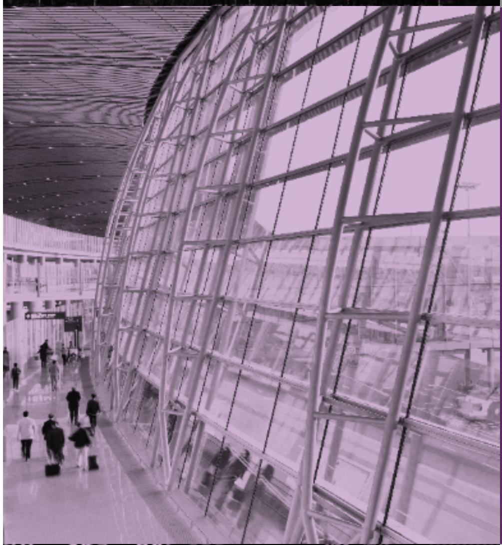
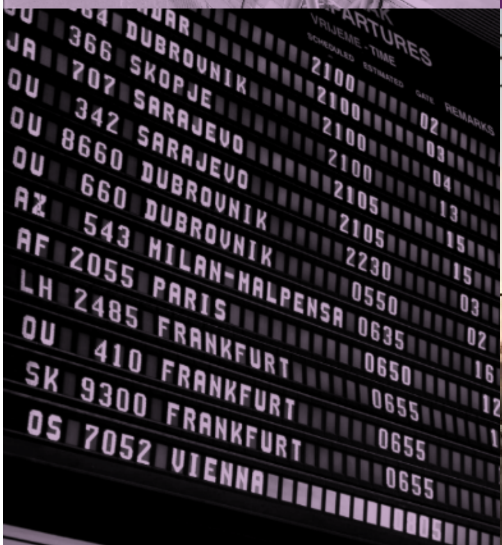


The Socio-Economic Impacts of Night Flying: Literature Review



Department for Transport

Final Report

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Contents

Glossary

Acronyms and Organisations

Term	Definition
ACI Europe	Airports Council International Europe, the trade association representing European airports.
ANNE	Aviation Night Noise Effects study commissioned by the Department for Transport examining the impacts of aviation noise at night.
APD	Air Passenger Duty, a UK tax levied on departing air passengers.
CAA	UK Civil Aviation Authority.
DfT	UK Department for Transport.
FSC	Full-Service Carrier. A network airline typically offering hub connectivity, transfer traffic and multiple cabin classes.
GDP	Gross Domestic Product.
GVA	Gross Value Added, a measure of economic output.
LCC	Low-Cost Carrier.
NQP	Night Quota Period. The regulated night period currently running from 23:30 to 06:00 at the designated airports.
O&D	Origin and Destination traffic. Passengers travelling between their true origin and final destination rather than transferring.
QC	Quota Count. A noise classification system applied to aircraft movements during the Night Quota Period.
TAG	Transport Analysis Guidance published by the Department for Transport.
WEIs	Wider Economic Impacts.

Policy and Regulatory Terms

Term	Definition
Designated Airports	Heathrow, Gatwick and Stansted airports, designated under Section 78 of the Civil Aviation Act 1982 for the purposes of night flight regulation.
Night Flight Regime	The system of restrictions governing night operations at the designated airports, including movement limits, noise quotas and operational rules.
Night Quota Period	The regulated night period currently running from 23:30 to 06:00 at the designated airports. This is the period that is the primary consideration in this research

Night Period	Used in noise assessment and in some local policy contexts. It is the period between 23:00 and 07:00.
Noise Contour	A geographic representation of aircraft noise exposure, typically measured using average noise metrics such as LAeq.
Slot	The right to schedule an arrival or departure at a coordinated airport at a specific time.

Airline and Operational Terms

Term	**Definition**
Aircraft Utilisation	The extent to which an aircraft is used during the day, usually measured in flying hours or rotations per day.
Airport Charges	Charges paid by airlines to airports for using airport infrastructure and services, including landing, passenger and other aeronautical charges.
Bellyhold Cargo	Freight carried in the cargo hold of passenger aircraft.
Capacity balance	The relationship between demand for airport capacity and the amount of capacity available. Where demand exceeds available capacity, access becomes scarce.
Connectivity	The availability, frequency, quality and convenience of air links between origins and destinations.
Coordination rules	The rules used by the airport coordinator to allocate slots at capacity-constrained airports.
Curfew	A restriction or prohibition on aircraft operations during specified hours.
Rotation	A sequence of flights operated by the same aircraft during a day.
Shadow cost / shadow price	The implicit economic value of scarce airport capacity. In this study, it reflects the value of a night-period movement where movement limits, noise quotas or slot availability constrain demand.
Slot release	The rules used by the airport coordinator to allocate slots at capacity-constrained airports.
Transfer Passenger	A passenger changing flights at an intermediate airport as part of a longer journey.

Freight and Logistics Terms

Term	Definition
Express Freight	Time-definite freight services providing guaranteed rapid delivery, typically overnight or next-day.
Integrator	A cargo operator providing end-to-end logistics services combining air and ground distribution, typically operating overnight hub-and-spoke networks.
Inventory Cost	The economic cost associated with holding additional stock due to delays or uncertainty in delivery.
Time-Definite Delivery	A logistics service guaranteeing delivery within a specified timeframe.

Economic and Appraisal Terms

Term	Definition
Consumer Surplus	The difference between what users are willing to pay and what they actually pay.
Elasticity	A measure of how sensitive demand or another variable is to changes in price, time, connectivity or cost.
Generalised Cost	The combined monetary value of fares, travel time, reliability and inconvenience associated with a journey or shipment.
Producer Surplus	The economic surplus earned by producers such as airlines and airports.
Rule of Half	A standard transport appraisal method used to estimate the welfare impact of a change in generalised cost. It assumes that existing users experience the full change in cost, while new or lost users experience, on average, half of that change.
Social Welfare	The total economic benefit to society, including user, producer and government effects.
Transport Economic Efficiency (TEE)	TAG appraisal of user and producer welfare impacts within the transport market.
Wider Economic Impacts	Economic effects beyond direct transport-user benefits, including productivity, trade and labour-market impacts.

Executive Summary

1. This literature review consolidates and interprets the existing evidence on the economic and social welfare importance of night flying in the UK and the analytical techniques used to measure its value. It draws together more than thirty key national and international studies published since 2000. Where relevant, the review also highlights where discussions with stakeholders as part of this process support and challenge the literature review findings.

2. The review has four objectives:

- To summarise what is known about the scale and nature of the economic benefits generated by night flights in the UK.
- To consider how markets—airlines, airports, passengers and freight operators—respond to changes in night flying policy.
- To identify from existing literature how freight and express-delivery activity can be incorporated within the Department for Transport's Transport Analysis Guidance (TAG) welfare framework, from which they are excluded to date.
- To review approaches for quantifying wider or catalytic economic impacts that extend beyond standard welfare analysis.

Evidence on the scale and nature of night flying

3. Across the literature there is strong consensus that night operations play a structural role in both passenger connectivity and freight logistics. This is supported by industry comments received in this study:

- Passenger connectivity – Early-morning arrivals and late-evening departures underpin same-day business travel and enable efficient aircraft and crew utilisation. They are also essential for hub functioning, with early-morning long-haul arrivals feeding the first departure banks.
- Freight and express logistics – Approximately 45–50% of UK air-cargo tonnage—particularly express parcels and high-value goods—moves during the night. Integrators such as DHL, UPS and FedEx depend on the 23:00–06:59 window for overnight sorting and next-day delivery.
- Regional significance – for instance, Oxera (2023) in its research for the airport found that at Gatwick, night and early-morning operations are particularly important for first-wave departures that sustain employment, inbound tourism and regional connectivity.

4. York Aviation (2021) for Airlines UK estimated that night flying across the UK generated around £16.5 billion GVA and 213,000 jobs in 2019, of which around £13 billion were wider or catalytic effects, such as productivity and trade effects. A complete ban was modelled to reduce GDP by over £12 billion per year. Other analyses, such as the New Economics Foundation (NEF) (2021), have suggested that such benefits may be overstated but do not provide an alternative quantified estimate at a UK level.

Market responses to policy change

5. Studies examining curfew scenarios, where no flights are allowed either in the NQP or in the broader night period, (SYSTRA 2017; York Aviation 2021) indicate that responses depend on capacity and network structure:

- Re-timing and rescheduling – Some flights can be shifted into shoulder periods, but scope is limited where slot scarcity exists.
- Diversion and displacement – Freight may switch to unconstrained continental hubs (e.g. Liège, Paris, Leipzig). Passenger flights may divert to other UK airports where appropriate capacity exists.
- Demand loss – A proportion of business and freight demand is foregone where timing is essential and no viable alternatives exist.

6. Overall, these adjustments recover only part of the lost activity, implying net national losses even after behavioural responses are taken into account.

Integrating freight into TAG analysis

7. Freight impacts have often been excluded from welfare appraisal by a range of organisations. A range of recent work demonstrates methods to close this gap:

- Value of Time (VOT) and Value of Reliability (VOR) – Express freight exhibits very high time sensitivity, with international evidence indicating delay penalties equivalent to 0.6–2.3% of shipment value per additional day of transit time (Hummels & Schaur 2013; Oxford Economics 2020).
- TAG compatibility – Reliability can be monetised analogously to passenger schedule delay, enabling freight-related impacts to be incorporated within Transport Economic Efficiency (TEE) analysis.
- Application – Night-flight restrictions can be represented as increases in freight generalised cost, producing measurable changes in shipper surplus and operator surplus.

Assessing wider or catalytic impacts

8. Beyond direct welfare impacts, aviation generates productivity and trade effects through connectivity, although care is required to avoid double counting:

- Connectivity–productivity elasticity – Multiple econometric studies (e.g. Oxford Economics 2013; Airports Commission 2013; SEO 2024) find that a 10% increase in air connectivity—defined in various ways—is associated with approximately a 0.5% increase in GDP.
- Regional employment elasticity – Oxera (2024) applied a Percoco-style model linking air-traffic volumes to regional employment, finding an elasticity of 0.13% employment for each 1% change in traffic.
- Methodological diversity – Evidence derives from input–output, CGE, econometric and consumer-surplus models. Each captures different components of value; together they present a consistent

narrative that connectivity supports productivity growth, although demonstrating causality remains challenging.

- Night-flying relevance – Because a substantial share of the most time-critical passenger and freight connectivity occurs in the night or shoulder periods, curfews could reduce connectivity in ways that have wider economic implications. Any translation of connectivity changes into GDP impacts must reflect robust elasticities and avoid double counting.

9. A recent meta-review by Zhang and Graham (2019) reinforces the importance of addressing causality when linking air connectivity and economic growth. They note that many observed correlations reflect economic activity driving air-transport demand rather than the reverse. Using instrumental-variable and panel-data evidence, the study finds that air connectivity and GDP growth are bidirectionally related but asymmetrically so: improvements in connectivity facilitate growth, but the magnitude is modest relative to the influence of general economic expansion. Recent work by the NEF (2025b) reaches a similar conclusion at a pan-European level, identifying diminishing marginal growth effects of connectivity in already well-connected, high-income regions, and emphasising that causal impacts vary significantly by region and market structure. While NEF's analysis does not consider night flying specifically, it underscores the need for careful causal identification and for applying context-specific elasticities. Taken together, this evidence supports treating air-connectivity improvements as a facilitator of productivity rather than a primary growth driver, consistent with the two-stage econometric frameworks developed by Percoco (2010) and applied in later UK studies.

Summary

10. The evidence demonstrates that night flying delivers material economic benefits through both direct welfare channels and wider catalytic mechanisms. While local environmental impacts remain significant, the loss of connectivity, productivity and freight reliability from curfews could impose substantial national costs. Approaches exist—both within TAG and in complementary wider-impact methods—to quantify these effects transparently and consistently, provided that causality, displacement and double-counting risks are carefully managed.

1. Introduction

Background

1.1 This report has been prepared by York Aviation for the Department for Transport (DfT) to support the current review of the socio-economic benefits of night flying at the UK's designated airports: Heathrow, Gatwick and Stansted. It is expected to form part of the wider evidence base informing policy decisions on the regulation of night operations at designated airports for the next Night Flight Regime (NFR) period. It is intended to inform the development of an effective, robust, and transparent approach to assessing the socio-economic impacts of night flying. It also supports the development of the accompanying model that York Aviation have developed to quantitatively assess these impacts.

1.2 The project has been undertaken in three phases:

- Phase 1 included a detailed review of relevant literature around night flying and its socio-economic effects, consultations with industry stakeholders, and the development of the overarching methodological framework set out in this report;
- Phase 2 involved the collection and collation of detailed data to support the development of a model to enable the consideration of the socio-economic effects of night flying and the construction of that model;
- Phase 3 then used the model developed to identify the socio-economic effects associated with a series of illustrative scenarios defined by DfT.

1.3 The outputs from the project include three interlinked reports:

- The Literature Review Report (this document);
- The Methodology Report;
- The Model Outputs Report.

1.4 These documents are published alongside each other.

1.5 Night flying remains one of the most contested aspects of UK aviation policy. The balance of the available literature suggests that it plays an important role in supporting business travel to and from the UK, the affordability of leisure travel, and the integrity of express-freight and logistics networks, but it also gives rise to significant environmental and community concerns. This study examines the economic and social dimensions of these trade-offs through a structured review of published evidence and stakeholder inputs. It should be noted that the DfT is undertaking other research projects examining the costs to society of night flying, specifically in relation to noise impacts.

Purpose of the Review

1.6 The review's purpose is to consolidate, analyse and interpret the existing literature on the socio-economic impacts of night flying in the UK, including:

- the scale and nature of welfare and market impacts on passengers, airlines, airports, freight operators and public accounts;
- the behavioural and market reactions to changes in night flying policy;

- integration of air-cargo activity into DfT's TAG surplus framework, which currently excludes them; and

- approaches to assessing wider and catalytic economic impacts, such as productivity and trade impacts, that extend beyond the current TAG and Green Book boundaries.

1.7 The objective is to establish a robust analytical foundation for the quantification of socio-economic impacts in any future night flight appraisal. For the avoidance of doubt, this study does not consider environmental impacts.

1.8 A key concept that is considered across much of the literature is that of connectivity. In this report, "connectivity" refers to the quantitative availability and quality of air links between origins and destinations. Connectivity is measured differently across the literature. CEPA (2016) and Oxera (2023) employ frequency- and capacity-based measures linked to schedule-delay modelling. SYSTRA (2017) uses WebTAG-consistent schedule-delay and frequency modelling rather than explicit network indices. Macro-economic studies reviewed by Zhang & Graham (2019) typically use composite connectivity indices, including frequency-weighted, seat-capacity and network-centrality measures. Unless otherwise stated, the term is used here in the broad sense of these capacity and frequency-based indices.

Scope of the Review

1.9 The literature review has drawn on over 30 core studies from government, academic, and industry sources, ranging from work on night flying, through the Airports Commission (2015), to recent studies by York Aviation (2021), New Economics Foundation (2021, 2023 and 2025), Oxera (2023 and 2024), SEO for ACI Europe (2024), and Oxford Economics (2024). These include both UK and international research. See a full list in the bibliography in Section 7.

1.10 The documents are drawn from a range of years and countries. All monetary values quoted are in the original study price base and currency. Appendix A standardises these to 2024 £ sterling using HM Treasury GDP deflators for UK reports and OECD PPP exchange rates for foreign currency studies.

1.11 Each section synthesises evidence on a series of particular questions that are central to the research being undertaken:

- Does night flying matter, why and how much?
- How will markets respond to changes in night flying policy?
- How can air-cargo activity be integrated into TAG surplus analysis?
- How can wider and catalytic economic impacts be effectively quantified?

1.12 It should be noted that the views expressed in the individual documents reviewed are the views of their authors. They do not necessarily represent the views of York Aviation.

2. Does Night Flying Matter, Why and How Much?

Introduction

2.1 This section reviews the available evidence on the economic and operational significance of night flights across passenger and freight markets. It examines how night operations contribute to airport and airline efficiency, facilitate business and leisure connectivity, and underpin the reliability of express-freight and logistics networks. The discussion summarises quantitative estimates of the scale of activity, the types of users affected, and the magnitude of the benefits identified in previous studies, providing a foundation for the later analysis of impacts and wider economic and social welfare effects.

2.2 Specifically, the section considers the following groups:

- Business passengers.
- Leasure passengers.
- Transfer passengers.
- Air cargo users.
- Airlines.
- Airports.

Business passengers

2.3 Across the literature, a consistent finding is that night and early-morning operations hold disproportionate value for business passengers because they enable same-day travel or long haul business travellers to arrive in the morning ready for a day's business, or to maximise available time by leaving late in the evening.

2.4 CEPA (2016, pp.20-23) formalised this link, noting that the primary welfare channel from night operations is *schedule delay* rather than increased flight volume. Using Department for Transport values of time[1] and schedule-delay coefficients, CEPA demonstrated that for Heathrow and Gatwick, the inability to land before 06:00 could increase generalised journey times for long-haul business passengers by 45–60 minutes, reducing welfare per trip by £30–£50. Those calculations informed the early TAG framework later used by SYSTRA (2017) in its government-commissioned assessment.

2.5 SYSTRA's study (2017, pp. 27–31 & Tables 5.1–5.3) introduced a more sophisticated approach, applying elasticity-of-connectivity methods to estimate welfare change. It showed that losing the 04:30–06:00 arrival window at Heathrow would reduce international connectivity (defined as the number and frequency of connections) by 5–7 per cent, translating to an annual loss of roughly £500–700 million in business-passenger surplus. SYSTRA emphasised that these figures reflect *marginal* loss at the system's capacity limit; where shoulder-hour capacity is available, the effect is smaller.

2.6 York Aviation (2021, pp. 23-29) highlighted the importance of night slots at both ends of the day for maximising time on the ground in relation to making day return business trips, thereby avoiding overnight stays and associated costs.

2.7 Oxera (2023, pp. 27–29 & Table 4.2), in its economic assessment of night flying for Gatwick Airport Limited, quantified these relationships within a TAG-consistent welfare framework. It concluded that

[1] This refers to the values of time in guidance at the time of the research. These have changed since this time and are currently being updated.

the congestion and scarcity effects surrounding the 06:00–07:00 hour generate around £900 million p.a. in passenger welfare costs under current limits. The study used detailed CAA ticket-sample data to separate business and leisure elasticities, finding that business travellers face the steepest welfare loss because their willingness to pay for reliability is more than three times that of leisure passengers. Oxera also noted that the *distribution* of welfare loss is highly uneven: a relatively small number of flights in the early-morning period create very large connectivity gains, meaning that a small change in the definition of "night" can produce disproportionate economic effects.

2.8 It is important to distinguish between "overnight" operations (typically 23:00–06:00) and "early-morning shoulder" flights (06:00–07:00). Most business travel and low-cost passenger operations rely on the shoulder period for first-wave departures and arrivals, whereas express-freight operations depend on the core night hours. The studies reviewed (CEPA 2016; SYSTRA 2017; York Aviation 2021) consistently find that welfare effects from restricting the 06:00–07:00 period are materially larger for passengers, while the core night period is most critical for cargo.

2.9 These modelling results are supported by real-world market evidence from analysis of the current slot allocation mechanism. Frontier Economics (2018 , pp. 8–10 & Table 2) showed that capacity constraints at Heathrow have produced a "congestion premium" of roughly 25 per cent on fares compared with comparable routes from less-constrained hubs. About one-third of this premium is attributable to scarcity of early-morning and late-evening slots. AEC (2024, 4, Section 4 'Scenario 3', pp. 26–28) extended this analysis, simulating alternative night regimes for IAG and showing that reform—specifically, replacement of the movement cap with a noise-quota system—could recover £350–400 million p.a. in passenger surplus while maintaining noise output.

2.10 Counter-evidence from CE Delft (2011 & 2012) and NEF (2021, 2025) questions whether these welfare values represent *net* national benefits or largely transfers between passengers and airlines. CE Delft argued that other studies overstated dependence on night arrivals because many business passengers could shift to slightly later flights or travel a day earlier, while NEF contended that the macroeconomic impact of such high-income business travel is modest relative to environmental cost.

2.11 Recent evidence from the DfT Business Travel Survey (2025) strengthens the empirical basis for the conclusions drawn from CEPA (2016), SYSTRA (2017) and York Aviation (2021). The survey shows that business travellers continue to place a high value on early-morning and late-evening flight options that enable same-day travel. Among respondents, 16 per cent of inbound and 12 per cent of outbound business flights occurred between 23:00 and 06:59 (Figure 4.5, p. 31), a pattern consistent with travellers seeking to arrive for the start of the working day or return home the same evening. Almost half of employers (46 per cent) allow overnight stays only in limited circumstances, while 9 per cent require all trips to be completed within a single day (pp. 29–30). This combination of organisational policy and flight-timing behaviour indicates a strong preference to avoid overnight accommodation and supports earlier modelling that valued the welfare benefits of early arrivals and late departures for same-day connectivity.

2.12 When asked how they would respond if night-period flights were unavailable, 74 per cent of surveyed firms said they would retime flights, 12 per cent would use a different mode, and 12 per cent would rely on remote meetings (DfT 2025, p. 31). Although these responses imply some flexibility, they also indicate that substitution entails cost and inconvenience. The survey commentary notes that very few travellers would extend their stay by an extra night, suggesting that curfews restricting the 23:00–06:59 period would most likely result in the loss of same-day travel opportunities rather than seamless rescheduling. These behavioural findings corroborate CEPA's (2016) and SYSTRA's (2017) schedule-delay estimates by confirming that the time value of early-morning connectivity for business travel is both significant and difficult to replace through retiming alone.

2.13 In sum, the analytical consensus across the literature is that for business passengers the 04:30–07:00 period delivers high marginal welfare: enabling early arrivals into London for the business day and early departures for short haul business users going into Europe. The end of the day is also important, as arriving back late enables business passengers to maximise 'on the ground time' for day return trips. These findings were supported by comments from airlines, with some in particular noting a significant yield premium for morning arrival and popularity of both ends of the day with corporate customers.

Leisure Passengers

2.14 For leisure markets, the relationship between night flying and welfare operates through price, availability and scheduling convenience. York Aviation (2021) highlights the importance of early-morning departures and late-evening arrivals for maximising aircraft utilisation and enabling popular sun-destination rotations, though it does not quantify utilisation uplift. Under tightening scenarios, short-haul passengers face retiming costs of £14–£18 per head and average fare increases of 0.1–1.0 per cent depending on airport type. These cost impacts reflect the limited retiming flexibility at slot-constrained airports, especially for sun-turn charter and low-cost leisure services, but the study does not estimate passenger volume losses under these scenarios.

2.15 CEPA (2019, pp. 34–35. (Heathrow slot-allocation context)) added that such constraints affect not only prices but also trip length. Early-morning departures and late returns allow tour operators to offer three- and four-day breaks that use weekend or holiday windows efficiently. Restricting flights before 06:00 or after 23:00 shortens effective stay length, reducing the perceived value of travel and therefore the consumer's willingness to pay.

2.16 The Airports Commission (2015 TEE, pp. 16–19) analysed the same effect in its transport-economic-efficiency (TEE) appraisal, observing that congestion pricing or extended hours yield similar consumer-surplus improvements because they allow the market to distribute demand more smoothly across the day. The Commission's modelling of runway expansion demonstrated that relief of capacity constraints reduced average fares by up to 7 per cent system-wide, with leisure passengers capturing most of the welfare gain.

2.17 Evidence from SYSTRA (2017 , pp. 33–36) supported these findings: in unconstrained airports with surplus shoulder capacity, leisure demand readily retimes with minimal welfare loss; but in London—where the shoulders are already saturated—there is little scope for displacement. In such contexts, restrictions translate into genuine traffic suppression rather than mere rescheduling.

2.18 Stakeholder submissions to the Department for Transport's consultations reflect this difference in perspective. The British Airways (2021) and Heathrow Airport Ltd (2021, 2024) consultation responses to the night flights consultations in 2021 and 2024 argued that night and shoulder flexibility directly support affordable leisure connectivity by enabling airlines to deploy quieter, larger aircraft more intensively, while NEF (2023) countered that any welfare benefit is offset by additional emissions and community disbenefits.

2.19 Overall, the literature agrees that leisure passengers benefit from night and late-evening flying primarily through lower fares and greater choice of destinations and times. At saturated airports, curfew extensions or earlier start times would ease congestion and generate real welfare gains; conversely, tighter definitions of night would raise costs and erode accessibility for price-sensitive markets.

Transfer Passengers

2.20 York Aviation (2021, pp. 23–25 & Annex B), working for Airlines UK, provided further context by modelling real airline schedules and transfer patterns. It found that around 19% of Heathrow's daily long-haul inbound seats from the Asia-Pacific region arrive before 06:00, feeding the first domestic and European departure banks. Removing those flights would eliminate same-day connectivity for large parts of Asia-Pacific, reducing transfer traffic by approximately 160,000 passengers per week. York Aviation's analysis of airline yields also showed that these early-morning connections sustain premium-cabin load factors that are critical to the viability of long-haul routes; without them, frequencies and network breadth would contract, affecting both transfer and origin–destination markets.

2.21 Evidence across the wider literature reinforces this dependence on early-morning arrival windows. CEPA (2016) demonstrated that arrival times before 06:00 are disproportionately valuable because they preserve onward connection options and minimise schedule delay. SYSTRA (2017, pp. 27–31) reached a similar conclusion, finding that the removal of the 04:30–06:00 window would reduce international connectivity at Heathrow by 5–7%, with transfer passengers bearing most of the welfare loss. In the context of runway expansion, CEPA (2019) showed that losing pre-07:00 arrivals would reduce viable long-haul–short-haul connection combinations by 10–15%, significantly weakening Heathrow's competitiveness relative to unconstrained European hubs. AEC (2024, pp. 26–27) similarly estimated that curfews tightening the early-morning period could divert 1.5 million transfer passengers per year to continental hubs such as Amsterdam, Paris and Frankfurt.

2.22 The Airports Commission (2015) also highlighted the role of early-morning long-haul arrivals in feeding the first wave of European departures, noting that even small timing restrictions can break key minimum-connect-time pairings and suppress transfer flows. Broader network-economics literature supports these findings: Frontier Economics (2018) showed that scarcity of early-morning slots contributes materially to the "congestion premium" embedded in fares at constrained hubs, reflecting the high willingness to pay for connection-bank integrity, while Zhang & Graham (2019) emphasised that hub-based transfer networks are particularly sensitive to timing disruptions because schedule coordination drives route viability.

2.23 Taken together, the evidence from multiple studies explain that night and early-morning operations—particularly between 04:30 and 07:00—are integral to maintaining Heathrow's position as an international transfer hub. Restrictions in these hours would undermine same-day connectivity, reduce long-haul route viability, and shift transfer traffic to competing European airports.

Air-cargo users

Express and time-definite freight

2.24 The strongest operational dependence on night flying arises in the express freight sector. CEPA (2016, pp. 28–30) describes the integrator cycle—late-afternoon collection, overnight hub sorting, and pre-08:00 distribution—as an essentially all-or-nothing model in which sustained curfews would make a UK-based hub operationally non-viable. In its full-curfew scenario, CEPA estimated that forcing express hub activity offshore could reduce UK GDP by £2–3 billion per year (2006 prices). The report emphasises that this represents a modelled upper-bound outcome, illustrating the scale of dependence on night operations rather than forecasting immediate withdrawal.

2.25 Subsequent industry and academic work corroborates this. The European Express Association / Oxford Economics (2011, pp. 6–10) estimated that express operators support 579,000 EU jobs and €23 billion GDP, with 60 per cent of shipments moved by air overnight. Frontier Economics (2015, pp. 18–20), for the Global Express Association, valued the global express industry at US$140 billion—0.19 per cent of world GDP—and found that each one-point improvement in customs or operational performance (for instance, extended night access) raises trade value by 4.4 per cent. These figures underline how small changes in night-period regulation can have large effects on cross-border trade efficiency.

2.26 FedEx (2023, pp. 11–13 & Table 3) provides a concrete case study: its Paris–CDG hub employs 22,000 people and generates €1.85 billion regional GDP. The report attributes this entirely to night-time sort operations, noting that “no viable day-time alternative” exists for maintaining next-day delivery across Europe. UK integrators such as DHL at East Midlands operate on the same pattern.

2.27 York Aviation (2021, Section 6 ‘Freight Impact’, pp. 40–42) reinforced this for the UK context, showing that express freight supports roughly £7 billion GVA and 38,000 direct jobs nationwide. The study demonstrated that even minor shifts in curfew timing increase missed-delivery penalties and inventory costs for UK manufacturers and e-commerce retailers.

2.28 Evidence across the base literature indicates that express freight is a highly heterogeneous segment in which a relatively small proportion of consignments generate most of the total economic value. Studies by the European Express Association and Oxford Economics (2011) and Frontier Economics (2015) describe express shipments as typically lightweight, high-value, and time-critical—often including pharmaceuticals, electronics, aircraft-on-ground parts, and financial or legal documents—while the majority of routine parcels and e-commerce items have much lower time sensitivity and economic worth. Although no study provides a precise quantitative split, Oxford Economics (2011) suggests that express shipments are on average more than ten times as valuable per tonne as general air cargo. York Aviation (2021) reaches a similar conclusion through value-of-time analysis, showing that ultra-urgent items contribute orders of magnitude more welfare benefit per tonne-hour than lower-value goods.

2.29 Again, this picture is strongly supported by evidence from discussions with stakeholders, who emphasised the importance of next day delivery to their customer base.

General cargo

2.30 For general freight, dependence on night operations is less absolute than for express operators but remains economically relevant. CEPA (2016, p. 39) and SYSTRA (2017, pp. 37–38) each find that night and early-morning arrivals support the timely distribution of perishable and high-value goods, and that curfews delaying these flights increase storage requirements and onward trucking costs for forwarders. Oxford Economics (2014, pp. 20–21) further identifies that air-freight-intensive industries—such as pharmaceuticals, electronics, and precision engineering—account for over 40 per cent of UK export value, and that their competitiveness is supported by reliable overnight distribution chains.

2.31 Comparative evidence from CE Delft (2011) indicates that when Frankfurt implemented a partial night flight ban, some cargo operations shifted to Cologne and Leipzig. While this redistribution had limited impact at an EU-wide level, the study reported notable local economic losses at Frankfurt, illustrating the capacity of freight networks to adapt geographically alongside local vulnerability to such changes.

2.32 In summary, express freight is structurally dependent on night operations, whereas general cargo primarily benefits through improved reliability and next-day distribution timing. Across freight markets, the evidence suggests that restrictions tend to shift activity to other UK or continental hubs rather than remove it entirely. Such adjustments, however, are associated with changes in service quality—for example, altered pick-up thresholds or extended delivery timelines—reflecting the operational constraints introduced by reduced night-period access.

Airlines

Low-cost carriers (LCCs)

2.33 Low-cost carriers (LCCs), such as Ryanair and easyJet, rely heavily on operating in the first and last hours of the day to maximise aircraft utilisation. York Aviation (2021, pp. 28–30) used fleet-rotation modelling to show that removing 06:00 departures would typically reduce utilisation by around 8–12 per cent, leading to higher unit costs and fares. Oxera (2023, pp. 31–33) corroborated this with airport-specific analysis, estimating that LCC cost per available seat kilometre (CASM) would rise by 5–7 per cent if night-period definitions were extended into the 06:00–07:00 hour. Late-evening arrivals play a complementary role: they allow aircraft to return to base for first-wave departures the following day, helping to maintain schedule reliability. Where arrivals after 23:00 are systematically restricted, the literature and industry evidence indicate a greater risk of aircraft being out of position, with knock-on disruption and, over time, pressure to remove rotations or based aircraft or to serve the market on a non-based aircraft basis from the affected airport.

2.34 The broader slot-allocation literature helps to explain why LCCs are particularly exposed to night and shoulder restrictions. Frontier Economics (2018, pp. 12–15) identified a substantial "congestion premium" at Heathrow arising from slot scarcity, while the Competition and Markets Authority (2018, pp. 7–9) and CEPA/CAA (2015, pp. 10–12) found that grandfathering rules tend to entrench incumbents and limit opportunities for new entrants. In this context, night and shoulder periods often represent the only accessible capacity for LCCs at constrained airports. Tightening curfews therefore reduces entry opportunities and can reinforce market concentration, whereas modest additional flexibility in these hours can facilitate LCC entry and strengthen competition, helping to keep average fares lower.

2.35 Consultations with LCCs through this project have reaffirmed the importance of the availability of night slots in supporting utilisation of aircraft assets. They have also identified the importance of an overnight break period to support maintenance and crew rotation.

Network and full-service carriers

2.36 Network carriers, such as British Airways, Virgin Atlantic and Emirates, are constrained by the need to maintain connection-bank integrity at both UK and overseas hubs. CEPA (2019, pp. 25–28) found that removing pre-07:00 arrivals would reduce the number of viable same-day long-haul–short-haul transfer combinations at Heathrow by around 10–15 per cent, with some marginal long-haul services becoming less commercially robust as a result of weaker feed. AEC (2024, pp. 26–27) similarly reported that tighter curfews would generate substantial welfare losses, primarily through reduced transfer volumes and reduced fleet-utilisation efficiency. CEPA also showed that when curfews are relaxed within existing noise-quota limits, airlines tend to re-time existing movements rather than add new ones, yielding 5–6 per cent connectivity improvements without enlarging the noise contour. Again, consultations with airlines as part of this process have reinforced these messages, as well as identifying the existence of yield premiums associated with early morning flights, reflecting their importance for business users in particular.

Charter and holiday airlines

2.37 For charter and leisure-focused airlines such as TUI and Jet2, night and shoulder flexibility supports high utilisation during short peak seasons. York Aviation (2021, p. 32) estimated that restricting departures before 06:00 or arrivals after 23:00 could reduce peak-season seat supply by up to 10 per cent, increasing some package prices and limiting holiday availability. Operators highlight that many core markets—particularly in the Eastern Mediterranean and Canary Islands—require aircraft to complete two rotations per day to be commercially viable, which often entails operating in the first and last hours of the day. In these cases, constrained night or shoulder access reduces the feasibility of maintaining high-utilisation "sun-turn"[2] patterns. Again, this requirement for a minimum of two rotations a day on short haul flying to achieve viable levels of utilisation was a central theme to come out from consultations undertaken as part of this work.

Integrators

2.38 Integrators, principally DHL, FedEx, and UPS, form a distinct segment of airline activity operating on a vertically integrated hub-and-spoke model that combines air and ground logistics within a single network. As noted by Oxford Economics (2011, pp. 6–10) and Frontier Economics (2015, pp. 10–14), these carriers manage the entire transport chain from shipper to consignee and rely on guaranteed overnight or next-day delivery as their core service proposition. Their network design concentrates around dedicated night-time sorting hubs—Leipzig/Halle (DHL), Cologne/Bonn (UPS), Paris CDG (Fedex) and East Midlands (DHL UK)—where aircraft arrive late in the evening, feed consignments into central automated facilities, and depart again before dawn to meet next-day distribution schedules. CE Delft (2011, pp. 55–59) emphasises that this operational pattern makes night access an intrinsic requirement of the express business model rather than a discretionary scheduling choice. York Aviation (2021, pp. 33–36) similarly observes that express networks depend on narrow hub-bank windows and that even short curfews can disrupt system-wide reliability and asset utilisation.

2.39 Integrators also differ from other freight operators in their economic contribution and cargo profile. Evidence from Oxford Economics (2011, pp. 8–9) and Frontier Economics (2015, pp. 18–20) shows that express consignments typically comprise high-value, low-weight and time-critical goods—such as pharmaceuticals, electronic components, aircraft-on-ground (AOG) parts, and legal or financial documents—that generate a disproportionate share of trade value relative to their tonnage. York Aviation (2021, pp. 37–40) confirms that these ultra-urgent categories have values of time several orders of magnitude above general cargo, implying that a small proportion of shipments delivers the majority of the sector's welfare benefit. CE Delft (2011, pp. 59–63) further notes that network efficiency and reliability are central to maintaining this value: disruption to night-hub operations can rapidly erode the economic return from high-value consignments. Together, these studies indicate that modest variations in night-period operating conditions can have large effects on express-network performance and associated productivity benefits, even when total movement numbers remain unchanged.

General Cargo airlines

2.40 Major general air cargo operators include Cargolux, Atlas Air, Lufthansa Cargo, Qatar Airways Cargo, Emirates SkyCargo, Turkish Airlines Cargo, and Cathay Pacific Cargo. These carriers operate scheduled or charter freighter services that handle a wide mix of goods—from perishables and textiles to automotive components and industrial machinery—on behalf of freight forwarders rather than end-to-end customers. As described by ACI Europe (2015, pp. 42–44) and York Aviation (2021, pp. 41–43), general cargo operations form the backbone of international trade logistics, complementing the express and integrator sectors by providing bulk capacity for less time-sensitive goods. Oxford Economics (2011, pp. 7–9) and Frontier Economics (2015, p. 14) both note that such carriers contribute substantial value

[2] A sun-turn is an operational pattern commonly used by charter and leisure airlines in which an aircraft completes two full rotations to short- or medium-haul holiday destinations within a single peak-season day. The aircraft departs early in the morning from its UK base, flies to a leisure destination, returns around midday, and then repeats the pattern with a second outbound and inbound flight, typically arriving back late in the evening.

through export enablement and supply-chain resilience, even though their individual shipments command lower values of time than those handled by integrators. Their schedules typically operate during daytime or shoulder periods, and they rely on a combination of belly-hold freight capacity on passenger aircraft and dedicated freighters. In contrast to integrators—whose night-time hub banks are critical for guaranteed next-day delivery—general cargo airlines optimise utilisation across global trade lanes, balancing network efficiency and airport slot availability rather than strict overnight cycles.

Airports

2.41 Airports are both beneficiaries and managers of night operations. The literature identifies four principal mechanisms through which night policies influence airport outcomes.

- Capacity and congestion relief – Oxera (2023, pp. 27–29) and York Aviation (2021) show that the 06:00–07:00 hour acts as a pressure-relief valve, redistributing movements from the 07:00–09:00 peak. If reclassified as "night", average delays would rise by around 3–5 minutes per movement, increasing fuel burn and emissions. SYSTRA (2017, pp. 40–42) similarly finds that using shoulder hours to smooth peaks can generate welfare gains equivalent to roughly a 5 per cent increase in runway capacity at constrained airports.

- Competitiveness and route retention – CEPA (2019, pp. 30–31) and AEC (2024, pp. 28–29) emphasise that airports with more flexible night regimes attract routes from stricter ones: Amsterdam, Paris and, to a lesser extent, Frankfurt have captured traffic that could not be scheduled through Heathrow's constrained early-morning window, reinforcing their natural time zone advantage. Frontier Economics (2018, pp. 8–10) and CMA (2018, pp. 7–9) show that at Heathrow such constraints contribute to a measurable congestion premium and limit new entry, meaning that night and shoulder slots form part of the scarce capacity that underpins both route retention and competition.

- Economic contribution and employment – York Aviation (2021, p. 41) estimated that night operations at Heathrow support around 9,000 direct and indirect jobs and £1.4 billion GVA, with AEC (2024, p. 27) reaching similar figures using input–output modelling. These effects are concentrated in high-value, aviation-intensive sectors, including finance, pharmaceuticals and logistics.

- Noise management and community relations – CEPA (2016, pp. 35–37) and Oxera (2023, pp. 31–33) highlight technological progress and fleet renewal that have reduced average noise per movement by roughly half since 2006. Noise-quota (QC-only) systems allow airports to hold total night-period noise approximately constant while accommodating some demand shifts through quieter aircraft. NEF (2025, p. 18) and CE Delft (2011, p. 26), however, argue that health and nuisance costs remain material, valuing European night-noise externalities at €2–3 billion per year. Oxera's appraisal suggests that UK noise-mitigation investments and fleet modernisation have substantially reduced these impacts since 2010, but they remain significant and require ongoing management.

2.42 Taken together, the airport-level evidence indicates that night flying supports operational stability, capacity management and strategic competitiveness, particularly at constrained hubs, while generating environmental and health impacts that, though still significant, can be contained within defined limits when governed by modern noise-quota and mitigation regimes.

Conclusions

2.43 Across the literature, night flying is shown to be a relatively small share of total movements, for instance it ranges between around 1.2% and 6.5% of total movements at the designated airports, but one that delivers disproportionately high operational and economic value. The degree of dependence varies across stakeholders:

- Business passengers – CEPA (2016) and Oxera (2023) find that early-morning restrictions increase generalised costs through a need to retime or travel the previous day and can break same-day long-haul–short-haul connections, generating material welfare losses for time-sensitive travellers. The literature also highlights the importance of late-evening arrivals, which enable domestic and short-haul day-return trips and allow long-haul travellers to complete a full working day at their destination before returning home. SYSTRA (2017) and York Aviation (2021) note that when arrivals after 23:00 are curtailed, the practicality of day-return travel diminishes and disruption to first-wave departures increases due to aircraft being out of position for the next morning.

- Leisure passengers – York Aviation (2021) and SYSTRA (2017) show that night and shoulder flexibility helps lower fares and expand trip timing options; constraints generate moderate but measurable reductions in affordability and availability.

- Cargo users – Evidence from Oxford Economics (2011), Frontier Economics (2015), FedEx (2023) and York Aviation (2021) indicates that express integrators depend structurally on overnight operations, while general cargo benefits primarily through improved reliability in early-morning distribution.

- Airlines – LCC, network and charter carriers use night and shoulder periods to sustain utilisation, manage hub banks, and maintain two-rotation or "sun-turn" patterns. CMA (2018) and CEPA/CAA (2015) explain how slot scarcity magnifies these effects by limiting alternative scheduling options.

- Airports – Oxera (2023), SYSTRA (2017) and AEC (2024) find that carefully managed flexibility during the first and last hours of the day supports peak smoothing, competitiveness and route retention, with connectivity benefits achievable within existing noise-quota limits.

2.44 While NEF and CE Delft caution that macroeconomic estimates of aviation's wider impacts may risk overstatement, their analyses represent broad correlation rather than the detailed modelling approaches employed by CEPA, SYSTRA and Oxera. Taken together, the wider evidence base supports the conclusion that night flying—particularly during the 04:30–07:00 and late-evening shoulder periods—plays an important role in sustaining UK connectivity, operational resilience and competitive performance, even as environmental impacts remain significant and require continued mitigation.

3. Market Reactions to Change

Introduction

3.1 Understanding how markets respond to changes in night flying policy is essential to assessing the overall economic consequences of restrictions. This section reviews the evidence on the behavioural and operational adjustments made by airlines, passengers, freight operators and airports when night operations are constrained. It considers the extent to which flights can be re-timed, re-routed or substituted, and how far demand is likely to be displaced or lost altogether. Drawing on national and international studies, the analysis distinguishes between short-term operational responses and longer-term structural effects, providing insight into the mechanisms through which curfews or quota changes influence both local and national outcomes.

Overview

3.2 Changes in night flying regimes—whether restrictions or relaxation—alter the economic and operational equilibrium of the aviation system. The literature shows that affected markets seldom collapse; rather, they adapt through a combination of schedule retiming, fleet and crew redeployment, network rationalisation, and spatial substitution. The scale and nature of these reactions depend on:

- the availability of capacity in adjacent shoulder hours;
- the willingness of demand to shift to alternative airports;
- the availability of seat capacity on existing alternative flights;
- the flexibility of airline operations and aircraft utilisation; and
- the degree of integration between passenger and freight networks.

3.3 Analytical evidence from CEPA (2016 pp. 10–12), SYSTRA (2017, pp. 5-8), York Aviation (2021, pp. 7-9), and Oxera (2023, pp. 5-6) forms the core of understanding of behavioural responses. Their results are reinforced by industry and policy sources—Frontier (2018), AEC (2024), the Airports Commission (2015), and others—which together describe an aviation ecosystem that reacts quickly to regulatory change but with consequences that can extend well beyond the affected hours.

Passenger Markets

Business Passengers

3.4 CEPA (2016, pp. 20–23) modelled schedule-delay impacts using TAG values of time and found that displacing Heathrow’s 04:30–06:00 arrivals into later periods increased generalised journey times for long-haul business passengers by the equivalent of 45–60 minutes, reducing welfare by £30–£50 per trip. CEPA also observed non-linear effects, with small losses in schedule alignment generating disproportionate welfare reductions as same-day connections began to fail.

3.5 SYSTRA (2017, pp. 27–31) confirmed these effects using DfT’s cost-benefit framework. It found that removing early arrivals across the UK would reduce international connectivity by around 5–7 per cent and generate scenario-dependent welfare losses of approximately £500–700 million per year. Where adjacent shoulder-hour capacity exists, many services retime; however, at fully utilised airports such as Heathrow—where the 06:00 hour already operates near saturation—restrictions tend to translate into lost demand rather than rescheduling.

3.6 York Aviation (2021, pp. 23–25; Annex B) provided behavioural context by analysing actual schedule and transfer data. Approximately 21 per cent of daily long-haul inbound seats arrive before 06:00, feeding the first domestic and European departure banks. When these arrivals are displaced into later hours, viable onward connections fall sharply—particularly to East Asia and Latin America—producing an estimated 160,000 weekly transfer losses. Interviews with airline scheduling teams indicated that such losses would trigger retiming and potentially the withdrawal of marginal routes, a pattern echoed in AEC (2024).

3.7 Where night flexibility increases, business passengers experience modest but positive benefits. Frontier Economics (2018, pp. 8–10, Table 2) estimated that relieving Heathrow's peak-period congestion could generate around £2 billion per year in net welfare gains, of which roughly one-third relates to reduced early-morning schedule delay. Oxera (2023, pp. 27–29, Table 4.2) modelled that a QC-neutral relaxation of early-morning movement restrictions could restore £350–400 million per year in welfare without increasing noise-contour areas. These represent modelled scenarios rather than forecasts.

3.8 Counter-evidence from CE Delft (2011, pp. 15–18) and NEF (2025a, pp. 12–14) suggests that some business travel may be capable of rescheduling when early-morning or late-evening flights are unavailable. These studies argue that macroeconomic effects may be smaller where travellers can shift to later flights or different travel days, although they do not quantify the scale of substitution or assess impacts on generalised cost.

3.9 Behavioural evidence from the DfT Business Travel Survey (2025) provides additional insight into likely responses. If early-morning arrivals or late-night departures were curtailed, most organisations report they would retain planned trips but use retimed flights, typically at higher cost or reduced efficiency. Only around one in eight businesses (12 per cent) would substitute virtual engagement, with cancellation being rarer (p. 31). The current distribution of flights—around 16 per cent of inbound and 12 per cent of outbound services operating between 23:00 and 06:59—indicates that shoulder and night-period movements play a role in reducing overnight stays for time-sensitive travellers. Restrictions removing these options would lengthen trips and increase accommodation needs, raising generalised costs. This aligns with CEPA (2016) and York Aviation (2021), which find that welfare losses from constraint arise primarily from reduced scheduling flexibility and reliability rather than from full trip suppression.

3.10 Overall, the literature indicates that business travel responds sharply to the loss of early arrivals but only incrementally to further expansion: welfare losses from restriction are large, whereas gains from limited easing are smaller but still measurable. It should also be noted that several underlying studies pre-date recent changes in business travel, and the 2025 DfT survey suggests some evolving patterns in trip frequency and virtual substitution.

3.11 While early-morning long-haul arrivals are essential for transfer connectivity, day-return short-haul business travel depends similarly on night-period flexibility at the departure end. CEPA (2016, pp. 28–31) and York Aviation (2021, pp. 26–28) show that first-wave departures before 07:00 underpin same-day access to European financial and political centres such as Brussels, Frankfurt and Geneva. Curtailing departures before 06:30 significantly reduces the ability to arrive for morning meetings and increases overnight stays. In CEPA's schedule-delay scenarios, removal of the early-morning departure window raised generalised travel costs by approximately 25–30 per cent on the most time-sensitive short-haul routes.

3.12 Evening return flights exert a parallel influence. SYSTRA (2017, pp. 32–34) and AEC (2024, pp. 27–29) note that late-evening flexibility—typically arrivals after 22:30—enables day-return travel on routes of two to three hours' flying time. When these options are constrained, the last feasible returns move into early evening, reducing effective working time at the destination and prompting partial substitution toward rail, virtual meetings or overnight stays. Frontier Economics (2018, p. 11) modelled that easing late-evening scheduling constraints could deliver a positive but smaller welfare gain—around £100–150 million per year—primarily through improved aircraft utilisation and higher load factors on business-heavy routes.

3.13 Taken together, the evidence indicates that business travel depends on access to both ends of the operating day. Early-morning departures and late-evening returns maximise productive time at destination and enable same-day travel that avoids accommodation costs. Restrictions affecting either window reduce the feasibility of day-return schedules, with disproportionate impacts on regional airports and short-haul business markets. Conversely, limited flexibility within shoulder periods can provide measurable welfare benefits.

Leisure Passengers

3.14 Leisure passengers adjust primarily through fare and frequency mechanisms. York Aviation (2021, pp. 30–31) used aircraft-utilisation modelling to show that removing departures before 06:00 or arrivals after 23:00 reduces short-haul utilisation by around 10 per cent, leading to average fare increases of 3–6 per cent and reducing annual leisure volumes by close to one million passengers. This reflects the constraints on daily rotations: without early or late slots, many short-haul airframes can operate only two rotations per day, and on longer sectors—such as the Eastern Mediterranean—the schedule may be limited to a single daily rotation.

3.15 CEPA (2019, pp. 34–35) extended this reasoning by showing that early departures and late returns are important for short-break tourism because they increase usable time at destination. Restricting these windows reduces trip utility and raises effective elasticity, amplifying the fare and frequency effects identified by York Aviation.

3.16 The Airports Commission (2015, TEE, pp. 16–19) quantified these dynamics by demonstrating that time-of-day capacity relief can generate welfare benefits comparable to adding new peak-period runway capacity. Consistent with this, York Aviation (2021, pp. 28–31) estimated that restoring early-morning and late-evening flexibility could reduce average short-haul fares by 3–6 per cent on the most time-sensitive leisure routes.

3.17 SYSTRA (2017, pp. 33–36) observed that at unconstrained regional airports, leisure passengers can often retime flights with limited welfare loss. Within the London system, however, the absence of spare shoulder capacity means that early- or late-period restrictions primarily lead to lost movements rather than retiming. NEF (2023) argues that these benefits may be overstated once wider environmental costs are included, though this assessment does not incorporate explicit modelling of scheduling substitution.

3.18 Overall, the literature indicates that leisure markets exhibit moderate demand elasticity: tightening night or shoulder restrictions increases prices and limits choice, while modest flexibility mainly enhances affordability and schedule convenience. These effects are materially larger at congested London airports than at regional airports with surplus capacity.

Air-Cargo Users

Express Freight

3.19 For express operators, the relationship with night flying is close to binary: night access is fundamental to maintaining next-day delivery networks. CEPA (2016, pp. 28–30) characterises this as an “all-or-nothing" operating model, noting that sustained curfews at major UK hubs would risk rendering current integrator operations commercially unviable and could prompt relocation of hub activity to continental airports such as Leipzig or Cologne. In a full-curfew scenario, CEPA modelled potential national GDP losses of £2–3 billion per year (2006 prices). The study, however, presents this as an upper-bound illustrative scenario rather than a prediction of immediate sector withdrawal.

3.20 Studies by EEA/Oxford Economics (2011, pp. 6–10) and Frontier Economics (2015, pp. 18–20) reinforce the sector's economic significance, estimating the express industry's contribution at approximately €23 billion to EU GDP and US$140 billion globally. Both studies highlight the high proportion of consignments moved through overnight networks, indicating that a majority of express shipments depend on night-period operations for next-day delivery.

3.21 Operator evidence supports this pattern. FedEx (2023, pp. 11–13) reports that its Paris–CDG hub—predicated on overnight sorting—supports 22,000 jobs and €1.85 billion in GVA. Similar models apply to DHL and UPS at East Midlands Airport. York Aviation (2021, pp. 40–42) estimates that the UK express-freight sector contributes around £7 billion GVA and 38,000 jobs. Industry interviews and case studies suggest that when night restrictions tighten, integrators tend to re-optimise networks rapidly—often within seasonal scheduling cycles—via rerouting to continental hubs, reducing UK throughput where night access cannot be maintained.

General Cargo

3.22 For non-integrator freight, reactions are more nuanced. SYSTRA (2017, pp. 37–38) found that when early-morning arrivals are delayed, forwarders increase warehouse inventories and switch high-value goods to road or sea-air combinations, raising logistics costs. CEPA (2019, pp. 22–23) noted that later belly-freight arrivals disrupt same-day distribution to the Midlands and North, while Oxford Economics (2014, pp. 20–21) identified knock-on productivity losses in export-intensive sectors.

Airlines

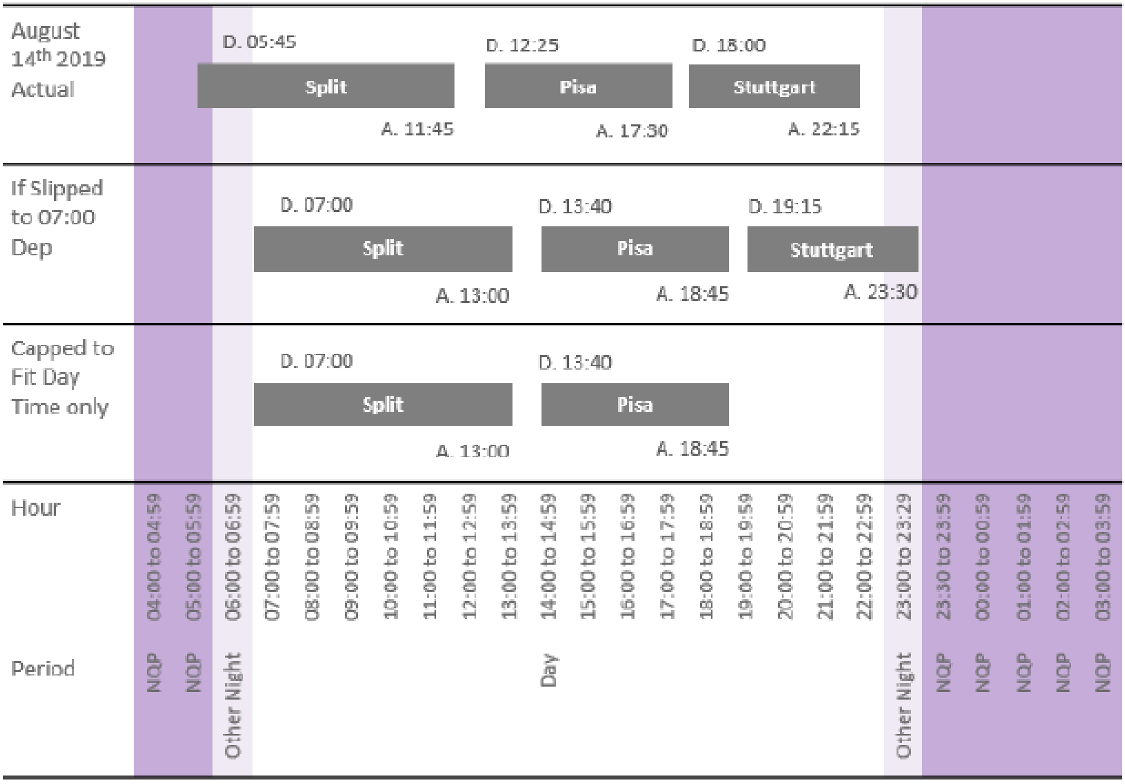
Low-Cost Carriers (LCCs)

3.23 LCC reactions are primarily governed by aircraft-utilisation economics. York Aviation (2021, pp. 28–30) shows that losing departures in the 06:00–07:00 hour typically removes one rotation from daily short-haul patterns, reducing utilisation by 8–12 per cent and increasing average fares. Oxera (2023, pp. 31–33) estimates that this translates into a 5–7 per cent rise in cost per available seat kilometre (CASM). Removal of late-evening flexibility produces similar effects, as aircraft may be unable to return to base, leading to out-of-position aircraft and next-day cancellations. York Aviation's schedule-illustration (2021, p. 27) demonstrates how early-morning and late-evening slots anchor the structure of an LCC operating day. In response, LCCs tend to adjust through a combination of higher fares, reduced rotations, or selective capacity withdrawal.

3.24 Slot-allocation literature explains this sensitivity. Frontier Economics (2018, pp. 12–15), the CMA (2018, pp. 7–9) and CEPA/CAA (2015, pp. 10–12) each find that grandfathering rules restrict new entry at congested airports, with scarce peak-period slots reinforcing incumbent advantage. Night and shoulder periods therefore represent the most accessible capacity for LCCs. Tightening curfews reduces these opportunities, whereas limited easing can support entry and strengthen fare competition.

3.25 Where early-morning or late-evening access is constrained, LCCs typically adjust through capacity trimming rather than widespread retiming. This reflects the economics of mixed-sector networks: the viability of the daily fleet plan depends on a scheduling window long enough to accommodate both shorter intra-European sectors and longer leisure markets. When the day shortens, the least efficient rotations are removed, reducing total seat supply on affected routes. Figure 3.1 shows an example of how an easyJet aircraft might lose a rotation if the day were to be shortened.

Figure 3.1: easyJet Example Schedule for London Gatwick Based Aircraft, Summer 2019



Source: OAG, York Aviation.

Network and Full-Service Carriers

3.26 Network carriers adjust primarily through connection-bank restructuring. CEPA (2019, pp. 25–28) simulated curfew scenarios for Heathrow and found that removing pre-07:00 arrivals reduced feasible same-day long-haul–short-haul connections by around 10–15 per cent, while allowing limited flexibility within existing night-period QC limits increased connectivity by 5–6 per cent without increasing total movements. AEC (2024, pp. 26–27) likewise projected that tighter early-morning restrictions could divert around one to one-and-a-half million transfer passengers, depending on the scenario, to continental hubs such as Amsterdam, Paris and Frankfurt. When relaxation occurs, carriers generally respond by retiming existing services rather than adding new movements, reflecting both slot scarcity and the structure of hub-bank operations. Decisions are therefore strongly influenced by whether adjacent shoulder-period slots are available for displacement or recovery.

Charter and Holiday Airlines

3.27 Charter and holiday airlines tend to react through programme compression when night or shoulder access is limited. York Aviation (2021, p. 32) found that prohibiting departures before 06:00 or arrivals after 23:00 can reduce peak-season seat supply by up to 10 per cent, particularly during school-holiday periods, with corresponding increases in some package prices. These effects arise because many leisure programmes rely on the aircraft completing two rotations per day to Mediterranean and Canary Islands destinations; when early-morning or late-evening slots are removed, only a single rotation becomes feasible. Conversely, limited relaxation of these windows allows operators to restore two-rotation schedules, improving aircraft utilisation and supporting more affordable peak-period pricing. This reflects the strong dependence of charter operations on daily utilisation and schedule length, rather than demand alone.

Cargo Airlines

3.28 General cargo operations exhibit high geographical mobility. Evidence from CE Delft (2011, pp. 15–18) shows that following Frankfurt's 2012 night-flight ban, a substantial share of freighter activity relocated to Cologne and Leipzig. While this produced only limited effects at the European system level, the study reported material local economic losses at Frankfurt, reflecting the ease with which non-express cargo can be reallocated across hubs. CEPA (2019, pp. 29–30) reaches similar conclusions for the UK, noting that in the absence of sufficient night or shoulder capacity, traffic would be likely to migrate to alternative European hubs—such as Liège, Cologne or Paris—rather than cease altogether. Such relocation would reduce UK-based employment in ground handling, maintenance and customs operations, lengthen supply-chain trucking distances, and diminish service quality for time-sensitive users, even if overall European freight capacity remained unchanged.

Integrator Airlines

3.29 Integrator airlines operate fully integrated networks combining air and ground distribution to deliver guaranteed overnight and next-day services. Their operations depend on tightly synchronised night-time hub banks, with arrivals into sorting centres such as East Midlands, Leipzig/Halle, Paris–Charles de Gaulle and Cologne/Bonn typically concentrated between late evening and the early hours of the morning (approximately 22:00–05:00). As noted by Oxford Economics (2011, pp. 6–10) and Frontier Economics (2015, pp. 10–14), these carriers manage the entire transport chain from shipper to consignee and rely on guaranteed next-day delivery as their core proposition; night-period access is therefore intrinsic to the business model rather than a discretionary scheduling choice. CE Delft (2011, pp. 55–59) similarly emphasises that this hub structure makes night access a necessary operational condition for express integrators.

3.30 The literature consistently finds that curfews or significant night restrictions would have structural, rather than marginal, effects on this segment. CEPA (2016, pp. 28–30) describes the express sector's relationship with night flying as effectively "all-or-nothing": if core hub operations at major UK airports were constrained, carriers would be likely to relocate to continental hubs where night operations are permitted. This would not imply an immediate network collapse but rather a progressive off-shoring of UK-based sorting and hub activity, with associated losses of high-value employment and ancillary logistics services. In a full-relocation scenario, CEPA estimated a potential GDP impact of £2–3 billion per year (2006 prices), explicitly characterising this as a modelled upper-bound outcome rather than a forecast.

3.31 Subsequent analyses reinforce the conclusion that integrators are more likely to respond through relocation than through scaling down their networks. York Aviation (2021, pp. 33–36) and CE Delft (2011, pp. 59–63) both show that express networks have a high degree of geographical flexibility across European hubs, enabling them to maintain service continuity even if one airport introduces tighter curfews. However, this flexibility entails substantial local displacement: national or EU-wide GDP effects may be muted, while job and revenue losses are concentrated around the affected airport. Frontier Economics (2015, pp. 18–20) similarly notes that the economic value generated by express freight is heavily concentrated in high-value, time-critical consignments, implying that the viability of the UK as a logistics base depends on maintaining predictable night-period access.

3.32 Overall, the evidence suggests that integrators are unlikely to adapt gradually to significantly tighter UK night restrictions. Instead, they would primarily restructure their networks around hubs offering more flexible night operations and more advantageous time zones, with continental airports such as Leipzig, Cologne, Liège or Paris being the most plausible alternatives. In the context of changes within the London system, some activity could also be re-based at other UK locations—most notably East Midlands—where night-time operations are better aligned with integrator requirements. This contrasts with general cargo airlines, which typically adjust through a mix of rescheduling, partial relocation and use of alternative airports within the same country.

Airports

3.33 Airports respond to night-flying regimes through a combination of operational management, slot policy and broader strategic positioning:

- Operational adaptation – Oxera (2023, pp. 27–29) and SYSTRA (2017, pp. 40–42) show that the 06:00–07:00 hour acts as a buffer that smooths the 07:00–09:00 peak. Reclassifying this hour as "night" would increase average delay by around 3–5 minutes per movement, raising fuel burn and emissions. Conversely, limited flexibility in this period can deliver reliability improvements equivalent to roughly a 5 per cent increase in effective runway capacity, without increasing movements.

- Slot allocation and competition – Frontier Economics (2018, pp. 12–15) estimated that scarcity rents at Heathrow are on the order of £2 billion per year, reflecting extreme slot scarcity. The CMA (2018, pp. 7–9) and CEPA/CAA (2015, pp. 10–12) find that grandfathering rules and limited time-of-day flexibility restrict entry opportunities and entrench incumbents. Night and shoulder periods therefore represent the only practical points of entry for new carriers. Tightening curfews reduces these opportunities, whereas limited easing can support slot trading and market contestability.

- Strategic positioning – Heathrow's night flight regime has remained largely unchanged since 2006, comprising a fixed movement cap (5,800 winter / 3,250 summer movements between 23:30–06:00) and a QC-based noise-quota system. While the aircraft mix has shifted towards quieter types, the regulatory framework has not materially loosened. This contrasts with several continental hubs—such as Paris-CDG and (historically) Amsterdam Schiphol—which operate aggregate noise-energy caps that allow some scheduling flexibility provided total noise remains stable. CEPA (2019, pp. 30–31) and AEC (2024, pp. 28–29) identify these airports as key beneficiaries of displaced transfer and cargo flows from Heathrow's constrained early-morning window. The literature indicates incremental diversion of specific long-haul arrivals and freight flows, rather than wholesale route loss. CEPA (2019) notes that some Asia-Pacific and African services unable to secure early-morning arrival slots at Heathrow have instead been developed at Amsterdam, Paris or Frankfurt, which offer arrivals between approximately 04:30 and 06:00 to feed morning banks. On the freight side, AEC (2024) and York Aviation (2021) observe that integrator and general-cargo operators have channelled incremental growth through Liège, Leipzig and Paris-CDG, reflecting their more permissive night-period regimes. While UK access is maintained, Heathrow's share of early-morning connectivity and its scope to attract new long-haul markets are constrained. Both CEPA (2019) and AEC (2024) conclude that increased scheduling flexibility within a constant-noise or QC-cap framework would enhance competitive performance without increasing environmental impacts.

- Economic and community outcomes – York Aviation (2021, p. 41) and AEC (2024, p. 27) estimate that night operations at Heathrow support approximately 9,000 jobs and £1.4 billion GVA, concentrated in high-value airport and logistics activities. Noise-quota systems provide a mechanism for balancing throughput with community impact management. CE Delft (2011, p. 26) and NEF (2025a, p. 18) argue that night-noise health costs remain significant, valuing European externalities at €2–3 billion per year.

Summary

3.34 The literature collectively indicates that aviation markets exhibit asymmetric but measurable responses to changes in night-flying policy. Impacts differ across user groups and market segments, reflecting variations in time-sensitivity, substitution possibilities and operational flexibility:

- Passengers – Business travellers remain the most time-sensitive, particularly those reliant on early-morning arrivals or late-evening returns. When access to these periods is restricted, they typically adjust through retimed flights, rerouting via continental hubs, or reducing the feasibility of same-day travel (CEPA 2016; SYSTRA 2017; Oxera 2023; York Aviation 2021). Leisure passengers, who are more price-sensitive, experience higher fares and reduced frequency when aircraft utilisation falls (York Aviation 2021). Airports Commission (2015 TEE) and SYSTRA (2017) show that where limited flexibility exists in adjacent shoulder hours, a significant share of displaced leisure demand can be re-accommodated, moderating overall impacts.

- Freight users – The express-freight model is highly time-dependent. Integrators rely on overnight hub operations to maintain guaranteed next-day delivery; material restrictions in the core night period would likely prompt the relocation of hub activity to continental Europe (CEPA 2016; Oxford Economics 2011; York Aviation 2021). In contrast, general-cargo operators display greater adaptability, commonly rescheduling operations or using alternative airports within the same country (CE Delft 2011; CEPA 2019). Overall, limited night flexibility supports efficient express operations, while tighter restrictions tend to redistribute activity to other hubs rather than eliminate it, with associated local economic effects.

- Airlines – The effects of night restrictions vary by business model. Low-cost carriers rely on early-morning and late-evening rotations to sustain high utilisation, so curfews increase unit costs and reduce seat availability (York Aviation 2021; Oxera 2023). Network carriers experience reductions in viable transfer combinations when pre-07:00 arrivals are curtailed, affecting the commercial robustness of some long-haul services (CEPA 2019; AEC 2024). Charter airlines face compression of summer programmes when the operating day shortens, reducing productivity and increasing fares. Across these models, the dominant effects occur through reduced efficiency and scheduling flexibility, with the greatest impacts at airports operating near capacity limits.

- Airports and competitiveness – Studies also identify wider strategic and market-structure effects. At congested airports such as Heathrow, tighter night restrictions increase slot scarcity and reinforce incumbent advantages (Frontier Economics 2018; Oxera 2023). Conversely, modest relaxation within constant noise-quota or QC caps can improve utilisation, connectivity and competitive positioning without expanding the noise footprint (CEPA 2019; AEC 2024). Continental hubs with more flexible night regimes, such as Paris-CDG and Amsterdam Schiphol, have been able to attract some traffic that cannot be accommodated within the UK's more constrained early-morning window.

3.35 Taken together, the studies reviewed—anchored in the work of CEPA, SYSTRA, York Aviation and Oxera, and supported by Frontier Economics, AEC, the Airports Commission and CE Delft—suggest that the UK aviation market is both resilient and sensitive to regulatory timing. The evidence points to significant impacts when night access is restricted at capacity-constrained airports, but more moderate gains from limited relaxation. These effects arise mainly through changes in connectivity, utilisation and network structure. However, in highly constrained environments, night-period restrictions can also materially affect total traffic volumes by limiting the feasibility of early-morning or late-evening movements.

4. Integrating Air Cargo Activity into TAG Surplus Analysis

Introduction

4.1 This section explores the available evidence on the Value of Freight Travel Time Savings (VFTTS) in the context of air cargo, with a particular focus on express freight services and time-critical logistics. The need for a robust treatment of freight VFTTS arises due to a recognised gap in the Department for Transport's TAG guidance, which currently provides freight-specific values mainly for surface modes and does not include dedicated values for air cargo. This omission is particularly material in the context of night flying, where curfews and restrictions can directly impact the time-sensitive operations of integrators such as DHL, FedEx and UPS, as well as specialist medical and critical logistics providers.

4.2 A range of international and academic literature has attempted to quantify VFTTS using varying approaches, including stated preference (SP) surveys, revealed preference (RP) methods, hedonic pricing models, and inventory-based theoretical frameworks. In the absence of UK-specific published VFTTS values, this review also presents a set of reasoned estimates developed by the authors, based on economic logic, international benchmarks, and UK trade data.

4.3 The section then moves on to consider how the literature reviewed might be used to integrate freight impacts into TAG for the purposes of this analysis.

Key Elements of TAG Surplus Analysis

4.4 TAG's aviation appraisal framework (TAG Unit A5.2) focuses primarily on Transport Economic Efficiency (TEE), with the core economic welfare changes being broken down into:

- Consumer surplus – The benefit to passengers who pay less (or gain more value) than their maximum willingness to pay.
- Producer surplus – The economic rent or benefit captured by airlines and airport operators.
- Government revenues – Mainly derived from aviation taxes and changes in public accounts.
- Time-related impacts – Including changes in Generalised Journey Time (GJT), delays, and frequency improvements.
- Environmental and social impacts – Including carbon, noise, air quality, and safety.
- Shadow costs – A central feature for capacity-constrained airports, representing the economic rent captured due to scarcity of slots.

4.5 These impacts are monetised using standard cost-benefit analysis principles, with changes calculated between baseline and intervention scenarios. In the context of this assessment of the socio-economic benefits of night flying, environmental impacts are out of scope for this analysis. The DfT is undertaking other studies to examine environmental impacts, notably the Aviation Night Noise Effects (ANNE) study and the Aviation Noise Attitudes Survey (ANAS).

4.6 TAG uses a demand curve and generalised cost framework to estimate surplus changes. Specifically:

- Consumer surplus is calculated using a rule-of-half method that captures changes in generalised cost (fare + time costs) and the corresponding change in passenger volumes.

- Producer surplus is the difference between revenue (including any shadow pricing) and operational costs.
- Shadow costs apply in constrained airports, allowing airlines to charge fares above marginal cost.
- GJT accounts for total non-fare costs including waiting time, delays, and frequency; it is monetised using the Value of Time (VoT) by passenger type.

4.7 The framework is presented diagrammatically in Appendix A of Unit A5.2, showing market equilibria before and after interventions (Figures A1–A3). These diagrams illustrate how changes in constraints, pricing, or supply influence welfare.

Fitting the TAG Aviation Framework to Cargo

4.8 The table below sets out how the cargo market can be appraised in the same welfare-theoretic framework, using VFTTS as the freight analogue of VoT and shipping cost as a proxy for generalised cost.

Table 4.1: Mapping of TAG to Air Cargo Equivalents

TAG Passenger Element	Air Cargo Equivalent
Consumer surplus	Shipper surplus – the gap between willingness to pay (WTP) and actual shipping cost per shipment or tonne.
Producer surplus	Airline/logistics provider surplus – economic rents from premium services or constrained access.
Government revenue	No direct equivalent to APD.
Generalised Journey Time	End-to-end delivery time including airport processing, flight time, and last-mile delivery.
Value of Time (VoT)	Value of Freight Travel Time Savings (VFTTS) – varies by commodity and urgency.
Shadow pricing	Slot or capacity constraints leading to pricing premiums in freight handling, particularly for integrators.

4.9 To replicate the TAG framework for cargo, it is, therefore, necessary to calculate the following:

- For cargo user (shipper) surplus:
  - Initial and changed shipping prices (or generalised costs).
  - Estimated demand response to changes in delivery time or cost.
  - Willingness to pay for different urgency classes of shipments.
  - Estimated VFTTS for different cargo types (e.g. £ per tonne hour by urgency).
- For cargo airline / operator surplus:
  - Operating cost changes (e.g. from delay, rerouting, curfews).
  - Revenue changes due to loss of premium shipments or reduced capacity.
  - Slot scarcity or delay penalties driving up effective pricing (shadow rents).
  - Capacity constraints on overnight or integrator slots.

4.10 This enables surplus to be calculated using either the rule-of-half (for consumer surplus) or changes in profit margins / rents (for producers), analogous to the equations used in TAG A5.2. Below, we consider specifically the evidence from literature around the value of time for air cargo.

Values of Time for Air Cargo

Research Approaches and Core Literature

4.11 The VFTTS literature is fragmented but growing. Shires and de Jong (2009) provide one of the most comprehensive efforts in their international meta-analysis of around 1,300 VTTS observations from 77 studies. They show that values of time vary widely by commodity, transport mode and journey purpose, and tend to be higher in higher-income contexts and for time-critical movements. Although the study is not focused on air cargo specifically, its findings are consistent with the expectation—confirmed more directly in freight-specific work such as De Jong et al. (2004) and Binsuwadan et al. (2021)—that air freight lies toward the upper end of the freight VFTTS distribution.

4.12 Zamparini and Reggiani (2007) similarly conduct a meta-analysis of passenger and freight VTTS across Europe and North America. They find that the value of time for air travellers—especially on business trips—is significantly higher than for other modes, with estimates for air business travel often exceeding about 140% of the traveller's hourly wage. This study focuses on passengers rather than freight, but the strength of time preferences in air business markets offers a useful analogue for express air freight, where speed and reliability are likewise core attributes.

4.13 Konishi et al. (2014) adopt a different approach, using hedonic pricing models to estimate the value of freight time in Japanese air cargo markets. Their model endogenises transport time as a function of observable shipment characteristics and freight charges. Applying this framework to shipment-level data, they estimate VFTTS values of ¥1,232–¥1,966 per hour (2010 yen), equivalent to roughly £6.50–£10.30 per hour at contemporary exchange rates. These estimates reflect average shipment-level decisions and imply much higher marginal values for high-value, low-weight goods—such as ultra-urgent cargo—where the time premium is disproportionate to mass.

4.14 The IATA Time and Temperature Task Force and associated industry case studies (e.g. DHL Express and FedEx service guarantees) highlight the commercial importance of time in sectors such as pharmaceuticals, organ transport, and emergency logistics. Although these sources rarely express VFTTS in monetary terms, they reinforce the conclusion that delay costs for time-critical cargo can be substantial and, in some cases, business- or life-threatening.

4.15 Recent UK-facing work, including York Aviation (2021) and Oxera (2023), has begun to draw these insights into slot-allocation and night-flying debates. York's work identifies cascading effects whereby missed night slots can undermine whole route structures, particularly for long-haul and express operations. Oxera's analysis for Gatwick Airport (2023) embeds these effects within a TAG-consistent welfare framework, while an earlier Oxera behavioural experiment for DfT (2019) examined the marginal value of slots under alternative allocation mechanisms. However, neither strand of work quantifies VFTTS directly. As such, the estimates developed in this review serve to fill that gap.

Express Freight in the Literature

4.16 A notable subset of the reviewed studies explicitly or implicitly considers express freight services—most commonly in the form of parcel, courier, or time-definite products handled by integrators. These studies consistently report values of time that are significantly higher than general cargo, sometimes by an order of magnitude.

4.17 Inregia (2001), in its Swedish stated preference study, included both air and express cargo and reported exceptionally high VTTS compared with other freight modes, consistent with the premium segment targeted by air express.

4.18 De Jong et al. (2004) segmented shippers by cargo type and found that parcel/express shipments exhibited extremely high VTTS, with air freight values reaching as much as €7,935 per shipment-hour. This result is one of the clearest indications of how express freight can dominate average VFTTS figures when not disaggregated.

4.19 Japanese hedonic pricing studies (e.g. Konishi 2014) also found especially high willingness-to-pay for speed among cargo types matching the express profile. Although these studies do not isolate express services explicitly, the segments analysed are close in structure to integrator-type operations.

4.20 The meta-analysis by Binsuwadan et al. (2021) identifies air freight as having the highest average VFTTS across all transport modes. While the study does not break out express separately, the extreme values attributed to air are understood to be strongly influenced by time-critical segments such as high-value parcels and express deliveries.

4.21 Feo-Valero et al. (2011, 2016) further observe that express freight markets are one of the few domains where stated preference surveys return consistently high valuations for time savings, supporting the case for differentiated modelling of such flows.

4.22 This evidence collectively supports the conclusion that express freight services represent the upper end of the VFTTS spectrum, and that failure to account for these services separately may result in substantial underestimation of time-related economic costs.

Table 4.2: Air Cargo VFTTS and Express Freight Consideration in the Literature

Study	VFTTS (Air Cargo)	VFTTS (Express Cargo)	Notes
Inregia (2001)	High (not quantified)	Very High (qualitative)	SP survey included express freight; values exceed road/rail significantly
De Jong et al. (2004)	~€400–800per tonne hour (implied)	€7,935 per shipment-hour	One of the few to report per-shipment express values
Konishi et al. (2014)	¥1,232–1,966/hr (~£6.5–£10.3/hr)	High (implied for high-value low-weight shipments)	Based on hedonic pricing in Japan, shipment-level data
Binsuwadan et al. (2021)	£40–£52/hr (converted)	Express likely drives upper bound	Meta-analysis; highest VFTTS values attributed to air freight overall
Feo-Valero et al. (2011, 2016)	Not numeric	Very High (qualitative)	Literature reviews highlight express as outlier in SP valuations

4.23 This table reinforces the view that the express freight segment consistently yields the highest time valuation, whether measured per tonne, per hour, or per shipment. These studies, despite varied methods, all converge on the conclusion that express cargo is economically distinct from general air freight and requires separate modelling in transport appraisal.

Summary of Key Studies on Freight VFTTS

4.24 The table below summarises the principal studies reviewed and their relevance to the estimation of VFTTS for air cargo.

Table 4.3: Summary of Value of Freight Time Savings Studies Reviewed

Study	Method	Key Findings	Strengths	Relevance to This Study
Binsuwadan et al. (2021)	Meta-analysis (106 valuations, 56 studies)	VFTTS varies by GDP, mode, and respondent; meta-regression allows estimation for missing contexts	Robust dataset; explanatory modelling	Key benchmark for UK VFTTS; supports differentiated estimates by mode/type
Feo-Valero et al. (2021)	Conceptual review	Highlights data gaps, decision-maker heterogeneity, and methodological issues	Strong critical framing	Supports structuring of assumptions and segmentation by decision agent
KTH Sweden (2014)	Empirical survey and modelling	Found modal and supply chain complexity affects VFTTS; air not directly sampled	Advanced logistics context	Validates modelling choices and multimodal chain logic
de Jong (2007)	Theoretical foundation	Classic summary of VFTTS concepts and methods; limited modern empirical evidence	Good for framing and consistency	Establishes baseline assumptions and history of VFTTS development
Konishi et al. (2014)	Hedonic pricing of Japanese shipment data	VFTTS estimates: ¥1,232–1,966/hr (~£6.50–£10.30/hr)	Based on real transactions; shipment-level	Supports modelling of high-value air cargo in express networks
Koike et al. (2020)	Computable General Equilibrium (CGE) model	VFTTS linked to productivity, not just inventory; systemic effects emerge	Captures macroeconomic feedbacks	Highlights that standard VFTTS may understate broader economic costs
IATA / Trade Consultants (2019+)	Trade elasticity modelling	1% increase in connectivity leads to 6.3% increase in trade	High policy relevance	Reinforces link between time, connectivity, and economic performance
ScienceDirect Meta (2021)	Meta-analysis (broad freight)	Confirms wide variance; explains heterogeneity by mode and commodity	Corroborates other meta-studies	Useful as a parallel reference for range and variation
Air Cargo Product Portfolio (2023)	Commodity mix impact on VFTTS	Composition of goods shapes time sensitivity in air cargo	Highlights dynamic change	Supports scenario sensitivity and futureproofing
Inregia (2001)	Stated preference (SP) survey in Sweden	Included express and air freight; reported very high VTTS for express cargo	Captures express freight explicitly in SP	Demonstrates premium time value in express/parcel logistics
Konishi et al. (2014)	Hedonic pricing of shipment-level data	Found high willingness to pay for time among parcels/express-type shipments	Based on detailed Japanese market data	Supports express freight valuation; strengthens hedonic pricing evidence

Deriving Estimates of VFTTS for Air Cargo

4.25 To estimate VFTTS across different urgency classes and operator types, a potential option is to adopt an inventory-cost-based approach widely used in freight appraisal (e.g. de Jong 2007; Feo-Valero et al. 2011) and consistent with the economic logic summarised in Shires and de Jong (2009). This method assumes that the value of saving an hour in transit is equal to the inventory carrying cost of goods in motion:

VFTTS = (Value per Tonne x Inventory Carrying Cost % per year) / Hours in a year

4.26 Where:

- *Value per tonne* is derived from UK HMRC trade data and international sources such as UN Comtrade.
- *Inventory carrying costs* reflect capital costs, depreciation, obsolescence, insurance, and risk, typically ranging from 8% to 20% per year.

4.27 A set of commodity-level estimates was constructed for ten representative HS-2 categories. For example, pharmaceuticals (HS 30) were assigned a value of £200,000 per tonne and a 20% annual carrying cost, yielding a VFTTS of £4.57 per tonne per hour. Lower-value categories, such as paper goods or cereals, yield values below £0.10per tonne hour.

4.28 Commodities were grouped into four urgency classes (ultra-urgent, high, medium, and low), with separate values for integrator and general air cargo operators. The tables below summarise the outcome. This approach could be applied directly to cargo travelling to / from the three designated airports using HMRC data.

Table 4.4: Detailed VFTTS Derivation Table

HS Code & Commodity	Value per tonne (£)	Inventory Cost (%/yr)	Annual Inventory Cost (£)	Hourly Cost (£) = VFTTS (£ per tonne hour)
HS 30 – Pharmaceuticals	200,000	20%	£40,000	**£4.57**
HS 85 – Electronics	150,000	18%	£27,000	**£3.08**
HS 90 – Medical instruments / optics	120,000	18%	£21,600	**£2.47**
HS 87 – Vehicles & parts	20,000	15%	£3,000	**£0.34**
HS 64 – Apparel & footwear	5,000	12%	£600	**£0.07**
HS 02 – Meat & meat offal	3,000	12%	£360	**£0.04**
HS 10 – Cereals	400	10%	£40	**£0.005**
HS 48 – Paper & printed goods	1,500	10%	£150	**£0.02**
HS 39 – Plastics & articles thereof	1,800	10%	£180	**£0.02**
HS 72 – Iron & steel	800	8%	£64	**£0.007**

Table 4.5: VFTTS by Urgency Category

Urgency Level	Typical Goods	General Cargo VFTTS (£ per tonne hour)	Integrator Cargo VFTTS (£ per tonne hour)	Basis
Ultra-Urgent	Documents, AOG, organs	£10	£50–100	High value/low mass; priced per item
High	Pharma, express electronics	£4.5	£15	Derived from £200k/t × 20% ÷ 8760
Medium	Perishables, apparel	£0.5	£2.0	Mid-value, time-sensitive
Low	Paper, plastics, steel	£0.05	£0.3	Low value, high tolerance

4.29 Overall, the literature clearly supports the economic significance of travel time for air cargo—particularly in time-definite and urgent sectors. While values differ by method and context, inventory-based approaches provide a practical and transparent method for estimating VFTTS in the absence of observed pricing data. Differentiating between general cargo and integrator services, and between urgency classes, is essential for credible evaluation. The estimates developed here offer a basis for embedding freight-related delay costs into appraisals of night flying restrictions, slot policies, and infrastructure development but will need further refinement.

Identified Gaps within Research

4.30 While the preceding sections capture the core literature on freight VFTTS, several important themes are under-represented or emerging:

- Express Freight as a Structurally Distinct Market - Much of the existing aviation appraisal literature treats cargo as a homogenous activity, without distinguishing between express services (such as DHL, UPS, and FedEx) and general freight. However, express freight operates on fundamentally different economics: speed is the primary product, and willingness-to-pay for reliability and early delivery windows is significantly higher. Integrators typically schedule peak operations in narrow night-time windows (22:00–06:00), and their value proposition is tightly coupled to these slot availabilities. Studies such as Inregia (2001) and de Jong et al. (2004) are particularly important for recognising this distinction, but broader integration into mainstream appraisal tools remains limited.

- Reliability and Predictability in Freight Valuation - Most economic valuations of freight time savings focus on mean delay or scheduled journey time. However, freight operators—especially in high-value, just-in-time (JIT) or medical logistics—often prioritise reliability over average speed. Variability in delivery times can disrupt downstream production, lead to missed client SLAs, or require costly inventory buffers. Although some studies in the passenger domain incorporate 'value of reliability', there is limited application to freight. This represents a methodological gap, as observed in KTH Sweden (2014), where the inclusion of variability and schedule risk altered valuations substantially.

- Cascading and Network Effects of Delay - The impact of delayed or displaced night freight flights may propagate across complex distribution networks. For integrators, missing a hub arrival window by even an hour can render the entire aircraft load obsolete for next-day delivery targets, leading to lost value that far exceeds a linear time cost. While York Aviation (2021) and Oxera (2023) begin to acknowledge the non-linear impacts of slot displacement, more detailed modelling of cascading network effects is lacking in standard appraisal methods.

- Modal Substitution and Market Leakage Risks - In some scenarios, curtailing night flying might push general freight to slower modes, such as road or maritime, or to non-UK airports. The opportunity cost of losing time-sensitive traffic to Amsterdam, Paris or Leipzig—major 24-hour European hubs—is not well captured in UK-specific appraisals.

- Empirical Data from Commercial Practice - While the academic literature provides strong theoretical grounding, evidence from commercial integrator operations—e.g. FedEx, DHL, UPS—offers valuable real-world validation. This includes pricing models, delivery guarantees, and customer service level agreements (SLAs) that embed time value implicitly. Annual reports, network optimisation research, and recent IATA-led studies provide insights into how VFTTS is operationalised in practice. For instance, the IATA (2023) report on *Air Cargo in Global Value Chains* links connectivity with trade elasticity, reinforcing the economic stakes of timeliness.

- Product Mix and Dynamic Time Sensitivity - A growing strand of research has highlighted how the composition of cargo affects VFTTS. The 2023 study on *The Value of the Air Freight Product Portfolio* demonstrates that changes in the mix of goods (e.g. increase in e-commerce, healthcare logistics) can shift aggregate VFTTS upward over time.

Conclusions

4.31 The literature to date highlights that there is no simple answer as to how to integrate air cargo activity within a TAG style appraisal of the socio-economic effects of night flying. There are, however, building blocks for a strong theoretical backing for their inclusion and that, certainly for express freight VFTTS is likely to be significant given the urgency and reliability type requirements of these shipments. Hence, while approaches have been identified in the accompanying methodology report that are reasonable for the purposes of this research, updating TAG more broadly would require further more detailed research to ensure effective integration.

5. Assessing Wider Economic Impacts

Introduction

5.1 Beyond the direct and welfare-based effects captured through standard appraisal methods, aviation generates a range of wider or catalytic economic impacts that influence productivity, trade, and regional development. This section examines how these broader effects have been defined, measured, and interpreted within the literature, and how they can be integrated into appraisal frameworks such as TAG. It reviews the principal analytical approaches used to estimate wider impacts—spanning input–output, econometric, computable general equilibrium, and regional elasticity models—and summarises the key findings from recent UK and international studies. The discussion focuses particularly on techniques that can be adapted to assess the wider economic implications of night flying, where connectivity, reliability and freight efficiency play a disproportionately important role.

What are Wider Economic (Catalytic) Impacts?

5.2 Aviation's influence on the economy extends well beyond the direct activities of airlines, airports and their immediate suppliers. In addition to the direct, indirect and induced effects captured by conventional input–output analysis, there exists a set of wider or catalytic effects that operate through the productive capacity of the economy. These arise when air connectivity enables firms and households to operate more efficiently, integrate with international supply chains and participate in high-value clusters of economic activity. This approach and interpretation are consistent with earlier Department for Transport–commissioned work on the wider economic impacts of regional air connectivity, which emphasised the conditional and context-dependent nature of such effects and the importance of connectivity quality rather than traffic volumes alone (Peak Economics, 2018). They include:

- Trade and investment channels – improved market access and FDI attraction through global connectivity.
- Agglomeration and knowledge spillovers – productivity advantages from spatial clustering of high-value industries.
- Labour-market access and mobility – enlargement of feasible job catchments, especially for high-skill labour.
- Reliability and resilience – time-critical logistics and network continuity, particularly dependent on night operations.

5.3 Recent synthesis work reinforces this interpretation, emphasising that aviation's wider economic impacts arise primarily through improved market access and network connectivity—rather than traffic volumes per se—by reducing effective distance between firms, markets and regions (Lenaerts et al., 2021).

5.4 These are *supply-side* effects that change the scale or efficiency of production rather than simply redistributing welfare between producers and consumers. In Green Book terminology they sit outside the conventional Transport Economic Efficiency (TEE) account but are part of the overall economic case for intervention. Capturing them is essential for aviation policy, because connectivity is both a consequence of and a driver for economic growth. Empirical evidence also indicates that the magnitude and nature of aviation's economic effects vary by airport role and network position, with hub and internationally connected airports typically exhibiting stronger and more persistent impacts than smaller or peripheral airports (Allroggen & Malina, 2014).

Integration with TAG A5.2 and the Green Book

5.5 TAG Unit A5.2 (Aviation Appraisal, May 2025) defines the analytical core of DfT's approach. It describes a welfare framework that compares consumer, producer and government surpluses between a baseline and a policy scenario. Passenger welfare changes are expressed through variations in fares, taxes, operating costs and *Generalised Journey Time (GJT)*; producer surplus reflects airport and airline profitability; and government surplus represents fiscal transfers. These form the TEE component of the Appraisal Summary Table.

5.6 However, A5.2 also recognises that *"there are potential aviation-specific impacts that are not explicitly addressed elsewhere within TAG … An aviation scheme may also lead to an increase in international trade and Foreign Direct Investment … There is currently no agreed methodology for estimating these aviation-specific impacts*" (para 3.2.15). In other words, DfT acknowledges the importance of catalytic effects but leaves their quantification to supplementary economic models. The practitioner is invited to apply *novel approaches* consistent with Green Book principles while avoiding double counting.

5.7 Three guiding rules follow:

- Complementarity – Wider impacts must be reported alongside, not within, the TEE to prevent overlap with consumer-surplus calculations.
- Evidence base – Quantification should rely on econometric or macro-structural relationships that link connectivity to productivity or output.
- Transparency and proportionality – Results should be presented separately in the Economic Case narrative with clear assumptions.

5.8 This provides latitude to extend appraisal beyond welfare effects. The remainder of this section therefore sets out how those extensions have been undertaken in the literature and how they can be embedded within the A5.2 framework when assessing the socio-economic benefits of night flying.

Channels of catalytic impact

(a) Trade and FDI

5.9 Oxford Economics (2013) used a growth-accounting framework to estimate how improved air connectivity[3] supports productivity and long-run GDP, treating trade, FDI and tourism as transmission channels rather than modelling them explicitly. It suggested that a 10% increase in connectivity could raise GDP by around 0.5%. Oxford Economics (2014) updated and extended this evidence base, quantifying the direct, indirect and induced effects of aviation from national accounts and discussing wider catalytic impacts using published econometric elasticities rather than input–output modelling. Early work for the Airports Commission by PwC (2013) reviewed the international econometric literature linking air connectivity to productivity, trade and foreign direct investment, identifying mechanisms through which improved connectivity can reduce effective trade frictions and expand market access.

[3] Defined as a measure focused on business-related air transport combining business passenger usage and air freight tonnage, then scaled by GDP to reflect the aviation-intensity of the economy.

Building on this evidence, the Airports Commission's wider economic impacts assessment (Airports Commission, 2015), drawing on analysis undertaken by PwC and other advisers, applied a hybrid approach in which connectivity–productivity relationships identified in the literature were translated into UK GVA and employment impacts using national supply-use tables. Together, this body of work concludes that improvements in air connectivity can contribute to long-term productivity growth and support trade and investment, while emphasising that these effects are incremental, subject to uncertainty, and dependent on assumptions about causality and market response..

(b) Agglomeration and productivity

5.10 Airports act as anchors for clusters of advanced services and manufacturing. The Airports Commission's wider economic impacts assessment (Airports Commission, 2015), together with subsequent analytical work for the Department for Transport, drew on agglomeration relationships from the empirical literature, consistent with WebTAG guidance (TAG A2.1). These studies typically adopt productivity elasticities with respect to effective employment density in the range reported in the wider agglomeration literature, rather than estimating new elasticities directly. The presence of international links enhances face-to-face contact and idea diffusion, magnifying these gains.

5.11 A recent meta-review by *Zhang and Graham (2019)* reinforces the importance of addressing causality when linking air connectivity and economic growth. They note that many observed correlations arise from demand following income, rather than the reverse. Using instrumental-variable and panel-data evidence, the study finds that air connectivity and GDP growth are bidirectionally related but asymmetrically so: improvements in connectivity do stimulate growth, yet the effect is modest relative to the influence of general economic expansion on air transport demand. This supports the treatment of air-connectivity improvements as a facilitator of productivity rather than a primary growth driver, consistent with the two-stage econometric frameworks developed by Percoco (2010) and adopted in later UK studies. Using U.S. industry-level data, Gillen (2016) finds that improvements in passenger airline network connectivity—particularly higher service frequency and a greater number of non-stop domestic and international destinations—are associated with higher productivity, with estimated elasticities of multi-factor productivity with respect to key connectivity measures typically in the range of around 0.03 to 0.09, depending on the sector and metric (Gillen, 2016).

5.12 New evidence from NEF (2025b) supports this need for causal caution. Using updated European regional panel data, they find that only 37% of regions show a causal effect from air connectivity to GDP, with most of Western Europe showing either no causal link or the reverse direction. NEF attribute this to business-travel decline, tourism deficits, and saturation in already well-connected regions.

(c) Labour-market and mobility effects

5.13 By connecting regional economies to national and global centres, aviation expands job opportunities and skill pools. Oxera's (2024) Gatwick study estimated a local employment elasticity of 0.13 % for every 1% change in air traffic, demonstrating measurable labour-market sensitivity to connectivity.

(d) Freight, reliability and supply-chain resilience

5.14 Express freight networks depend critically on the night window. York Aviation (2021) and FedEx (2024) report that around 45–50% of UK air-cargo tonnage moves at night. Curfews raise the "time cost of trade", estimated by Oxford Economics (2020 EEA study) at 0.6–2.3 % of goods value per day of delay. These reliability losses transmit directly into productivity reductions across time-sensitive industries.

(e) Dynamic and spatial spillovers

5.15 Connectivity also influences regional balance and innovation potential. The NEF (2025a) critique of Heathrow expansion emphasised displacement risks, yet the same mechanism operates in reverse: restricting capacity or night flights can drain high-productivity clusters of competitiveness with limited compensating gain elsewhere.

5.16 Independent reviews by the New Economics Foundation (2021; 2023; 2025) question the scale of aviation's wider economic benefits but do not provide new econometric evidence. Their analyses rest on secondary sources and advocacy arguments, emphasising potential double counting of catalytic effects and distributional concerns rather than presenting alternative quantified models. As such, these papers complement rather than contradict the empirical literature, reinforcing the need for clear causal distinction and careful treatment of displacement and double counting, but not overturning the general evidence that improved connectivity supports economic activity.

Methods and modelling approaches

Input–Output and multiplier models

5.17 Input–output (I-O) analysis forms the foundation of almost every airport impact assessment. It measures direct expenditure by the airport and airlines, indirect supply-chain purchases, and induced household spending. UK studies typically report GVA multipliers of 1.7–2.0 and employment multipliers of 2.0–2.5.

5.18 **Advantages**: transparency, regional disaggregation, and straightforward adaptation to local datasets (e.g. ONS SUT tables).

5.19 **Limitations**: fixed technical coefficients, no crowding-out, and inability to represent productivity change or displacement.

5.20 I-O remains the best method for *gross* local-area effects, including those from night flying activity (e.g. employment of ground staff and freight-handlers). To estimate *net* national effects, I-O results must be combined with econometric evidence on productivity and trade.

Connectivity–productivity econometric models

5.21 Econometric models establish the causal link between air connectivity, defined in a wide range of different ways, and macroeconomic performance. They relate regional or sectoral productivity (GVA per worker or TFP) to indices of air connectivity—often combining business passenger demand or passenger demand and / or freight tonnage:

- *Oxford Economics (2013, 2014)*: panel regression of 31 UK sectors (1980–2010), controlling for capital, labour and intermediate inputs; found 0.5 % productivity gain per 10 % connectivity rise.
- Using exogenous variation in long-distance air links across a global network, *Campante and Yanagizawa-Drott (2018)* provide strong causal evidence that improved air connectivity raises income and economic development, with implied effects equivalent to elasticities on the order of a few tenths of a percent for plausible increases in connectivity.
- *SEO (2024) for ACI Europe*: European regional panel (2004–2019) using spatial econometrics; 0.47% GDP and 1.6 % employment per 10 % connectivity.

- *Zhang and Graham* (2019) also provide quantitative context for the scale of catalytic or spillover effects. Their review suggests that, once endogeneity is controlled, a one-per-cent increase in air connectivity typically raises regional GDP by 0.02–0.05 per cent. The paper emphasises that spillovers through inward investment and agglomeration occur gradually and are strongest where connectivity is initially limited. For mature hub economies, marginal connectivity gains yield diminishing spillovers, supporting the use of cautious elasticity values in UK appraisal. Related work similarly cautions against relying solely on traffic volumes, noting that network-based connectivity measures provide a more informative representation of aviation's economic role (Van de Vijver et al.).

- Recent work by NEF (2025b) strengthens the case for careful use of conservative, context-specific elasticities. Their analysis identifies diminishing marginal productivity of connectivity in high-income aviation markets, with growth effects concentrated in Eastern Europe and inbound tourism regions. For the UK, classified predominantly within their "Cluster 3/4" group, NEF find limited evidence of connectivity-led GDP growth at the regional level.

5.22 **Advantages**: causal identification and policy relevance.

5.23 **Limitations**: high data requirement, limited to long-run average effects, typically national or regional rather than airport-specific.

5.24 For night flying analysis, these elasticities can translate marginal connectivity losses (e.g. removal of 10 % of departures) into productivity impacts consistent with Green Book reporting.

CGE and macro-simulation models

5.25 Computable General Equilibrium (CGE) models simulate the inter-industry and fiscal effects of aviation policies within a closed system of supply, demand and government accounts. The Airports Commission (2015) combined TAG wider-impact parameters (agglomeration, imperfect competition, labour tax) with PwC's trade elasticities in a national CGE framework. For Heathrow NWR, total wider impacts reached £ 11.5 billion NPV, dominated by trade-related productivity gains.

5.26 **Advantages**: economy-wide consistency, explicit displacement and tax feedbacks.

5.27 **Limitations**: complexity, parameter uncertainty, limited transparency to non-specialists.

5.28 CGE analysis is useful for national policy changes, such as curfews, carbon pricing or slot reform, but less suited to single-airport assessments.

Consumer-surplus and schedule-delay models

5.29 Where full econometric modelling is infeasible, *consumer-surplus* estimation provides a tractable alternative. Braun et al. (2010) demonstrated how constant-elasticity demand curves yield consumer-surplus changes as the area under the inverse-demand function. Applied to German air markets, aggregate surplus equalled €59 billion, roughly twice total revenue.

5.30 For night flying analysis, this approach can quantify willingness-to-pay for frequency and timing. By estimating elasticity of demand with respect to flight-time convenience, one can derive the welfare loss from moving flights out of the night period —a necessary complement to producer-surplus and shadow-price calculations in TAG A5.2 equations (1)–(3).

Network-reliability and resilience models

5.31 Reliability valuation treats predictability and timing as economic attributes of transport performance. In freight logistics, greater variability in delivery time forces firms to hold additional inventory or extend lead times in supply chains, both of which increase costs. International research on the value of reliability (notably Hummels & Schaur, 2013; Infras, 2008) shows that for high-value or time-sensitive consignments, each additional day in transit can be equivalent to an ad-valorem cost of roughly 0.6–2.3% of shipment value. For express freight, where guaranteed overnight delivery underpins the service model, even small reductions in network flexibility—such as curfews removing the ability to operate in preferred night or shoulder hours—translate into systematic expected delays relative to baseline schedules. This does not mean that individual flights are late, but that the earliest achievable delivery time for the market as a whole becomes later and less predictable.

5.32 Integrating such reliability valuations into productivity or GVA models allows analysts to translate night-flying restrictions into quantifiable economic impacts, analogous to the treatment of reliability within DfT WebTAG for surface transport. Applied to air-cargo networks, this captures how limits on night or shoulder-hour flexibility increase expected delivery times and reduce the effective productivity of high-value, time-critical sectors. In practice, any conversion from per-day time costs into hourly or scenario-specific values should be treated cautiously and tested in sensitivity analysis.

Case Study: Oxera (2024) Gatwick and the Percoco Method

5.33 The Oxera (2024) Gatwick Economic Impact Study introduces a potentially important methodological innovation by adapting the *Percoco (2010)* approach originally developed for Italian regional airports. Percoco's model estimated the elasticity between airport passenger volumes and regional employment/productivity using cross-sectional econometrics, allowing identification of net economic effects at the regional level after accounting for displacement.

5.34 Method structure:

- Step 1 – Estimate local employment–traffic elasticity -Using historical Gatwick employment and passenger data for the surrounding "Six Authorities Area", Oxera derived an elasticity of 0.13 % employment for each 1 % change in air traffic. This links changes in airport throughput to changes in total local employment rather than aviation jobs alone.

- Step 2 – Translate to GVA - Average GVA per worker by sector was applied to the incremental employment to yield total regional GVA change. This produces a *net* effect already adjusted for leakage and multiplier overlap, since the regression captures observed historical relationships rather than theoretical gross linkages.

- Step 3 – Apply proportionality to forecast scenarios - The derived elasticity was applied to future traffic scenarios, producing catalytic GVA estimates of £ 0.91 billion and 12,780 jobs—around 17 % of Gatwick's total economic footprint.

5.35 **Strengths**: Empirically grounded in observed regional dynamics rather than national averages. It helps to reduce the risk of double counting with direct/indirect I-O multipliers, since the regression outcome already embeds those effects. Provides a transparent way to infer *net* catalytic impacts of changes at an individual airport—precisely the challenge for night flying assessment.

5.36 **Limitations:** Cross-sectional rather than causal: correlation may not fully isolate exogenous traffic changes. Dependent on historic conditions; elasticities may differ in post-COVID contexts or under slot constraints. Does not explicitly separate passenger and freight effects.

5.37 The Oxera-Percoco framework offers a bridge between micro and macro approaches. It can be replicated for other airports using local employment data and thus provides a practical pathway for estimating the net regional impacts of night flight restrictions. If night operations constitute, say, 10 % of annual ATMs, applying the 0.13 % elasticity implies a 1.3 % reduction in local employment—an interpretable, evidence-based measure of net loss. There is also potential to extend the analysis to examine levels of productivity and the effects of freight.

Conclusions

5.38 The reviewed body of major studies shows broad convergence around a small set of empirically stable parameters but wide variation in technique and scope. Across all sources, three consistent patterns emerge.

- **Connectivity–productivity elasticity.** Independent estimates cluster tightly between **0.2 % and 0.6 % GDP gain for each 10 % rise in connectivity** (Oxford Economics 2013; Airports Commission 2013; SEO for ACI Europe 2024; Brueckner & Zhang 2020). This stability lends credibility for policy use.

- **Scale of catalytic contribution.** In comprehensive footprint studies such as Heathrow (2024) or Gatwick (2024), *catalytic* impacts account for roughly **45–60 % of total GVA**, exceeding the direct aviation footprint.

- **Disproportionate value of freight and night operations.** York Aviation (2021) and FedEx (2024) demonstrate that express freight, though a minority of tonnage, generates more than half of aviation's trade-related GVA because of high value-density and time sensitivity.

5.39 These findings imply that any restriction on night operations—where much of this freight and first-wave passenger traffic occurs—could plausibly impose losses that are significantly larger than those captured by standard welfare analysis alone, particularly in capacity-constrained systems. The extent of this divergence will depend on the scale of restrictions, the availability of alternative capacity, and the responsiveness of airlines and shippers.

5.40 There are a number of approaches identified that could be built upon to provide a targeted approach to considering the socio-economic impacts of night flying that would contribute positively to understanding above and beyond the confines of the core approach within TAG A5.2.

6. Conclusions

6.1 The literature reviewed provides a consistent and well-supported picture of the role of night flying within the UK aviation system. Although night-period movements form a small share of total ATMs, they support several functions that cannot readily be replicated within daytime capacity—most notably early-morning long-haul arrivals, late-evening returns, first-wave short-haul departures, and the overnight sorting operations of express freight integrators. These activities exhibit high marginal value because they enable airline schedules, transfer networks and time-critical logistics chains to operate efficiently.

6.2 Across the studies examined, restrictions on night flying are found to have asymmetric impacts: the losses associated with reduced night or shoulder-hour flexibility are typically larger than the gains achievable through limited relaxation. At capacity-constrained airports, where retiming options are limited, curfews translate directly into reduced connectivity, increased schedule delay or diminished operational resilience. For leisure markets, constraints lead to lower aircraft utilisation and higher fares; for business travel, they reduce the practicality of same-day trip patterns; and for freight, they raise the risk of missed cut-offs and impaired service reliability. Express operators, in particular, exhibit limited scope for within-day adjustment and therefore respond primarily through rerouting or relocating operations to more flexible European hubs when night access is materially curtailed.

6.3 The integration of cargo into TAG-style appraisal requires explicit treatment of freight time values. The literature demonstrates that VFTTS varies substantially by commodity and urgency class, and that express freight consistently occupies the upper end of the range due to its dependence on guaranteed delivery windows. Inventory-based estimation methods, hedonic price studies and stated-preference evidence provide workable approaches for deriving air-freight VFTTS in the absence of UK-specific empirical values. Reliability considerations are especially important, as delay penalties for freight are typically assessed at the daily level, reflecting the compounding effects of missed processing and delivery cycles.

6.4 The wider-economic literature also points to stable and empirically supported relationships between changes in air connectivity and productivity. Independent studies—including Oxford Economics (2013), Airports Commission (2013), Brueckner & Zhang (2020) and SEO (2024)—find that increases in connectivity are associated with GDP gains on the order of 0.2–0.6% per 10% connectivity improvement, once endogeneity is controlled for. These impacts operate through trade, inward investment, labour-market access and agglomeration mechanisms. Recent work by NEF (2025b) reinforces the need for careful causal identification and avoidance of double counting, noting that connectivity-led growth effects may be smaller in already well-connected, high-income regions and that methodological choices can influence estimated elasticities. However, these studies do not provide alternative quantified UK estimates or materially contradict the broader empirical finding that air connectivity can contribute to productivity, particularly where airports face binding capacity constraints or where business and freight connectivity are significant.

6.5 Taken together, the studies reviewed indicate that night flying, though limited in scale, contributes disproportionately to airline efficiency, freight performance and wider economic outcomes. The literature also identifies a range of established and adaptable methods—TEE analysis, VFTTS estimation, connectivity–productivity elasticities and regional employment models—that can be used to assess the socio-economic implications of night-flying policy within a TAG-consistent framework. These approaches support a more complete understanding of how restrictions on night or shoulder operations could affect the UK's connectivity, competitiveness and regional economic performance.

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8. Appendix A: Standardised Monetary Values

Category	Value	Currency	Price Base	Page Ref.	Source	Standardised 2024 Price GBP
UK Impacts	£16.5bn GVA; 213k jobs	GBP	2021 prices	Page 1	York Aviation (2021)	£19bn GVA; 213k jobs
UK Impacts	£13bn wider effects	GBP	2021 prices	Page 1	York Aviation (2021)	£15bn GDP loss (full ban)
UK Impacts	£12bn GDP loss (full ban)	GBP	2021 prices	Page 1	York Aviation (2021)	£14bn GDP loss (full ban)
Heathrow	£1.4bn GVA; 9,000 jobs	GBP	2021 prices	Page 13	York Aviation (2021); AEC (2024)	£1.6bn
UK Express	£7bn GVA; 38k jobs	GBP	2021 prices	Page 10	York Aviation (2021)	£8bn
Paris CDG	€1.85bn GDP; 22k jobs	EUR	2019 prices	Page 9	FedEx (2023)	£2bn
EU Express	€23bn GDP; 579k jobs	EUR	2010 prices	Page 9, 18	Oxford Economics (2011)	£29bn
Global Express	US$140bn value	USD	2015 prices	Page 9, 18	Frontier (2015)	£141bn value
Curfew Impact	£2–3bn GDP loss	GBP	2006 prices	Page 9, 20	CEPA (2016)	£3–£5bn GDP loss
Noise Externalities	€2–3bn	EUR	2010 prices	Page 22	CE Delft (2011)	£3-£4bn
Business Trip Loss	£30–£50 per trip	GBP	2016 prices	Page 6	CEPA (2016)	£39–£65 per trip
Welfare Loss	£500–£700m/yr	GBP	2017 prices	Page 6, 15	SYSTRA (2017)	£642–£899m/yr
Welfare Gain	£2bn/yr	GBP	2018 prices	Page 21	Frontier (2018)	£3bn/yr
Welfare Gain	£350–£400m/yr	GBP	2023 prices	Page 7, 16	Oxera (2023)	£363–£414m/yr
Welfare Gain	£100–£150m/yr	GBP	2018 prices	Page 17	Frontier (2018)	£126–£189m/yr
Welfare Loss	£900m/yr	GBP	2024 prices	Page 6	AEC (2024)	£900m/yr
Congestion Premium	£2bn/yr	GBP	2018 prices	Page 16	Frontier (2018)	£3bn/yr
Air Freight VFTTS	€400–€800/tonne-hour	EUR	2004 prices	Page 27	De Jong et al. (2004)	£580-£1,160/tonne-hour
Express VFTTS	€7,935/shipment-hour	EUR	2004 prices	Page 27	De Jong et al. (2004)	£11,496/shipment-hour
Meta VFTTS	£40–£52/hr	GBP	2021 prices	Page 27	Binsuwadan et al. (2021)	£47–£61/hr

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