035	2036	2037	2038	2039	2040	2041
154.7	158.1	161.6	165.1	168.7	172.5	176.2	180.1	184.1



2042      2043      2044      2045      2046      2047      2048      2049      2050









2042      2043      2044      2045      2046      2047      2048      2049      2050

74.9	78.1	81.4	84.7	88.0	91.3	94.6	97.9	101.2
149.7	156.3	162.9	169.4	176.0	182.6	189.2	195.7	202.3
224.6	234.4	244.3	254.2	264.0	273.9	283.8	293.6	303.5



2042      2043      2044      2045      2046      2047      2048      2049      2050

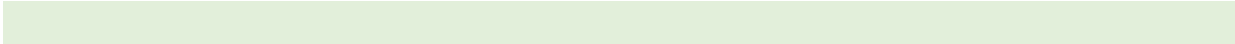
74.9	78.1	81.4	84.7	88.0	91.3	94.6	97.9	101.2
149.7	156.3	162.9	169.4	176.0	182.6	189.2	195.7	202.3
224.6	234.4	244.3	254.2	264.0	273.9	283.8	293.6	303.5

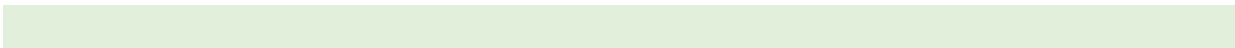


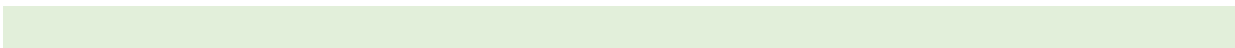
2042	2043	2044	2045	2046	2047	2048	2049	2050
188.1	192.3	196.5	200.8	205.2	209.8	214.4	219.1	223.9



2051      2052      2053      2054      2055      2056      2057      2058      2059

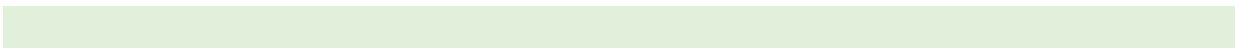


2051      2052      2053      2054      2055      2056      2057      2058      2059

103.7	106.0	108.3	110.6	112.6	114.6	116.4	118.1	119.7
209.5	216.4	223.4	230.3	237.1	243.9	250.4	256.8	263.1
315.3	326.8	338.4	350.1	361.6	373.1	384.4	395.5	406.4



2051      2052      2053      2054      2055      2056      2057      2058      2059

103.7	106.0	108.3	110.6	112.6	114.6	116.4	118.1	119.7
209.5	216.4	223.4	230.3	237.1	243.9	250.4	256.8	263.1
315.3	326.8	338.4	350.1	361.6	373.1	384.4	395.5	406.4



2051	2052	2053	2054	2055	2056	2057	2058	2059
228.8	233.9	239.0	244.3	249.6	255.1	260.8	266.5	272.4





2060      2061      2062      2063      2064      2065      2066      2067      2068



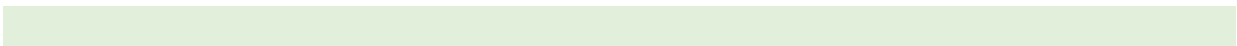






2060      2061      2062      2063      2064      2065      2066      2067      2068

121.1	122.0	122.7	123.2	123.5	123.6	123.7	123.4	123.1
269.2	274.0	278.9	283.2	287.3	290.9	294.5	297.5	300.2
417.2	426.1	435.0	443.2	451.1	458.2	465.3	471.5	477.3



2060      2061      2062      2063      2064      2065      2066      2067      2068

121.1	122.0	122.7	123.2	123.5	123.6	123.7	123.4	123.1
269.2	274.0	278.9	283.2	287.3	290.9	294.5	297.5	300.2
417.2	426.1	435.0	443.2	451.1	458.2	465.3	471.5	477.3



2060	2061	2062	2063	2064	2065	2066	2067	2068
278.3	284.5	290.7	297.1	303.7	310.3	317.2	324.1	331.3

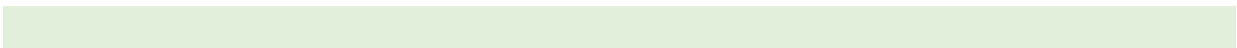


2069      2070      2071      2072      2073      2074      2075      2076      2077



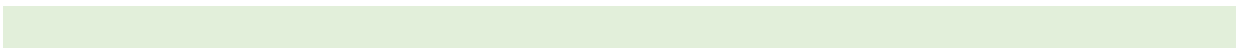






2069      2070      2071      2072      2073      2074      2075      2076      2077

122.5	121.8	121.0	120.2	119.1	117.9	116.7	115.2	113.6
302.5	304.5	306.4	308.1	309.5	310.3	311.2	311.3	311.4
482.5	487.2	491.8	496.0	499.8	502.7	505.7	507.3	509.1



2069      2070      2071      2072      2073      2074      2075      2076      2077

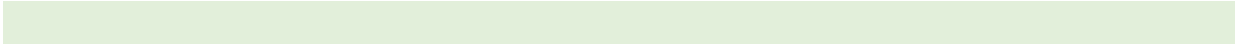
122.5	121.8	121.0	120.2	119.1	117.9	116.7	115.2	113.6
302.5	304.5	306.4	308.1	309.5	310.3	311.2	311.3	311.4
482.5	487.2	491.8	496.0	499.8	502.7	505.7	507.3	509.1



2069	2070	2071	2072	2073	2074	2075	2076	2077
338.6	346.0	353.6	361.4	369.4	377.5	385.8	394.3	402.9

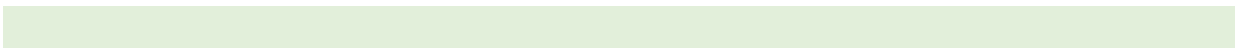


2078 2079 2080 2081 2082 2083 2084 2085 2086









2078 2079 2080 2081 2082 2083 2084 2085 2086

112.0	110.2	108.2	106.6	104.9	103.0	101.1	99.2	97.2
311.0	310.4	309.3	309.1	308.4	307.5	306.4	305.4	303.8
510.0	510.6	510.3	511.6	512.0	512.0	511.6	511.5	510.3



2078 2079 2080 2081 2082 2083 2084 2085 2086

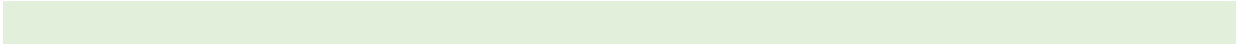
112.0	110.2	108.2	106.6	104.9	103.0	101.1	99.2	97.2
311.0	310.4	309.3	309.1	308.4	307.5	306.4	305.4	303.8
510.0	510.6	510.3	511.6	512.0	512.0	511.6	511.5	510.3



2078	2079	2080	2081	2082	2083	2084	2085	2086
411.8	420.9	430.1	439.6	449.3	459.2	469.3	479.6	490.1

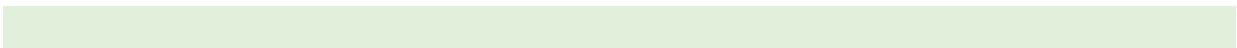


2087      2088      2089      2090      2091      2092      2093      2094      2095



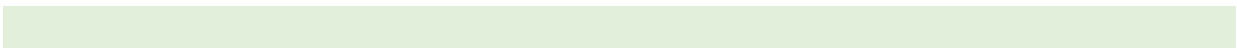






2087      2088      2089      2090      2091      2092      2093      2094      2095

95.1	93.0	90.9	88.7	86.7	84.7	82.5	80.4	78.3
301.9	300.1	297.9	295.7	293.9	292.0	289.6	287.2	284.7
508.8	507.1	505.0	502.7	501.1	499.3	496.7	494.0	491.1



2087      2088      2089      2090      2091      2092      2093      2094      2095

95.1	93.0	90.9	88.7	86.7	84.7	82.5	80.4	78.3
301.9	300.1	297.9	295.7	293.9	292.0	289.6	287.2	284.7
508.8	507.1	505.0	502.7	501.1	499.3	496.7	494.0	491.1



2087	2088	2089	2090	2091	2092	2093	2094	2095
500.9	511.9	523.2	534.7	546.5	558.5	570.8	583.3	596.2





2096      2097      2098      2099      2100



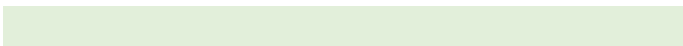






2096      2097      2098      2099      2100

76.2	74.1	71.9	69.9	67.8
282.1	279.6	276.7	274.0	271.1
488.0	485.1	481.4	478.2	474.4



2096      2097      2098      2099      2100

76.2	74.1	71.9	69.9	67.8
282.1	279.6	276.7	274.0	271.1
488.0	485.1	481.4	478.2	474.4



2096	2097	2098	2099	2100
609.3	622.7	636.4	650.4	664.7



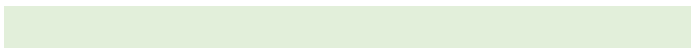
*year\_in*



*Non\_traded\_emissions\_road\_without\_scheme\_in*  
*Non\_traded\_emissions\_road\_with\_scheme\_in*  
*Non\_traded\_emissions\_rail\_without\_scheme\_in*  
*Non\_traded\_emissions\_rail\_with\_scheme\_in*



*Traded\_emissions\_road\_without\_scheme\_in*  
*Traded\_emissions\_road\_with\_scheme\_in*  
*Traded\_emissions\_rail\_without\_scheme\_in*  
*Traded\_emissions\_rail\_with\_scheme\_in*



*CO2e\_values\_low\_in*  
*CO2e\_values\_central\_in*  
*CO2e\_values\_high\_in*



*CO2e\_values\_low\_in\_non\_traded*  
*CO2e\_values\_central\_in\_non\_traded*  
*CO2e\_values\_high\_in\_non\_traded*



*GDP\_deflator\_in*

# 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)	41133.66 <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)	16638.34 <i>Traded_emissions_change_60years</i>			

**Total change in CO2e emissions                      0                      0                      0**

Change over 60 years (tCO2e)	57772 <i>TOTAL_emissions_change_60years</i>
Change in opening year (tCO2e)	4915 <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 (tCO<sub>2</sub>e)

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	5778.547	<i>Traded_emissions_change_Budget_3</i>
Carbon Budget 4	7659.936	<i>Traded_emissions_change_Budget_4</i>

### Change in non-traded emissions (tCO<sub>2</sub>e)

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	14285.85	<i>Non_traded_emissions_change_Budget_3</i>
Carbon Budget 4	18937.06	<i>Non_traded_emissions_change_Budget_4</i>

## Emission valuations

### Price adjustment

	2010	2011	2012
GDP deflator	100.0	102.0	103.6
CO <sub>2</sub> 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 <sub>2</sub> e)	26.2	26.5	26.9
central (£/tCO <sub>2</sub> e)	52.3	53.1	53.9
high (£/tCO <sub>2</sub> e)	78.5	79.6	80.8

### Valuing changes in emissions (non-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

#### Discounted GHG benefits

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

#### Present values

Low (£)	-821,229	<i>NPV_low</i>
Central (£)	#####	<i>NPV_central</i>
High (£)	#####	<i>NPV_high</i>



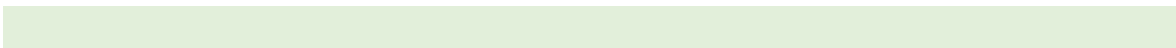




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- 1
- 2
- 3
- 4



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

27.3	27.8	28.2	28.6	29.0	29.5	29.9
54.7	55.5	56.3	57.2	58.0	58.9	59.8
82.0	83.3	84.5	85.8	87.1	88.4	89.7

0.0	0.0	0.0	0.0	0.0	0.0	-104634.7
0.0	0.0	0.0	0.0	0.0	0.0	-209269.5
0.0	0.0	0.0	0.0	0.0	0.0	-313904.2

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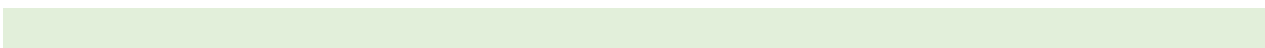
3.5%	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%
1.11	1.15	1.19	1.23	1.27	1.32	1.36

0.0	0.0	0.0	0.0	0.0	0.0	-76773.7
0.0	0.0	0.0	0.0	0.0	0.0	-153547.5
0.0	0.0	0.0	0.0	0.0	0.0	-230321.2





0	0	0	0	0	0	0
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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

30.3	30.9	31.4	31.9	32.4	32.9	33.4
60.7	61.7	62.7	63.7	64.7	65.8	66.8
91.0	92.6	94.1	95.6	97.1	98.6	100.2

-107660.6	-110935.6	-114259.2	-117631.3	-121052.0	-124521.1	-128038.9
-215321.3	-221871.3	-228518.4	-235262.6	-242103.9	-249042.3	-256077.8
-322981.9	-332806.9	-342777.6	-352893.9	-363155.9	-373563.4	-384116.7

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

-76322.7	-75984.9	-75614.8	-75213.9	-74783.7	-74325.5	-73840.8
-152645.3	-151969.8	-151229.7	-150427.9	-149567.4	-148651.0	-147681.6
-228968.0	-227954.7	-226844.5	-225641.8	-224351.1	-222976.5	-221522.4



2027	2028	2029	2030	2031	2032	2033
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0	0	0	0	0	0	0
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3883.3904	3931.3792	3979.368	0	0	0	0
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3883.3904	3931.3792	3979.368	0	0	0	0
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3883.3904	3931.3792	3979.368	0	0	0	0
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0	0	0	0	0	0	0
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1570.8096	1590.2208	1609.632	0	0	0	0
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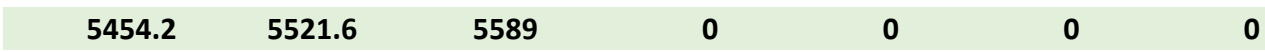
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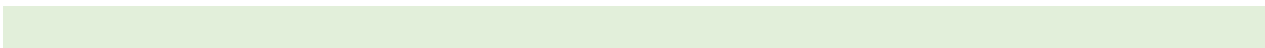
1570.8096	1590.2208	1609.632	0	0	0	0
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<b>5454.2</b>	<b>5521.6</b>	<b>5589</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
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0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
1	0	0	0	0	0	0



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

33.9	34.4	34.9	35.4	38.7	42.0	45.3
67.8	68.8	69.8	70.8	77.4	84.0	90.5
101.7	103.2	104.7	106.2	116.1	125.9	135.8

-131605.2	-135220.0	-138883.4	0.0	0.0	0.0	0.0
-263210.4	-270440.0	-277766.8	0.0	0.0	0.0	0.0
-394815.5	-405660.0	-416650.2	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

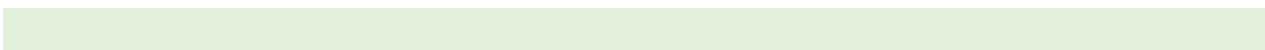
-73330.9	-72797.2	-72241.0	0.0	0.0	0.0	0.0
-146661.8	-145594.4	-144482.0	0.0	0.0	0.0	0.0
-219992.7	-218391.6	-216723.0	0.0	0.0	0.0	0.0







0	0	0	0	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



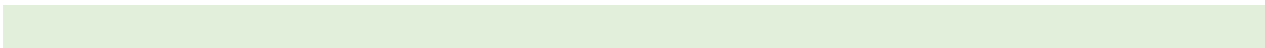
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0.0	0.0	0.0	0.0	0.0	0.0	0.0



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

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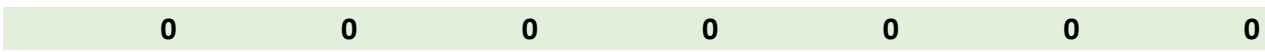
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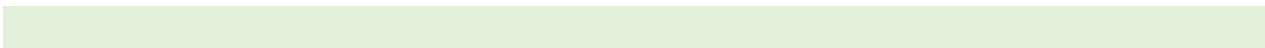
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0	0	0	0	0	0	0
0	0	0	0	0	0	0



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

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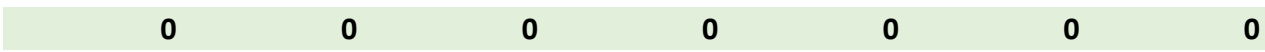
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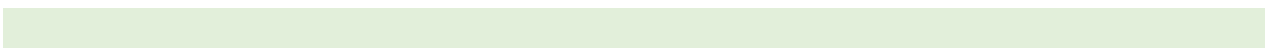
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2048	2049	2050	2051	2052	2053	2054
214.4	219.1	223.9	228.8	233.9	239.0	244.3

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



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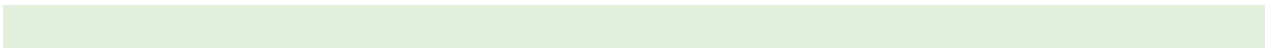
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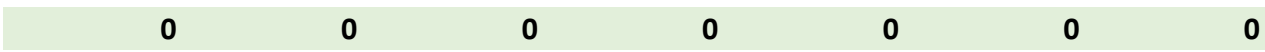
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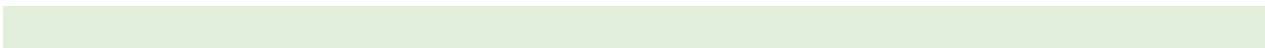
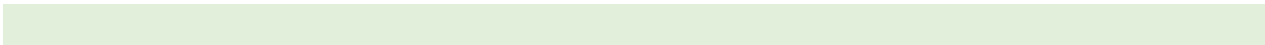
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0	0	0	0	0	0	0



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



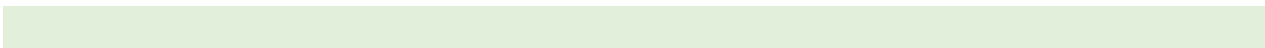
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0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0



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

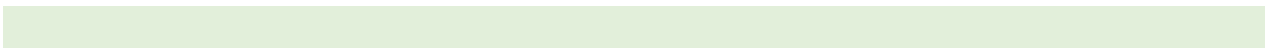








0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0



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

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0                  0                  0                  0                  0                  0                  0

0                  0                  0                  0                  0                  0                  0

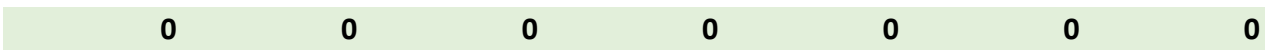
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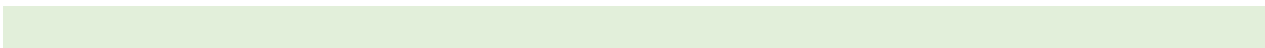
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**0                  0                  0                  0                  0                  0                  0**



0	0	0	0	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



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0                  0                  0                  0                  0                  0                  0

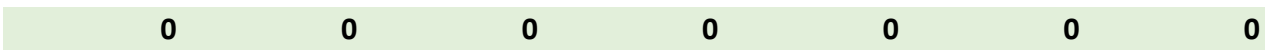
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0                  0                  0                  0                  0                  0                  0



**0                  0                  0                  0                  0                  0                  0**



0	0	0	0	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



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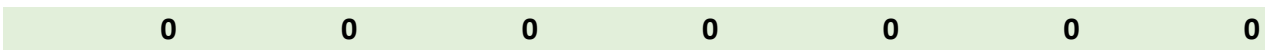
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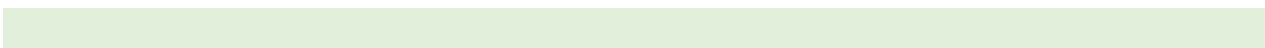
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**0                  0                  0                  0                  0                  0                  0**



0	0	0	0	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



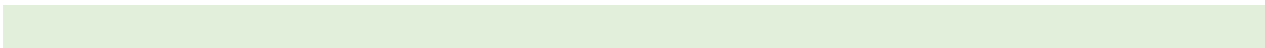
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0.0	0.0	0.0	0.0	0.0	0.0	0.0



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



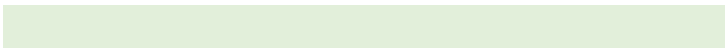
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0	0	0	0
1	1	1	1



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



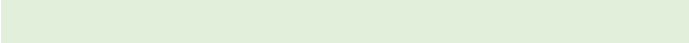



*year*



*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*

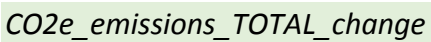
*Traded\_emissions\_road\_change*

*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 - 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)	41133.66 <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)	16638.34 <i>Traded_emissions_change_60years</i>			

**Total change in CO2e emissions                      0                      0                      0**

Change over 60 years (tCO2e)	57772 <i>TOTAL_emissions_change_60years</i>
Change in opening year (tCO2e)	4915 <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 (tCO<sub>2</sub>e)

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	5778.547 <i>Traded_emissions_change_Budget_3</i>
Carbon Budget 4	7659.936 <i>Traded_emissions_change_Budget_4</i>

### Change in non-traded emissions (tCO<sub>2</sub>e)

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	14285.85 <i>Non_traded_emissions_change_Budget_3</i>
Carbon Budget 4	18937.06 <i>Non_traded_emissions_change_Budget_4</i>

## Emission valuations

### Price adjustment

	2010	2011	2012
GDP deflator	100.0	102.0	103.6
CO <sub>2</sub> 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 <sub>2</sub> e)	12.3	11.1	5.8
central (£/tCO <sub>2</sub> e)	12.3	11.1	5.8
high (£/tCO <sub>2</sub> 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 (£)	-139,391	<i>NPV_low</i>
Central (£)	-307,809	<i>NPV_central</i>
High (£)	-478,277	<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      3499.48

0      0      0      0      0      0      3499.48

0      0      0      0      0      0      0

0      0      0      0      0      0      0

0      0      0      0      0      0      0

0      0      0      0      0      0      3499.48



0      0      0      0      0      0      0

0      0      0      0      0      0      1415.52

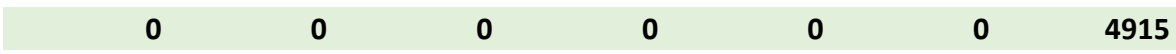
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0      0      0      0      0      0      1415.52



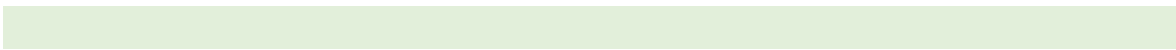
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0	0	0	0	0	1	1
0	0	0	0	0	0	0



- 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	-5516.4
0.0	0.0	0.0	0.0	0.0	0.0	-9993.9

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	-4047.6
0.0	0.0	0.0	0.0	0.0	0.0	-7332.8



2020	2021	2022	2023	2024	2025	2026
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0	0	0	0	0	0	0
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1	1	1	1	1	1	1
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0	0	0	0	0	0	0
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3547.4688	3595.4576	3643.4464	3691.4352	3739.424	3787.4128	3835.4016
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3547.4688	3595.4576	3643.4464	3691.4352	3739.424	3787.4128	3835.4016
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0	0	0	0	0	0	0
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0	0	0	0	0	0	0
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0	0	0	0	0	0	0
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3547.4688	3595.4576	3643.4464	3691.4352	3739.424	3787.4128	3835.4016
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0	0	0	0	0	0	0
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1434.9312	1454.3424	1473.7536	1493.1648	1512.576	1531.9872	1551.3984
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1434.9312	1454.3424	1473.7536	1493.1648	1512.576	1531.9872	1551.3984
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0	0	0	0	0	0	0
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0	0	0	0	0	0	0
---	---	---	---	---	---	---

0	0	0	0	0	0	0
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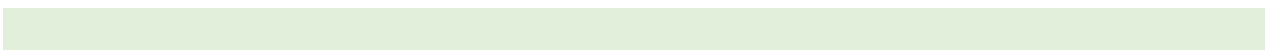
1434.9312	1454.3424	1473.7536	1493.1648	1512.576	1531.9872	1551.3984
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<b>4982.4</b>	<b>5049.8</b>	<b>5117.2</b>	<b>5184.6</b>	<b>5252</b>	<b>5319.4</b>	<b>5386.8</b>
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0	0	0	0	0	0	0
0	0	0	0	0	0	0
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0	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	-5149.3	-10398.9	-15750.9	-21207.5	-26770.7	-32442.2
-5837.9	-15623.9	-25654.4	-35930.3	-46452.5	-57221.8	-68238.7
-12576.3	-26919.8	-41641.7	-56741.9	-72220.4	-88077.3	-104312.6

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%
1.41	1.46	1.51	1.56	1.62	1.68	1.73

0.0	-3527.0	-6881.8	-10071.2	-13101.6	-15979.2	-18709.6
-4138.6	-10701.5	-16977.6	-22974.0	-28697.5	-34155.1	-39353.7
-8915.6	-18438.6	-27557.8	-36281.0	-44616.5	-52572.5	-60157.7



2027	2028	2029	2030	2031	2032	2033
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0	0	0	0	0	0	0
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1	1	1	1	1	1	1
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0	0	0	0	0	0	0
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3883.3904	3931.3792	3979.368	0	0	0	0
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3883.3904	3931.3792	3979.368	0	0	0	0
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0	0	0	0	0	0	0
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0	0	0	0	0	0	0
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0	0	0	0	0	0	0
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3883.3904	3931.3792	3979.368	0	0	0	0
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0	0	0	0	0	0	0
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1570.8096	1590.2208	1609.632	0	0	0	0
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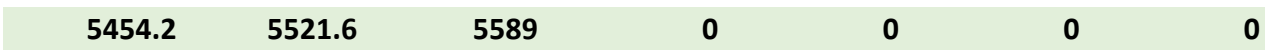
1570.8096	1590.2208	1609.632	0	0	0	0
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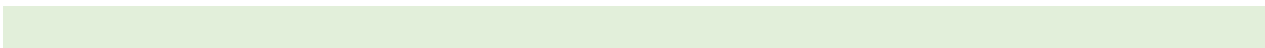
1570.8096	1590.2208	1609.632	0	0	0	0
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<b>5454.2</b>	<b>5521.6</b>	<b>5589</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
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0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
1	0	0	0	0	0	0



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

-38223.7	-44116.7	-50122.5	0.0	0.0	0.0	0.0
-79504.0	-91018.3	-102782.1	0.0	0.0	0.0	0.0
-120926.2	-137918.1	-155288.4	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

-21298.4	-23750.7	-26071.5	0.0	0.0	0.0	0.0
-44300.0	-49000.7	-53462.7	0.0	0.0	0.0	0.0
-67380.5	-74249.7	-80774.1	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



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

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0                  0                  0                  0                  0                  0                  0

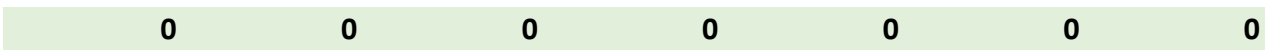
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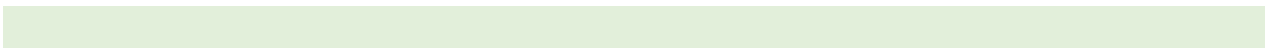
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0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0



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



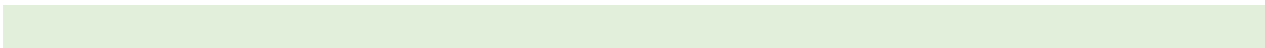
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0.0	0.0	0.0	0.0	0.0	0.0	0.0



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

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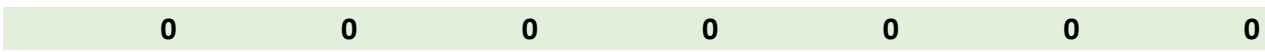
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**0                  0                  0                  0                  0                  0                  0**



0	0	0	0	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

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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

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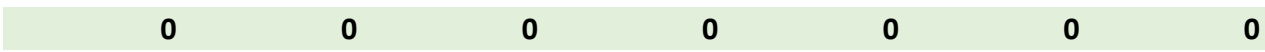
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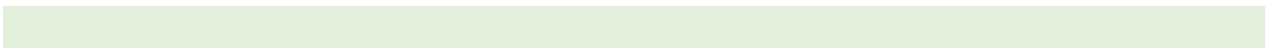
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0	0	0	0	0	0	0
0	0	0	0	0	0	0



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



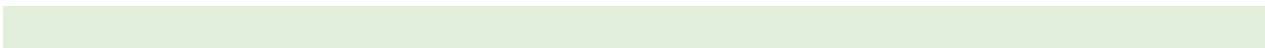
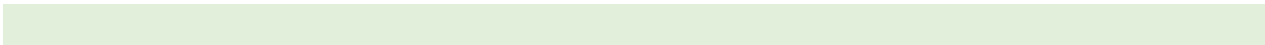
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0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0



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

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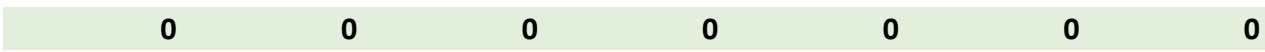
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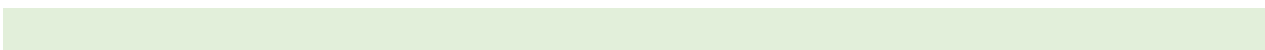
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0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0



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









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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

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0                  0                  0                  0                  0                  0                  0

0                  0                  0                  0                  0                  0                  0

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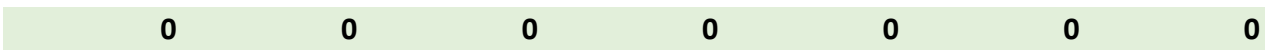
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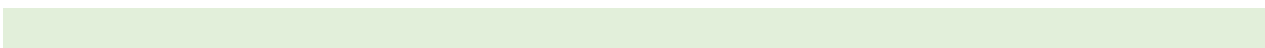
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0	0	0	0	0	0	0
0	0	0	0	0	0	0
0	0	0	0	0	0	0



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

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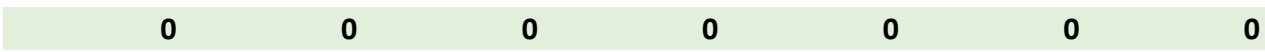
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0                  0                  0                  0                  0                  0                  0



**0                  0                  0                  0                  0                  0                  0**



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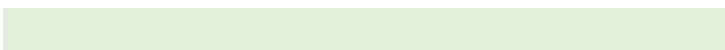
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0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0



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



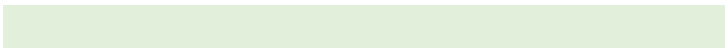
0	0	0	0
0	0	0	0
1	1	1	1



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



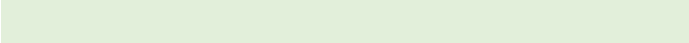



*year*



*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*

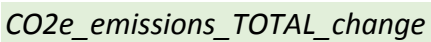
*Traded\_emissions\_road\_change*

*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: EGD323 - with new routes

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. CO2E 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	5778.5472	7659.936
Non-traded sector	0	0	14285.8528	18937.064

**Qualitative Comments:**

This scheme includes the addition of new routes to mitigate the impact of the enlarged danger area. The proportion of traded vs non-traded has been calculated according to the following:  
 The proportion of Intra-EU flights is 71.2% (classed as traded)  
 Flights starting or finishing outside of the EU make up 28.8% for all flights (classed as non-traded)

**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:**

Computer simulation using AirTOP modelling tool, with BADA performance data.

Traffic data extracted using Eurocontrol's Network Strategic Tool (NEST).  
Traffic growth rates as per NATS base case traffic forecasting

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