



Module 8: Carbon  
Carbon: Further Assessment

Prepared for the  
Airports Commission

May 2015

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## Correction

An error has been identified with Table 3.7 in the Airports Commission’s 8. Carbon: Baseline (Airport Commission, 2014).

The table below presents the correct table.

**Table 3.7 – Baseline Carbon emissions due to construction at Gatwick.**

<b>Emissions</b>	<b>Baseline (Carbon emitted 2025 – 2085)</b>
<b>Embodied Carbon</b>	2,974,970
<b>Carbon emissions due to fuel use in construction</b>	41,249
<b>Total carbon emissions due to construction</b>	<b>3,016,218</b>

## Executive Summary

This report provides an assessment of the three shortlisted airport schemes against the Airports Commission’s objective of minimising carbon emissions in airport construction and operation, and analyses the impact under a “carbon traded” scenario rather than a “carbon capped” scenario.

The report has been prepared as an addendum to the Airports Commission’s 8. Carbon: Baseline and 8. Carbon: Assessment reports, (Airports Commission, 2014) in order to show the results that would result from an alternative demand forecast scenario. The scenarios, and where they are assessed, are shown in Table A1.

**Table A1: Demand scenarios**

Scenario	Description	Where is it assessed?
Carbon capped	The level of aviation demand consistent with the Committee on Climate Change’s current assessment of how UK climate targets can be met, constrained by UK airport capacity.	This scenario is assessed within the Airports Commission’s 8. Carbon: Baseline and 8. Carbon: Assessment reports, (Airports Commission, 2014)
Carbon traded	The total potential demand for UK aviation, constrained by UK airport capacity. It also assumes that aviation continues to participate in existing emissions trading schemes, such as the EU Emissions Trading System (ETS), so passengers face a carbon cost, but no specific emissions level is targeted. These forecasts assume that the total emissions allowed beyond 2030 in the global market are set with reference to stabilisation targets and that society seeks to make reductions where they are most desirable or efficient across the global economy, and so global traded emissions will be the same across proposed schemes.	This scenario, both the relevant baseline and the assessment of change, is assessed within this addendum.

This addendum identifies the potential impact of the three proposed schemes in terms of carbon (dioxide) emissions and the addendum has been prepared to add to the evidence that supports the Airports Commission’s Appraisal Framework Module 8: Carbon, (Airports Commission, 2014):

- Gatwick Airport Second Runway (Gatwick 2R) promoted by Gatwick Airport Limited (GAL)
- Heathrow Airport Northwest Runway (Heathrow NWR) promoted by Heathrow Airport Limited (HAL)
- Heathrow Airport Extended Northern Runway (Heathrow ENR) promoted by Heathrow Hub Limited (HH).

The addendum considers estimates of ‘do minimum’ and future runway scheme (‘do something’) emissions as far as is possible given the detail available at this stage. The ‘do minimum’ base case is defined as *‘how the airport will develop in the absence of a scheme to deliver an additional runway’*. Carbon emissions related to the future operation of Gatwick and Heathrow based on most recent 2030 master plans are considered and reported on separately. The Heathrow 2030 master plan is taken to be the baseline for both Heathrow Airport expansion schemes because the baseline is identical in the absence of either development. Carbon data for ATMs are taken directly from the Airports Commission AoN Demand Forecast aviation model outputs and may marginally differ (by +/- 2%) to the operational limits in order for the aviation model to reach equilibrium across UK airports to meet demand.

In establishing the basis for a 60 year appraisal, the ‘do minimum’ has a base date of 2025 for Gatwick 2R and 2026 for Heathrow NWR and ENR in line with assumed opening dates of ‘do something’ development, and corresponding end dates at 2085 / 2086. Comparisons for the years 2030, 2040 and 2050 are considered.

The Appraisal Framework identified where emissions may change due to:

- increased airport capacity leading to a net change in air travel;
- departure and arrival route changes through altered flight operations;
- construction of new facilities and surface access infrastructure.
- airside ground movements and airport operations; and
- changes in non-aviation transport patterns brought about by a scheme’s surface access strategy;

As in the original report, no further quantitative assessment is offered for potential changes in departure and arrival routes.

It is considered that there will not be any substantial changes between proposed construction within the carbon traded and carbon capped scenarios. Therefore, the analysis of construction presented in the Carbon Baseline Report and the Carbon Assessment Report is considered to be applicable to the carbon traded scenario.

Table A2 outlines where the elements of Appraisal Framework are addressed within this appraisal.

**Table A2: Appraisal Framework topics within this report**

Appraisal Framework Emissions Area	Reported in:
Increased airport capacity	Total aircraft emissions (Air travel)
Airside ground movements	Airside (aircraft) ground movement emissions [subset of aircraft emissions] (Ground movements component).
Airport operations	Airport operations emissions from energy & fuel use.
Changes in non-aviation transport	Passenger surface access emissions.

## Carbon Assessment – Gatwick Airport Second Runway

Table A3 outlines the findings of the carbon assessment for Gatwick 2R in terms of the change in tonnes of carbon dioxide, assessing the change in operational emissions associated with Gatwick Airport Second Runway and within a 60 year appraisal period. Table A4 details the net present value (NPV) (£ 2014 prices) for the predicted change. It is considered that there will not be any substantial changes between proposed construction within the carbon traded and carbon capped scenarios and so the analysis of construction presented in the Carbon Baseline Report and the Carbon Assessment Report is considered to be applicable to the carbon traded scenario.

**Table A3 - Carbon assessment findings for Gatwick 2R: change in tCO<sub>2</sub>**

Area of Emissions	2030	2040	2050	Additional tCO <sub>2</sub> to Do Minimum over 60 year appraisal period	Total tCO <sub>2</sub> over 60 year appraisal period
<b>Air travel</b>	788,168	1,056,790	2,296,038	110,285,679	358,622,783
<i>Ground movements component</i>	27,945	64,869	133,719	6,300,353	14,653,144
<b>Passenger surface access</b>	44,730	99,858	215,535	10,108,189	28,788,131
<b>Airport operations energy &amp; fuel use</b>	12,801	14,477	21,619	1,119,070	2,759,471
<b>Total operational CO<sub>2</sub> emissions</b>	<b>845,699</b>	<b>1,171,125</b>	<b>2,533,192</b>	<b>121,512,938</b>	<b>390,170,385</b>

**Table A4 - Carbon assessment findings for Gatwick 2R: change in central carbon value, (NPV) for emission sources**

Area of Emissions	2030	2040	2050	Additional £ to Do Minimum over 60 year appraisal period	Total £ over 60 year appraisal period
<b>Air travel</b>	£35,301,326	£64,713,197	£175,787,780	£7,061,591,251	£22,205,049,481
<i>Ground movements component</i>	£1,251,630	£3,972,275	£10,237,713	£405,482,768	£916,469,781
<b>Passenger surface access journeys</b>	£2,003,414	£6,114,853	£16,501,627	£650,463,140	£1,794,285,957
<b>Airport operations energy &amp; fuel use</b>	£573,335	£886,483	£1,655,202	£71,017,654	£168,714,841
<b>Total operational CO<sub>2</sub> emissions</b>	<b>£37,878,075</b>	<b>£71,714,533</b>	<b>£193,944,609</b>	<b>£7,783,072,045</b>	<b>£24,168,050,279</b>

## Carbon Assessment – Heathrow Airport Northwest Runway

Table A5 outlines the findings of the carbon assessment for Heathrow NWR in terms of the change in tonnes of carbon dioxide, assessing the change in operational emissions associated with Heathrow Airport Northwest Runway and within a 60 year appraisal period. Table A6 details the net present value (£ 2014 prices) for the predicted change. It is considered that there will not be any substantial changes between proposed construction within the carbon traded and carbon capped scenarios and so the analysis of construction presented in the Carbon Baseline Report and the Carbon Assessment Report is considered to be applicable to the carbon traded scenario.

**Table A5 - Carbon assessment findings for Heathrow NWR: change in tCO<sub>2</sub>**

Area of Emissions	2030	2040	2050	Additional tCO <sub>2</sub> to Do Minimum over 60 year appraisal period	Total tCO <sub>2</sub> over 60 year appraisal period
<b>Air travel</b>	4,388,689	5,494,800	4,905,046	298,876,568	1,410,447,296
<i>Ground movements component</i>	163,761	218,298	226,064	12,984,384	36,827,360
<b>Passenger surface access journeys</b>	78,631	116,960	135,334	7,426,348	34,950,190
<b>Airport operations energy &amp; fuel use</b>	52,699	45,795	40,053	2,557,493	7,929,530
<b>Total operational CO<sub>2</sub> emissions</b>	<b>4,520,019</b>	<b>5,657,555</b>	<b>5,080,433</b>	<b>308,860,409</b>	<b>1,453,327,016</b>

**Table A6 - Carbon assessment findings for Heathrow NWR: change in central carbon value, (NPV) for emission sources**

Area of Emissions	2030	2040	2050	Additional £ to Do Minimum over 60 year appraisal period	Total £ over 60 year appraisal period
<b>Air travel</b>	£196,565,311	£336,477,621	£375,536,891	£18,526,092,532	£85,894,020,036
<i>Ground movements component</i>	£7,334,717	£13,367,596	£17,307,768	£810,517,687	£2,267,569,748
<b>Passenger surface access journeys</b>	£3,521,810	£7,162,094	£10,361,337	£467,690,134	£2,169,259,232
<b>Airport operations energy &amp; fuel use</b>	£2,360,332	£2,804,311	£3,066,540	£155,949,879	£477,376,495
<b>Total operational CO<sub>2</sub> emissions</b>	<b>£202,447,453</b>	<b>£346,444,026</b>	<b>£388,964,768</b>	<b>£19,149,732,545</b>	<b>£88,540,655,763</b>



## Carbon Assessment – Heathrow Airport Extended Northern Runway

Table A7 outlines the findings of the carbon assessment for Heathrow ENR in terms of the change in tonnes of carbon dioxide, assessing the change in operational emissions associated with Heathrow Airport Extended Northern Runway and within a 60 year appraisal period. Table A8 details the net present value (£ 2014 prices) for the predicted change. It is considered that there will not be any substantial changes between proposed construction within the carbon traded and carbon capped scenarios and so the analysis of construction presented in the Carbon Baseline Report and the Carbon Assessment Report is considered to be applicable to the carbon traded scenario.

**Table A7 - Carbon assessment findings for Heathrow ENR: change in tCO<sub>2</sub>**

Area of Emissions	2030	2040	2050	Additional tCO <sub>2</sub> to Do Minimum over 60 year appraisal period	Total tCO <sub>2</sub> over 60 year appraisal period
<b>Air travel</b>	4,394,752	4,677,738	3,971,847	251,263,850	1,362,834,578
<i>Ground movements component</i>	164,160	185,776	191,574	11,175,314	35,018,290
<b>Passenger surface access journeys</b>	79,436	97,977	112,587	6,277,857	33,801,700
<b>Airport operations energy &amp; fuel use</b>	46,718	36,648	31,740	2,062,485	7,434,522
<b>Total operational CO<sub>2</sub> emissions</b>	<b>4,520,906</b>	<b>4,812,363</b>	<b>4,116,174</b>	<b>259,604,192</b>	<b>1,404,070,800</b>

**Table A8 - Carbon assessment findings for Heathrow ENR: change in central carbon value, (NPV) for emission sources**

Area of Emissions	2030	2040	2050	Additional £ to Do Minimum over 60 year appraisal period	Total £ over 60 year appraisal period
<b>Air travel</b>	£196,836,889	£286,444,296	£304,089,933	£15,471,007,576	£82,838,935,081
<i>Ground movements component</i>	£7,352,583	£11,376,084	£14,667,142	£694,409,255	£2,151,461,316
<b>Passenger surface access journeys</b>	£3,557,853	£5,999,713	£8,619,849	£393,832,166	£2,095,401,632
<b>Airport operations energy &amp; fuel use</b>	£2,092,474	£2,244,163	£2,430,045	£125,229,026	£446,655,642
<b>Total operational CO<sub>2</sub> emissions</b>	<b>£202,487,216</b>	<b>£294,688,172</b>	<b>£315,139,827</b>	<b>£15,990,068,768</b>	<b>£85,380,992,355</b>

# 1 Gatwick Airport Second Runway Carbon Impact Assessment

This section covers the emissions categories of total aircraft emissions (Air travel), airside (aircraft) ground movement emissions, airport operations emissions from energy & fuel use, and passenger surface access emissions for Gatwick Airport Second Runway. The section is broken into:

- Jacobs assessment of impacts;
- Conclusions.

## 1.1 Total aircraft emissions

### Impact Assessment

The assumptions made relating to the outputs of the DfT model are the same as those used in the carbon capped scenario (8. Carbon: Baseline and 8. Carbon: Assessment, Airports Commission 2014). The AoN carbon traded demand forecasts of ATMs reach up to 559,000 annual ATMs for Gatwick 2R in 2050. The limit on ATMs assumed for operational purposes at Gatwick 2R is 560,000 ATMs. Therefore the AoN carbon traded ATMs, and resultant emissions forecasts, sit within the operational limits of the 2R configuration in mixed mode.

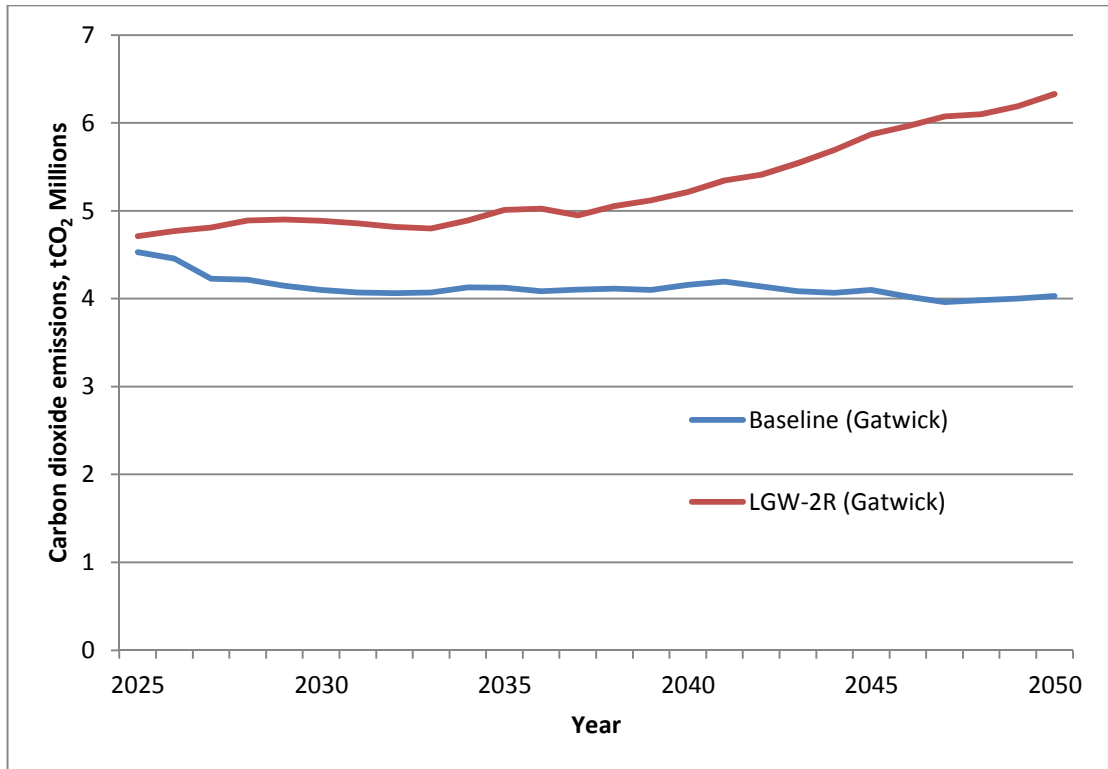
**Table 1.1 - Carbon emissions, carbon traded: Gatwick Do Minimum, for 2025 – 2050**

Year	Gatwick Airport, Number of passengers	Gatwick Airport, Numbers of ATMs	Gatwick Airport, tonnes CO <sub>2</sub>	UK Aviation Total, tonnes CO <sub>2</sub>	Gatwick as % of UK Total for aviation carbon emissions
2025	39,894,908	278,819	4,529,281	39,560,240	11.4
2030	42,330,144	283,200	4,098,655	40,393,641	10.1
2040	46,187,884	288,279	4,157,648	41,135,703	10.1
2050	47,473,872	282,681	4,030,354	39,944,049	10.1

**Table 1.2 - Carbon emissions, carbon traded: Gatwick 2R, for 2025 – 2050**

Year	Gatwick Airport, Number of passengers	Gatwick Airport, Numbers of ATMs	Gatwick Airport, tonnes CO <sub>2</sub>	UK Aviation Total, tonnes CO <sub>2</sub>	Gatwick as % of UK Total for aviation carbon emissions
2025	42,204,244	299,310	4,712,745	39,974,622	11.8
2030	49,564,968	340,869	4,886,824	41,147,552	11.9
2040	62,051,904	422,146	5,214,437	42,422,105	12.3
2050	81,907,152	558,632	6,326,393	41,056,585	15.4

**Figure 1.1 - Carbon emissions from departing flights at Gatwick Airport, 2025 – 2050: Do Minimum and Gatwick 2R scenarios, carbon traded**



**Table 1.3 - Comparison of the carbon emissions in 2030, 2040 and 2050 for the Gatwick Airport Do Minimum and Gatwick 2R forecast scenarios**

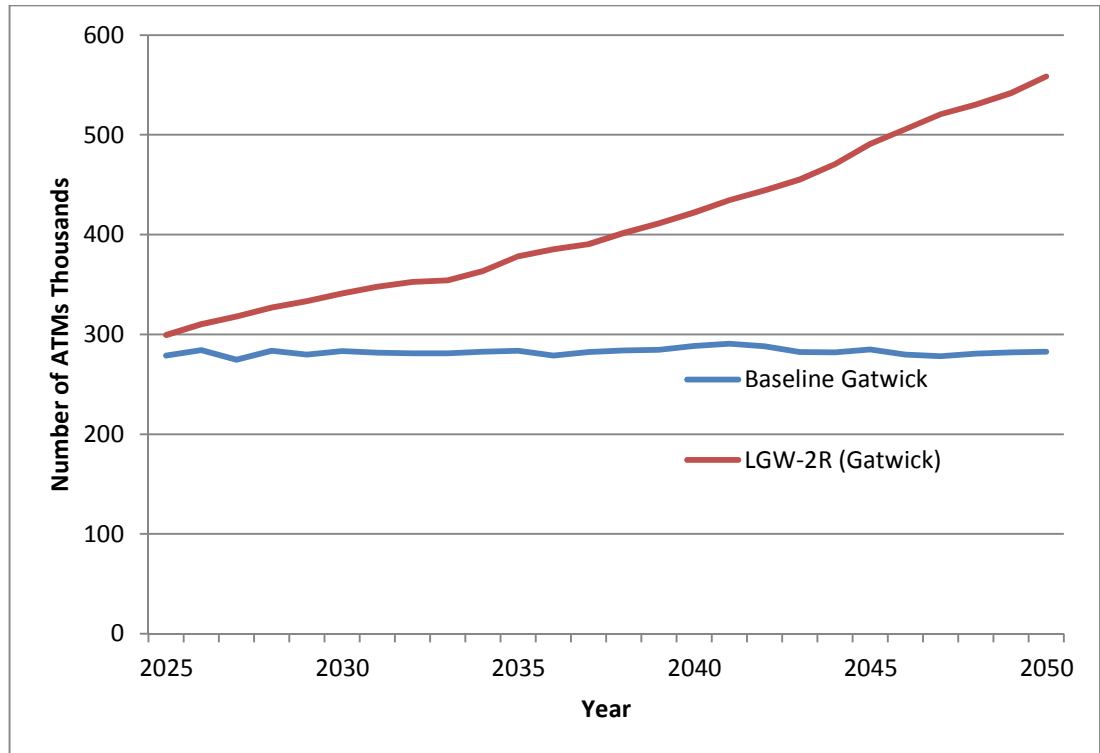
Year	Do Minimum tonnes CO <sub>2</sub>	Gatwick 2R tonnes CO <sub>2</sub>	Change (%)
2030	4,098,655	4,886,824	19.2
2040	4,157,648	5,214,437	25.4
2050	4,030,354	6,326,393	57.0

The AoN carbon traded demand forecast model does not limit ATMs on an operational basis and has calculated carbon emissions from air travel up to 559,000 annual ATMs for Gatwick 2R in 2050. The maximum ATMs assumed for operational purposes at Gatwick 2R are 560,000 ATMs in 2050. Therefore, the AoN carbon traded ATMs, and resultant emissions forecasts, sit within the operational limits of the 2R configuration in mixed mode. This is presented in Table 1.4

**Table 1.4 - Comparison of the ATMs in 2030, 2040 and 2050 for the Gatwick Airport Do Minimum and Gatwick 2R forecast scenarios**

Year	Gatwick Do Minimum, Numbers of ATMs	Operational cap for Gatwick 2R	Gatwick 2R, Numbers of ATMs
2030	283,200	560,000	340,869
2040	288,279	560,000	422,146
2050	282,681	560,000	558,632

**Figure 1.2 - Air transport movements (ATMs) during the period 2025 – 2050 at Gatwick Airport, Do Minimum and Gatwick 2R scenarios, carbon traded**



**1.2 Airside (aircraft) ground movement emissions**

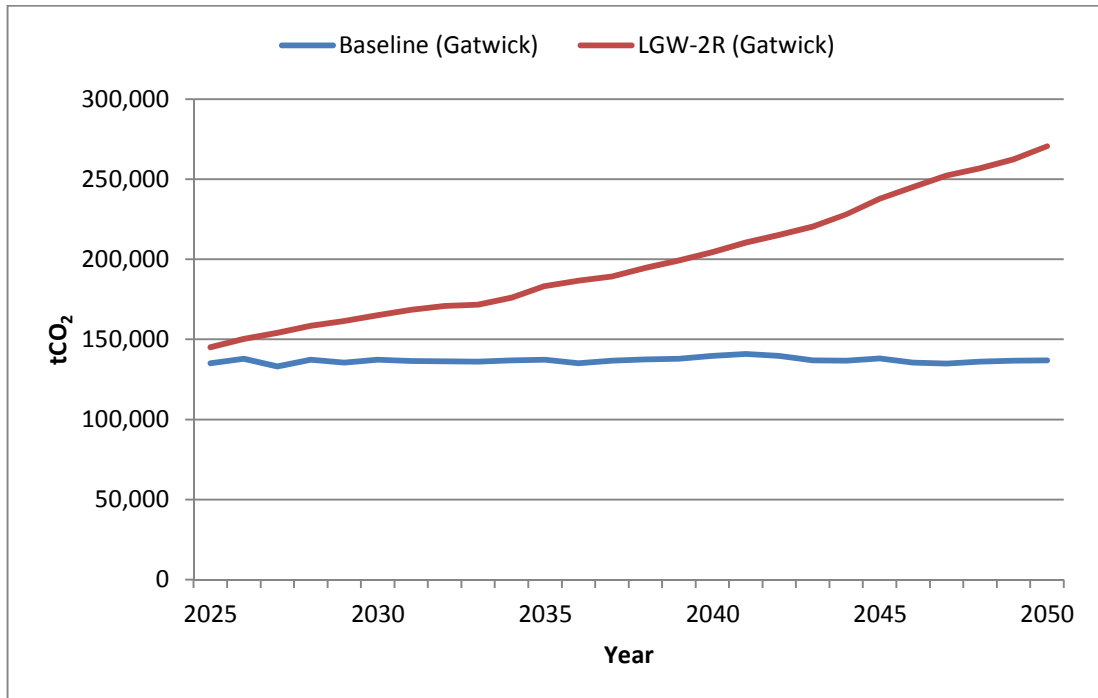
Impact Assessment

The assumptions made relating to the time-on-ground are the same as those used in the carbon capped scenario (8. Carbon: Baseline and 8. Carbon: Assessment, Airports Commission 2014). The main driver behind ground movement emissions are ATMs, rather than passenger numbers. This means that increased demand and passenger numbers are moderated by any moves to larger aircraft that reduce total ATMs, and so the change in ground movement emissions will not directly correlate with passenger numbers.

**Table 1.5 - Comparison of the aircraft ground movement emissions 2025 – 2050 for the Gatwick Airport Do Minimum and Gatwick 2R forecast scenarios**

Year	Do Minimum, tCO <sub>2</sub>	Gatwick 2R, tCO <sub>2</sub> , ICAO-Times <sup>1</sup>	Gatwick 2R, tCO <sub>2</sub> , GAL-Reported Times <sup>2</sup>
2025	135,109	145,038	135,005
2030	137,232	165,177	153,750
2040	139,693	204,562	190,410
2050	136,980	270,699	251,973

**Figure 1.3 - Carbon emissions due to airside ground movements 2025 – 2050 for the Do Minimum and Gatwick 2R forecast scenarios**



### 1.3 Passenger surface access emissions

#### Impact Assessment

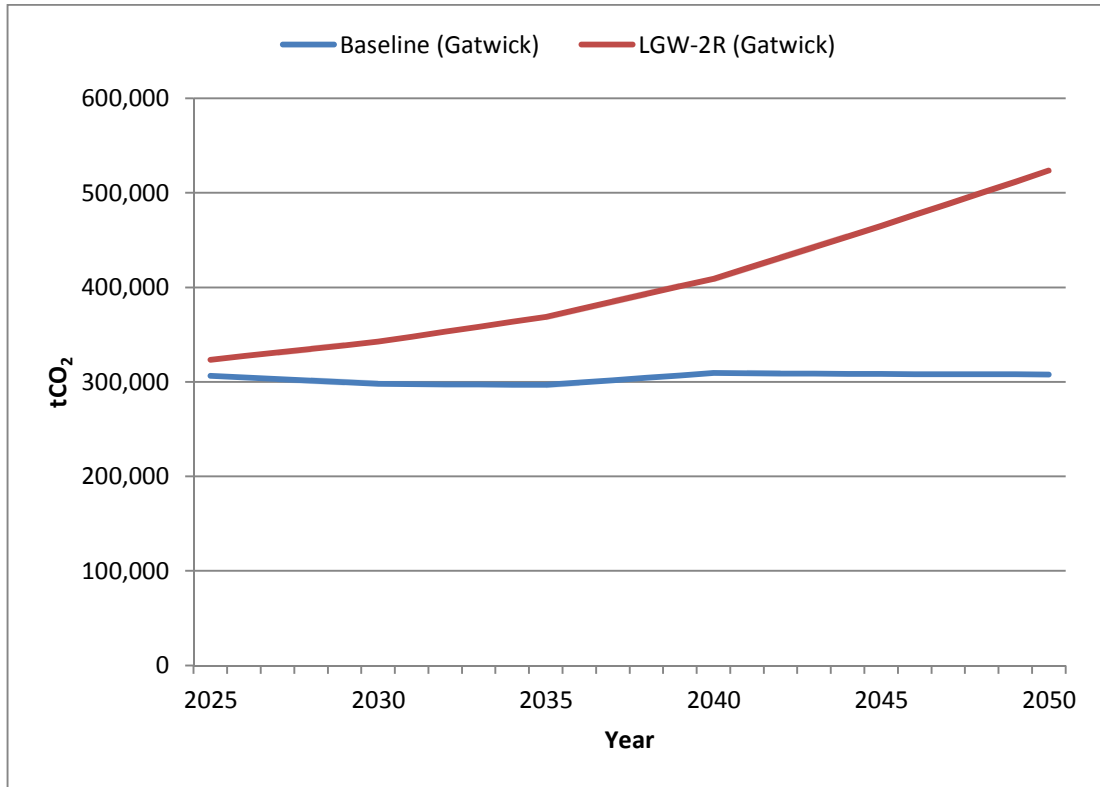
The assumptions made relating to the travel modes and proportions are the same as those used in the carbon capped scenario (8. Carbon: Baseline and 8. Carbon: Assessment, Airports Commission 2014). In addition, the full methodology used for passenger surface access emissions is explained in detail in Annex I of UK Air Passenger Demand and CO<sub>2</sub> Forecasts. The model makes use of forecasts of demand for travel to each of the UK’s airports from UK origin / destinations on a

<sup>1</sup> This basic assessment uses historic reported emissions associated with Landing and Take-Off (LTO) from both Gatwick (Gatwick Airport Limited, 2014a) and Heathrow (Heathrow Airport Limited, 2014) and reported ATMs in those years in order to create a factor representing LTO emissions per ATM. The proportion of the LTO which is ground based is then determined using ICAO Times-in-Mode (TIM) resulting in an ICAO-Times forecast.

<sup>2</sup> A sensitivity is also generated utilising times in mode submitted by the proposers, which is presented within our results as “HAL/GAL Reported Times” forecast.

regional basis; for this reason, changes in regional demand can have impacts that may seem out of proportion with the change in passenger numbers.

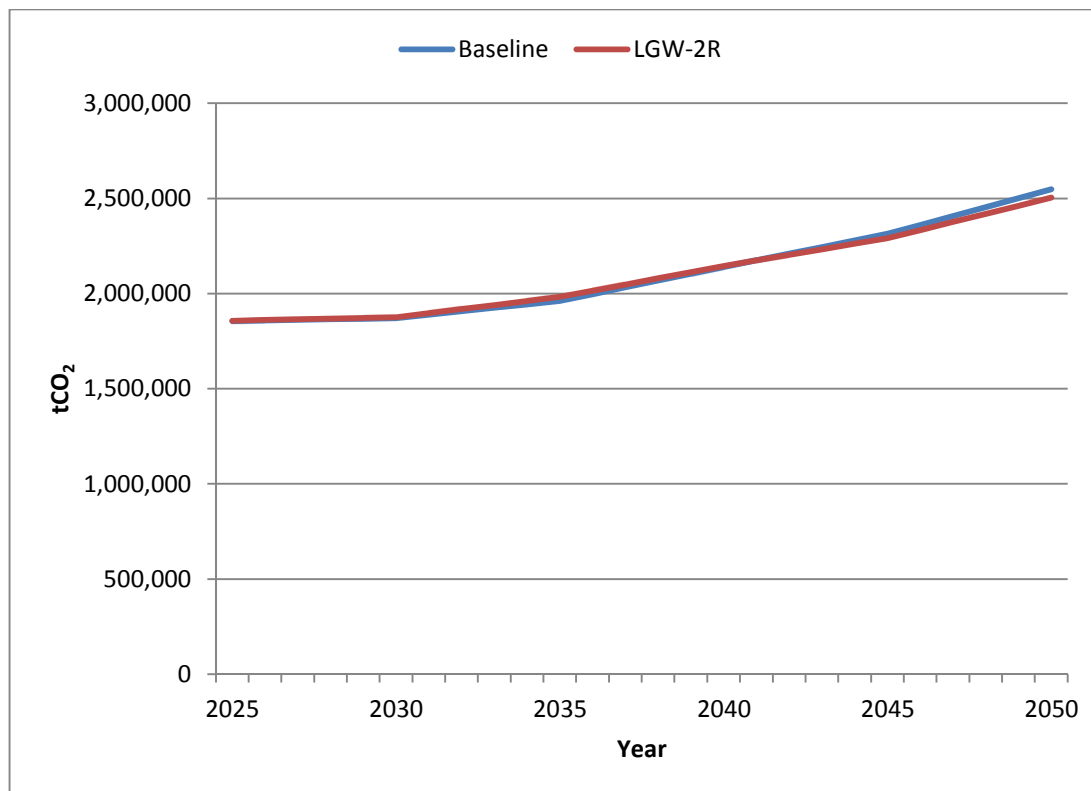
**Figure 1.4 - Emissions due to surface access for Do Minimum and Gatwick 2R forecast scenarios**



**Table 1.6 - Emissions due to surface access for 2025 – 2050 for Do Minimum and Gatwick 2R forecast scenarios**

Year	Do Minimum emissions due to surface access to Gatwick Airport, tonnes CO <sub>2</sub>	Gatwick 2R emissions due to surface access to Gatwick Airport, tonnes CO <sub>2</sub>	Change from Do Minimum (%)
2025	306,339	323,422	5.6%
2030	297,820	342,550	15.0%
2040	309,323	409,181	32.3%
2050	307,898	523,433	70.0%

**Figure 1.5 - The emissions due to surface access across the UK airport system for Do Minimum and Gatwick 2R forecast scenarios**



**Table 1.7 - The emissions due to surface access across the UK airport system, 2025 – 2050 for Do Minimum and Gatwick 2R forecast scenarios**

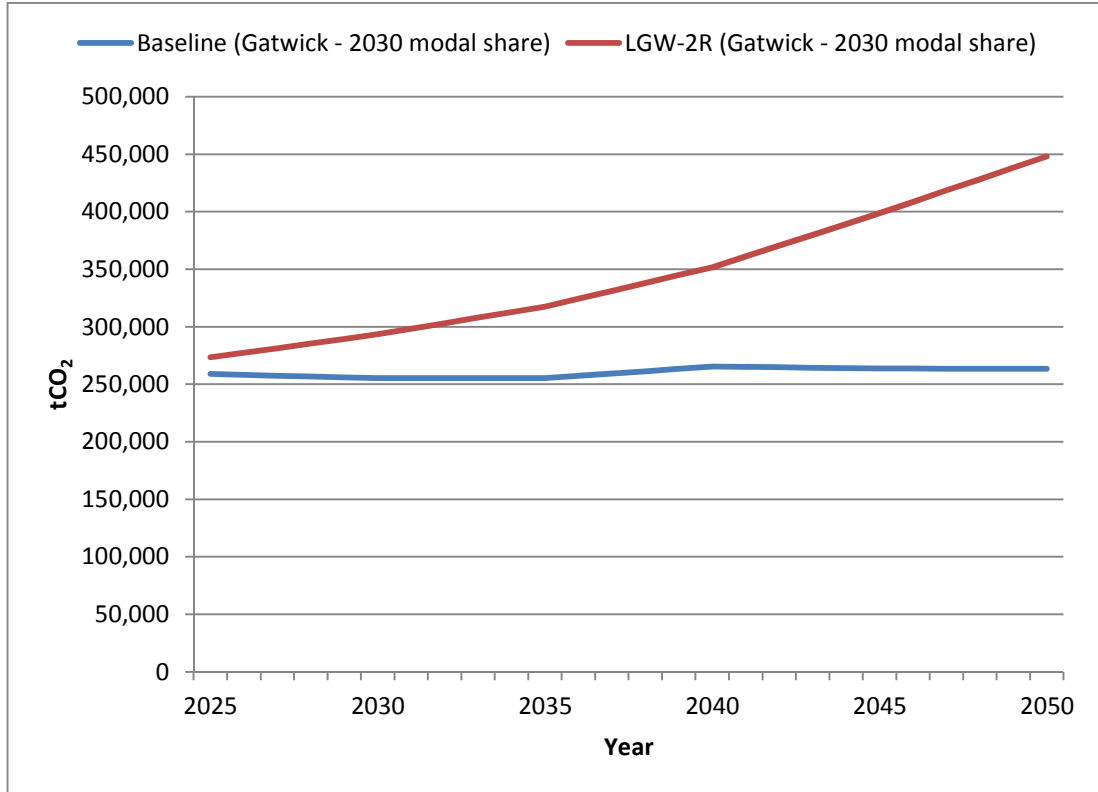
Year	Do Minimum emissions due to surface access to UK airports <sup>3</sup> , tonnes CO <sub>2</sub>	Emissions due to surface access to UK airports with Gatwick 2R <sup>4</sup> , tonnes CO <sub>2</sub>	% change
2025	1,855,591	1,857,446	0.1%
2030	1,870,223	1,875,194	0.3%
2040	2,139,566	2,145,089	0.3%
2050	2,548,469	2,504,002	-1.7%

<sup>3</sup> The airports used are: Aberdeen, Birmingham, Bournemouth, Bristol, Cardiff, East Midlands, Edinburgh, Exeter, Gatwick, Glasgow, Heathrow, Humberside, Leeds/Bradford, Liverpool, London City, Luton, Manchester, Newcastle, Newquay, Norwich, Southend, Southampton, Stansted, Teesside, Blackpool, Doncaster Sheffield, Prestwick.

<sup>4</sup> The airport set previously described.

*Sensitivity: 2030 Modal split<sup>5</sup>*

**Figure 1.6 - Emissions due to surface access at Gatwick, using a 2030 modal share for Do Minimum and Gatwick 2R forecast scenarios**



**Table 1.8 – Emissions from Surface Access with 2030 Modal split for 2025 – 2050 for Do Minimum and Gatwick 2R forecast scenarios**

Year	Do Minimum emissions due to surface access to Gatwick Airport, tonnes CO <sub>2</sub>	Gatwick 2R emissions due to surface access to Gatwick Airport, tonnes CO <sub>2</sub>
2025	258,883	273,346
2030	255,309	293,519
2040	265,375	351,784
2050	263,327	448,096

<sup>5</sup> A sensitivity test was undertaken using adjusted 2030 modal share projection, derived from Jacobs 2014 Surface Access analyses.

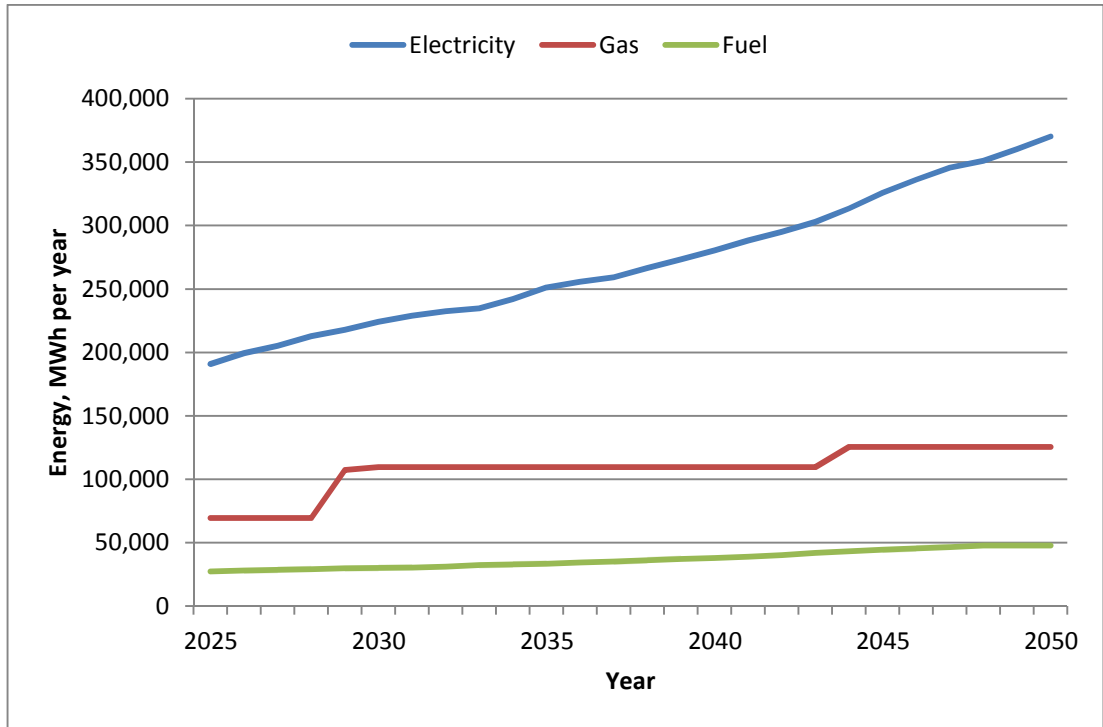


**1.4 Airport operations emissions from energy & fuel use**

Impact Assessment

The assumptions made relating to the electricity, gas and fuel calculations are the same as those used in the carbon capped scenario (8. Carbon: Baseline and 8. Carbon: Assessment, Airports Commission 2014).

**Figure 1.7 - Energy use at Gatwick, by source, 2025 – 2050 for Gatwick 2R**



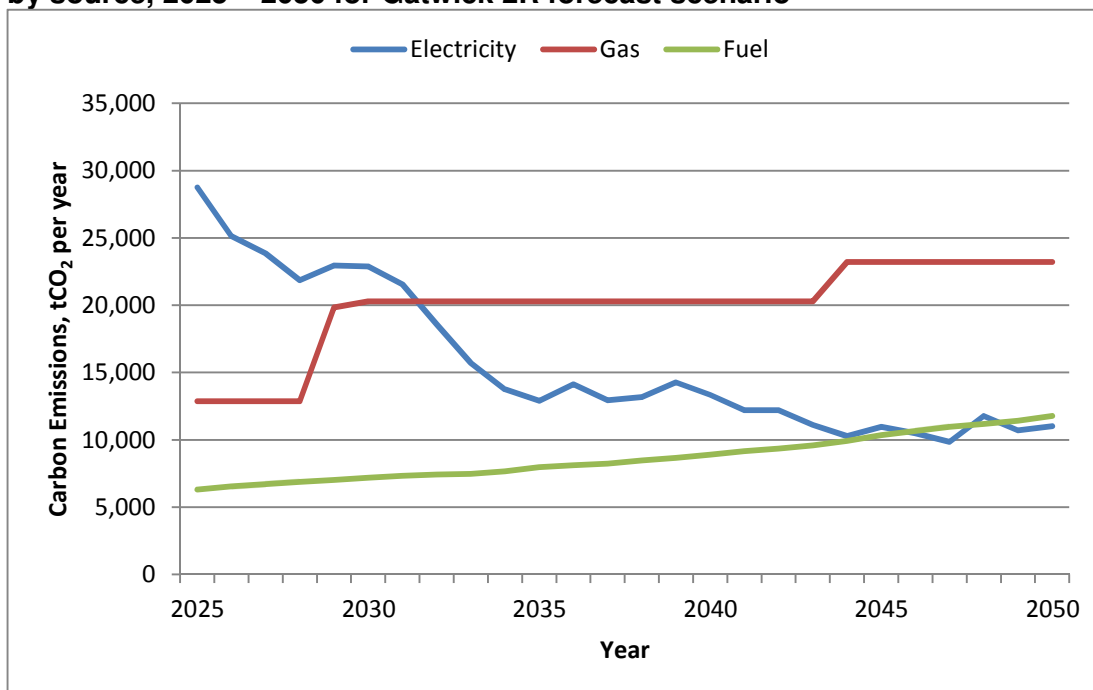
**Table 1.9 - Carbon emissions due to airport operation at Gatwick, by source, 2025 – 2050 for Do Minimum forecast scenario**

Year	Emissions due to electricity use at Gatwick Airport, tonnes CO <sub>2</sub>	Emissions due to gas use at Gatwick Airport, tonnes CO <sub>2</sub>	Emissions due to fuel use at Gatwick Airport, tonnes CO <sub>2</sub>	Total emissions due to airport operation at Gatwick Airport, tonnes CO <sub>2</sub>
2025	27,174	11,591	5,876	44,641
2030	19,545	12,041	5,968	37,554
2040	9,930	12,041	6,075	28,046
2050	6,383	12,041	5,957	24,381

**Table 1.10 - Carbon emissions due to airport operation at Gatwick, by source, 2025 – 2050 for Gatwick 2R forecast scenario**

Year	Emissions due to electricity use at Gatwick Airport, tonnes CO <sub>2</sub>	Emissions due to gas use at Gatwick Airport, tonnes CO <sub>2</sub>	Emissions due to fuel use at Gatwick Airport, tonnes CO <sub>2</sub>	Total emissions due to airport operation at Gatwick Airport, tonnes CO <sub>2</sub>
2025	28,747	12,865	6,307	47,919
2030	22,885	20,286	7,183	50,355
2040	13,340	20,286	8,896	42,523
2050	11,012	23,216	11,772	46,000

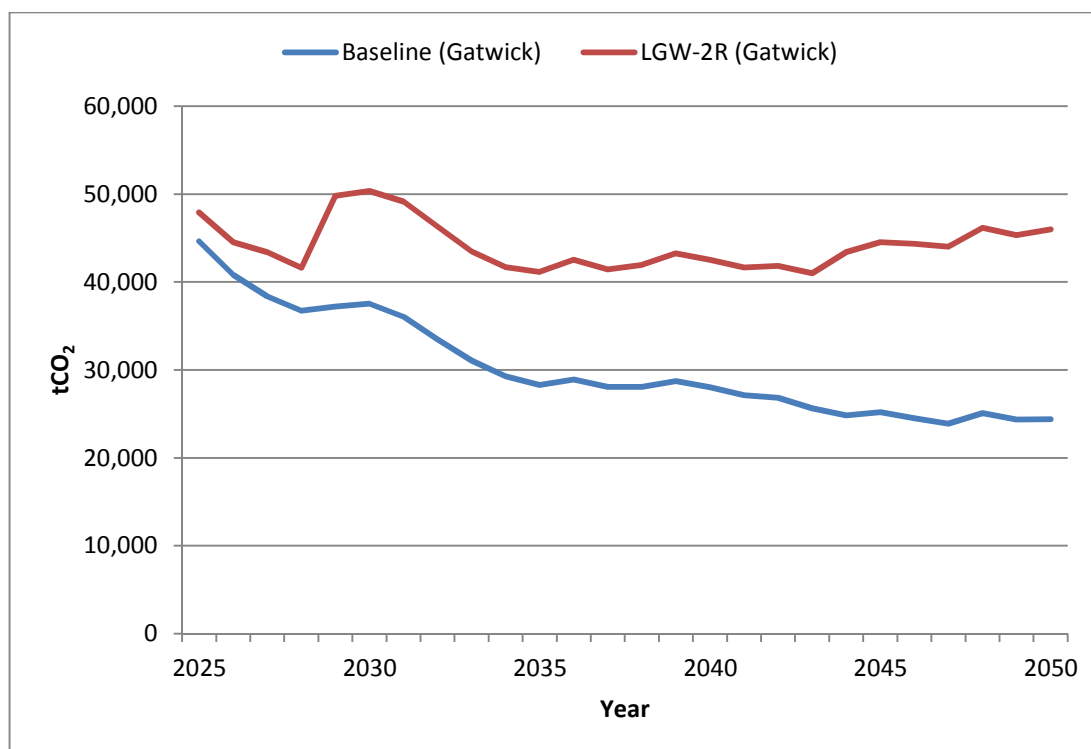
**Figure 1.8 - Carbon emissions due to airport operation energy use at Gatwick, by source, 2025 – 2050 for Gatwick 2R forecast scenario**



**Table 1.11 - Operational emissions due to energy and fuel at Gatwick, 2025 – 2050 for Gatwick 2R forecast scenario**

Year	Do Minimum, tonnes CO <sub>2</sub>	Gatwick 2R, tonnes CO <sub>2</sub>	Change from Do Minimum (%)
2025	44,641	47,919	7.3%
2030	37,554	50,355	34.1%
2040	28,046	42,523	51.6%
2050	24,381	46,000	88.7%

**Figure 1.9 - Operational emissions due to energy and fuel at Gatwick, 2025 – 2050 for Do Minimum and Gatwick 2R forecast scenarios**



### 1.5 Conclusions

**Table 1.12 - Carbon assessment findings for Gatwick 2R: change in tCO<sub>2</sub>**

Area of Emissions	2030	2040	2050	Additional tCO <sub>2</sub> to Do Minimum over 60 year appraisal period	Total tCO <sub>2</sub> over 60 year appraisal period
<b>Air travel</b>	788,168	1,056,790	2,296,038	110,285,679	358,622,783
<i>Ground movements component</i>	27,945	64,869	133,719	6,300,353	14,653,144
<b>Passenger surface access journeys</b>	44,730	99,858	215,535	10,108,189	28,788,131
<b>Airport operations energy &amp; fuel use</b>	12,801	14,477	21,619	1,119,070	2,759,471
<b>Total operational CO<sub>2</sub> emissions</b>	<b>845,699</b>	<b>1,171,125</b>	<b>2,533,192</b>	<b>121,512,938</b>	<b>390,170,385</b>

\* Construction emissions are calculated as tCO<sub>2</sub>e.

### 1.6 Gatwick 2R Carbon Assessment Monetisation

In Table 1.13, the carbon results are displayed in a monetised format. This has been done for both the Net Present Value (NPV) of the additional carbon emissions over the 60 year appraisal period as a result of the scheme, and also for particular assessment years in terms of £ in 2014 prices. The value of emissions resulting

from construction, as calculated in the 8. Carbon: Assessment (Airports Commission, 2014), are included in the totals presented in Table 1.13 and 1.15.

In monetising the emissions the traded value of emissions as presented in the “Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal” (DECC, 2014) was used throughout the analysis. Post 2030 it is assumed that a global carbon market is in place and therefore one carbon value applies to all emissions, regardless of whether they originate in the current traded or non-traded sector of the economy. For consistency, the traded value was also used for emissions between 2025 and 2030.

**Table 1.13 - Gatwick Airport additional central carbon value (NPV) for Gatwick 2R forecast scenario**

	Monetised value of carbon emissions
<b>Total Additional Value (£)</b>	£7,929,659,421
<b>Snapshot 2030 (£)</b>	£37,878,074
<b>Snapshot 2040 (£)</b>	£85,032,119
<b>Snapshot 2050 (£)</b>	£193,944,610
<b>Snapshot 2060 (£)</b>	£192,006,524

**Table 1.14: Additional and total central carbon value, (NPV) for emission sources for Gatwick 2R scenario**

Area of Emissions	Monetised value of carbon emissions, additional £ over 60 year appraisal period	Monetised value of carbon emissions, total £ over 60 year appraisal period
<b>Air travel</b>	£7,061,591,251	£22,205,049,481
<i>Ground movements component</i>	£405,482,768	£916,469,781
<b>Passenger surface access journeys</b>	£650,463,140	£1,794,285,957
<b>Airport operations energy &amp; fuel use</b>	£71,017,654	£168,714,841
<b>Total operational CO<sub>2</sub> emissions</b>	<b>£7,783,072,045</b>	<b>£24,168,050,279</b>

In Table 1.15 and Table 1.16, the carbon results are displayed as the range from the low to high assumptions on carbon value. This has been done for both the Net Present Value (NPV) of the additional carbon emissions over the 60 year appraisal period as a result of the scheme, and also for particular assessment years in terms of £ in 2014 prices.

**Table 1.15: Additional Low to High carbon value, (NPV) for Gatwick 2R forecast scenario**

	Monetised value of carbon emissions
<b>Total Additional Value (£)</b>	£3,503,109,988 - £12,397,049,873
<b>Snapshot 2030 (£)</b>	£18,939,037 - £56,817,112
<b>Snapshot 2040 (£)</b>	£42,516,059 - £127,548,178
<b>Snapshot 2050 (£)</b>	£96,972,305 - £290,916,915
<b>Snapshot 2060 (£)</b>	£86,402,936 - £297,610,113

**Table 1.16: Additional Low to High carbon value, (NPV) for emission sources for Gatwick 2R forecast scenario**

Area of Emissions	Monetised value of carbon emissions, additional £ over 60 year appraisal period
<b>Air travel</b>	£3,114,733,128 - £11,019,607,221
<i>Ground movements component</i>	£178,530,476 - £632,866,369
<b>Passenger surface access journeys</b>	£286,208,008 - £1,015,405,699
<b>Airport operations energy &amp; fuel use</b>	£31,589,058 - £110,574,717

## 2 Heathrow Airport Northwest Runway

This section covers the emissions categories of total aircraft emissions (Air travel), airside (aircraft) ground movement emissions, airport operations emissions from energy & fuel use, and passenger surface access emissions for Heathrow Airport Northwest Runway. The section is broken into:

- Jacobs assessment of impacts;
- Conclusions

### 2.1 Total aircraft emissions

#### Impact Assessment

The assumptions made relating to the outputs of the DfT model are the same as those used in the carbon capped scenario (8. Carbon: Baseline and 8. Carbon: Assessment, Airports Commission 2014). The AoN carbon traded demand forecasts of ATMs reach up to 754,000 annual ATMs for Heathrow NWR in 2040, reducing to 748,000 annual ATMs in 2050, compared to a nominal operation limit of 740,000 annual ATMs. Forecasts used are derived directly from Airports Commission AoN Demand Forecast aviation model outputs and may marginally differ (by +/- 2%) to the operational limits in order for the aviation model to reach equilibrium across UK airports. The effect is a conservative (i.e. higher) estimate of carbon emissions.

**Table 2.1 - Carbon emissions, carbon traded: Heathrow Do Minimum, for 2026 – 2050<sup>6</sup>**

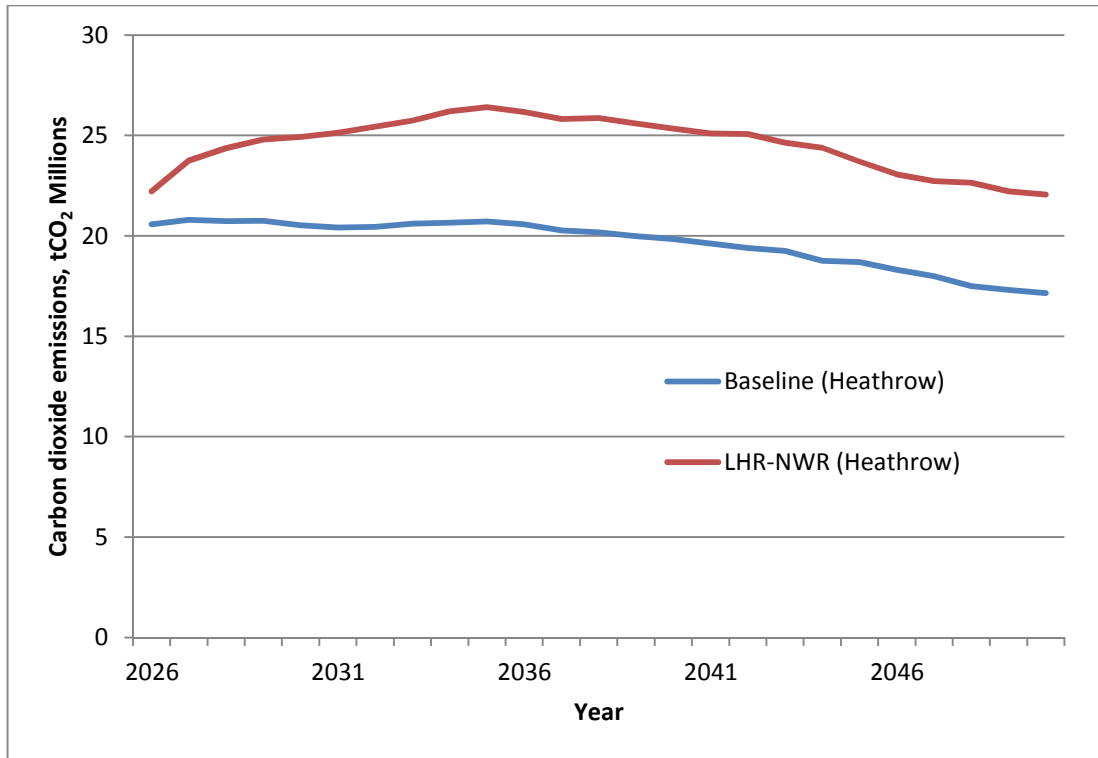
Year	Heathrow Airport, Number of passengers	Heathrow Airport, Numbers of ATMs	Heathrow Airport, tonnes CO <sub>2</sub>	UK Aviation Total, tonnes CO <sub>2</sub>	Heathrow as % of UK Total for carbon emissions
2026	82,219,824	482,073	20,566,718	39,791,963	51.7
2030	85,483,664	484,227	20,530,830	40,393,641	50.8
2040	90,472,248	487,646	19,844,858	41,135,703	48.2
2050	94,906,328	472,147	17,145,585	39,944,049	42.9

**Table 2.2 - Carbon emissions, carbon traded: Heathrow NWR, for 2026 – 2050**

Year	Heathrow Airport, Number of passengers	Heathrow Airport, Numbers of ATMs	Heathrow Airport, tonnes CO <sub>2</sub>	UK Aviation Total, tonnes CO <sub>2</sub>	Heathrow as % of UK Total for carbon emissions
2026	92,958,872	558,450	22,218,299	41,327,919	53.8
2030	116,208,352	684,162	24,919,519	43,754,775	57.0
2040	133,862,832	754,164	25,339,658	45,485,931	55.7
2050	137,772,480	748,147	22,050,631	43,519,841	50.7

<sup>6</sup> An equilibrium solution which satisfies capacity limits at all airports is computationally intensive and progressively more difficult to solve as demand mounts through the forecasting period. The solution is generally deemed to be found when over-capacity airports are within +/-1.5% of their input capacities. Runway capacity is regarded as a "harder" capacity than terminal capacity in the search for an equilibrium solution.

**Figure 2.1 – Carbon emissions from departing flights at Heathrow Airport, 2026 – 2050: Do Minimum and Heathrow NWR scenarios, carbon traded**



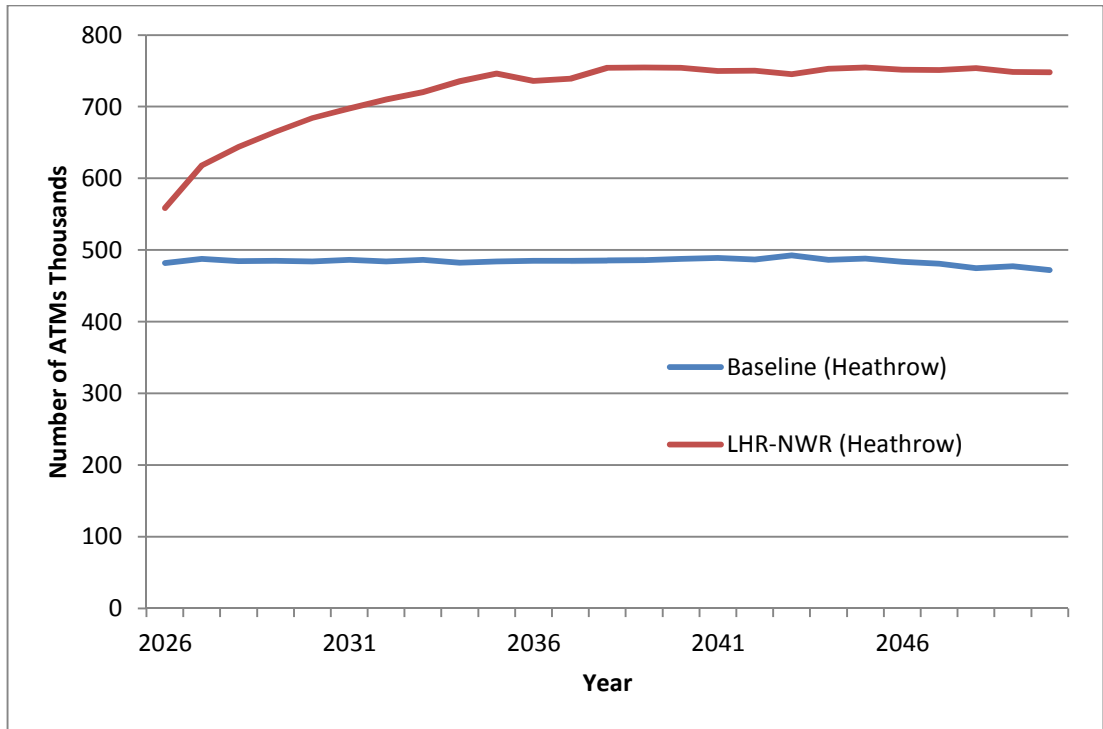
**Table 2.3 - Comparison of the carbon emissions in 2030, 2040 and 2050 for the Heathrow Airport Do Minimum and Heathrow NWR forecast scenarios**

Year	Do Minimum tonnes CO <sub>2</sub>	Heathrow NWR tonnes CO <sub>2</sub>	Change from Do Minimum (%)
2030	20,530,830	24,919,519	21.4
2040	19,844,858	25,339,658	27.7
2050	17,145,585	22,050,631	28.6

**Table 2.4 - Comparison of the ATMs in 2030, 2040 and 2050 for the Heathrow Airport Do Minimum and Heathrow NWR forecast scenarios**

Year	Heathrow Do Minimum, Numbers of ATMs	Operational cap for Heathrow NWR	Heathrow NWR, Numbers of ATMs
2030	484,227	740,000	684,162
2040	487,646	740,000	754,164
2050	472,147	740,000	748,147

**Figure 2.2 - Air transport movements (ATMs) during the period 2026 – 2050 at Heathrow Airport, Do Minimum and Heathrow NWR scenarios carbon traded**



**2.2 Airside (aircraft) ground movement emissions**

Impact Assessment

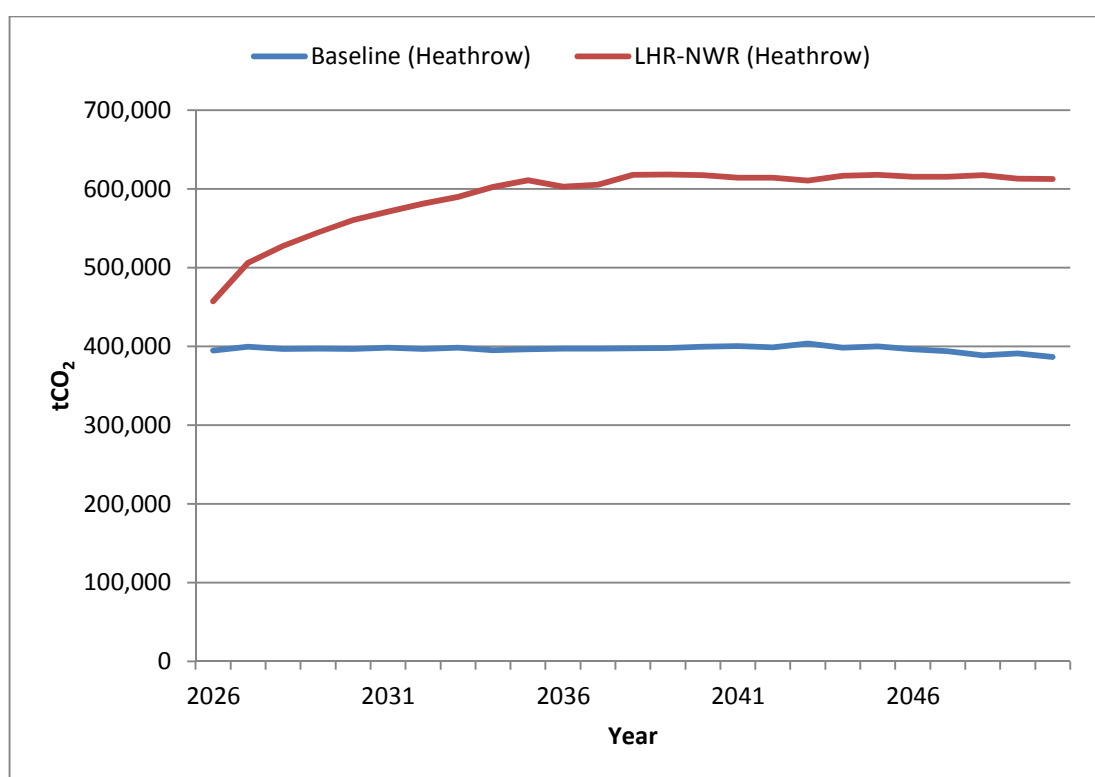
The assumptions made relating to the time-on-ground are the same as those used in the carbon capped scenario (8. Carbon: Baseline and 8. Carbon: Assessment, Airports Commission 2014). The main driver behind ground movement emissions are ATMs, rather than passenger numbers. This means that increased demand and passenger numbers are moderated by any moves to larger aircraft that reduce total ATMs, and so the change in ground movement emissions will not directly correlate with passenger numbers.



**Table 2.5 - Comparison of the aircraft ground movement emissions 2026 – 2050 for the Heathrow Airport Do Minimum and Heathrow NWR forecast scenarios**

Year	Do Minimum, tonnes CO <sub>2</sub>	Heathrow NWR, tonnes CO <sub>2</sub> , ICAO-Times <sup>7</sup>	Heathrow NWR, tonnes CO <sub>2</sub> , HAL-Reported times <sup>8</sup>
2026	394,853	457,411	362,547
2030	396,617	560,378	444,160
2040	399,418	617,715	489,606
2050	386,723	612,787	485,699

**Figure 2.3 - Carbon emissions due to airside ground movements 2026 – 2050 for the Do Minimum and Heathrow NWR forecast scenarios**



### 2.3 Passenger surface access emissions

#### Impact Assessment

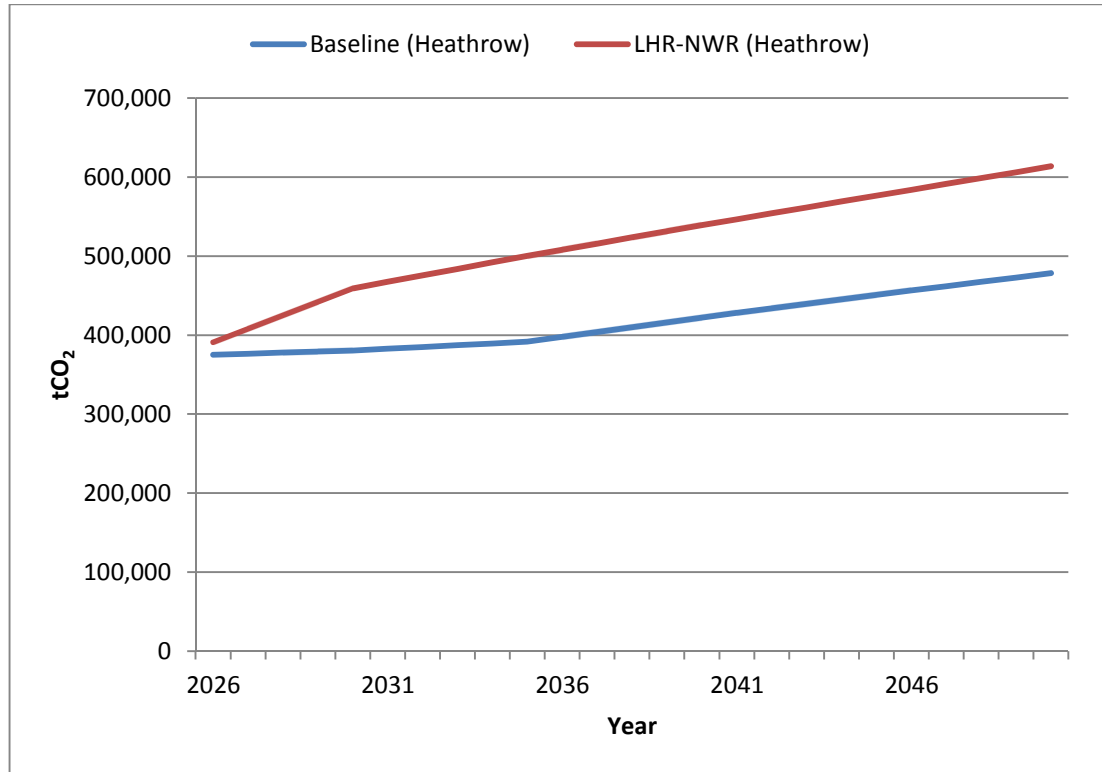
The assumptions made regarding to the travel modes and proportions are the same as those used in the carbon capped scenario (8. Carbon: Baseline and 8. Carbon: Assessment, Airports Commission 2014). In addition, the full methodology used for passenger surface access emissions is explained in detail in Annex I of UK Air Passenger Demand and CO<sub>2</sub> Forecasts. The model makes use of forecasts of

<sup>7</sup> This basic assessment uses historic reported emissions associated with Landing and Take-Off (LTO) from both Gatwick (Gatwick Airport Limited, 2014a) and Heathrow (Heathrow Airport Limited, 2014) and reported ATMs in those years in order to create a factor representing LTO emissions per ATM. The proportion of the LTO which is ground based is then determined using ICAO Times-in-Mode (TIM) resulting in an ICAO-Times forecast.

<sup>8</sup> A sensitivity is also generated utilising times in mode submitted by the proposers, which is presented within our results as “HAL/GAL Reported Times” forecast.

demand for travel to each of the UK's airports from UK origin / destinations on a regional basis; for this reason, changes in regional demand can have impacts that may seem out of proportion with the change in passenger numbers.

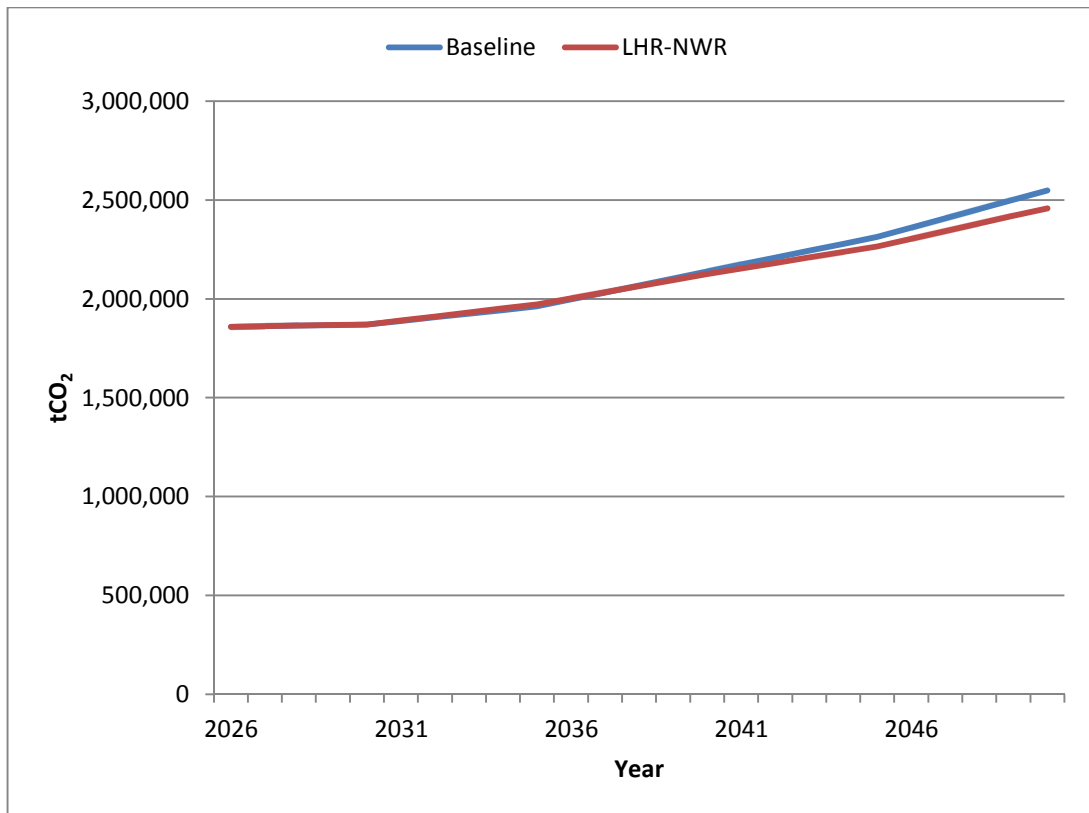
**Figure 2.4 - Emissions due to surface access for Do Minimum and Heathrow NWR forecast scenarios**



**Table 2.6 - Emissions due to surface access for 2026 – 2050 for Do Minimum and Heathrow NWR forecast scenarios**

Year	Do Minimum emissions due to surface access to Heathrow Airport, tonnes CO <sub>2</sub>	Heathrow NWR emissions due to surface access to Heathrow Airport, tonnes CO <sub>2</sub>	Change from Do Minimum (%)
2026	374,999	390,725	4.2%
2030	380,563	459,194	20.7%
2040	422,288	539,247	27.7%
2050	478,305	613,639	28.3%

**Figure 2.5 - The emissions due to surface access across the UK airport system for Do Minimum and Heathrow NWR forecast scenarios**



**Table 2.7 - The emissions due to surface access across the UK airport system, 2026 – 2050 for Do Minimum and Heathrow NWR forecast scenarios**

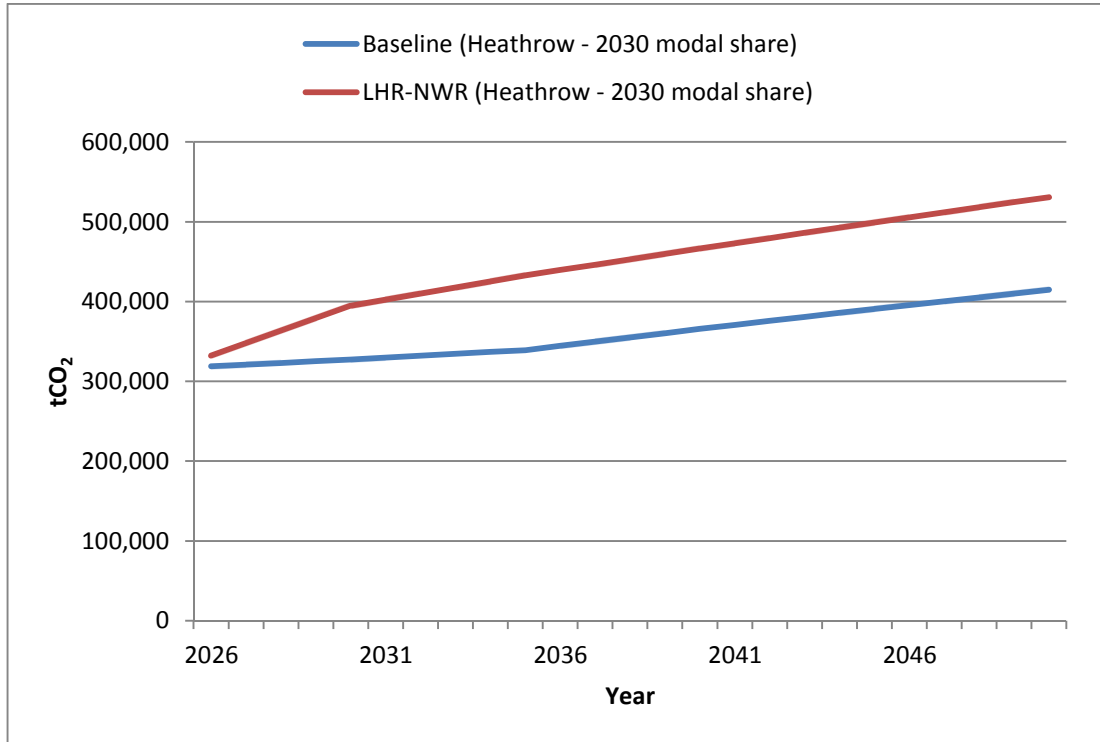
Year	Do Minimum emissions due to surface access to UK airports <sup>9</sup> , tonnes CO <sub>2</sub>	Emissions due to surface access to UK airports with Heathrow NWR <sup>10</sup> , tonnes CO <sub>2</sub>	Change from Do Minimum (%)
2026	1,858,517	1,858,599	0.0%
2030	1,870,223	1,870,634	0.0%
2040	2,139,566	2,126,197	-0.6%
2050	2,548,469	2,458,642	-3.5%

<sup>9</sup> The previously referenced set.

<sup>10</sup> The previously referenced set.

*Sensitivity: 2030 Modal split<sup>11</sup>*

**Figure 2.6 - Emissions due to surface access at Heathrow, using a 2030 modal share for Do Minimum and Heathrow NWR forecast scenarios**



**Table 2.8 - Emissions due to surface access at Heathrow, for 2026 – 2050 for Do Minimum and Heathrow NWR forecast scenarios**

Year	Do Minimum emissions due to surface access to Heathrow Airport, tonnes CO <sub>2</sub>	Heathrow NWR emissions due to surface access to Heathrow Airport, tonnes CO <sub>2</sub>
2026	318,770	332,209
2030	327,531	394,726
2040	365,699	466,435
2050	414,791	530,953

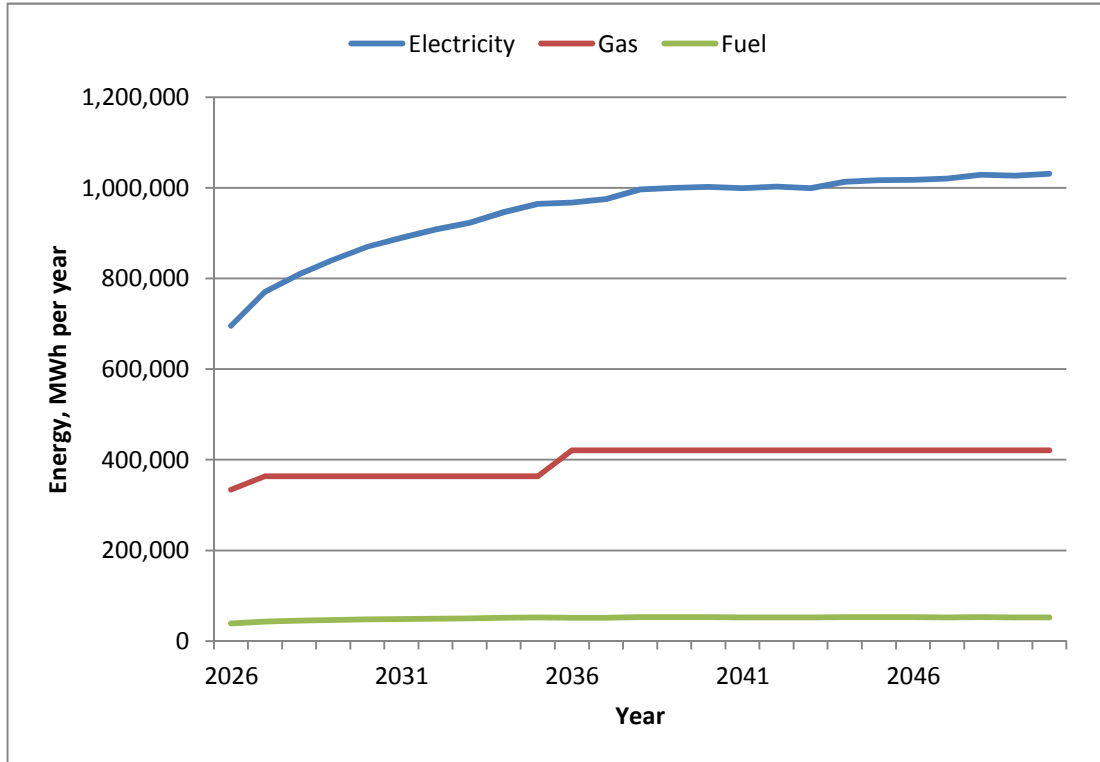
<sup>11</sup> A sensitivity test was undertaken using adjusted 2030 modal share projection, derived from Jacobs 2014 Surface Access analyses.

**2.4 Airport operations emissions from energy & fuel use**

Impact Assessment

The assumptions made relating to the electricity, gas and fuel calculations are the same as those used in the carbon capped scenario (8. Carbon: Baseline and 8. Carbon: Assessment, Airports Commission 2014).

**Figure 2.7 - Energy use at Heathrow, by source, 2026 – 2050 for Heathrow NWR**



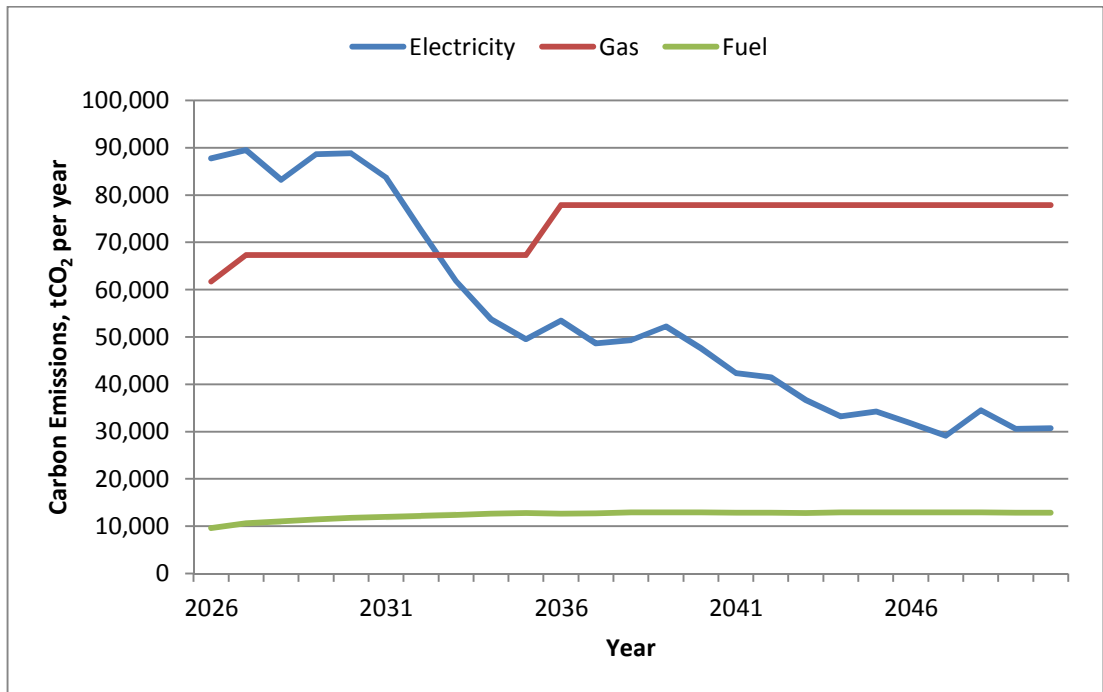
**Table 2.9 – Carbon emissions due to airport operation energy use at Heathrow, by source 2026 – 2050 for Do Minimum forecast scenario**

Year	Emissions due to electricity use at Heathrow Airport, tonnes CO <sub>2</sub>	Emissions due to gas use at Heathrow Airport, tonnes CO <sub>2</sub>	Emissions due to fuel use at Heathrow Airport, tonnes CO <sub>2</sub>	Total emissions due to airport operation at Heathrow Airport, tonnes CO <sub>2</sub>
2026	77,628	41,520	8,268	127,417
2030	65,369	41,520	8,305	115,194
2040	32,213	52,099	8,364	92,677
2050	21,133	52,099	8,098	81,330

**Table 2.10 – Carbon emissions due to airport operation energy use at Heathrow, by source 2026 – 2050 for Heathrow NWR forecast scenario**

Year	Emissions due to electricity use at Heathrow Airport, tonnes CO <sub>2</sub>	Emissions due to gas use at Heathrow Airport, tonnes CO <sub>2</sub>	Emissions due to fuel use at Heathrow Airport, tonnes CO <sub>2</sub>	Total emissions due to airport operation at Heathrow Airport, tonnes CO <sub>2</sub>
2026	87,768	61,717	9,578	159,063
2030	88,864	67,294	11,735	167,893
2040	47,663	77,874	12,935	138,472
2050	30,678	77,874	12,832	121,384

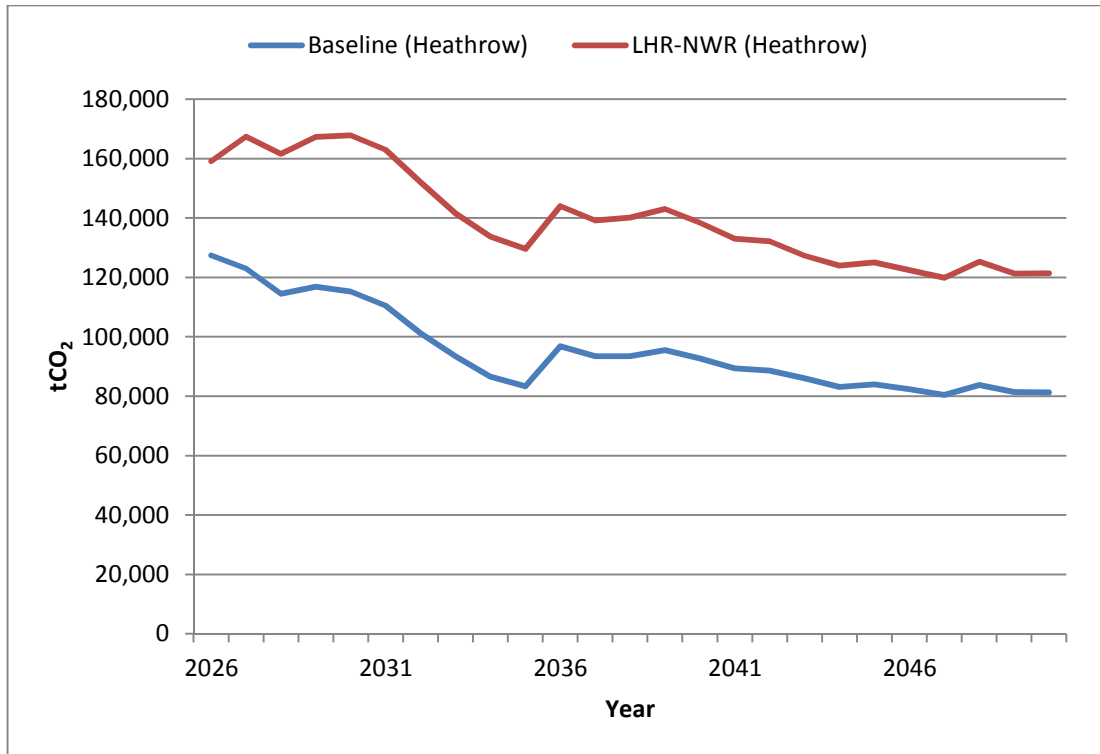
**Figure 2.8 - Carbon emissions due to airport operation energy use at Heathrow, by source, 2026 – 2050 for Heathrow NWR forecast scenario**



**Table 2.11 - Operational emissions at Heathrow due to energy and fuel use, 2026 – 2050 for Heathrow NWR forecast scenario**

Year	Do Minimum, tonnes CO <sub>2</sub>	Heathrow NWR, tonnes CO <sub>2</sub>	Change from Do Minimum (%)
2026	127,417	159,063	24.8%
2030	115,194	167,893	45.7%
2040	92,677	138,472	49.4%
2050	81,330	121,384	49.2%

**Figure 2.9 - Operational emissions due to energy and fuel at Heathrow, 2026 – 2050 for Do Minimum and Heathrow NWR forecast scenarios**



**2.5 Conclusions**

**Table 2.12 - Carbon assessment findings for Heathrow NWR: change in tCO<sub>2</sub>**

Area of Emissions	2030	2040	2050	Additional tCO <sub>2</sub> to Do Minimum over 60 year appraisal period	Total tCO <sub>2</sub> over 60 year appraisal period
<b>Air travel</b>	4,388,689	5,494,800	4,905,046	298,876,568	1,410,447,296
<i>Ground movements component</i>	163,761	218,298	226,064	12,984,384	36,827,360
<b>Passenger surface access journeys</b>	78,631	116,960	135,334	7,426,348	34,950,190
<b>Airport operations energy &amp; fuel use</b>	52,699	45,795	40,053	2,557,493	7,929,530
<b>Total operational CO<sub>2</sub> emissions</b>	<b>4,520,019</b>	<b>5,657,555</b>	<b>5,080,433</b>	<b>308,860,409</b>	<b>1,453,327,016</b>

**2.6 Heathrow NWR Carbon Assessment Monetisation**

In Table 2.13 and Table 2.14, the carbon results are displayed in a monetised format. This has been done for both the Net Present Value (NPV) of the additional carbon emissions over the 60 year appraisal period as a result of the scheme, and also for particular assessment years in terms of £ in 2014 prices. The value of emissions that are the result of construction, as calculated in the Carbon Assessment report, are included in the totals presented in Table 2.13 and 2.15.

In monetising the emissions the traded value of emissions as presented in the “Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal” (DECC, 2014) was used throughout the analysis. Post 2030 it is assumed that a global carbon market is in place and therefore one carbon value applies to all emissions, regardless of whether they originate in the current traded or non-traded sector of the economy. For consistency, the traded value was also used for emissions between 2025 and 2030.

**Table 2.13 – Heathrow Airport additional central carbon value (NPV) for the Heathrow NWR forecast scenario**

	Monetised value of carbon emissions
<b>Total Additional Value (£)</b>	£19,402,780,817
<b>Snapshot 2030 (£)</b>	£204,597,241
<b>Snapshot 2040 (£)</b>	£346,444,025
<b>Snapshot 2050 (£)</b>	£388,964,769
<b>Snapshot 2060 (£)</b>	£385,077,850

**Table 2.14 - Additional and total central carbon value, (NPV) for emission sources for the Heathrow NWR scenario**

Area of Emissions	Monetised value of carbon emissions, additional £ over 60 year appraisal period	Monetised value of carbon emissions, total £ over 60 year appraisal period
<b>Air travel</b>	£18,526,092,532	£85,894,020,036
<i>Ground movements component</i>	£810,517,687	£2,267,569,748
<b>Passenger surface access journeys</b>	£467,690,134	£2,169,259,232
<b>Airport operations energy &amp; fuel use</b>	£155,949,879	£477,376,495
<b>Total operational CO<sub>2</sub> emissions</b>	<b>£19,149,732,545</b>	<b>£88,540,655,763</b>

In Table 2.15 and Table 2.16, the carbon results are displayed as the range from the low to high assumptions on carbon value. This has been done for both the Net Present Value (NPV) of the additional carbon emissions over the 60 year appraisal period as a result of the scheme, and also for particular assessment years in terms of £ in 2014 prices.

**Table 2.15 - Additional Low to High carbon value, (NPV) for Heathrow NWR forecast scenario**

	Monetised value of carbon emissions
<b>Total Additional Value (£)</b>	£8,728,246,740 – £30,276,711,120
<b>Snapshot 2030 (£)</b>	£102,298,620 - £306,895,861
<b>Snapshot 2040 (£)</b>	£173,222,013 - £519,666,038
<b>Snapshot 2050 (£)</b>	£194,482,384 - £583,447,153
<b>Snapshot 2060 (£)</b>	£173,285,032 - £596,870,667



**Table 2.16 - Additional Low to High carbon value (NPV) for emission sources for Heathrow NWR forecast scenario**

	<b>Monetised value of carbon emissions, additional £ over 60 year appraisal period</b>
<b>Increased airport capacity - net change in air travel</b>	£8,336,865,106 - £28,764,341,274
<i>Airside ground movements</i>	£362,615,740 - £1,260,215,450
<b>Passenger surface access journeys</b>	£208,363,038 - £727,590,127
<b>Airport operations</b>	£70,380,136 - £242,264,757

### 3 Heathrow Airport Extended Northern Runway

This section covers the emissions categories of total aircraft emissions (Air travel), airside (aircraft) ground movement emissions, airport operations emissions from energy & fuel use, and passenger surface access emissions for Heathrow Airport Extended Northern Runway. The section is broken into:

- Jacobs assessment of impacts;
- Conclusions

#### 3.1 Total aircraft emissions

##### Impact Assessment

Assumptions made regarding outputs of the DfT model are the same as those used in the carbon capped scenario (8. Carbon: Baseline and 8. Carbon: Assessment, Airports Commission 2014). The AoN carbon traded demand forecasts of ATMs reach up to 714,000 annual ATMs for Heathrow ENR in 2040, reducing to 706,000 annual ATMs in 2050, compared to a nominal operation limit of 700,000 annual ATMs. Forecasts used are derived directly from Airports Commission AoN Demand Forecast aviation model outputs and may marginally differ (by +/- 2%) to the operational limits in order for the aviation model to reach equilibrium across UK airports. The effect is a conservative (i.e. higher) estimate of carbon emissions.

**Table 3.1 - Carbon emissions, carbon traded: Heathrow Do Minimum, for 2026 – 2050<sup>12</sup>**

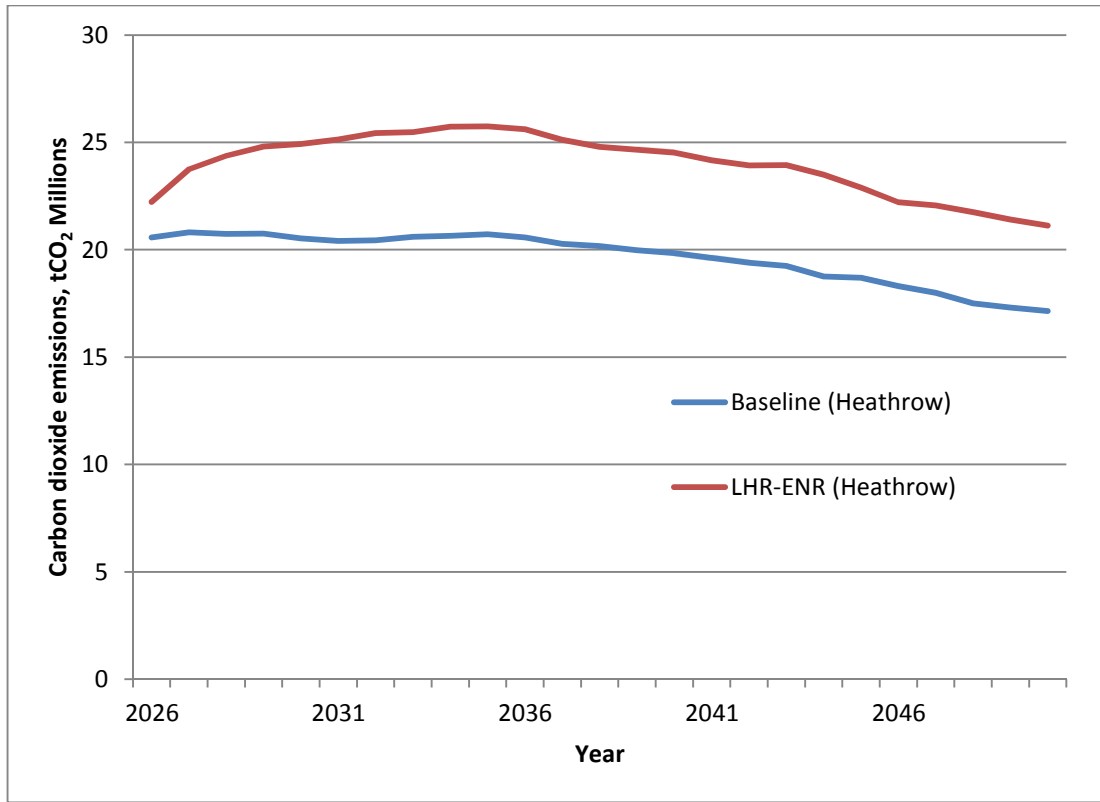
Year	Heathrow Airport, Number of passengers	Heathrow Airport, Numbers of ATMs	Heathrow Airport, tonnes CO <sub>2</sub>	UK Aviation Total, tonnes CO <sub>2</sub>	Heathrow as % of UK Total for carbon emissions
2026	82,219,824	482,073	20,566,718	39,791,963	51.7
2030	85,483,664	484,227	20,530,830	40,393,641	50.8
2040	90,472,248	487,646	19,844,858	41,135,703	48.2
2050	94,906,328	472,147	17,145,585	39,944,049	42.9

**Table 3.2 - Carbon emissions, carbon traded: Heathrow ENR, for 2026 – 2050**

Year	Heathrow Airport, Number of passengers	Heathrow Airport, Numbers of ATMs	Heathrow Airport, tonnes CO <sub>2</sub>	UK Aviation Total, tonnes CO <sub>2</sub>	Heathrow as % of UK Total for carbon emissions
2026	92,985,344	558,665	22,220,178	41,328,661	53.8
2030	116,278,816	684,649	24,925,582	43,750,823	57.0
2040	127,055,792	714,458	24,522,596	44,991,738	54.5
2050	130,817,672	706,038	21,117,432	42,858,909	49.3

<sup>12</sup> An equilibrium solution which satisfies capacity limits at all airports is computationally intensive and progressively more difficult to solve as demand mounts through the forecasting period. The solution is generally deemed to be found when over-capacity airports are within +/-1.5% of their input capacities. Runway capacity is regarded as a "harder" capacity than terminal capacity in the search for an equilibrium solution.

**Figure 3.1 – Carbon emissions from departing flights at Heathrow Airport, 2026 – 2050: Do Minimum and Heathrow ENR scenarios, carbon traded**



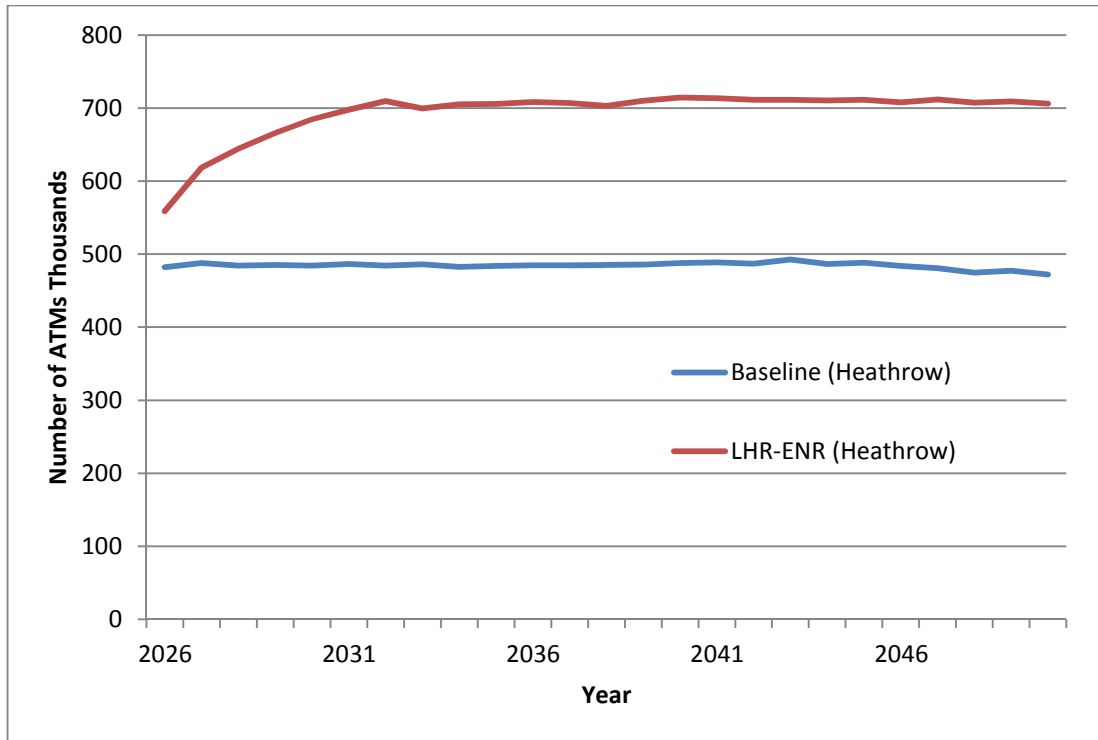
**Table 3.3 - Comparison of the carbon emissions in 2030, 2040 and 2050 for the Heathrow Airport Do Minimum and Heathrow ENR forecast scenarios**

Year	Do Minimum tonnes CO <sub>2</sub>	Heathrow ENR tonnes CO <sub>2</sub>	Change from Do Minimum (%)
2030	20,530,830	24,925,582	21.4
2040	19,844,858	24,522,596	23.6
2050	17,145,585	21,117,432	23.2

**Table 3.4 - Comparison of the ATMs in 2030, 2040 and 2050 for the Heathrow Airport Do Minimum and Heathrow ENR forecast scenarios**

Year	Heathrow Do Minimum, Numbers of ATMs	Operational cap for Heathrow ENR	Heathrow ENR, Numbers of ATMs
2030	484,227	740,000	684,649
2040	487,646	740,000	714,458
2050	472,147	740,000	706,038

**Figure 3.2 - Air transport movements (ATMs) during the period 2026 – 2050 at Heathrow Airport, Do Minimum and Heathrow ENR scenarios carbon traded**



**3.2 Airside (aircraft) ground movement emissions**

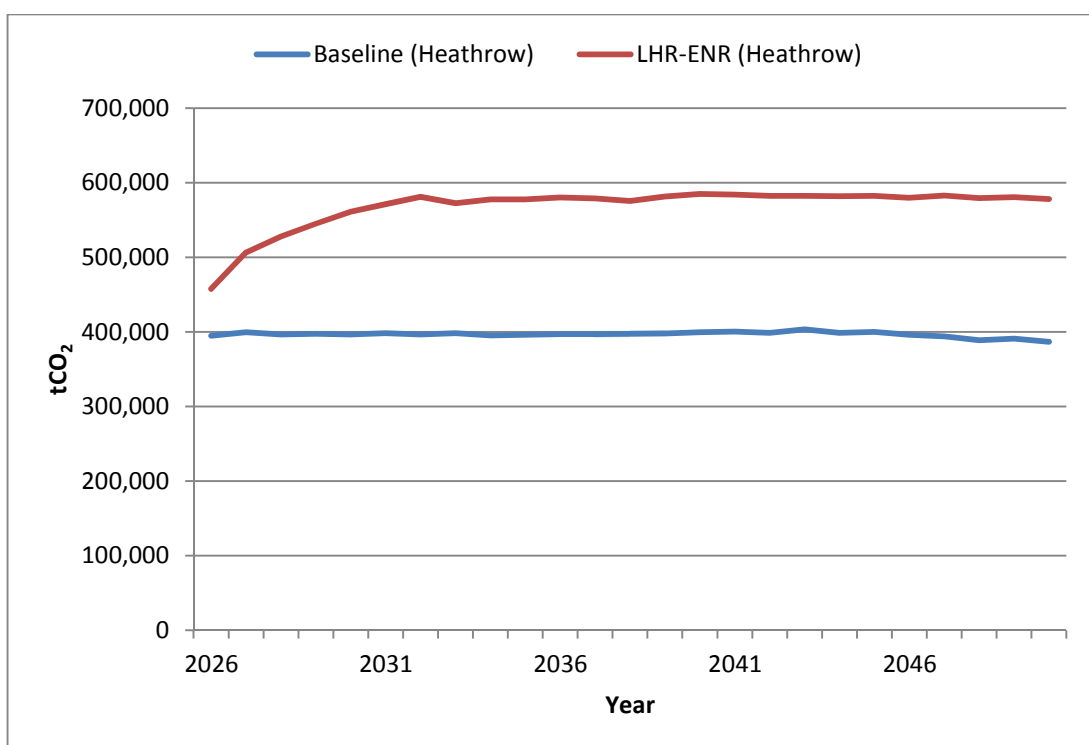
*Impact Assessment*

Assumptions made regarding time-on-ground are held constant from the carbon capped scenario (8. Carbon: Baseline and 8. Carbon: Assessment, Airports Commission 2014) and the carbon traded scenario which is covered in this Addendum. The main driver behind ground movement emissions are ATMs, rather than passenger numbers. This means that increased demand and passenger numbers are moderated by any moves to larger aircraft that reduce total ATMs, and so the change in ground movement emissions will not directly correlate with passenger numbers.

**Table 3.5 - Comparison of the aircraft ground movement emissions 2026 – 2050 for the Heathrow Airport Do Minimum and Heathrow ENR forecast scenarios**

Year	Do Minimum, tonnes CO <sub>2</sub>	Heathrow ENR, tonnes CO <sub>2</sub> , ICAO-Times <sup>13</sup>	Heathrow ENR, tonnes CO <sub>2</sub> , HAL-Reported times <sup>14</sup>
2026	394,853	457,587	355,879
2030	396,617	560,777	424,896
2040	399,418	585,193	460,499
2050	386,723	578,296	461,494

**Figure 3.3 - Carbon emissions due to airside ground movements 2026 – 2050 for the Do Minimum and Heathrow ENR forecast scenarios ENR scenarios**



### 3.3 Passenger surface access emissions

#### Impact Assessment

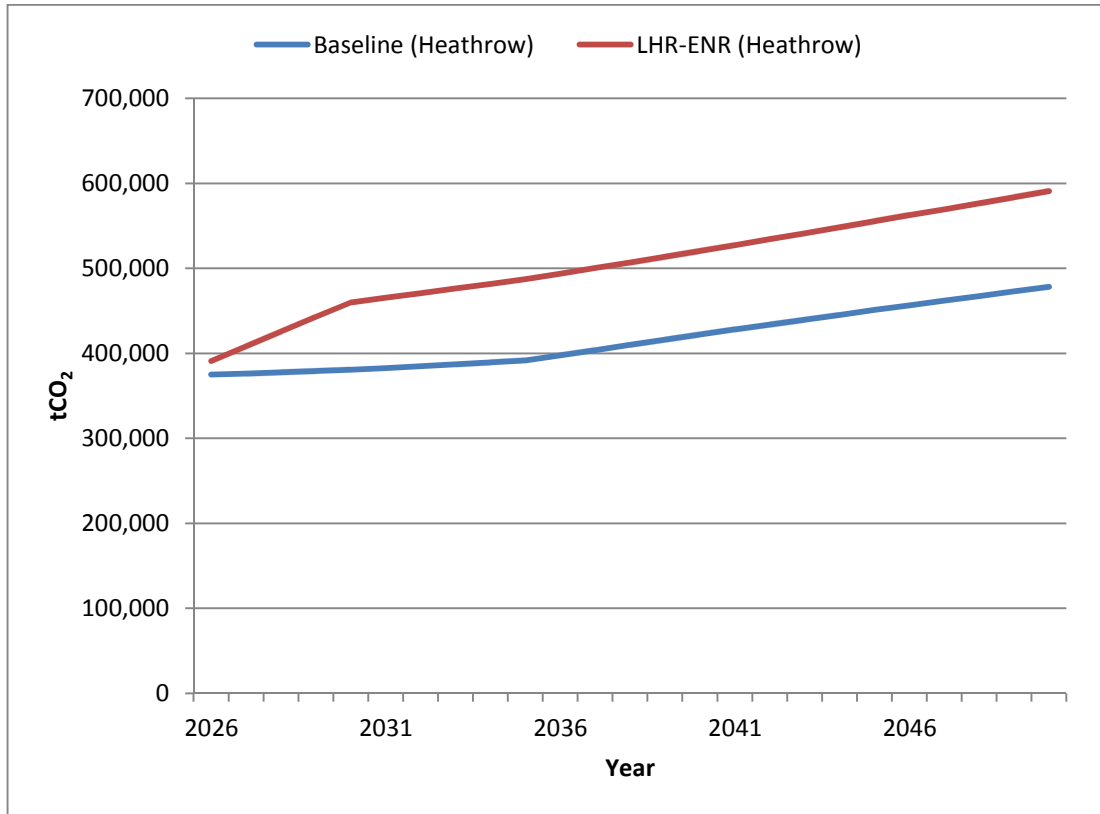
The assumptions made relating to the travel modes and proportions are the same as those used in the carbon capped scenario (8. Carbon: Baseline and 8. Carbon: Assessment, Airports Commission 2014). In addition, the full methodology used for passenger surface access emissions is explained in detail in Annex I of UK Air Passenger Demand and CO<sub>2</sub> Forecasts. The model makes use of forecasts of demand for travel to each of the UK’s airports from UK origin / destinations on a

<sup>13</sup> This basic assessment uses historic reported emissions associated with Landing and Take-Off (LTO) from both Gatwick (Gatwick Airport Limited, 2014a) and Heathrow (Heathrow Airport Limited, 2014) and reported ATMs in those years in order to create a factor representing LTO emissions per ATM. The proportion of the LTO which is ground based is then determined using ICAO Times-in-Mode (TIM) resulting in an ICAO-Times forecast.

<sup>14</sup> A sensitivity is also generated utilising times in mode submitted by the proposers, which is presented within our results as “HAL/GAL Reported Times” forecast.

regional basis; for this reason, changes in regional demand can have impacts that may seem out of proportion with the change in passenger numbers.

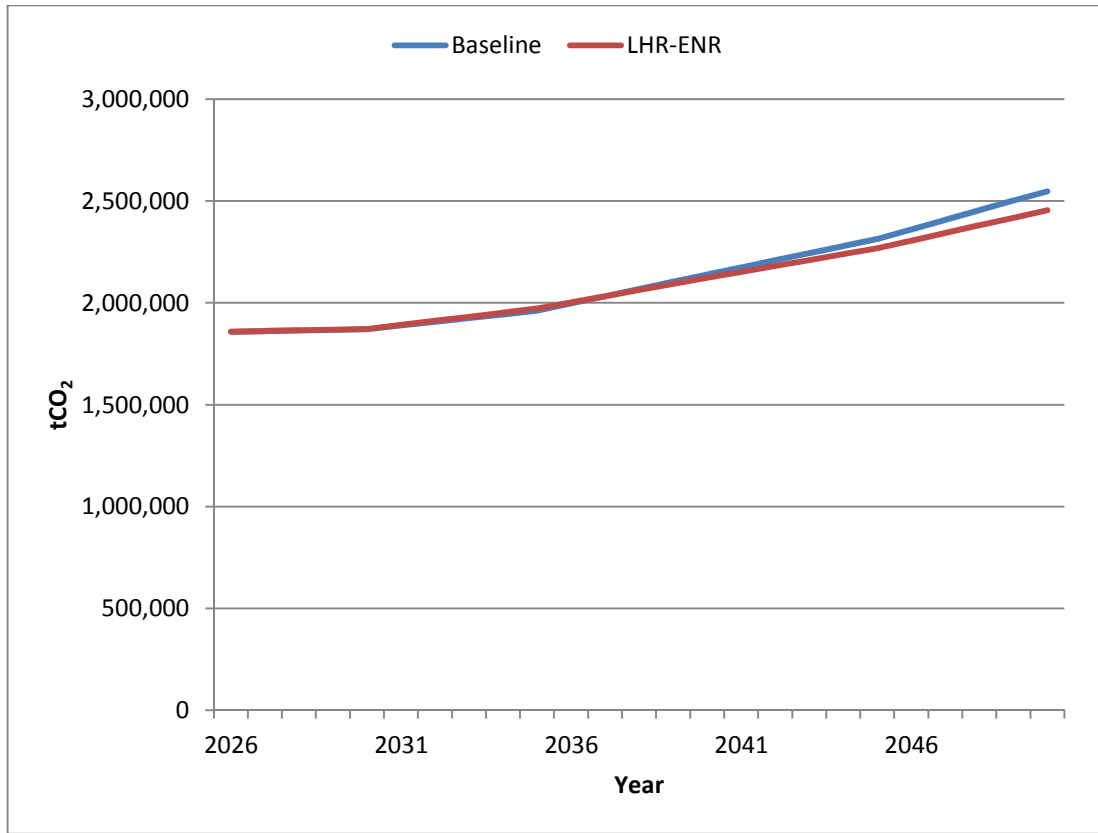
**Figure 3.4 - Emissions due to surface access for Do Minimum and Heathrow ENR forecast scenarios**



**Table 3.6 - Emissions due to surface access for 2026 – 2050 for Do Minimum and Heathrow ENR forecast scenarios**

Year	Do Minimum emissions due to surface access to Heathrow Airport, tonnes CO <sub>2</sub>	Heathrow ENR emissions due to surface access to Heathrow Airport, tonnes CO <sub>2</sub>	Change from Do Minimum (%)
2026	374,999	390,886	4.2%
2030	380,563	459,998	20.9%
2040	422,288	520,265	23.2%
2050	478,305	590,893	23.5%

**Figure 3.5 - The emissions due to surface access across the UK airport system for Do Minimum and Heathrow ENR forecast scenarios**



**Table 3.7 - The emissions due to surface access across the UK airport system, 2026 – 2050 for Do Minimum and Heathrow ENR forecast scenarios**

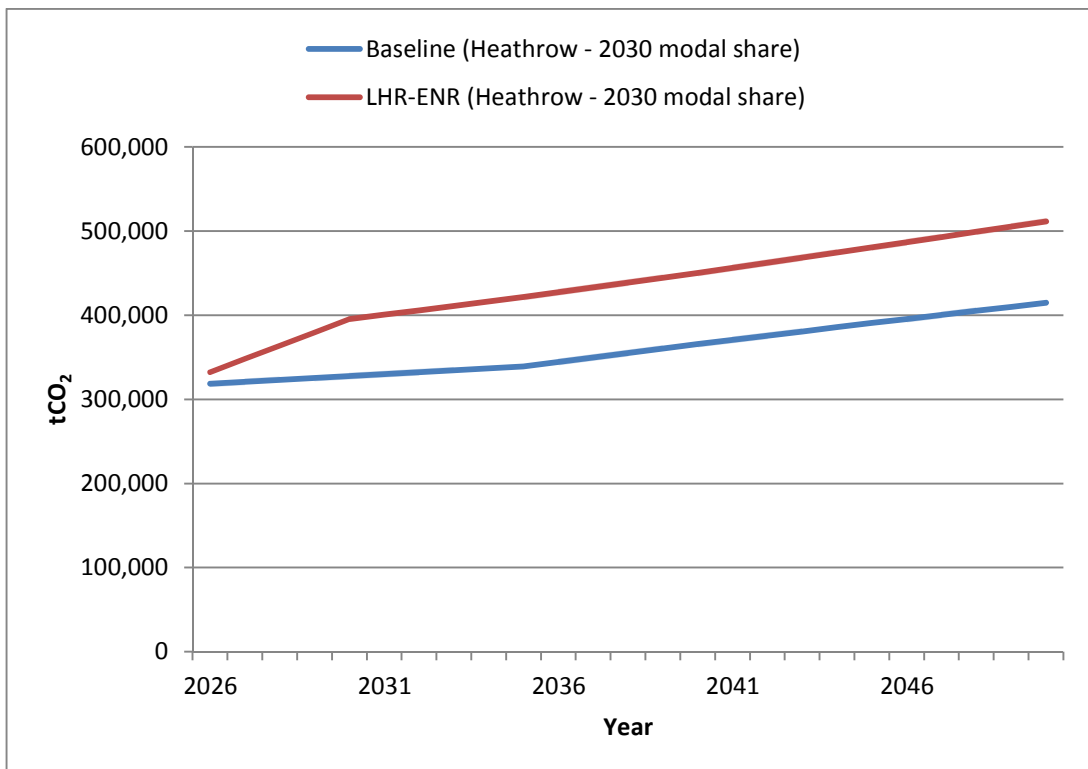
Year	Do Minimum emissions due to surface access to UK airports <sup>15</sup> , tonnes CO <sub>2</sub>	Emissions due to surface access to UK airports with Heathrow ENR <sup>16</sup> , tonnes CO <sub>2</sub>	Change from Do Minimum (%)
2026	1,858,517	1,858,599	0.0%
2030	1,870,223	1,870,634	0.0%
2040	2,139,566	2,126,197	-0.6%
2050	2,548,469	2,458,642	-3.5%

<sup>15</sup> The previously referenced set.

<sup>16</sup> The previously referenced set.

*Sensitivity: 2030 Modal split<sup>17</sup>*

**Figure 3.6 - Emissions due to surface access at Heathrow, using a 2030 modal share for Do Minimum and Heathrow ENR forecast scenarios**



**Table 3.8 - Emissions due to surface access at Heathrow, for 2026 – 2050 for Do Minimum and Heathrow ENR forecast scenarios**

Year	Do Minimum emissions due to surface access to Heathrow Airport, tonnes CO <sub>2</sub>	Heathrow ENR emissions due to surface access to Heathrow Airport, tonnes CO <sub>2</sub>
2026	318,770	332,348
2030	327,531	395,422
2040	365,699	450,165
2050	414,791	511,421

<sup>17</sup> A sensitivity test was undertaken using adjusted 2030 modal share projection, derived from Jacobs 2014 Surface Access analyses.

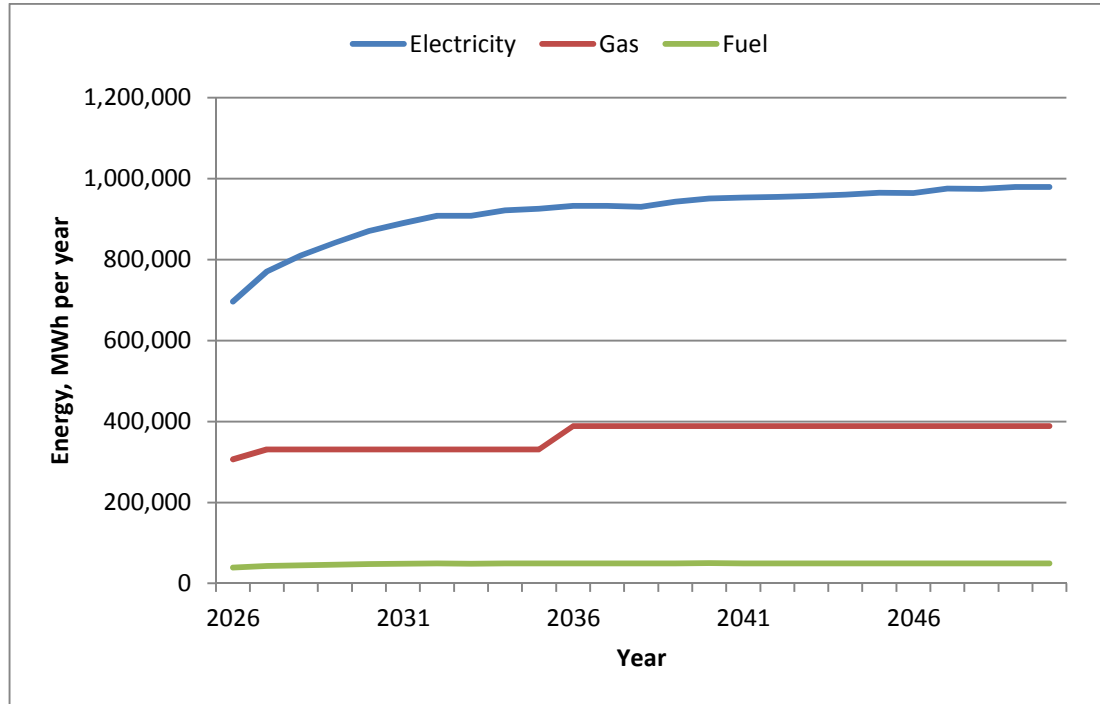


**3.4 Airport operations emissions from energy & fuel use**

Impact Assessment

The assumptions made relating to the electricity, gas and fuel calculations are the same as those used in the carbon capped scenario (8. Carbon: Baseline and 8. Carbon: Assessment, Airports Commission 2014).

**Figure 3.7 - Energy use at Heathrow, by source, 2026 – 2050 for Heathrow ENR**



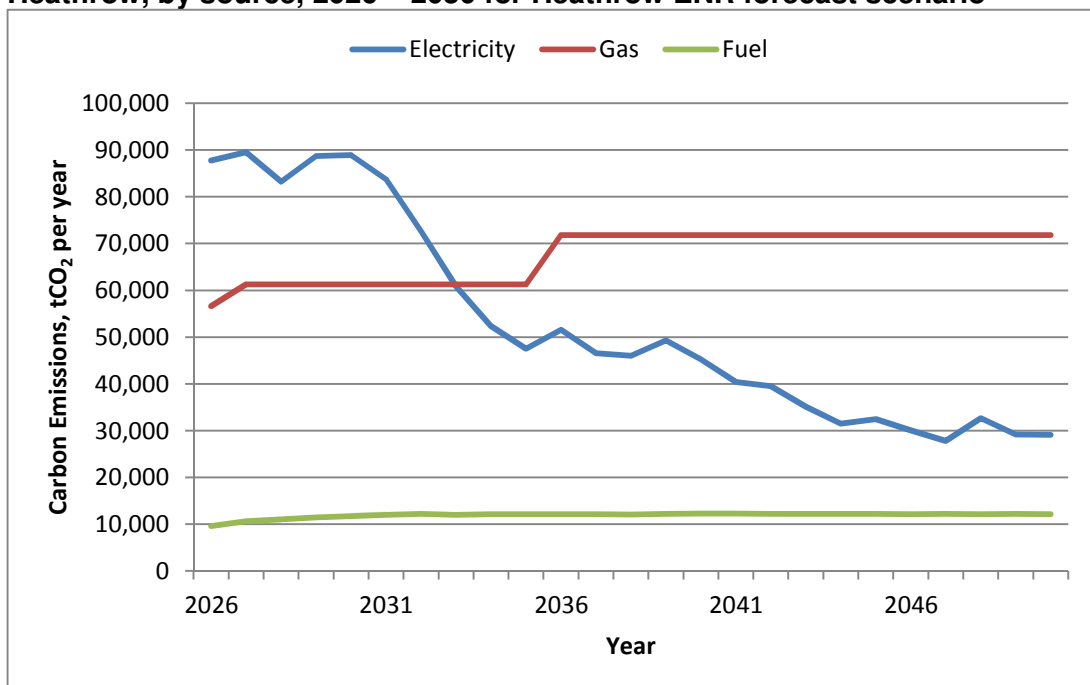
**Table 3.9 – Carbon emissions due to airport operation energy use at Heathrow, by source 2026 – 2050 for Do Minimum forecast scenario**

Year	Emissions due to electricity use at Heathrow Airport, tonnes CO <sub>2</sub>	Emissions due to gas use at Heathrow Airport, tonnes CO <sub>2</sub>	Emissions due to fuel use at Heathrow Airport, tonnes CO <sub>2</sub>	Emissions due to airport operation at Heathrow Airport, tonnes CO <sub>2</sub>
2026	77,628	41,520	8,268	127,417
2030	65,369	41,520	8,305	115,194
2040	32,213	52,099	8,364	92,677
2050	21,133	52,099	8,098	81,330

**Table 3.10 – Carbon emissions due to airport operation energy use at Heathrow, by source 2026 – 2050 for Heathrow ENR forecast scenario**

Year	Emissions due to electricity use at Heathrow Airport, tonnes CO <sub>2</sub>	Emissions due to gas use at Heathrow Airport, tonnes CO <sub>2</sub>	Emissions due to fuel use at Heathrow Airport, tonnes CO <sub>2</sub>	Emissions due to airport operation at Heathrow Airport, tonnes CO <sub>2</sub>
2026	87,793	56,635	9,582	154,010
2030	88,918	61,252	11,743	161,913
2040	45,239	71,831	12,254	129,325
2050	29,129	71,831	12,110	113,070

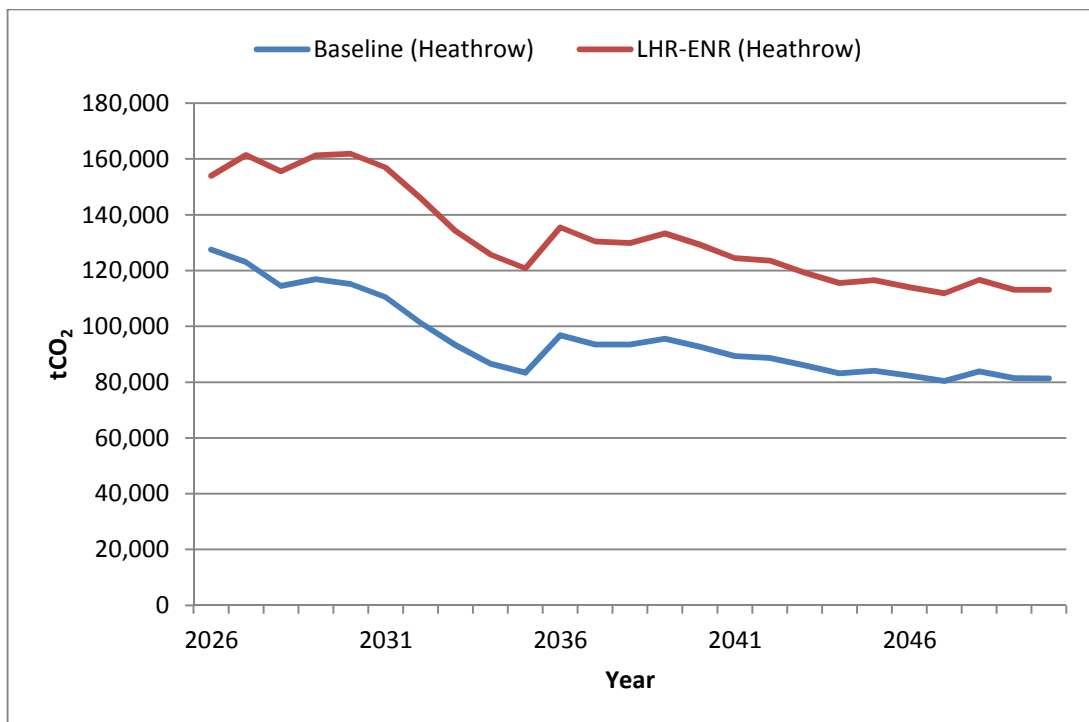
**Figure 3.8 - Carbon emissions due to airport operation energy use at Heathrow, by source, 2026 – 2050 for Heathrow ENR forecast scenario**



**Table 3.11 - Operational emissions due to energy and fuel use at Heathrow, 2026 – 2050 for Heathrow ENR forecast scenario**

Year	Do Minimum, tonnes CO <sub>2</sub>	Heathrow ENR, tonnes CO <sub>2</sub>	Change from Do Minimum (%)
2026	127,417	154,010	20.9%
2030	115,194	161,913	40.6%
2040	92,677	129,325	39.5%
2050	81,330	113,070	39.0%

**Figure 3.9 - Operational emissions due to energy and fuel at Heathrow 2026 – 2050 for Heathrow ENR**



### 3.5 Conclusions

**Table 3.12 - Carbon assessment findings for Heathrow ENR: change in tCO<sub>2</sub>**

Area of Emissions	2030	2040	2050	Additional tCO <sub>2</sub> to Do Minimum over 60 year appraisal period	Total tCO <sub>2</sub> over 60 year appraisal period
<b>Air travel</b>	4,394,752	4,677,738	3,971,847	251,263,850	1,362,834,578
<i>Ground movements component</i>	164,160	185,776	191,574	11,175,314	35,018,290
<b>Passenger surface access journeys</b>	79,436	97,977	112,587	6,277,857	33,801,700
<b>Airport operations energy &amp; fuel use</b>	46,718	36,648	31,740	2,062,485	7,434,522
<b>Total operational CO<sub>2</sub> emissions</b>	<b>4,520,906</b>	<b>4,812,363</b>	<b>4,116,174</b>	<b>259,604,192</b>	<b>1,404,070,800</b>

### 3.6 Heathrow ENR Carbon Assessment Monetisation

In Table 3.13 and Table 3.14, the carbon results are displayed in a monetised format. This has been done for both the Net Present Value (NPV) of the additional carbon emissions over the 60 year appraisal period as a result of the scheme, and also for particular assessment years in terms of £ in 2014 prices. The value of carbon emissions resulting from construction, as calculated in the Carbon Assessment report, are included in the totals presented in Table 3.13 and 3.15.

In monetising the emissions the traded value of emissions as presented in the “Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal” (DECC, 2014) was used throughout the analysis. Post 2030 it is assumed that a global carbon market is in place and therefore one carbon value applies to all emissions, regardless of whether they originate in the current traded or non-traded sector of the economy. For consistency, the traded value was also used for emissions between 2025 and 2030.

**Table 3.13 - Heathrow Airport additional central carbon value (NPV) for the Heathrow ENR forecast scenario**

	Monetised value of carbon emissions
<b>Total Additional Value (£)</b>	£16,219,619,630
<b>Snapshot 2030 (£)</b>	£204,637,003
<b>Snapshot 2040 (£)</b>	£294,688,173
<b>Snapshot 2050 (£)</b>	£315,139,826
<b>Snapshot 2060 (£)</b>	£311,990,639

**Table 3.14 - Additional and total central carbon value, (NPV) for emission sources for the Heathrow ENR scenario**

Area of Emissions	Monetised value of carbon emissions, additional £ over 60 year appraisal period	Monetised value of carbon emissions, total £ over 60 year appraisal period
<b>Air travel</b>	£15,471,007,576	£82,838,935,081
<i>Ground movements component</i>	£694,409,255	£2,151,461,316
<b>Passenger surface access journeys</b>	£393,832,166	£2,095,401,264
<b>Airport operations energy &amp; fuel use</b>	£125,229,026	£446,655,642
<b>Total operational CO<sub>2</sub> emissions</b>	<b>£15,990,068,769</b>	<b>£85,380,991,987</b>

In Table 3.15 and Table 3.16, the carbon results are displayed as the range from the low to high assumptions on carbon value. This has been done for both the Net Present Value (NPV) of the additional carbon emissions over the 60 year appraisal period as a result of the scheme, and also for particular assessment years in terms of £ in 2014 prices.

**Table 3.15 - Additional Low to High carbon value, (NPV) for Heathrow ENR forecast scenario**

	Monetised value of carbon emissions
<b>Total Additional Value (£)</b>	£7,319,355,784 - £25,303,236,994
<b>Snapshot 2030 (£)</b>	£102,318,502 - £306,955,505
<b>Snapshot 2040 (£)</b>	£147,344,086 - £442,032,259
<b>Snapshot 2050 (£)</b>	£157,569,913 - £472,709,740
<b>Snapshot 2060 (£)</b>	£140,395,787 - £483,585,490

**Table 3.16 - Additional Low to High carbon value (NPV) for emission sources for Heathrow ENR forecast scenario**

	<b>Monetised value of carbon emissions, additional £ over 60 year appraisal period</b>
<b>Increased airport capacity - net change in air travel</b>	£6,984,662,834 - £24,006,452,281
<b>Of which:</b>	
<i>Airside ground movements</i>	£311,041,868 - £1,079,576,448
<b>Passenger surface access journeys</b>	£175,707,530 - £612,535,562
<b>Airport operations</b>	£56,591,414 - £194,507,840

## Appendix A Full Tables

### Gatwick Airport Second Runway (Gatwick 2R) Carbon Impact Assessment

**Table C.1 - Carbon emissions, carbon traded; Gatwick 2R, for 2025 – 2050 (Table 1.2)**

Year	Gatwick Airport, Number of passengers	Gatwick Airport, Numbers of ATMs	Gatwick Airport, tonnes CO <sub>2</sub>	UK Aviation Total, tonnes CO <sub>2</sub>	Gatwick as % of UK Total for aviation carbon emissions
2025	42,204,244	299,310	4,712,745	39,974,622	11.8%
2026	44,098,896	310,159	4,768,471	40,359,799	11.8%
2027	45,426,136	318,006	4,809,192	40,557,317	11.9%
2028	47,048,776	326,868	4,889,445	40,935,260	11.9%
2029	48,206,724	333,410	4,901,455	41,170,230	11.9%
2030	49,564,968	340,869	4,886,824	41,147,552	11.9%
2031	50,669,684	347,613	4,857,241	41,216,897	11.8%
2032	51,415,328	352,594	4,818,042	41,519,682	11.6%
2033	51,948,780	354,162	4,798,882	41,832,864	11.5%
2034	53,557,592	363,355	4,887,829	42,053,848	11.6%
2035	55,573,392	378,329	5,008,510	42,291,200	11.8%
2036	56,569,892	385,135	5,023,730	42,432,312	11.8%
2037	57,340,536	390,499	4,946,196	42,307,074	11.7%
2038	58,939,776	401,777	5,052,736	42,281,594	12.0%
2039	60,489,488	411,235	5,117,543	42,249,280	12.1%
2040	62,051,904	422,146	5,214,437	42,422,105	12.3%
2041	63,783,144	434,230	5,346,446	42,597,543	12.6%
2042	65,252,360	444,153	5,409,937	42,575,535	12.7%
2043	67,028,900	455,068	5,539,715	42,794,208	12.9%
2044	69,355,968	470,614	5,691,594	42,269,445	13.5%
2045	72,107,568	490,861	5,870,611	41,812,334	14.0%
2046	74,377,792	505,574	5,962,662	41,582,188	14.3%
2047	76,446,152	520,502	6,072,993	41,457,829	14.6%
2048	77,690,360	530,188	6,097,239	41,248,708	14.8%
2049	79,690,312	541,729	6,188,169	41,105,360	15.1%
2050	81,907,152	558,632	6,326,393	41,056,585	15.4%

**Table C.3 - Comparison of the aircraft ground movement emissions 2025 – 2050 for the Gatwick Airport Do Minimum and Gatwick 2R forecast scenarios (Table 1.5)**

Year	Do Minimum, tCO <sub>2</sub>	Gatwick 2R, tCO <sub>2</sub> , ICAO-Times	Gatwick 2R, tCO <sub>2</sub> , GAL-Reported Times
2025	135,109	145,038	135,005
2026	137,799	150,295	139,898
2027	133,049	154,098	143,438
2028	137,385	158,392	147,435
2029	135,595	161,562	150,386
2030	137,232	165,177	153,750
2031	136,546	168,445	156,792
2032	136,201	170,858	159,039
2033	136,175	171,618	159,746
2034	136,947	176,073	163,893
2035	137,360	183,329	170,647
2036	135,109	186,627	173,717
2037	136,744	189,226	176,136
2038	137,523	194,691	181,223
2039	137,831	199,274	185,489
2040	139,693	204,562	190,410
2041	140,846	210,417	195,861
2042	139,669	215,226	200,337
2043	136,809	220,515	205,260
2044	136,635	228,048	212,272
2045	138,071	237,859	221,405
2046	135,586	244,989	228,041
2047	134,857	252,223	234,774
2048	136,084	256,916	239,143
2049	136,645	262,509	244,349
2050	136,980	270,699	251,973

**Table C.4 - Emissions due to surface access for 2025 – 2050 for Do Minimum and Gatwick 2R forecast scenarios (Table 1.6)**

<b>Year</b>	<b>Do Minimum emissions due to surface access to Gatwick Airport, tonnes CO<sub>2</sub></b>	<b>Gatwick 2R emissions due to surface access to Gatwick Airport, tonnes CO<sub>2</sub></b>	<b>Change from Do Minimum (%)</b>
2025	306,339	323,422	5.6%
2026	304,635	327,247	7.4%
2027	302,931	331,073	9.3%
2028	301,227	334,899	11.2%
2029	299,524	338,724	13.1%
2030	297,820	342,550	15.0%
2031	297,604	347,790	16.9%
2032	297,388	353,030	18.7%
2033	297,173	358,271	20.6%
2034	296,957	363,511	22.4%
2035	296,741	368,752	24.3%
2036	299,258	376,837	25.9%
2037	301,774	384,923	27.6%
2038	304,290	393,009	29.2%
2039	306,807	401,095	30.7%
2040	309,323	409,181	32.3%
2041	309,113	420,345	36.0%
2042	308,904	431,509	39.7%
2043	308,694	442,673	43.4%
2044	308,485	453,837	47.1%
2045	308,275	465,001	50.8%
2046	308,200	476,688	54.7%
2047	308,124	488,374	58.5%
2048	308,049	500,060	62.3%
2049	307,974	511,747	66.2%
2050	307,898	523,433	70.0%



**Table C.5 - The emissions due to surface access across the UK airport system, 2025 – 2050 for Do Minimum and Gatwick 2R forecast scenarios (Table 1.7)**

Year	Do Minimum emissions due to surface access to UK airports <sup>18</sup> , tonnes CO <sub>2</sub>	Emissions due to surface access to UK airports <sup>19</sup> with Gatwick 2R, tonnes CO <sub>2</sub>	Change from Do Minimum (%)
2025	1,855,591	1,857,446	0.1%
2026	1,858,517	1,860,996	0.1%
2027	1,861,444	1,864,545	0.2%
2028	1,864,370	1,868,095	0.2%
2029	1,867,297	1,871,644	0.2%
2030	1,870,223	1,875,194	0.3%
2031	1,888,486	1,896,682	0.4%
2032	1,906,749	1,918,171	0.6%
2033	1,925,011	1,939,660	0.8%
2034	1,943,274	1,961,148	0.9%
2035	1,961,537	1,982,637	1.1%
2036	1,997,142	2,015,127	0.9%
2037	2,032,748	2,047,618	0.7%
2038	2,068,354	2,080,108	0.6%
2039	2,103,960	2,112,598	0.4%
2040	2,139,566	2,145,089	0.3%
2041	2,174,324	2,174,157	0.0%
2042	2,209,083	2,203,225	-0.3%
2043	2,243,842	2,232,294	-0.5%
2044	2,278,601	2,261,362	-0.8%
2045	2,313,360	2,290,430	-1.0%
2046	2,360,382	2,333,145	-1.2%
2047	2,407,404	2,375,859	-1.3%
2048	2,454,426	2,418,574	-1.5%
2049	2,501,447	2,461,288	-1.6%
2050	2,548,469	2,504,002	-1.7%

<sup>18</sup> The airport set previously described.

<sup>19</sup> The airport set previously described.

**Table C.7 – Emissions from Surface Access with 2030 Modal split for 2025 – 2050 for Do Minimum and Gatwick 2R forecast scenarios (Table 1.8)**

<b>Year</b>	<b>Do Minimum emissions due to surface access to Gatwick Airport, tonnes CO<sub>2</sub></b>	<b>Gatwick 2R emissions due to surface access to Gatwick Airport, tonnes CO<sub>2</sub></b>
2025	258,883	273,346
2026	258,168	277,381
2027	257,453	281,415
2028	256,739	285,450
2029	256,024	289,485
2030	255,309	293,519
2031	255,299	298,320
2032	255,290	303,120
2033	255,280	307,921
2034	255,270	312,722
2035	255,260	317,522
2036	257,283	324,375
2037	259,306	331,227
2038	261,329	338,079
2039	263,352	344,932
2040	265,375	351,784
2041	265,056	361,165
2042	264,737	370,546
2043	264,418	379,927
2044	264,099	389,308
2045	263,780	398,689
2046	263,690	408,570
2047	263,599	418,452
2048	263,508	428,333
2049	263,418	438,214
2050	263,327	448,096

**Table C.8 - Carbon emissions due to airport operation at Gatwick, by source, 2025 – 2050 for Gatwick 2R forecast scenario (Table 1.10)**

Year	Emissions due to electricity use at Gatwick Airport, tonnes CO <sub>2</sub>	Emissions due to gas use at Gatwick Airport, tonnes CO <sub>2</sub>	Emissions due to fuel use at Gatwick Airport, tonnes CO <sub>2</sub>	Total Emissions due to airport operation at Gatwick Airport, tonnes CO <sub>2</sub>
2025	28,747	12,865	6,307	47,919
2026	25,140	12,865	6,536	44,540
2027	23,851	12,865	6,701	43,417
2028	21,867	12,865	6,888	41,620
2029	22,950	19,836	7,026	49,811
2030	22,885	20,286	7,183	50,355
2031	21,539	20,286	7,325	49,150
2032	18,587	20,286	7,430	46,304
2033	15,733	20,286	7,463	43,483
2034	13,762	20,286	7,657	41,706
2035	12,894	20,286	7,973	41,153
2036	14,131	20,286	8,116	42,534
2037	12,936	20,286	8,229	41,451
2038	13,174	20,286	8,467	41,928
2039	14,285	20,286	8,666	43,238
2040	13,340	20,286	8,896	42,523
2041	12,211	20,286	9,151	41,648
2042	12,200	20,286	9,360	41,846
2043	11,122	20,286	9,590	40,998
2044	10,275	23,216	9,917	43,408
2045	10,971	23,216	10,344	44,531
2046	10,482	23,216	10,654	44,352
2047	9,848	23,216	10,969	44,033
2048	11,778	23,216	11,173	46,167
2049	10,714	23,216	11,416	45,346
2050	11,012	23,216	11,772	46,000

**Table C.9 - Operational emissions at Gatwick, 2025 – 2050 for Gatwick 2R forecast scenario (Table 1.11)**

<b>Year</b>	<b>Do Minimum, tonnes CO<sub>2</sub></b>	<b>Gatwick 2R, tonnes CO<sub>2</sub></b>	<b>Change from Do Minimum (%)</b>
2025	44,641	47,919	7.34%
2026	40,801	44,540	9.16%
2027	38,376	43,417	13.14%
2028	36,738	41,620	13.29%
2029	37,201	49,811	33.90%
2030	37,554	50,355	34.09%
2031	36,050	49,150	36.34%
2032	33,448	46,304	38.43%
2033	31,048	43,483	40.05%
2034	29,276	41,706	42.45%
2035	28,303	41,153	45.40%
2036	28,900	42,534	47.18%
2037	28,056	41,451	47.74%
2038	28,085	41,928	49.29%
2039	28,735	43,238	50.47%
2040	28,046	42,523	51.62%
2041	27,109	41,648	53.63%
2042	26,847	41,846	55.87%
2043	25,638	40,998	59.91%
2044	24,843	43,408	74.73%
2045	25,192	44,531	76.77%
2046	24,486	44,352	81.13%
2047	23,887	44,033	84.34%
2048	25,081	46,167	84.07%
2049	24,344	45,346	86.27%
2050	24,381	46,000	88.67%

## Heathrow Airport North-West Runway (Heathrow NWR) Carbon Impact Assessment

**Table C.22 - Carbon emissions, carbon traded: Heathrow NWR, for 2026 – 2050 (Table 2.2)**

Year	Heathrow Airport, Number of passengers	Heathrow Airport, Numbers of ATMs	Heathrow Airport, tonnes CO <sub>2</sub>	UK Aviation Total, tonnes CO <sub>2</sub>	Heathrow as % of UK Total for carbon emissions
2026	92,958,872	558,450	22,218,299	41,327,919	53.8%
2027	102,933,752	618,042	23,742,774	42,398,960	56.0%
2028	108,154,064	644,098	24,370,500	43,035,247	56.6%
2029	112,385,000	665,066	24,796,953	43,496,361	57.0%
2030	116,208,352	684,162	24,919,519	43,754,775	57.0%
2031	118,873,704	697,496	25,133,658	44,011,137	57.1%
2032	121,290,696	709,854	25,429,010	44,389,114	57.3%
2033	123,351,944	720,227	25,742,296	44,727,114	57.6%
2034	126,404,992	735,405	26,191,165	45,448,559	57.6%
2035	128,865,256	746,211	26,401,528	45,772,350	57.7%
2036	129,254,592	735,847	26,162,182	45,795,809	57.1%
2037	130,263,096	739,155	25,810,797	45,597,623	56.6%
2038	133,144,040	754,383	25,857,761	45,766,560	56.5%
2039	133,614,512	754,716	25,586,399	45,566,161	56.2%
2040	133,862,832	754,164	25,339,658	45,485,931	55.7%
2041	133,525,688	749,792	25,104,012	45,603,673	55.0%
2042	133,930,928	750,180	25,060,031	45,645,197	54.9%
2043	133,531,784	745,301	24,637,519	45,517,333	54.1%
2044	135,403,872	753,001	24,382,905	45,387,539	53.7%
2045	135,827,136	754,665	23,688,682	44,730,884	53.0%
2046	135,977,584	751,586	23,063,574	44,204,407	52.2%
2047	136,298,800	751,331	22,728,453	43,949,757	51.7%
2048	137,431,856	753,811	22,636,517	43,807,591	51.7%
2049	137,189,824	748,429	22,217,410	43,457,597	51.1%
2050	137,772,480	748,147	22,050,631	43,519,841	50.7%

**Table C.24 - Comparison of the aircraft ground movement emissions 2026 – 2050 for the Heathrow Airport Do Minimum and Heathrow NWR forecast scenarios (Table 2.5)**

Year	Do Minimum, tonnes CO <sub>2</sub>	Heathrow-NWR, tonnes CO <sub>2</sub> , ICAO-Times	Heathrow-NWR, tonnes CO <sub>2</sub> , HAL-Reported times
2026	394,853	457,411	362,547
2027	399,455	506,221	401,235
2028	396,742	527,563	418,150
2029	397,317	544,737	431,763
2030	396,617	560,378	444,160
2031	398,468	571,300	452,817
2032	396,570	581,422	460,839
2033	398,162	589,918	467,574
2034	395,183	602,350	477,427
2035	396,341	611,201	484,442
2036	397,201	602,712	477,714
2037	397,064	605,422	479,862
2038	397,425	617,895	489,748
2039	397,896	618,167	489,964
2040	399,418	617,715	489,606
2041	400,378	614,134	486,767
2042	398,805	614,452	487,019
2043	403,587	610,456	483,852
2044	398,497	616,763	488,851
2045	399,969	618,125	489,931
2046	396,263	615,604	487,932
2047	393,829	615,395	487,766
2048	388,679	617,426	489,376
2049	391,052	613,018	485,882
2050	386,723	612,787	485,699

**Table C.25 - Emissions due to surface access for 2026 – 2050 for Do Minimum and Heathrow NWR forecast scenarios (Table 2.6)**

Year	Do Minimum emissions due to surface access to Heathrow Airport, tonnes CO <sub>2</sub>	Heathrow-NWR emissions due to surface access to Heathrow Airport, tonnes CO <sub>2</sub>	Change from Do Minimum (%)
2026	374,999	390,725	4.2%
2027	376,390	407,842	8.4%
2028	377,781	424,959	12.5%
2029	379,172	442,076	16.6%
2030	380,563	459,194	20.7%
2031	382,777	467,404	22.1%
2032	384,991	475,614	23.5%
2033	387,205	483,825	25.0%
2034	389,419	492,035	26.4%
2035	391,633	500,246	27.7%
2036	397,764	508,046	27.7%
2037	403,895	515,846	27.7%
2038	410,026	523,647	27.7%
2039	416,157	531,447	27.7%
2040	422,288	539,247	27.7%
2041	428,030	546,690	27.7%
2042	433,772	554,133	27.7%
2043	439,514	561,576	27.8%
2044	445,257	569,019	27.8%
2045	450,999	576,461	27.8%
2046	456,460	583,897	27.9%
2047	461,922	591,333	28.0%
2048	467,383	598,768	28.1%
2049	472,844	606,204	28.2%
2050	478,305	613,639	28.3%

**Table C.26 - The emissions due to surface access across the UK airport system, 2026 – 2050 for Do Minimum and Heathrow NWR forecast scenarios (Table 2.7)**

Year	Do Minimum emissions due to surface access to UK airports <sup>20</sup> , tonnes CO <sub>2</sub>	Emissions due to surface access to UK airports with Heathrow-NWR <sup>21</sup> , tonnes CO <sub>2</sub>	Change from Do Minimum (%)
2026	1,858,517	1,858,599	0.0%
2027	1,861,444	1,861,608	0.0%
2028	1,864,370	1,864,617	0.0%
2029	1,867,297	1,867,626	0.0%
2030	1,870,223	1,870,634	0.0%
2031	1,888,486	1,890,950	0.1%
2032	1,906,749	1,911,266	0.2%
2033	1,925,011	1,931,581	0.3%
2034	1,943,274	1,951,897	0.4%
2035	1,961,537	1,972,213	0.5%
2036	1,997,142	2,003,010	0.3%
2037	2,032,748	2,033,806	0.1%
2038	2,068,354	2,064,603	-0.2%
2039	2,103,960	2,095,400	-0.4%
2040	2,139,566	2,126,197	-0.6%
2041	2,174,324	2,153,913	-0.9%
2042	2,209,083	2,181,628	-1.2%
2043	2,243,842	2,209,344	-1.5%
2044	2,278,601	2,237,060	-1.8%
2045	2,313,360	2,264,776	-2.1%
2046	2,360,382	2,303,549	-2.4%
2047	2,407,404	2,342,322	-2.7%
2048	2,454,426	2,381,096	-3.0%
2049	2,501,447	2,419,869	-3.3%
2050	2,548,469	2,458,642	-3.5%

<sup>20</sup> The previously referenced set.

<sup>21</sup> The previously referenced set.



**Table C.28 - Emissions due to surface access at Heathrow, with 2030 Modal split for 2026 – 2050 for Do Minimum and Heathrow NWR forecast scenarios (Table 2.8)**

<b>Year</b>	<b>Do Minimum emissions due to surface access to Heathrow Airport, tonnes CO<sub>2</sub></b>	<b>Heathrow-NWR emissions due to surface access to Heathrow Airport, tonnes CO<sub>2</sub></b>
2026	318,770	332,209
2027	320,960	347,838
2028	323,150	363,468
2029	325,341	379,097
2030	327,531	394,726
2031	329,858	402,334
2032	332,185	409,942
2033	334,512	417,549
2034	336,840	425,157
2035	339,167	432,765
2036	344,473	439,499
2037	349,780	446,233
2038	355,086	452,967
2039	360,393	459,701
2040	365,699	466,435
2041	370,724	472,967
2042	375,748	479,499
2043	380,772	486,030
2044	385,797	492,562
2045	390,821	499,094
2046	395,615	505,466
2047	400,409	511,838
2048	405,203	518,210
2049	409,997	524,582
2050	414,791	530,953

**Table C.29 - Carbon emissions due to airport operation energy use at Heathrow, by source 2026 – 2050 for Heathrow NWR forecast scenario (Table 2.10)**

Year	Emissions due to electricity use at Heathrow Airport, tonnes CO <sub>2</sub>	Emissions due to gas use at Heathrow Airport, tonnes CO <sub>2</sub>	Emissions due to fuel use at Heathrow Airport, tonnes CO <sub>2</sub>	Total Emissions due to airport operation at Heathrow Airport, tonnes CO <sub>2</sub>
2026	87,768	61,717	9,578	159,063
2027	89,511	67,294	10,601	167,406
2028	83,252	67,294	11,047	161,594
2029	88,611	67,294	11,407	167,313
2030	88,864	67,294	11,735	167,893
2031	83,688	67,294	11,963	162,946
2032	72,622	67,294	12,175	152,091
2033	61,871	67,294	12,353	141,519
2034	53,795	67,294	12,614	133,703
2035	49,519	67,294	12,799	129,612
2036	53,476	77,874	12,621	143,971
2037	48,670	77,874	12,678	139,221
2038	49,290	77,874	12,939	140,103
2039	52,260	77,874	12,945	143,079
2040	47,663	77,874	12,935	138,472
2041	42,337	77,874	12,860	133,071
2042	41,472	77,874	12,867	132,213
2043	36,695	77,874	12,783	127,352
2044	33,222	77,874	12,915	124,011
2045	34,227	77,874	12,944	125,045
2046	31,738	77,874	12,891	122,503
2047	29,080	77,874	12,887	119,841
2048	34,508	77,874	12,929	125,311
2049	30,548	77,874	12,837	121,259
2050	30,678	77,874	12,832	121,384

**Table C.30 - Operational emissions at Heathrow due to energy and fuel use, 2026 – 2050 for Heathrow NWR forecast scenario (Table 2.11)**

Year	Do Minimum, tonnes CO <sub>2</sub>	Heathrow-NWR, tonnes CO <sub>2</sub>	Change from Do Minimum (%)
2026	127,417	159,063	24.84%
2027	122,971	167,406	36.14%
2028	114,541	161,594	41.08%
2029	116,846	167,313	43.19%
2030	115,194	167,893	45.75%
2031	110,465	162,946	47.51%
2032	101,257	152,091	50.20%
2033	93,316	141,519	51.66%
2034	86,625	133,703	54.35%
2035	83,376	129,612	55.45%
2036	96,788	143,971	48.75%
2037	93,433	139,221	49.01%
2038	93,434	140,103	49.95%
2039	95,533	143,079	49.77%
2040	92,677	138,472	49.41%
2041	89,369	133,071	48.90%
2042	88,643	132,213	49.15%
2043	86,041	127,352	48.01%
2044	83,123	124,011	49.19%
2045	84,040	125,045	48.79%
2046	82,324	122,503	48.80%
2047	80,410	119,841	49.04%
2048	83,797	125,311	49.54%
2049	81,452	121,259	48.87%
2050	81,330	121,384	49.25%

## Heathrow Airport Extended Northern Runway (Heathrow ENR) Carbon Impact Assessment

**Table C.44 - Carbon emissions, carbon traded: Heathrow ENR, for 2026 – 2050 (Table 3.2)**

Year	Heathrow Airport, Number of passengers	Heathrow Airport, Numbers of ATMs	Heathrow Airport, tonnes CO <sub>2</sub>	UK Aviation Total, tonnes CO <sub>2</sub>	Heathrow as % of UK Total for carbon emissions
2026	92,985,344	558,665	22,220,178	41,328,661	53.8%
2027	102,968,728	618,311	23,751,022	42,405,586	56.0%
2028	108,187,392	644,315	24,372,996	43,035,516	56.6%
2029	112,483,112	665,616	24,802,436	43,496,325	57.0%
2030	116,278,816	684,649	24,925,582	43,750,823	57.0%
2031	118,897,528	697,625	25,134,923	44,011,103	57.1%
2032	121,286,304	709,672	25,429,405	44,387,592	57.3%
2033	121,280,072	699,319	25,474,020	44,534,561	57.2%
2034	123,078,080	705,140	25,727,599	45,135,307	57.0%
2035	123,598,136	705,555	25,739,646	45,339,913	56.8%
2036	124,613,720	708,309	25,615,715	45,492,664	56.3%
2037	124,560,928	706,717	25,125,559	45,193,008	55.6%
2038	124,232,272	702,840	24,790,683	45,063,707	55.0%
2039	125,997,944	709,942	24,656,949	44,979,330	54.8%
2040	127,055,792	714,458	24,522,596	44,991,738	54.5%
2041	127,371,464	713,416	24,168,539	44,942,463	53.8%
2042	127,515,248	711,300	23,930,002	44,705,098	53.5%
2043	127,869,872	711,192	23,947,737	44,939,077	53.3%
2044	128,282,064	710,368	23,488,692	44,627,307	52.6%
2045	128,876,912	711,091	22,881,613	44,073,561	51.9%
2046	128,829,648	707,762	22,216,780	43,489,752	51.1%
2047	130,287,632	711,847	22,058,144	43,402,961	50.8%
2048	130,144,456	707,453	21,751,169	43,126,052	50.4%
2049	130,872,984	709,162	21,405,259	42,920,309	49.9%
2050	130,817,672	706,038	21,117,432	42,858,909	49.3%

**Table C.46 - Comparison of the aircraft ground movement emissions 2026 – 2050 for the Heathrow Airport Do Minimum and Heathrow ENR forecast scenarios (Table 3.5)**

Year	Do Minimum, tonnes CO <sub>2</sub>	Heathrow-ENR, tonnes CO <sub>2</sub> , ICAO-Times	Heathrow-ENR, tonnes CO <sub>2</sub> , HAL-Reported times
2026	394,853	457,587	362,687
2027	399,455	506,442	401,409
2028	396,742	527,741	418,291
2029	397,317	545,188	432,120
2030	396,617	560,777	444,476
2031	398,468	571,406	452,900
2032	396,570	581,273	460,721
2033	398,162	572,793	454,000
2034	395,183	577,561	457,779
2035	396,341	577,901	458,048
2036	397,201	580,157	459,836
2037	397,064	578,853	458,803
2038	397,425	575,677	456,286
2039	397,896	581,494	460,897
2040	399,418	585,193	463,828
2041	400,378	584,340	463,152
2042	398,805	582,606	461,778
2043	403,587	582,518	461,708
2044	398,497	581,843	461,173
2045	399,969	582,435	461,642
2046	396,263	579,709	459,481
2047	393,829	583,054	462,133
2048	388,679	579,455	459,281
2049	391,052	580,855	460,390
2050	386,723	578,296	458,362

**Table C.47 - Emissions due to surface access for 2026 – 2050 for Do Minimum and Heathrow ENR forecast scenarios (Table 3.6)**

Year	Do Minimum emissions due to surface access to Heathrow Airport, tonnes CO <sub>2</sub>	Heathrow ENR emissions due to surface access to Heathrow Airport, tonnes CO <sub>2</sub>	Change from Do Minimum (%)
2026	374,999	390,886	4.2%
2027	376,390	408,164	8.4%
2028	377,781	425,442	12.6%
2029	379,172	442,720	16.8%
2030	380,563	459,998	20.9%
2031	382,777	465,452	21.6%
2032	384,991	470,906	22.3%
2033	387,205	476,359	23.0%
2034	389,419	481,813	23.7%
2035	391,633	487,266	24.4%
2036	397,764	493,866	24.2%
2037	403,895	500,466	23.9%
2038	410,026	507,066	23.7%
2039	416,157	513,665	23.4%
2040	422,288	520,265	23.2%
2041	428,030	527,280	23.2%
2042	433,772	534,295	23.2%
2043	439,514	541,311	23.2%
2044	445,257	548,326	23.1%
2045	450,999	555,341	23.1%
2046	456,460	562,452	23.2%
2047	461,922	569,562	23.3%
2048	467,383	576,672	23.4%
2049	472,844	583,783	23.5%
2050	478,305	590,893	23.5%

**Table C.48 - The emissions due to surface access across the UK airport system, 2026 – 2050 for Do Minimum and Heathrow ENR forecast scenarios (Table 3.7)**

Year	Do Minimum emissions due to surface access to UK airports <sup>22</sup> , tonnes CO <sub>2</sub>	Emissions due to surface access to UK airports with Heathrow - ENR <sup>23</sup> , tonnes CO <sub>2</sub>	Change from Do Minimum (%)
2026	1,858,517	1,858,835	0.0%
2027	1,861,444	1,862,079	0.0%
2028	1,864,370	1,865,323	0.1%
2029	1,867,297	1,868,567	0.1%
2030	1,870,223	1,871,811	0.1%
2031	1,888,486	1,891,987	0.2%
2032	1,906,749	1,912,162	0.3%
2033	1,925,011	1,932,337	0.4%
2034	1,943,274	1,952,513	0.5%
2035	1,961,537	1,972,688	0.6%
2036	1,997,142	2,002,814	0.3%
2037	2,032,748	2,032,941	0.0%
2038	2,068,354	2,063,067	-0.3%
2039	2,103,960	2,093,194	-0.5%
2040	2,139,566	2,123,320	-0.8%
2041	2,174,324	2,152,229	-1.0%
2042	2,209,083	2,181,138	-1.3%
2043	2,243,842	2,210,046	-1.5%
2044	2,278,601	2,238,955	-1.7%
2045	2,313,360	2,267,864	-2.0%
2046	2,360,382	2,305,395	-2.3%
2047	2,407,404	2,342,925	-2.7%
2048	2,454,426	2,380,456	-3.0%
2049	2,501,447	2,417,987	-3.3%
2050	2,548,469	2,455,518	-3.6%

<sup>22</sup> The previously referenced set.

<sup>23</sup> The previously referenced set.

**Table C.50 - Emissions due to surface access at Heathrow, with 2030 modal split for 2026 – 2050 for Do Minimum and Heathrow ENR forecast scenarios (Table 3.8)**

<b>Year</b>	<b>Do Minimum emissions due to surface access to Heathrow Airport, tonnes CO<sub>2</sub></b>	<b>Heathrow-ENR emissions due to surface access to Heathrow Airport, tonnes CO<sub>2</sub></b>
2026	318,770	332,348
2027	320,960	348,117
2028	323,150	363,885
2029	325,341	379,653
2030	327,531	395,422
2031	329,858	400,650
2032	332,185	405,879
2033	334,512	411,107
2034	336,840	416,336
2035	339,167	421,564
2036	344,473	427,284
2037	349,780	433,004
2038	355,086	438,725
2039	360,393	444,445
2040	365,699	450,165
2041	370,724	456,285
2042	375,748	462,405
2043	380,772	468,526
2044	385,797	474,646
2045	390,821	480,766
2046	395,615	486,897
2047	400,409	493,028
2048	405,203	499,159
2049	409,997	505,290
2050	414,791	511,421



**Table C.51 - Carbon emissions due to airport operation energy use at Heathrow, by source 2026 – 2050 for Heathrow ENR forecast scenario (Table 3.10)**

Year	Emissions due to electricity use at Heathrow Airport, tonnes CO <sub>2</sub>	Emissions due to gas use at Heathrow Airport, tonnes CO <sub>2</sub>	Emissions due to fuel use at Heathrow Airport, tonnes CO <sub>2</sub>	Total Emissions due to airport operation at Heathrow Airport, tonnes CO <sub>2</sub>
2026	87,793	56,635	9,582	154,010
2027	89,542	61,252	10,605	161,399
2028	83,278	61,252	11,051	155,580
2029	88,689	61,252	11,417	161,357
2030	88,918	61,252	11,743	161,913
2031	83,705	61,252	11,966	156,922
2032	72,619	61,252	12,172	146,043
2033	60,832	61,252	11,995	134,078
2034	52,379	61,252	12,094	125,725
2035	47,495	61,252	12,102	120,848
2036	51,556	71,831	12,149	135,536
2037	46,539	71,831	12,121	130,492
2038	45,991	71,831	12,055	129,877
2039	49,281	71,831	12,177	133,289
2040	45,239	71,831	12,254	129,325
2041	40,385	71,831	12,236	124,453
2042	39,485	71,831	12,200	123,517
2043	35,139	71,831	12,198	119,168
2044	31,474	71,831	12,184	115,490
2045	32,476	71,831	12,196	116,503
2046	30,069	71,831	12,139	114,040
2047	27,798	71,831	12,209	111,838
2048	32,678	71,831	12,134	116,643
2049	29,141	71,831	12,163	113,136
2050	29,129	71,831	12,110	113,070

**Table C.52 - Operational emissions due to energy and fuel use at Heathrow, 2026 – 2050 for Heathrow ENR forecast scenario (Table 3.11)**

<b>Year</b>	<b>Do Minimum, tonnes CO<sub>2</sub></b>	<b>Heathrow-ENR, tonnes CO<sub>2</sub></b>	<b>Change from Do Minimum (%)</b>
2026	127,417	154,010	20.87%
2027	122,971	161,399	31.25%
2028	114,541	155,580	35.83%
2029	116,846	161,357	38.09%
2030	115,194	161,913	40.56%
2031	110,465	156,922	42.06%
2032	101,257	146,043	44.23%
2033	93,316	134,078	43.68%
2034	86,625	125,725	45.14%
2035	83,376	120,848	44.94%
2036	96,788	135,536	40.03%
2037	93,433	130,492	39.66%
2038	93,434	129,877	39.00%
2039	95,533	133,289	39.52%
2040	92,677	129,325	39.54%
2041	89,369	124,453	39.26%
2042	88,643	123,517	39.34%
2043	86,041	119,168	38.50%
2044	83,123	115,490	38.94%
2045	84,040	116,503	38.63%
2046	82,324	114,040	38.52%
2047	80,410	111,838	39.08%
2048	83,797	116,643	39.20%
2049	81,452	113,136	38.90%
2050	81,330	113,070	39.03%