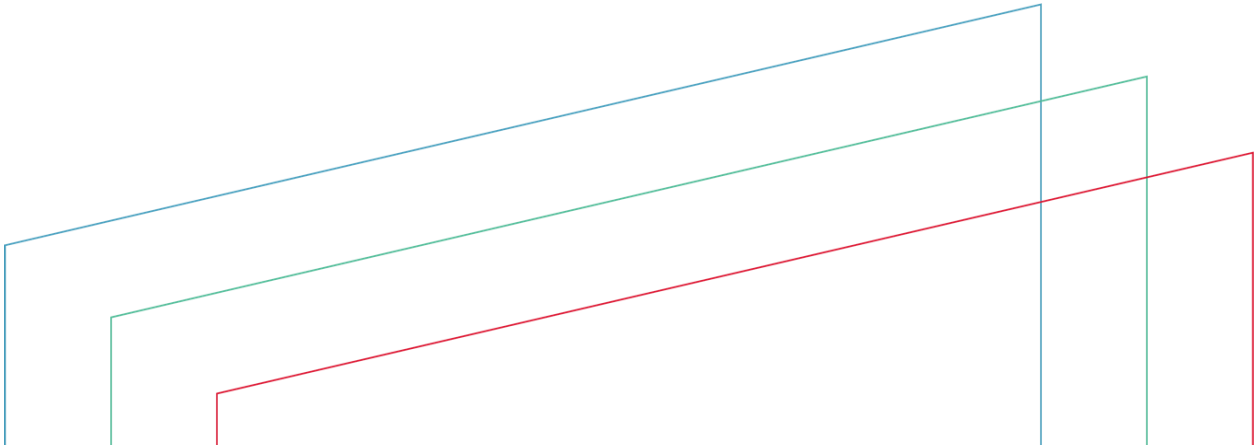
SUPPLEMENTARY ANALYSIS OF THE ECONOMIC CASE FOR THE EXPANSION OF LEEDS BRADFORD AIRPORT

Findings of independent research commissioned by the Group for Action on Leeds Bradford Airport

New Economics Foundation



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The New Economics Foundation is the UK's leading think tank promoting social, economic, and environmental justice to transform the economy so that it works for people and the planet.

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EXECUTIVE SUMMARY

NEF Consulting was commissioned by the Group for Action on Leeds Bradford Airport (GALBA) to conduct a review and supplementary analysis of the economic and monetised environmental impacts of the proposed expansion of Leeds Bradford Airport (LBA). If granted approval, the decision would likely represent the largest single driver of growth in carbon emissions in the Leeds City Region since the airport's last application, and since both the UK government and Leeds City Council have declared a climate change emergency. It is paramount, therefore, that the claimed social and economic benefits of the scheme are subjected to thorough scrutiny and that complete transparency of the assumptions underpinning projections is provided.

This document reports NEF Consulting's fourth such assessment since 2019, having previously conducted analyses on plans for Heathrow, Bristol, and Southampton airports. Common issues have arisen across all analyses, including methodological inconsistencies and the presentation of incomplete evidence. In some cases, these issues arose because the existing local planning guidance is fundamentally ill-equipped to process applications with national and international ramifications relating to transport connectivity and carbon emissions. Decision-makers must also grapple with the challenging vacuum in national policy on aviation emissions, and differences of opinion between the government and its statutory advisor, the Committee on Climate Change.

Our analysis finds that Leeds Bradford Airport Ltd (the applicant), has understated the environmental impacts of the scheme by choosing not to adequately recognise the non-CO_2 effects of airplane emissions on global warming. In doing so, they have contravened the advice of multiple statutory bodies. In addition, the applicant has not monetised the carbon emissions expected to be produced by the proposed expansion. While this is not a statutory obligation, it is best practice, and indeed standard practice for transport infrastructure proposals such as this (eg applied by the Department for Transport (DfT) on the proposed expansion of Heathrow Airport).

NEF Consulting conducted additional supplementary modelling of the impacts of the proposed scheme. Our aim was to address gaps in the applicant's submission and aggregate sufficient information to allow a decision-maker to weigh the public costs and benefits of the scheme. Our aggregated impact accounts include a gross domestic product/gross value added (GDP/GVA) accounting framework approach and a social welfare benefit-cost analysis (BCA). This analysis identified several issues of concern with the applicant's submission.

Overestimation of the number of direct jobs created by the scheme

LBA estimates that it will be able to deliver much higher job intensities into the future than achieved by other comparable airports. These projections contradict LBA's stated aims to automate processes in their airport, wider trends across the aviation industry of falling job intensities, and recent consolidation by the aviation sector through the Covid-19 crisis. LBA also projects that the enhanced and expanded airport facilities resulting from this application will increase the job intensity of the airport compared to the without-development scenario. This is extremely unlikely as a key impact of airport expansion and passenger growth is to enable efficiency savings (returns-to-scale) and implementation of job-replacing technologies. In addition, jobs created in the airport which are not linked to aviation (eg in

hospitality) are very likely to be displaced from other locations and not newly created. NEF's modelling, which considers jobs trends in the industry, suggests the applicant has over-claimed the new job creation of the scheme by approximately 33%. This over-claim is likely to have translated into an over-claim of the net direct GVA of a similar magnitude.

Inconsistent application of displacement and monetisation

Whether a scheme or development creates new value and new jobs, or simply displaces (relocates) them from one location to another is a critical factor in determining the scheme's net impact. For a decision-maker to adequately appraise an application, displacement must be applied consistently across different impact areas. Monetisation across each impact area is also useful to facilitate the comparison of different impact magnitudes and is recommended in multiple official guidance documents. The applicant has failed to implement a consistent approach (Table 1) and has strongly favoured an assumption of zero displacement (i.e. that all activity is new activity). We note that a previous review of the economic case for expansion commissioned by the council also identified this as a persistent issue running throughout the socioeconomic case.[1]

Table 1: Summary of the applicant's approach to product displacement and the monetisation of costs and benefits

Report section	Product displacement	Monetisation	Additional comments
Direct benefits	Zero displacement assumed	Monetised	Best-case displacement assumption
Indirect and induced benefits	Zero displacement assumed	Monetised	Best-case displacement assumption
Productivity benefits	Zero displacement assumed	Monetised	Best-case displacement assumption
Tourism benefits	Zero displacement assumed	Monetised	Best-case displacement assumption
Tourism costs	Total displacement assumed	Not monetised	Best-case displacement assumption (costs left out entirely)
Socioeconomic welfare benefits	Significant displacement assumed	Monetised	Precise displacement assumption not reported
Carbon costs	Zero displacement assumed	Not monetised	Worst-case displacement assumption (but not monetised)
Air quality	Zero displacement assumed	Not monetised	Worst-case displacement assumption (but not monetised)
Noise damage	Zero displacement assumed	Monetised in an appendix	Worst-case displacement assumption

As shown in Table 1, the applicant has applied zero product displacement (and hence made a best-case assumption) to all of the main scheme benefits. In direct contradiction, the applicant has effectively applied total displacement to the negative outbound tourism impacts and significant displacement to the socioeconomic welfare benefits. This decision results in a logically impossible scenario in which passengers are simultaneously newly created and displaced from another airport. While the applicant applies zero displacement to negative

impacts from carbon and air quality (a worst-case assumption), they fail to monetise these impacts, hence removing the reader's ability to compare magnitudes.

Net impact

Our first net impact account looks at macro-economic factors using a GDP/GVA approach (Table 2). This analysis, conducted across three geographies, suggests the proposed scheme has a strongly negative impact at the Leeds City Region and UK levels. At the most local scale, the net impact over the assessment period (2024–2050) is positive, primarily due to the contribution from new business productivity. However, given the falling aviation-intensity of the business economy in general, and the impact of Covid-19 (which is not included by the applicant), we regard this to be an overly optimistic assessment. If adjustments were made for this issue, the net GDP impact would likely be negative across all geographies.

Table 2: Net economic impact, adjusted (FIR and NEF calculations, inferred values are presented in italics)

		Economic footprint	Inbound tourism	Outbound tourism	Productivity	Carbon subsidy	Grand total
Leeds	**2024–2050**	*£1,584m*	*264m*	-£1,711m	*£576m*	-£102m	**£611m**
Leeds City Region	**2024–2050**	*£1,608m*	*£432m*	-£3,137m	*£960m*	-£102m	**-£239m**
UK	**2024–2050**	*£2,382m*	*£748m*	-£5,432m	*£1,280m*	-£102m	**-£1,124m**

Our second impact account looks at social welfare (Table 3). We conducted original modelling which allows the spectrum of costs and benefits to be assessed. The net social welfare impact is shown to be strongly negative. This account is dominated by the monetised cost of carbon emissions which, in the absence of a functioning carbon taxation and/or capping system, will materialise as a social cost. If the applicant provided a more reasonable product displacement estimate (eg an estimate congruent with other assumptions in their submission), this component could reduce but would still be negative. The social welfare impact would be negative even if the monetised carbon impacts were excluded entirely.

Table 3: Net social welfare impact, adjusted (Further Information Report and NEF calculations, inferred values are presented in italics)

	LBA passengers	Affected by noise, aviation limit	Affected by air quality	UK taxpayers (surface access)	Affected by climate change	Grand total
2024–2050	*+£88m*	-£16m (-£7m to -£69m)	-£19m (-£6m to -£66m)	-£70m (£0m to -£140m)	-£865m (-£432m to -£1,298m)	**-£883m (-£358 to -£1,486)**

The pandemic context

In addition to the exceptional carbon impact of the scheme, a significant economic impact of the proposed scheme is to transfer leisure spending from domestic spend to international spend via international tourism. Our best estimate suggests a net outflow from the UK economy of £5.4 billion over the appraisal period (2024–2050). It is difficult to know where this lost spending would occur, particularly as the applicant has not provided reasonable product displacement estimates. A proportion will be experienced as lost leisure spend in the Leeds City Region, resulting in a reduction in jobs in the local economy likely to far outweigh the number of jobs the scheme creates. At a time when the hospitality and leisure industry is in deep recession, this proposal is difficult to rationalise.

KEY MESSAGES

- The applicant has understated the global warming potential of the scheme and, through inconsistent and incomplete data analysis, has made public scrutiny and appraisal of its net costs and benefits more difficult.
- The proposed development is of regional and national significance and should be assessed in the wider context of UK transport and carbon emissions planning.
- The Leeds City Region boundary, used by the applicant as their maximum modelling extent, is inadequate for the proposed scheme as it obscures its net impact.
- The applicant has applied a selective and logically inconsistent approach to estimating how much of each cost and benefit will be newly created versus how much will simply be relocated from one place to another (ie displacement).
- While the applicant has claimed most of the benefits of the scheme will be newly created, the most significant cost, the increased outflow of international tourism, has not been modelled. NEF modelling suggests this impact could cost the Leeds City Region up to £3.1 billion over the 2024–2050 assessment period.
- The applicant has over-estimated the job creation potential of the scheme, ignoring recent trends in the aviation industry and their own stated ambitions to automate processes at their airport. NEF modelling suggests the likely job creation potential is at least 33% lower than the applicant's forecast.
- The new business productivity projected by the applicant is unlikely to materialise as the impact of the Covid-19 crisis has accelerated a trend away from business air travel use.
- NEF conducted additional modelling to allow significant scheme costs which were not monetised by the applicant (carbon and air quality) to be included in two forms of net impact account.
- NEF modelling suggests the net GDP/GVA impact of the scheme is likely strongly negative at the Leeds City Region (-£239 million) and UK (-£1.1 billion) levels.
- The social welfare impact of the scheme is likely to be strongly negative (-£883 million), even if the very significant social costs of carbon emissions are excluded (-£18 million).
- NEF Consulting's monetised impact estimates should be treated with caution and revised should the applicant submit realistic and logically consistent projections of displacement.

CONTENTS

INTRODUCTION

Leeds Bradford Airport Ltd (henceforth 'the applicant' or 'the airport') has submitted a planning application proposing to deliver enhanced facilities, access, and adjusted flight times, facilitating an increase in the airport's passenger throughput to 7 million passengers per annum (mppa).

Leeds Bradford Airport (LBA) currently sees around 4 million passenger departures per year. A Section 106 agreement relating to a previously approved planning application by the airport appears to suggest their current capacity is capped at 5 mppa. The same figure for maximum terminal capacity at the airport is assumed in the Department for Transport (DfT) UK Aviation Forecasts 2017.[2] However, the application under consideration treats the current maximum throughput as 5.5 mppa. The application therefore proposes to increase the annual passenger departures by 1.5 or 2 million passengers depending on which baseline figure is correct.

NEF Consulting was commissioned by the Group for Action on Leeds Bradford Airport (GALBA) to conduct a technical review and supplementary analysis of the socioeconomic and environment impacts of the proposal. This report considers the background papers provided to support the planning application, as well as relevant documentation sourced from outside the planning application, particularly official guidance from relevant statutory bodies. Our aim is to independently assess the costs and benefits of the proposed scheme. In particular, we address gaps in the applicant's assessment with regard to the net costs and benefits of the scheme to the public including, but not limited to, its gross domestic product (GDP) impact.

About us

NEF Consulting is the wholly owned consultancy subsidiary of the not-for-profit UK think tank the New Economics Foundation. NEF Consulting supports organisations across the private, public, and third sectors to put new economic thinking into practice. We have a long track record in transport infrastructure appraisal. Recent projects include acting as independent reviewer of the climate change aspects of the proposal to expand Southampton Airport (for Eastleigh Borough Council), reviewing the business case for the proposed extension to the M4 motorway (for the Future Generations Commissioner for Wales), reviewing the application to expand Bristol Airport (for CPRE), and reviewing the regional impacts of expanding Heathrow Airport (for the No Third Runway Coalition).

This assessment was conducted by Dr Alex Chapman and Marc Postle, Consultant and Associate Consultant at NEF Consulting, respectively. Alex Chapman is a specialist in policy impact analysis and evaluation. He has a PhD from the University of Southampton focused on the socioeconomic evaluation of climate change adaptation options. Marc Postle is a specialist in transport systems appraisal. He was previously economics consultant for the Future Cities Catapult, and prior to that held the same role at Jacobs. Marc conducted an economic and carbon analysis for the Airports Commission's Phase 2 report, as well as carbon footprint and emissions trading assessments for Heathrow and London City airports.

CONTEXT

The UK government has declared a climate emergency and passed into law a commitment to reach net zero greenhouse gas (GHG) emissions by 2050. While many climate researchers regard this target as inadequate if we are to prevent catastrophic climate breakdown, Net Zero 2050 nonetheless means rapid and fundamental changes to ways of life in the UK. Every sector of the UK economy must dramatically reduce its GHG emissions, and most must achieve total carbon neutrality. The UK government's statutory advisor on climate change, the UK Committee on Climate Change (UKCCC) has set out a pathway to Net Zero 2050 which also allows the UK to meet its obligations to the United Nations Paris Climate Agreement. This pathway provides the scientific rationale behind the Net Zero 2050 commitment.

The UK aviation sector occupies a fortunate position in that the UKCCC's pathway does not require it to reach total carbon neutrality. Indeed, the pathway set out allows a degree of growth in passenger departures, despite the direct link between passenger departures and emissions. The UKCCC is clear however, that growth in passenger numbers must be managed. Principally this is because decarbonisation of the UK aviation sector cannot be achieved through technological solutions alone. Progress in improving fuel efficiency has not been fast enough to offset the growth in the size of the industry. For instance, in 2018 the 58 largest global airlines achieved efficiency improvements of around 1%; in the same year the industry's growth led to an overall increase in emissions of 5.2%.[3]

The UKCCC sets out three levels of ambition for the UK aviation sector. Under its least ambitious pathway sector, growth must be limited to a 60% increase over 2005 levels. Its higher ambition options involve limiting growth to 20% or 40% above 2005 levels.[4] In 2019, departures were already 30% higher than 2005 levels. Critically however, if all planned airport expansions go ahead, capacity in the UK airports system would allow passenger departures to rise 90% above 2005 levels.[5] In other words, if all planned expansions go ahead, the UK would face a choice of holding significant under-utilised airport capacity (potentially leading to stranded assets), or driving emissions incompatible with its commitment to the Paris Climate Agreement.

To date, the UK government has largely left Britain's devolved and local authorities to deal with airport capacity expansion proposals outside of the London Airport System. This is despite the issue being a 'system problem' with implications on national and international connectivity, laws, agreements, and security. To illustrate this point, it is useful to note that airport expansion applications are currently under consideration by the relevant authorities at Bristol Airport and Southampton Airport. These applications, along with Leeds Bradford Airport (LBA), all make the claim that their resulting additional GHG emissions are insignificant in size compared to the overall sector budget. In aggregate however, they are not. The number of passenger departures from non-London airports has risen significantly over the past two decades (Figure 1).

Figure 1: Passenger departure numbers from the 10 largest airports outside the London system

The planning guidelines are poorly equipped to support local authorities in effectively managing applications of this nature, yet the stakes are extremely high. In the absence of a clear decarbonisation pathway for aviation at national level, planning authorities can only assume that all proposed growth associated with any airport capacity expansion will ultimately materialise (ie assuming a worst-case scenario regarding environmental impacts). It is critical that decision-makers have access to a comprehensive, transparent, quality-assured bank of information with which to assess such proposals.

ECONOMIC IMPACTS

The primary socio-economic case for the expansion of Leeds Bradford Airport (LBA) put forward to decision-makers is described in Chapter 11 (Socio-economics) of the Environmental Statement,[6] as well as the accompanying Appendix 11.1 Economic Impact Report.[7] These documents present three major components of analysis.

- **Economic footprint**: an analysis of employment and value added, looking at LBA's direct employment, the supply chain effect, and induced spending (ie spending that occurs as a result of higher wages).
- **Wider economic benefits**: includes an analysis of employment and gross value added (GVA) as a result of potential productivity gains that occur as a consequence of business travel or freight movement, and an analysis of the relationship between passenger numbers and inbound tourists.
- **Socio-economic welfare benefits**: a passenger-focussed assessment that presents the output of travel models, with monetised impacts on travel time, non-time travel cost, and potential air-fare changes.

Throughout the analysis, the report uses three key study areas, corresponding to the immediate area of the airport, the Leeds Local Authority, and the wider Leeds City Region. As aviation is often considered to be a national-level infrastructure, it may have been useful to have incorporated a national-level study area. The decision not to conduct a national or regional impact assessment is justified by the applicant on the grounds that the majority (77%) of passengers departing from the airport live in or originate from the Leeds City Region. In addition, 90% of airport staff reside within the study area. Choosing to exclude national and regional impact assessments significantly affects the analysis in terms of displacement and the additionality of costs and benefits.

The Environment Statement approaches LBA's expansion through the lens of a regional intervention – targeted at the Leeds City Region. When assessed, these types of intervention should be appraised for:

- Leakage – effects outside of the target area.
- Displacement and diversion – where increases are offset by reductions elsewhere.
- Substitution – consumers or firms substituting one activity for another to take advantage of government aid.
- Deadweight – what would have happened regardless.

By conducting a baseline assessment and projecting forward, LBA has presented the deadweight level to which the scheme can be compared.

Substitution is not likely to be a relevant effect for this scheme.

By choosing the study area based on capturing the majority of staff origins, the assessment is able to claim leakage levels at or below 10%.

The baseline data, particularly the statement that 77% of passengers at LBA are from the Leeds City Region study area, is presented to imply that displacement will be a minor issue – indeed, the final choice to apply a factor reduction of 25% to the results corresponds with

this proportion of passengers. The applicant's approach to product displacement, however, is highly contestable.

Displacement

A critical issue to understand when reviewing any business case is that of displacement. Displacement is particularly significant where transport infrastructure is concerned and many issues relating to displacement and the additionality of claimed benefits arise in this report. Any business case making claims to scheme benefits must demonstrate how and why they believe that these benefits will be truly additional as opposed to just involving the relocation of a good or service from one place to another. A scheme's 'true' impact is its net impact after displacement of both costs and benefits is considered; this extends to the non-economic factors as well.

A worst-case approach to displacement in each topic would mean assuming no displacement of negative impacts and total displacement of positive impacts. This approach is likely too pessimistic, so determining an appropriate level of displacement is essential to claim benefits. In fact, Department for Transport (DfT) guidance on assessing non-transformative transportation schemes suggests that a scheme promoter should present credible evidence to claim anything other than 100% displacement at the appropriate geographical assessment area.

Transport Analysis Guidance (TAG), states:[8]

> When estimating the complete extent of additionality, scheme promoters should consider a large enough geographical area to capture fully the behavioural responses of households and firms at the national level. With respect to supply-side effects of non-transport factors of production, the default assumption is 100% displacement; this applies for all types of economic modelling. The onus is on the scheme promoter to present credible evidence that the particular transport investment will affect a non-transport factor of production. If the scheme promoter is unable to present credible evidence of additionality, the particular economic impacts will be considered displaced from elsewhere. (TAG: p.4)

The assessment splits displacement into two component parts for consideration. It describes these as **product displacement** and **factor displacement**.

Product displacement

Here the applicant is presumably referring to **product market displacement**. This is where the proposed scheme results in taking market share away from other firms or organisations within the study area.

Chapter 11 of the Environment Statement states:

> 11.3.28 In relation to product displacement, there are no other airports in either Leeds or the Leeds City Region with the potential to offer significant commercial air services. As a consequence, we have not assumed any displacement of economic activity relating to product displacement. (p.7)

In other words, the applicant has applied zero (0%) product displacement and assumed that all the transportation provided by the scheme will be newly provided or additional. While it is correct that there are no other airports offering comparable services within either Leeds or the Leeds City Region, this is more reflective of the decision on where to draw the study area than it is on people's market choices within that study area. A review of travel data shows that use of Manchester Airport, among others, is significant in the travel preferences of people in the Leeds City Region. Drawing a geographical boundary which excludes Manchester Airport means that impacts and dynamics relating to LBA's main business competitor are missing from the assessment. The appendix to Chapter 11 of the Environment Statement states:

> 2.33. The majority of the airport's demand is from within the Leeds City Region itself, but its market penetration for international routes is relatively weak, with Manchester Airport currently fulfilling the majority of the Leeds City Region's demand for international travel. (Appendix 11.1: p.14)

The case for widening the study area to appropriately assess product market displacement is substantial. Further, the report contains a serious inconsistency: the proposal that some travellers will substitute a departure from another airport for a departure from LBA fundamentally underpins the social welfare benefits presented later in the report. This premise is fundamentally incompatible with the level of product displacement assumed elsewhere in the assessment (0%).

Even if the study area is taken as presented, the report takes a very limited view of what the product being sold is – in many cases a consumer is not shopping for a flight from Leeds but rather transport to their preferred destination. Consumers will almost always have multiple travel route and mode options to reach their chosen destination.

This is particularly significant for business passengers, where more than half are travelling domestically. In 2017, 4.8% of passengers at LBA were UK residents on business, of which 2.7% were travelling domestically and 2.1% internationally.[9] Business passengers, as we will see, are critical to the productivity case made in the report. For these passengers, particularly those who do not have any further onward travel, there is product market displacement from both rail travel and private vehicle usage. These travel modes are, of course, not exact substitutes for a flight from LBA – an individual journey taker decides between them based on their merits and with respect towards their personal preferences and time-costs.

Notably, 50% of business travellers from LBA to Heathrow have no onward travel. When it comes to travel time, for business passengers heading to Heathrow Airport, either to connect or with London as their actual destination, we see that other modes are highly comparable (Table 4).

Table 4: Travel times to central London

	Car travel	Rail travel	Air travel
Central Leeds to central London	3.5 hours	3 hours to central London station	3 hours to central London station
	Dependant on traffic	Subject to reliable services	Including connection from airport

The likelihood that passengers will shift between travel modes is a key consideration when it comes to product market displacement, particularly for any claimed 'new' passengers. This kind of shifting has been investigated and is referred to as the diversion factors of particular modes.

- **Diversion factors** are used to determine the source and extent of new traffic resulting from an investment. They can also help understand how a policy intervention in one mode can result in traffic moving away from that mode. Unfortunately, evidence is limited on the diversion factors of air travel; indeed, for certain categories of journey the diversion is far less likely. Nonetheless, research in this area[10] has found that for 'new' business travellers, typically only 10% are not actually diverting from another method of travel.

Factor displacement

Factor displacement is the diversion of labour, land, or capital from other productive usage. It is recognised in the report that factor displacement is typically a concern where government crowding out can occur. At the Leeds City Region level, factor displacement from permitting this development is likely very low and the proposed levels for factor displacement are considered conservative. Factor displacement is typically most strongly associated with situations where the decisions of a government, regulatory, or other authority can significantly adjust the status quo of the relevant market. The factors used are likely reasonable for the scale and location of the scheme, though they only represent a fraction of the total likely displacement.

Construction and operations

The construction impacts of the scheme are calculated according to best practice. The costs are converted into employment; they are then multiplied to determine the knock-on effect of the spending. This approach uses adjusted input-output tables, looking at the industry-to-industry flows of spending, and allowing for a derivation of indirect jobs as a result of that spending.

This additionality assessment factored in leakage (benefits flowing to outside of the study area) through an assessment of localised labour market sources. It included an assessment of product displacement (construction workers and resources switching to work on the scheme) and factor displacement (other workers and resources switching into the construction industry).

Direct jobs

At the core of the applicant's submission are projections on direct job creation. LBA states that it expects the development to create 160 (gross) new jobs in 2024 and 1,180 (gross) in 2030 in the Leeds City Region. These figures fall to an additional 120 in 2024 and 890 in 2030 when taken as a net figure after displacement of jobs within the region (Table 5). It is on these numbers that the full analysis of induced and indirect impacts rest.

Table 5: Job numbers projected in the original LBA application documents

	2019	2024	2030
Without development	2,770	3,200	3,250
With development		3,360	4,430
Change		160	1,180

Employment in the aviation sector is in flux. Over the past decade the employment intensity of the sector (ie the number of jobs per passenger) has been falling consistently over time (Figure 2) as the sector utilises automation and other efficiency-improving measures to reduce employment costs. Indeed, the job intensity of the sector fell by around 2.6% per year between 2001 and 2018.[11] In addition, as has been widely reported in the press, airlines and airports have been making significant redundancies and pay cuts throughout the Covid-19 crisis.

As an airport increases in size, its employment intensity will generally fall as it is able to make efficiency savings on a per-passenger basis. In 2019, LBA provided 693 jobs per million passengers. However, the job intensity at LBA appears to be unusually high. In comparison, Southampton Airport, with just under half the number of passengers, maintains a job intensity of around 533 jobs per million passengers. Liverpool Airport provides around 505 jobs per million passengers. The aviation sector at-large, provided around 454 jobs per million passengers in 2018 (although this figure is not directly comparable because airports also host jobs in sectors such as retail).

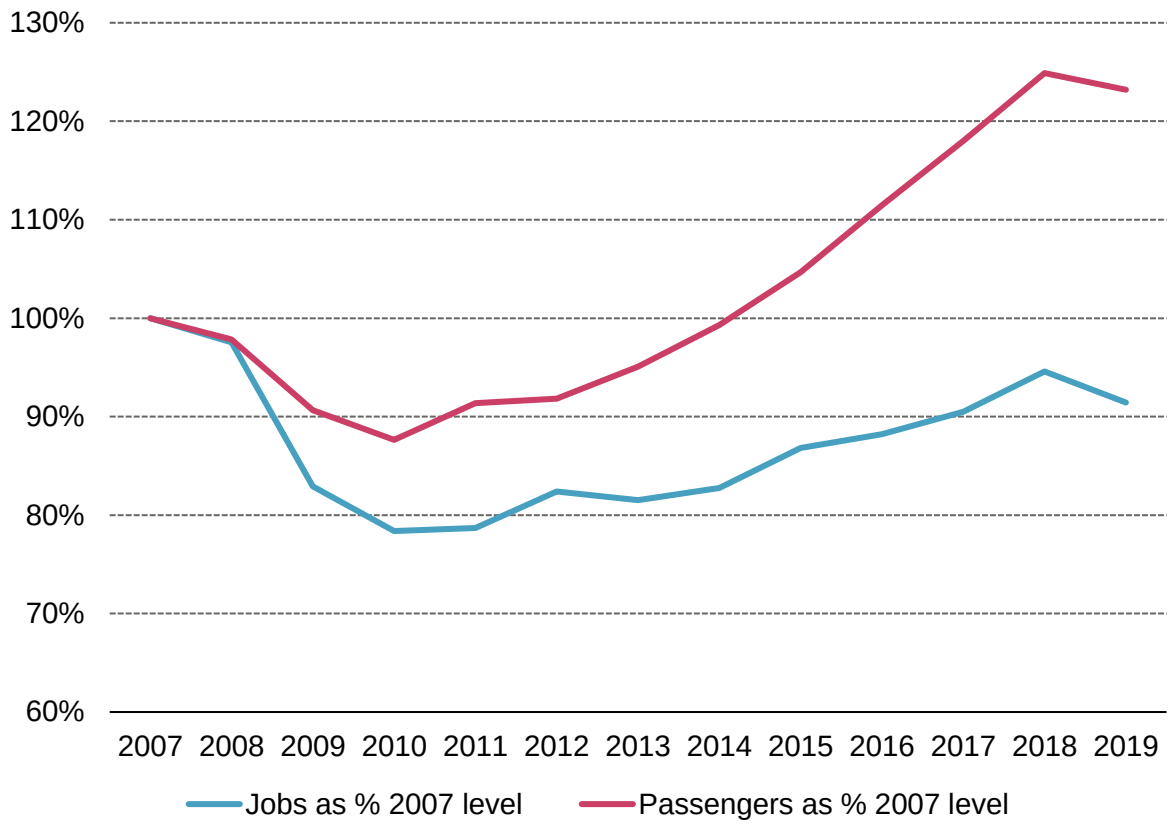

Figure 2: National aviation sector jobs and passengers as a percentage of 2007 levels

To investigate the applicant's claims in greater detail, we conducted our own jobs modelling based on the forecast rise in passenger numbers. We note two key inconsistencies in the applicant's modelling. First, their job intensities in 2030 remain very high, much higher than airports of a similar size. Bristol Airport, which is just over double the size of LBA by passenger numbers, only provided 433 jobs per million passengers in 2018. LBA claims it will provide around 600 jobs per million passengers in 2030 when it reaches a size comparable with Bristol. It does not seem credible that LBA could maintain such a high job intensity, given both the recent trends in the sector and the likely impacts of growth. Indeed, LBA stated an intention to automate processes at the airport in its 2017 Masterplan:

> Through the installation of boarding card readers, automated check-in, and accommodation to facilitate newer aircraft models, we can provide improved facilities and services to new passenger markets.

The second issue is that the applicant appears to forecast an increase in the job intensity of the airport (ie more jobs per passenger) with the expansion of the airport in 2030 (Table 6). This does not seem credible as a key feature of airport infrastructure enhancement is to improve efficiencies and enable greater returns-to-scale. As such, job intensities rising by 7% seems unlikely. It is possible that this increase reflects the applicant's ambition to increase the non-aviation business functions at LBA (eg hospitality). If indeed this is the driver of the proposed job growth (although it is not clear in the applicant's submission), it is likely that these jobs would be subject to almost total (100%) displacement and would not be additional at the Leeds City Region level. We note that the two issues discussed above appear not to have been considered in an earlier review of the socioeconomic impacts of the expansion commissioned by the council.[1]

NEF modelling utilising data on recent job trends estimates the likely job intensity at LBA would be 18% lower in 2030 than forecast by the applicant (Table 6).

Table 6: Jobs per million passengers

		2019	2024	2030
Implied by LBA application	**Without development**	693	653	591
	With development	N/A	646	633
	Change	N/A	-7	42
NEF modelling based on recent sector trends	**With development**	693	608	521
Change against LBA application with development scenario		N/A	-6%	-18%

Using NEF's estimate of the job intensity of the sector in 2030, we can calculate an alternate job creation forecast. Our estimate suggests the with-development scenario would produce 781 jobs in the Leeds City Region (gross), and around 589 jobs (net) in 2030. These figures are around one-third (33%) less than the applicant's projections (Table 7). These figures remain optimistic, however, as they still rely on the applicant's forecasts of passenger demand growth. With international aviation in turmoil, and industry bodies not expecting a return to pre-crisis level for some years, the likelihood of these passenger departure growth figures being met seems low.

Table 7: Expected job numbers based on NEF modelling of job intensities

	2019	2024	2030
Without development	2,770	2,981	2,865
With development	N/A	3,164	3,646
Change (gross)	N/A	183	781
Change after displacement (net)	N/A	138	589

According to the methodology presented, the assessment of direct and indirect GVA and indirect jobs are based on the applicant's direct jobs figures. If LBA's direct employment is over-estimated by 33%, then this 33% shortfall will likely flow through to the GVA numbers. The precise figures would depend on what type of jobs are susceptible to automation, and their relative values in LBA's multiplier tables.

Business productivity

LBA calculates the boost to productivity in the economy associated with travel that is solely reliant on Leeds Bradford Airport. It is not clear how this proportion is reached and to what extent it has accounted for non-aviation diversion among business passengers. This undisclosed number of passengers/freight flights is factored through an econometric relationship developed by Oxford Economics,[12] which has been used to look at how changes in connectivity, as measured by changes in business passenger spending and numbers

would feed through to changes in overall economic productivity.[13] The presumption is that this subset of business passengers who would not fly if LBA did not exist can be viewed, and used in a model, as a proxy for additional connectivity in the region.

A critique of this approach, especially for determining the economic footprint of a scheme, is that it infers a relationship between the impact that higher spending and passenger numbers across the economy as a whole may have on total factor productivity (the Oxford Economics relationship) with the impact of, by definition, marginal travellers on a geographically limited-in-scope economy (the LBA calculation).

In terms of the future productivity improvement, the Oxford Economic relationship can be broadly characterized as a 10% increase in business travel leading to a 0.5 % improvement in gross domestic product (GDP) in the UK. However, the actual ratio in a given application is sensitive to the makeup of local industries and the assumed future GDP level, as the connectivity factor is based on the aviation-intensity of the economy. It is unclear the extent to which this has been considered in the assessment. There are several reasons why this is important, but in particular, the recent events surrounding Covid-19 have almost certainly driven a decline in the aviation-intensity of the business economy, as businesses have adopted new methods of telecommunication.

Another consideration which must be made in the current context, is that the counterfactual to air travel, which in many cases will relate to the use of Internet-based communication systems, has changed. Recent months have transformed the business productivity achievable via long-distance communication, and as such the marginal improvement gained via international air travel will likely have diminished.

Overall, when it comes to business productivity, the approach used by LBA obscures more than it reveals. A reader of the application is left not knowing what proportion of business travellers is additional, what connectivity GDP co-efficient derived through the Oxford Economics method is actually used, and how the disconnect between the impact of marginal passengers and average passengers is accounted for. This is further confounded when a second displacement factor is applied to the results, which has the confusing implication that even those passengers who would not otherwise have flown are partially displaced from elsewhere.

Tourism

LBA presents the baseline and potential ‘with scheme’ tourism impact. In both cases, this is described as the totality of inbound passengers coming to the City Region through Leeds Bradford Airport, multiplied by average spend per trip. This is then uplifted through multiplier effects specified for the region’s tourism economy and, at the final stage, a displacement factor is applied: 10% for Leeds and 25% for the Leeds City Region.

On a passenger basis, outbound tourism is a welfare improvement for the individual passengers; otherwise they would not be making the trip. However, when making an argument about regional GDP/GVA, it should be recognised that outbound tourism represents a flow of spending out of the study area, with negative knock-on effects on GDP. Appendix 11.1 of the Environment Statement notes that outbound tourists are “sometimes viewed as a negative in terms of economic impact”. No attempt is made to quantify that

impact. This issue appears not to have been considered in an earlier independent review of the socioeconomic impacts of the scheme commissioned by the council.[1]

We do so here by inverting the described positive tourism effect: taking all those who exit the Leeds City Region via LBA and multiplying by the average spend per trip. The background, as presented in the Appendix, shows that the current passenger mix is 71.5% UK-resident leisure travellers, so either departing or returning tourists. This mix is not presumed to alter drastically among the new passengers enabled by the scheme.

Combining the outbound passenger numbers with country-specific trip spends,[14] we can determine the total outbound spend. This is then factored down to the Leeds and Leeds City Region levels. This is presented for both the demand schedule in Chapter 11 of the Environment Statement (Table 8) as well as that described in the Further Information Report (FIR; Table 9).[15]

Table 8: NEF modelling of outbound tourism GDP/GVA 'loss' under the with-development scenario, with dates per the original assessment, before applying displacement

2020 £, net present value, to nearest £100k	2024	2030	2050	Cumulative 2024–2050
Leeds	-£18,700,000	-£91,900,000	-£86,700,000	-£2,202,600,000
Leeds City Region	-£41,200,000	-£202,300,000	-£190,700,000	-£4,845,600,000
UK Residents	-£53,500,000	-£262,700,000	-£247,700,000	-£6,293,000,000

Table 9: NEF modelling of outbound tourism GDP/GVA 'loss' under the with-development scenario, with FIR dates, before applying displacement

2020 £, net present value, to nearest £100k	2026	2032	2050	Cumulative 2024–2050
Leeds	-£10,900,000	-£87,800,000	-£86,700,000	-£1,901,400,000
Leeds City Region	-£23,900,000	-£193,300,000	-£190,700,000	-£4,183,000,000
UK residents	-£31,000,000	-£251,000,000	-£247,700,000	-£5,432,400,000

These represent the increase to the outbound tourism economic footprint of the scheme and should be contrasted with the total impact numbers for inbound tourism. They have not been factored through any multiplier, as no judgement has been taken on how this money might otherwise have been spent. To align them with LBA's inbound tourism value, displacement factors of 10% at the Leeds level and 25% at the Leeds City Region level have been applied.

Broader socio-economic welfare effects for passengers

LBA presents a set of impacts under the heading of welfare effects for passengers. Looking at this is useful as it provides valuable context on how the scheme will improve the passenger experience. However, the numbers derived are based on a subset of passengers who are presumed to switch from other airports. Not only does looking at alternative airports

undermine some of the conclusions, as that is only part of the story (see discussion of Diversion Factors above), it also implies that LBA is well aware of the level of airport switching that will occur, and has not used this figure elsewhere where it might reduce their positive economic impacts. We recommend that LBA clearly states the proportions of travellers that they believe will switch from other airports, and what proportions they view as truly additional. These assumptions could be used directly as product market displacement factors.

The assessment period for this effect is referred to as “the next 20 years”. This is presumably the 2020–2040 period, though it is possible that it refers to the period 2024–2044. Choosing to use a modelled period which is different to that used in any other part of the evidence base is unhelpful to the reader, impairing their ability to make comparisons.

The welfare effect is derived through a process where the cost associated with using LBA is compared to the next best airport option available for the relevant passenger; based on the background information this will most likely be Manchester Airport. The changes in travel time and travel cost are used to derive the bulk of the welfare change. To this, changes in fare costs are aggregated.

There are several issues with this approach.

- The data presented for business traveller connections suggests that some travellers may be seeking to connect elsewhere – in these cases, the ‘next best’ airport through an insufficiently specified travel-cost model may in fact be inferior to directly travelling to the connecting airport.
- The assessment looks at LBA as a destination, interchangeable with another airport. This, however, clouds the fact that doing so makes this is a partial journey approach – a passenger is not deciding on their travel cost to ‘an airport’ but rather the whole journey to their desired destination. A fully specified travel-cost model would incorporate airfare prices and changes in flight times into the assessment of passenger choices, rather than using the airfare price change as an add-on after calculating the travel behaviour change.
- Generally, it should be noted that the bulk of this social welfare is derived from time changes, and so is highly sensitive to assumptions and changes to the value-of-time.
- Fare changes are partially symmetric – the saving made by a passenger is potentially offset by a surplus lost to an airline when conducting analysis on a system scale. It should also be noted that the assessment of the fare saving for those who have switched airports also represents a transfer of the full-fare price between airports, and therefore UK regions. This is substantial displacement of value, once again contradicting the decision to apply product displacement of zero (0%) in other sections of the assessment.

Surface access costs

The scale of the changes sought in the LBA application is such that consideration has had to be made for how up to 2 million additional passengers per year will access the airport without creating substantial negative effects for local road users and other travellers. While assessing the accuracy of this investigation is beyond the scope of this report, what it does

is raise the issue of the responsibility for the costs incurred locally and nationally when providing for access to the airport.

The current proposal by LBA is to create a £4 million sustainable travel fund; this is understood to operate concurrently with the extant Section 106 support commitments. The extant commitments are as follows:

- £228,000 p.a. towards improved bus services until a level of 10% of passengers travel by public transport is achieved and maintained.
- £1,050,000 to junction improvements.
- Up to £70,000 p.a. travel plan fund for employees and non-airport employees.
- £33,750 surveys and monitoring.
- Land for a tram/train link.

If these two proposals were accepted, we can presume that the Section 106 support package would be of an approximate value of £5 million, plus the ongoing support where its ending is conditional on meeting transportation targets.

This level of support should be contrasted with the indirect support that the airport receives from transportation infrastructure schemes. While these local projects should each be beneficial, as public transport projects should stand on their own business cases, it should be acknowledged that when determining the benefits of transport infrastructure schemes the calculations may rely in part or in full on current airport traffic and the additional traffic that LBA expects.

While the exact details of local transport schemes are still in development, along with the level to which LBA is a beneficiary of each scheme's positive impacts, it has been estimated that a rail and road connectivity package would cost approximately £70 million.[16] Given that the delivery of the Parkway Station is considered to be something that LBA is "reliant upon if it is to grow sustainably to 7 mppa",[17] we think it appropriate to consider this cost alongside the other costs of LBA's proposed expansion.

Due to the considerable uncertainty both in cost, attribution, and funding source, we have used £70 million as a central estimate, with a low estimate of £0, which represents either independently beneficial transport projects or full support by LBA, and a high estimate of £140 million, which represents the cost of a reversion to earlier strategies involving substantial highways infrastructure.

ENVIRONMENTAL IMPACTS

It is recognised that provision of aviation services should balance the public's demand for travel against both local and national environmental goals. A full understanding of the societal and environmental benefits and costs will allow consumers, Leeds Bradford Airport (LBA), and key decision-makers, such as Leeds City Council, to make decisions that maximise benefits and minimise costs.

While costing environmental impacts is not currently required in the production on an Environmental Statement, it is typically considered best practice for several topic areas. It can provide valuable evidence when deciding whether an application sufficiently serves the public good or, at the very least, minimises its negative impact of the public. Further, costs can be used to determine appropriate levels of spending on mitigation or contributions towards social welfare when mitigation is not possible.

LBA's Environmental Statement only provides these values for noise damage costs (in an appendix). By not including air quality and carbon costs, the applicant essentially ignores material impacts. As stated in the *Green Book: Central Government Guidance on Appraisal and Evaluation*:[18]

> When there is no market price for costs and benefits to society they need to be estimated and are known as shadow prices. This is particularly important for environmental, social and health effects (p.40).

We conducted supplementary modelling to monetise the remaining environmental impacts and provide a more complete view of these costs. In doing so we took the underlying emissions and noise modelling by the applicant at face value. However, we are aware that these predictions may be open to challenge on various grounds, particularly in respect of the assumed fleet-mix. Others have pointed out that the without-development scenario is based on a contested interpretation of the aircraft allowed to operate at LBA under the current planning conditions and the with-development scenario is based on the controversial assumption that the development would accelerate fleet renewal. Alternative interpretations would increase the predicted increment in noise and emissions due to the development and thus add to the costs of the development

Air quality

The health impacts of worsening air quality are widely known, and elucidated within Chapter 13 Human Health.[19] Several methods exist to monetise this effect, in order to allow it to be considered alongside the benefits of a scheme or to set the potential level of mitigation required for the impact. Appendix 9 Air Quality[20] states in the explanation of best practice that the best practice guidance "offers a widely used approach for quantifying costs associated with pollutant emissions from transport", referring to damage cost assessment. In addition, when impacts are expected to be large, or where the information is already readily available, another approach, known as Impact Pathway Analysis, exists which is a more refined, bottom-up, approach. Neither of these approaches has been used in the application. We encourage the Council to request these, seeing as their provision is described by LBA as best practice and allows for a benchmark against which sustainability measures and S106 contributions can be contrasted.

In the absence of these results, we have chosen to estimate the possible damage costs. The information required to do so is not directly presented in Chapter 9[21] or Appendix 9. However, working backwards from the carbon emissions presented in Chapter 7[22] for operational vehicle usage, it is possible to estimate the magnitude of fuel that is predicted to be used by various emission sources. Using the activity costs provided by UK government we then calculate the air quality impact in each year, under the baseline and the proposal.

The impact of aviation emissions is likely to be over-estimated when using a damage-cost approach because a large quantity of the emissions at ground-level occur on the runway, associated with take-off and landing, as well as high levels of emissions at terminal aprons. Except for working staff, these areas are not populated at the assumed densities implicit in the damage-cost approach. Further, emissions from cruise are highly dispersed and dependent on the course taken by the planes. Despite this, we have included these monetised impacts as indicative values.

While the Further Information Report (FIR) concludes no substantial difference from the delay in growth of flights at LBA, it does impact the calculated outputs due to the higher willingness to pay for health over time and the projected discount rates. Estimates based on both the original assessment and the FIR are presented here (Table 10).

Table 10: Air quality damage costs

2020 £, net present value, to nearest £100k	Additional emissions, excluding aviation	Additional emissions, including aviation, Central	Additional emissions, including aviation, low	Additional emissions, including aviation, high
Original assessment	£4,600,000	£29,700,000	£7,200,000	£98,400,000
FIR	£3,000,000	£19,100,000	£5,700,000	£65,600,000

Noise

The damage costs for noise are presented by LBA in Appendix 10, Part 2, pages 99–100.[23] Presenting a screenshot of the output sheet of the WebTAG noise calculation tool, it is difficult to infer additional details for the costs presented. In this case, the appraisal period is not specified by the applicant. Elsewhere in the Environmental Statement, LBA uses the period of 2024–2050, while the WebTAG default is 60 years. Indeed, national grade infrastructure such as airports can sometimes require assessment over even longer timeframes. It has also been suggested that the appraisal only covers the period 2024–2030.[24] It is unlikely that the applicant has made this error, but given the absence of evidence to the alternative, it should be considered. Table 11 presents net present value estimates over the appraisal period (2024–2050) using different assumptions regarding the model period used by the applicant.

Table 11: Noise damage costs, range of values

2020 £, net present value, to nearest £100k	LBA calculation: 'project sky' damage costs	26 years estimate, assuming 60 years were modelled	26 years estimate, assuming 6 years were modelled
Total damage costs	£67,300,000	£29,100,000	£291,500,000
Damage costs, excluding below 51 dB (aviation sensitivity)	£15,900,000	£6,900,000	£69,000,000

For comparison, the noise damage cost of the major increase in flights proposed by the Heathrow Third Runway [over 100,000 air traffic movements (ATMs) per year] over the period 2024–2084 was approximately £600 million for the 51 decibel (dB) threshold limited values.[25] LBA is looking at approximately 10,000 additional ATMs per year. While the values are highly sensitive to the specific circumstances, modelling, and flight paths (as well as noise impact being non-linear), if the Heathrow costs were scaled down on a per-ATM basis to the same period we would see an approximate £30 million cost for 10,000 flights per annum, counting only damage costs above the threshold of 51 dB.

These results give us a potential range for the 2024–2050 period. Because of how the data are presented, adjusting to account for the FIR was not deemed reasonable; if the pattern seen for air quality costs is repeated, the values could be lower by up to a third.

Carbon

The construction and operational atmospheric carbon dioxide equivalent emissions (CO_2e or carbon emissions) are presented in Chapter 7 (Climate Change) of the Environment Statement. The methodologies applied to calculate the components of the total emissions resulting from the scheme appear broadly in line with national transport appraisal guidance.[26] Further, the chapter takes the view that the emissions are totally additional, presenting an absolute worst case. However, LBA has made some key choices in representing the outputs that need to be considered.

Non-CO_2 effects

LBA was directly requested by Leeds City Council to consider the impact of non-CO_2 effects, which are in the context of aviation also sometimes called radiative forcing. It declined to do so on the grounds that:

> the advice of the Committee on Climate Change (CCC) is therefore not to account for the radiative effects of non-CO_2 emissions at altitude until there is improved scientific evidence. (ES, Chapter 7, p.7)

Reviewing the referenced CCC report,[27] we find that the actual comment given is as follows:

> […] non-CO_2 effects from aviation warm the climate and approximately double the warming effect from past and present aviation CO_2 emissions.

The UK Committee on Climate Change (UKCCC) also observes that:

> […] these non-CO_2 effects are not, at the moment included in national or international emissions inventories (Box 6.1. Non-CO_2 effects from aviation and shipping).[28]

The message is very different from what LBA describes – rather than advice not to include non-CO_2 effects, the UKCCC simply states the fact that these are not, currently, part of emissions inventories but that they are acknowledged to have a substantial global warming potential.

LBA goes on to say that it follows the advice from the DfT on this matter. However, once again, reviewing the referenced document reveals that the figures calculated in the forecasts are CO_2 only, due to the fuel-use validated methodology, and that:

> […] once the non-CO_2 climate effects of aviation are taken into account, aviation's overall climate effects could be up to double the climate effect of its CO_2 emissions alone (Box: Non-CO_2 climate effects).[29]

LBA then quotes Aviation 2050, where the government proposes "to keep non CO_2 emissions under review and reassess the UK's policy position as more evidence becomes available".[30] It is important to note that this is in the context of forming mitigation policies, as non-CO_2 aviation emissions can have complex trade-offs when adjusting aircraft operation or design (though no non-CO_2 trade-offs when it comes to more flights or fewer). On this issue, the report that informs Aviation 2050 has proposed that the non-CO_2 effects over a 100-year time horizon might be 1.1 Global Temperature-change Potential (GTP) and about 2 Global Warming Potential (GWP).[31]

Finally, LBA states that its calculations are compliant with government emissions factors for aviation fuel, implying that these factors do not include radiative forcing. However, a review of the associated methodology paper shows that while the complexities of incorporating radiative forcing should be acknowledged, there is more benefit considering this impact as "it is clear that aviation imposes other effects on the climate which are greater than that implied from simply considering its CO_2 emissions alone".[32] They recommend the application of a 1.9 multiplier to the CO_2 proportion of emissions in order to account for these. When accounting for trade-offs between aviation and other forms of travel (or not traveling) this can be appropriate, even though the multiplier approach cannot help in determining trade-offs in the development of future aircraft.

This is summarised in the Conversion Factors worksheet as follows:

> Organisations should include the influence of radiative forcing RF in air travel emissions to capture the maximum climate impact of their travel habits (Worksheet: Business travel- air).[33]

We have therefore included both the impact of radiative forcing in our calculations of monetised carbon emissions. These are presented alongside the quantities given in Chapter 7 and those inferred from the FIR. For information, we also provide the total monetised carbon emissions inclusive of inbound flights as well as outbound. While responsibility for inbound CO_2 emissions is usually delegated elsewhere (eg at the point of departure), the expansion of LBA may still incentivise creation or relocation of new inbound flights.

Carbon costs – the monetisation of emissions

When it comes to the monetisation of carbon emissions, there is not the same direct impact pathway to the harm an individual suffers as there is with noise and air quality. The social and financial costs of carbon emissions are experienced at the societal level. However, given the UK's commitments to reduce our overall emissions, where a carbon tax, or similar mechanism, is not in place it should be considered that each additional tonne of CO_2 emitted

by a project represents a subsidy supplied by the public to the emitter. Beyond this, the aviation sector has attributes that mean that the subsidy is more than just theoretical – it is in actuality a cost borne by the UK government. The UK is legally committed to achieve net-zero greenhouse gas (GHG) emissions by 2050 and has signed up to the Paris Climate Agreement. Further to this national commitment, Leeds City Council declared a climate emergency as of March 2019.

Given this, emissions in both local and national contexts that are additional to the target decarbonisation pathway will necessarily require actions to offset, or reduce, emissions elsewhere at a more rapid pace and to a larger degree.

UK Aviation currently participates in both the European Union Emission Trading System (EU ETS) and the International Civil Aviation Organisation's Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA). The application notes that most traffic through Leeds Airport is, and is expected to remain, to European destinations. The UK has committed to enacting a cap-and-trade Emission Trading Scheme, or a carbon tax, that is at least as ambitious as the EU ETS.[34] Assuming that the UK ETS, in the worst case, will be no more ambitious than the EU Aviation ETS, then additional emissions associated with LBA aviation operations will be directly subsidised through airline's receipt of an allowance of free credits.

Between 2013 and 2020, 82% of the sector's capped emissions allowance was granted for free to aircraft operators under the EU ETS system. When allowances are given away, it reduces the economy-wide pressure on moving towards lower-carbon technologies, and represents, in effect, a subsidy to that industry. In fact, research from the UKCCC and the Department for Transport (DfT) on the impact of carbon prices on carbon leakage and competitiveness shows that an allowance giveaway is a double-subsidy, since it incentivises not just the departing flight but an arriving one as well.[35] While it is intended that the giveaway under EU ETS, and therefore UK ETS, will reduce by 2.2% a year from 2021, there will still be a giveaway of 60% of emissions allowances in 2030, 38% of the required allowances in 2040, and 16% in 2050.

To determine this potential carbon cost and subsidy, the following methodology was used. The carbon emissions presented in the Environmental Statement were extracted for each modelled year. Other years were linearly interpolated between these dates. It is recognised that this results in a variance with the full scheme totals, particularly in the period 2030–2050, where the ES uses a 1.2% decline, followed by a 10% reduction in 2050. However, in the absence of the full annual emissions tables, this simplifying assumption shouldn't create excessive variance.

When presenting uncertain outcomes, it can be valuable to look at forecast ranges. For this reason, Table 12 presents the UK government's low and high forecast carbon assessment values. These BEIS prices were calculated based on the UK government's previous carbon reduction target of an 80% decline by 2050. In addition, a policy paper by the Grantham Research Institute on Climate Change and the Environment, *How to price carbon to reach net-zero emissions in the UK*, was published in the wake of the UKCCC's case for net-zero emissions by 2050. These prices are different from those of the UK government, front-loading much of the cost to the period of 2020 to 2030, as well as having potentially greater prices after 2075. The price path ends in 2050; however the 3.8% growth rate indicated in the policy paper has been used to extend it as necessary.

In addition to these pricing sensitivities, it is important to split out the potential carbon costs with reference to how they might fit in an assessment of the LBA scheme.

Total carbon cost for appraisal

The carbon cost for appraisal recognises that when a project results in the emission of carbon dioxide it will require additional abatement action somewhere else in the economy; in the period covered by the cost estimates, the price of an EU allowance is considered to reflect the average cost of abatement, though it is recognised that there can be significant deviation in the short and even medium term. Essentially, the cost of the emission is borne somewhere, regardless of whether an allowance is purchased. A likely result, as emissions taxes or caps become more prevalent, is that this will be partially borne by passengers as increased fare prices. This is the assumption made in national-level modelling. When considering this, in the context of a global convergence towards carbon trading by 2050, it is appropriate to consider all the emissions associated with the project. This includes the impact of non-CO_2 emissions and radiative forcing, as such impacts will necessitate more abatement elsewhere in order to meet climate targets (Table 13).

Table 12: Carbon costs used in the carbon model[36, 37]

2018 £/tCO_2e	Carbon price, traded, central	Carbon price, traded, low	Carbon price, traded, high	Carbon price, Grantham for Aviation
2018	13	2	26	46
2024	41	16	65	58
2030	81	40	121	73
2032	96	48	144	78
2050	231	115	346	153

Table 13: Carbon costs of the LBA expansion

2020 £, net present value, to nearest £100k	Central	Low	High	Grantham
LBA expansion	£252,600,000	£125,900,000	£379,400,000	£183,800,000
LBA expansion (FIR adjusted)	£267,100,000	£133,300,000	£400,800,000	£191,000,000
LBA expansion + radiative forcing factor	£453,300,000	£226,200,000	£680,500,000	£328,100,000
LBA expansion + radiative forcing factor (FIR adjusted)	£437,500,000	£218,500,000	£656,500,000	£311,500,000
LBA expansion + radiative forcing factor + arrivals	£896,900,000	£447,700,000	£1,346,000,000	£646,900,000
LBA expansion + radiative forcing factor + arrivals (FIR adjusted)	£865,200,000	£432,300,000	£1,298,200,000	£614,400,000

Direct financial subsidy under the likely UK ETS

The free allowances given away to airlines under the EU ETS seem likely to continue, or at least in a worst case they will. The EU ETS for aviation does not include radiative forcing, nor would the accounting be likely to use both departing and arriving flights (though both EU ETS and CORSIA do include requirements associated with travel to countries that are not covered by their respective schemes), so it can be presumed that the UK ETS will follow the same practice. The most appropriate number to use is likely the one without arrivals and radiative forcing; however, it is possible that these schemes will adjust to the reality that aviation has higher impacts than just the CO_2 would indicate and so the full range are presented (Table 14).

Table 14: UK (and EU) government subsidies to airlines implicit in the LBA expansion

2020 £, net present value, to nearest £100k	Central	Low	High	Grantham
LBA expansion	£99,000,000	£49,200,000	£148,800,000	£75,200,000
LBA expansion (FIR adjusted)	£102,300,000	£51,000,000	£153,600,000	£75,700,000
LBA expansion + radiative forcing factor	£176,700,000	£88,000,000	£265,400,000	£133,000,000
LBA expansion + radiative forcing factor (FIR adjusted)	£165,300,000	£82,500,000	£248,100,000	£121,600,000
LBA expansion + radiative forcing factor + arrivals	£348,200,000	£173,700,000	£522,700,000	£260,500,000
LBA expansion + radiative forcing factor + arrivals (FIR adjusted)	£325,700,000	£162,600,000	£488,700,000	£238,400,000

ACCOUNTING IMPACT AND BENEFIT-COST ANALYSIS

Benefit-cost analysis (BCA) is one method of summing up the positive and negative impacts of a project. The tools and methods used in the UK are well established and considered to be robust for assessing the impact of marginal transport interventions under assumptions of static impacts. It is also important to recognise the limitation of such approaches. BCA has difficulty capturing dynamic effects, where an intervention is of such a transformative nature that behaviour changes and structural shifts occur in the economy. This has led to the use of gross domestic product (GDP) impact-style assessments for transformative schemes, sitting either instead of or alongside the BCA. The value of this measurement depends on the extent to which a scheme is truly transformative, rather than just providing additional capacity. Both the GDP and BCA approaches have significant limitations when it comes to capturing social wellbeing, health, culture, and environmental impacts. More qualitative mechanisms such as multi-criteria analysis can better assess impacts in these domains but are not standard practice in the local planning system.

GDP/GVA Accounting Framework

Before discussing the results of our analysis, it is worth restating that the evidence reviewed demonstrates that Leeds Bradford Airport's (LBA's) choice to limit the study area to the Leeds City Region appears to be a strategic one, rather than one based on the actual extent of the scheme's impacts. By excluding any other commercial airports, and by not considering other ways of travelling, LBA is able to claim that it creates benefits (ie assume zero product displacement), such as business productivity, as opposed to simply shifting the location of those benefits. This is not appropriate because, while there are no competing airports within the study area, many residents use airports outside of the study area.

Where the report does acknowledge displacement effects, it attempts to frame this as a rebalancing away from London airports towards the Leeds City Region. However, the baseline data presented shows that a far more likely outcome is the impoverishment of other UK regions, such as Manchester.

In Table 15 we combine all the costs and benefits available which are suitable for aggregation in a GDP/gross value added (GVA) accounting framework. Unless otherwise stated we apply the displacement factors used by the applicant.

- Economic footprint:
    - We scale the applicant's figures down by 33%, based on NEF modelling of job intensity data.
- Productivity:
    - While there are questions regarding the methodology and approach as discussed, there is likely some positive impact and we include the applicant's figures.

- Tourism:
    - We include the applicant's estimate of inbound tourism and NEF's estimate of outbound tourism.
- Carbon emission fiscal subsidy:
    - The value of emission credit giveaways flying out of LBA is included as a net cost to the City, region, and nation. This assumes that the emissions made as a result of LBA's expansion deduct from an implicit regional and national carbon allowance, and hence require offsetting elsewhere or alternatively, if these emissions are not offset they will come with a social carbon cost incurred by future generations.

Table 15: Net economic impact, adjusted (FIR and NEF calculations, inferred values are presented in italics)

£mil		Economic footprint	Inbound tourism	Outbound tourism	Productivity	Carbon subsidy (central)	Grand total
Leeds	**2026**	8	2	-10	4	0	**4**
	2032	66	11	-80	24	-7	**14**
	2050	*66*	*11*	-80	*24*	-2	**19**
	2024-2050	*1,584*	*264*	-1,711	*576*	-102	**611**
Leeds City Region	**2026**	8	3	-18	7	0	**0**
	2032	67	18	-145	40	-7	**-27**
	2050	*67*	*18*	-143	*40*	-2	**-20**
	2024-2050	*1,608*	*432*	-3,137	*960*	-102	**-239**

In Table 16 we go further, looking at the UK scale. Given the halting progress towards national climate commitments, the fractured policy space for aviation, and the aviation industry's seeming desire to expand despite the negative effects, we believe that at the national scale an assumption of zero displacement represents a realistic worst case.

Table 16: Net UK economic impact, adjusted (FIR and NEF calculations, inferred values are presented in italics)

£mil		Economic footprint	Inbound tourism	Outbound tourism	Productivity	Carbon subsidy (central)	Grand total
UK	**2026**	*12*	*5*	-31	*9*	-0	**-5**
	2032	*99*	*31*	-251	*53*	-7	**-75**
	2050	*99*	*31*	-248	*53*	-2	**-67**
	2024-2050	*2,382*	*748*	-5,432	*1,280*	-102	**-1,124**

- **On discounting**: The applicant does not provide complete information on the approach it used to discounting. It is not clearly stated whether the economic impact estimates for

single modelled years (eg 2030) relating to issues such as direct GVA benefits, indirect and induced benefits, tourism, and productivity have had discounting applied. We have assumed discounting has been applied in Table 15 and Table 16 (a best-case assumption), based on the applicant's use of discounting on construction impacts in Appendix 11.1. But we strongly recommend that the applicant is requested to provide clarification.

Social welfare benefit-cost analysis

Through this report we have collated and generated evidence that can be used to address the gaps in a BCA of the LBA proposal. Our assessment is shown in Table 17. This should not be considered to be exhaustive – there are likely areas of both benefits and costs that could be included in this account. However, these are the ones that are typically considered within such assessments for transportation schemes for which LBA presented sufficient evidence to include.

A key factor when reviewing these kinds of outputs is an appreciation for who is being affected by each impact. While typically in assessments the impacts may be summed and then compared to the financial cost of the project, this can sometimes hide which group in society is experiencing benefits and which group experiences costs.

- **Passenger welfare** – the benefits presented by LBA accrue to a subset of passengers: those who would otherwise have travelled to a more distant (or costlier to reach) airport. These have been included despite the logical inconsistency in the applicant's displacement assumption.
- **Noise** – these are negative health outcomes that are borne by people near to the airport and its flightpaths.
- **Air quality** – these are negative health outcomes that are borne by people near to the airport and the modelled road network.
- **Surface access costs** – individual surface access schemes will need to be justified by their potential benefits; they will also have distinct funding mixes. However, the costs attributable to the proposed LBA expansion will typically be borne by taxpayers in the local region and the wider UK.
- **Carbon costs** – the costs presented here are likely to impact everyone in the UK, through increased costs to decarbonise other sectors, or the social cost of carbon through the direct negative impacts of climate changes on human lives.

Table 17: Net social welfare impact, adjusted (FIR and NEF calculations, inferred values are presented in italics)

£mil	LBA passengers	Affected by noise, aviation limit	Affected by air quality	UK taxpayers (surface access)	Affected by climate change	Grand total
2024-2050	*+£88*	-£16 (-£7 to -£69)	-£19 (-£6 to -£66)	-£70 (£0 to -£140)	-£865 (-£432 to -£1,298)	**-£883** **(-£358 to -£1,486)**

Switching value – displacement of emissions

It is acknowledged that the assumption that all the emissions are additional is an absolute worst-case scenario. It is worthwhile considering what level of displacement would be required to make the public impacts of the LBA proposal break even.

First, using central estimates of noise, air quality, and surface access costs, no amount of displacement makes the scheme break even.

Using the low estimate for surface access (assuming that each scheme is justifiable independent of LBA's expansion), we find that carbon emission displacement would need to be 94% in order for the scheme to break even. Such significant displacement seems unlikely given the historical record, which shows growth in passenger numbers from regional airports over the past decade (Figure 1).

Comments on equity

When considering impacts on people, it is of value to consider distributional impacts. While we were not able to do detailed supplementary analysis here, we think it is a worthwhile issue to raise. When a key proportion of the scheme's GVA benefits are the result of direct job displacement, it is important to consider who will lose out. The evidence provided by LBA indicates that these displaced jobs will primarily be in Manchester – the second most deprived local authority nationally.[38]

On social welfare, the balance to be considered is that the benefits accrue to passengers while the health costs are incurred by residents. Research found that the mean household income of UK-resident international leisure flyers at LBA (who represent the majority of passengers) was £48,297 in 2017.[39] This is in contrast to the average household income in Yorkshire and the Humber of approximately £39,305 in the same year.[40] Indeed the data would suggest that a significant majority of the users of LBA come from households with above-average income levels.

There are also intergenerational equity issues that are relevant to carbon emissions, due to the long-lasting negative impacts of climate change. As the UK has yet to develop effective sectoral and regional carbon budgeting systems, the carbon subsidy discussed earlier must inevitably be provided by future generations. While we have followed the standard approaches to carbon accounting, the figures presented here are only one way of considering the harm that results from carbon emissions.

A final and topical issue to consider is the impact of airport expansion during a recession and particularly a crisis in the hospitality and leisure industry. The most significant cost of the

proposed scheme is likely to be its impact on the industries consumers might otherwise spend their money with if they were not travelling abroad. The proposed scheme will likely result in significant job losses in hospitality and leisure industry, an industry which typically employ a disproportionate number of low-wage earners. The precise location of these jobs is difficult to estimate as it requires detailed knowledge of consumer spending choices; however, many are likely to be lost within the Leeds City Region.

FURTHER READING

For further reading on many of the issues discussed in this report, see NEF's other recent reports:

Chapman, A. & Wheatley, H. (2020). *Crisis support to aviation and the right to retrain.* Retrieved from https://neweconomics.org/2020/06/crisis-support-to-aviation-and-the-right-to-retrain

Chapman, A., Kiberd, E., Pendleton, A., Wilson-Morris, B. & Postle, M. (2020). *Baggage claim: the regional impact of Heathrow's third runway.* Retrieved from https://neweconomics.org/2020/02/baggage-claim

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[11] NEF analysis based on BRES employment data and CAA airport data. For more details see Chapman, A. & Wheatley, H. (2020). *Crisis support to aviation and the right to retrain.* New Economics Foundation. Retrieved from https://neweconomics.org/2020/06/crisis-support-to-aviation-and-the-right-to-retrain

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[26] Text here was amended between the pre- and post-publication stages of this report to clarify that NEF Consulting's review of the methodologies relating to carbon emissions related only to their accordance with national appraisal guidelines. We are aware that several commentators have criticised the appropriateness of those guidelines, and their implementation in the applicant's Environment Statement. We make no judgement in this regard.

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