The Socio-Economic Impacts of Night Flying: Methodology Report

Department for Transport

Final Report

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York Aviation

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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. Night flying accounts for only a small share of total UK air traffic, but operators report that it plays a distinctive role in how the system functions day-to-day. Early-morning arrivals and late-evening departures are used by some airlines to align with international connection banks, maintain aircraft utilisation patterns, and support overnight cargo and express-freight operations. Because these activities interact with passenger connectivity, airline scheduling, and time-sensitive supply chains, changes to the Night Flight Regime have the potential to influence a range of outcomes across the aviation industry and the wider economy. This methodology report sets out an objective model framework for assessing those impacts.

2. The model framework links the operational and behavioural effects of policy change to the Department for Transport's appraisal framework (TAG A5.2 – Aviation) and the HM Treasury Green Book. The framework follows a logical chain:

   policy change → behavioural response → market outcomes → economic value.

3. In response to a policy change, on the supply side, airports adjust charges and capacity management, while airlines decide whether to retime, substitute aircraft, choose where to operate from, or add or remove based aircraft. The model framework distinguishes carefully between airline types: full-service carriers seeking to maintain hub connectivity, low-cost and leisure operators driven by aircraft utilisation, and all-cargo and integrator airlines dependent on overnight cycles.

4. On the demand side, passengers then respond through changes in price, timing, and reliability preferences. Business and transfer travellers are highly time-sensitive; leisure and visiting-friends-and-relatives markets are more price-sensitive. Cargo users make similar trade-offs between cost, delivery time, and reliability- with express and just-in-time segments most affected by night-period restrictions.

5. These behavioural effects feed directly into the TAG welfare framework, which measures the monetary value of changes in fares, travel and delivery times, reliability, and operating costs. User and producer welfare changes are supplemented by changes in government revenue from Air Passenger Duty, corporation tax, and other fiscal channels. The result is a view of how increasing or decreasing restrictions in the Night Flight Regime influences the welfare of users, the profitability of the aviation sector, and the public finances.

6. The model framework distinguishes carefully between direct welfare impacts—valued in line with TAG—and wider-economic impacts. Wider effects are applied only to changes to the structural elements of connectivity—such as the availability of early morning arrivals, late evening departures, and the resilience of international links—rather than direct time or cost changes already valued through TAG. Welfare effects and wider impacts are reported separately to maintain transparency and minimise potential overlap.

7. Beyond direct market effects, the methodology examines how changes in night-period operations may influence wider patterns of connectivity, productivity and trade. Two complementary analytical approaches are used to explore potential wider-economic impacts.". The first examines the relationship between changes in structural international connectivity and national productivity, drawing on a wide body of international literature. This evidence shows mixed but informative relationships between air connectivity and economic performance, and elasticities are applied cautiously.. The second uses a Percoco-style regional model, adapted for UK data, to measure how changes in air traffic affect local employment and output around airports and across regions. Both approaches explicitly incorporate

cargo, recognising the importance of express, Just in Time and high-value freight flows, and their reliance on overnight and early-morning operations.

8. The model framework is explicitly bidirectional: it evaluates both more restrictive and less restrictive policy options in a symmetrical way, allowing for the possibility of gains or losses depending on how airlines, passengers and cargo users respond.

9. The methodology is designed to be transparent, replicable, and policy-neutral. It will quantify the costs and benefits of both more restrictive and less restrictive regimes in a consistent way, ensuring that decision makers can understand not only welfare, but also how they influence the UK's competitiveness and economic performance. Phase 2 will implement this framework with real data, producing quantified results that show the national and regional economic and social implications of alternative night-flying scenarios.

1. Introduction

Background

1.1 The Department for Transport (DfT) has commissioned York Aviation to develop a robust, transparent methodology for assessing the socio-economic impacts of night flying at the UK's designated airports[1] — London Heathrow, Gatwick and Stansted.

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

1.4 These documents are published alongside each other.

1.5 This Methodology Report was developed in Phase 1. It sets out the analytical model framework to quantify these impacts consistently with the Green Book and TAG Unit A5.2 guidance. It defines how policy changes to the Night-Flight Regime will be translated into measurable effects on users, operators, and the wider economy.

1.6 At the outset, it is helpful to define 'night' in this context:

- The Night Flight Regime defines controls within the Night Quota Period (NQP). This runs between 23:30 and 06:00;
- The night period for noise assessment in the UK is the period between 23:00 and 07:00.

1.7 This document talks about night in a broad sense, recognising that changing the definition of the NQP is one possible policy option, and hence the methodology developed needs to consider a range of possibilities.

[1] The 'designated airports' are Heathrow, Gatwick and Stansted. These airports are formally designated under Section 78 of the Civil Aviation Act 1982, giving the Secretary of State powers to regulate night-time noise through the Night Flight Regime.

1.8 The methodology report should be read alongside the accompanying literature review, which provides the evidential basis for the approach set out[2].

Purpose of the methodology report

1.9 The purpose of this methodology report is to establish the conceptual design of the modelling approach.

1.10 Specifically, this report:

- Identifies the causal mechanisms through which night flights create socio-economic value.
- Describes the behavioural responses expected from airlines, airports, passengers and cargo users, and cargo operators under alternative night-flight policies.
- Sets out how these behavioural changes will be captured within a TAG-compliant welfare framework.
- Defines data requirements and the overall modelling architecture.

Scope of this Report

1.11 The methodology applies to the three designated airports but is designed to be flexible for wider use. It focuses on:

- Direct impacts — user and producer welfare within aviation markets.
- Wider impacts — Gross Value Added (GVA) and employment supported through connectivity, trade and productivity.

1.12 The analysis excludes the assessment of health or environmental disbenefits, which are being considered by wider work being undertaken by the DfT. For example, the DfT's Aviation Night Noise Effects (ANNE) study is developing the evidence base on how aviation noise at night impacts annoyance and sleep disturbance.

Structure of the Report

1.13 The report is structured as follows:

- In Section 2 we set out a **Methodology Overview** – overall process and modelling logic.
- In Section 3 we consider **Supply-Side Reactions** – how airports and airlines respond to changes in night-flying regulation.
- In Section 4 we examine **Demand-Side Reactions** – how passengers and cargo users adjust to resulting service changes.
- In Section 5 we set out the pathway for **Integration with TAG Welfare and Wider Economic Impact Analysis** – conversion of behavioural outcomes into economic welfare and wider GVA effects.

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[2] York Aviation for Department for Transport (2025) - The Socio-Economic Impacts of Night Flying: Literature Review.

- In Section 6 we set out **the linkages and data requirements** for Phase 2 model development.

2. Methodology Overview

Purpose and Approach

2.1 This section explains how the methodology will assess the socio-economic impacts of night flying at the UK's designated airports.

2.2 The aim is to trace, in a structured and transparent way, how changes to night-flying policy (such as adjustments to the night period, movement limits, or Quota Count allowances) influence the behaviour of airlines, airports, passengers and cargo users, and how those behaviours translate into changes in economic welfare and wider economic activity.

2.3 At the heart of this approach is a set of linked behavioural models. Each describes how one part of the aviation system reacts to a policy change, while remaining consistent with Department for Transport (DfT) TAG Unit A5.2 guidance on the valuation of aviation impacts.

2.4 The framework recognises two fundamental channels of effect:

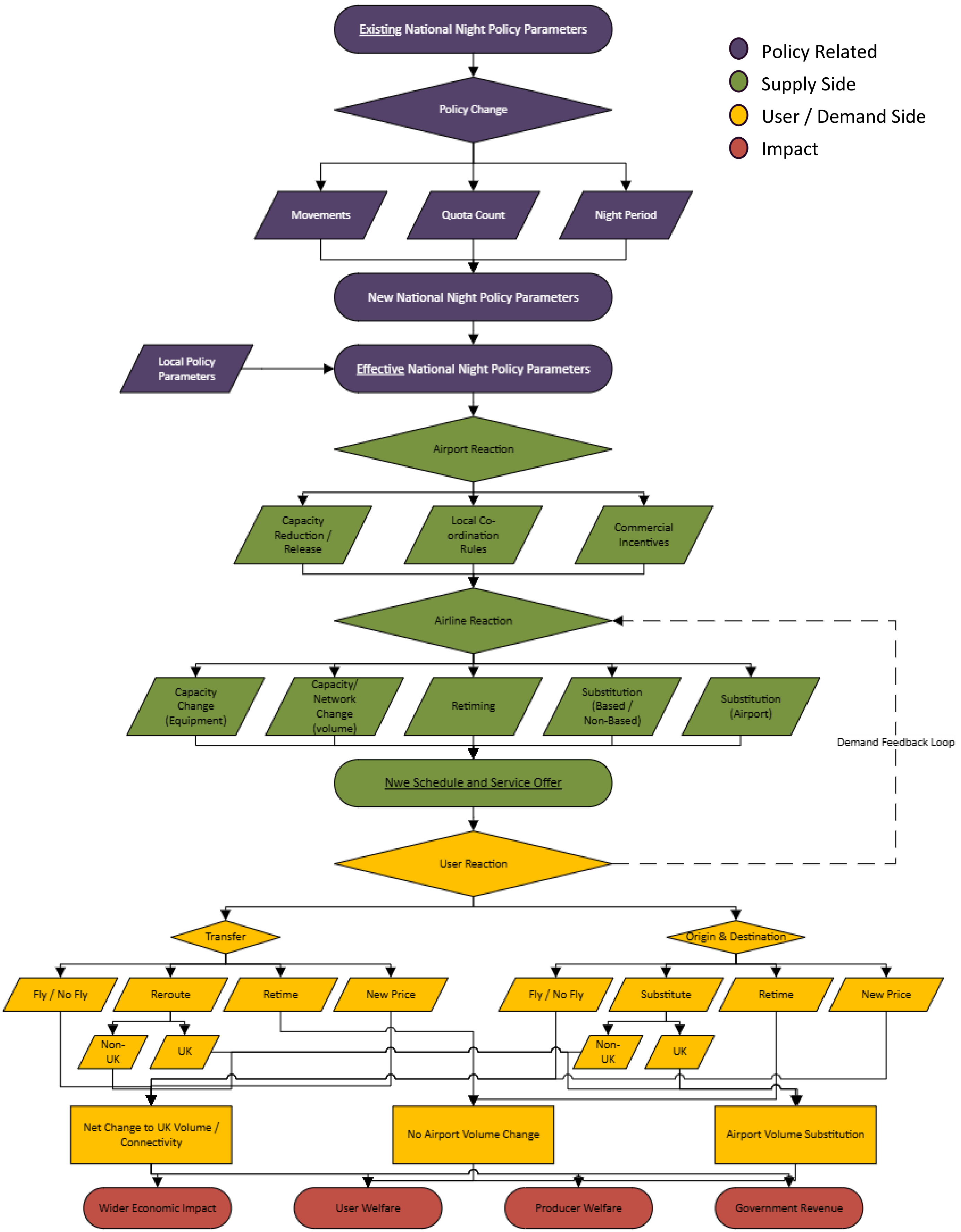
- Direct or first-order impacts – changes in costs, revenues, and welfare for the main market participants (airlines, airports, passengers and cargo users, and cargo operators).
- Wider or second-order impacts – the productivity, trade, tourism and employment effects that result from changes in air connectivity and service availability.

Overview of the Methodological Flow

2.5 Figure 2.1 summarises the overall methodological sequence. It begins with the definition of a policy scenario, flows through the supply-side and demand-side reactions, and concludes with the calculation of economic welfare impacts and wider economic impacts:

- **Policy and Scenario Definition** – the starting point for all analysis. Key parameters (e.g., the night period, movement quotas, or QC weighting) are specified and converted into effective local operating constraints for each designated airport. It should be noted that the scenarios to be examined via this project are illustrative and without prejudice to what the DfT might put forward as policy proposals in future.
- **Supply-Side Reaction** – airports and airlines respond to the new regulatory environment:
  - Airports may adjust charges, slot allocation or coordination rules.
  - Airlines reassess the profitability and feasibility of individual services, retime flights, reallocate capacity (including to other airports), or withdraw operations.
- **Demand-Side Reaction** – passengers and cargo customers respond to the changed schedule, prices, or service quality:
  - Passengers may alter travel times, choose alternative airports or carriers, or forego travel altogether.
  - Cargo users may reroute shipments, retime consignments, or switch to non-UK hubs.

Figure 2.1: Methodology Overview



- **Impact Assessment** – the combined supply- and demand-side outcomes are expressed in terms of:
  - User Welfare (Consumer Surplus) – the benefit passengers and cargo customers derive from the services available.
  - Producer Welfare (Producer Surplus) – the economic returns to airlines and airports.
  - Government Revenue – changes in taxation and fee income.
  - Wider Economic Impacts – the knock-on effects on productivity, trade, investment, and employment.

Establishing the Baseline Market Position

2.6 The analysis begins by establishing a consistent baseline of current aviation activity across the UK system. It should be noted that, for consistency with published schedules data, flights timings are considered in terms of stand time, i.e. the time a flight is scheduled to depart/arrive at the stand/gate. For the three designated airports, detailed operational and scheduling data are taken from airport operational databases to provide an accurate representation of night-period and shoulder-period movements. For other UK airports, scheduled services are drawn from OAG, with passenger and cargo flows taken from CAA statistics to provide a system-wide view of existing demand.

2.7 Passenger and cargo demand at each airport is then projected forward using outputs from the Department for Transport's aviation forecasting model. These forecasts provide a consistent basis for estimating how activity may evolve over the appraisal horizon. Daily and hourly movement profiles are generated by applying projected growth to existing patterns of use, subject to each airport's capacity constraints and the limits set by the current Night Flight Regime. This baseline forms the reference case against which all policy scenarios are assessed.

2.8 The key steps in this process can be summarised as follows:

- **Compile detailed operational data** for the three designated airports using their airport operational databases, capturing actual night-period and shoulder-period activity.
- **Extract scheduled services** for all other UK airports from OAG to provide a full system-wide picture of flight timings, frequencies and aircraft types.
- **Assign passenger and cargo volumes** using CAA statistics, ensuring consistency with observed traffic flows by airport and route.
- **Project passenger and cargo demand forward** using the Department for Transport's aviation forecasting model to establish future-year activity levels on a consistent basis.
- **Grow daily and hourly profiles** by applying forecast growth to existing patterns of use, while reflecting each airport's specific capacity constraints and the limits imposed by the current Night Flight Regime.
- **Construct the baseline reference case** against which all policy scenarios are compared, ensuring that changes in movements, timings or connectivity are measured relative to a consistent starting point.

Conclusions

2.9 The model framework reproduces the real sequence from policy change to operational and user outcomes. Each stage — behavioural, welfare and productivity — is treated separately to ensure consistency and prevent double counting.

3. Supply Side Reactions

Introduction

3.1 The supply side describes how the providers of air transport capacity – airports and airlines – react to a change in night-flying policy. Their behaviour determines how much capacity remains available, at what cost, and in which time periods. This in turn, shapes the options available to passengers and cargo users.

3.2 Both airports and airlines are assumed to behave rationally, balancing the operational and commercial impacts of any change in night flying policy, positive or negative, against potential gains from reallocating capacity elsewhere in their networks. This behaviour reflects the feed back received from stakeholders, analysis of night flying patterns at airports outside the UK (notably Frankfurt, Budapest, and Amsterdam), and is also consistent with the results of the literature review and theory.

Airport Reaction

3.3 Figure 3.1 illustrates how an airport operator responds to a change in the Night Flight Regime:

- **Starting Position:** Each airport has a defined set of night-time movements, associated revenues (aeronautical and non-aeronautical), and a pattern of utilisation.
- **Policy Change**: Alterations to the Night Flight Regime (e.g., new movement limits or QC thresholds) are translated into local operating constraints. These may also reflect local planning restrictions, such as those currently in place at Stansted.
- **Assessment of Capacity Balance:**
  - If *demand exceeds capacity*, the airport experiences an increase in the shadow cost[3] of night operations.
  - If *capacity exceeds demand*, the shadow cost falls.
- **Operational Mechanisms:** Airports can respond through:
  - Adjusting aeronautical charges (e.g., night surcharges or discounts).
  - Modifying slot capacity release rules.
  - Applying aircraft type or noise restrictions.
- **Outcome:** The resulting pattern of capacity utilisation and charging determines changes in:
  - The airport's operating surplus (Producer Surplus).
  - Slot availability for airlines.

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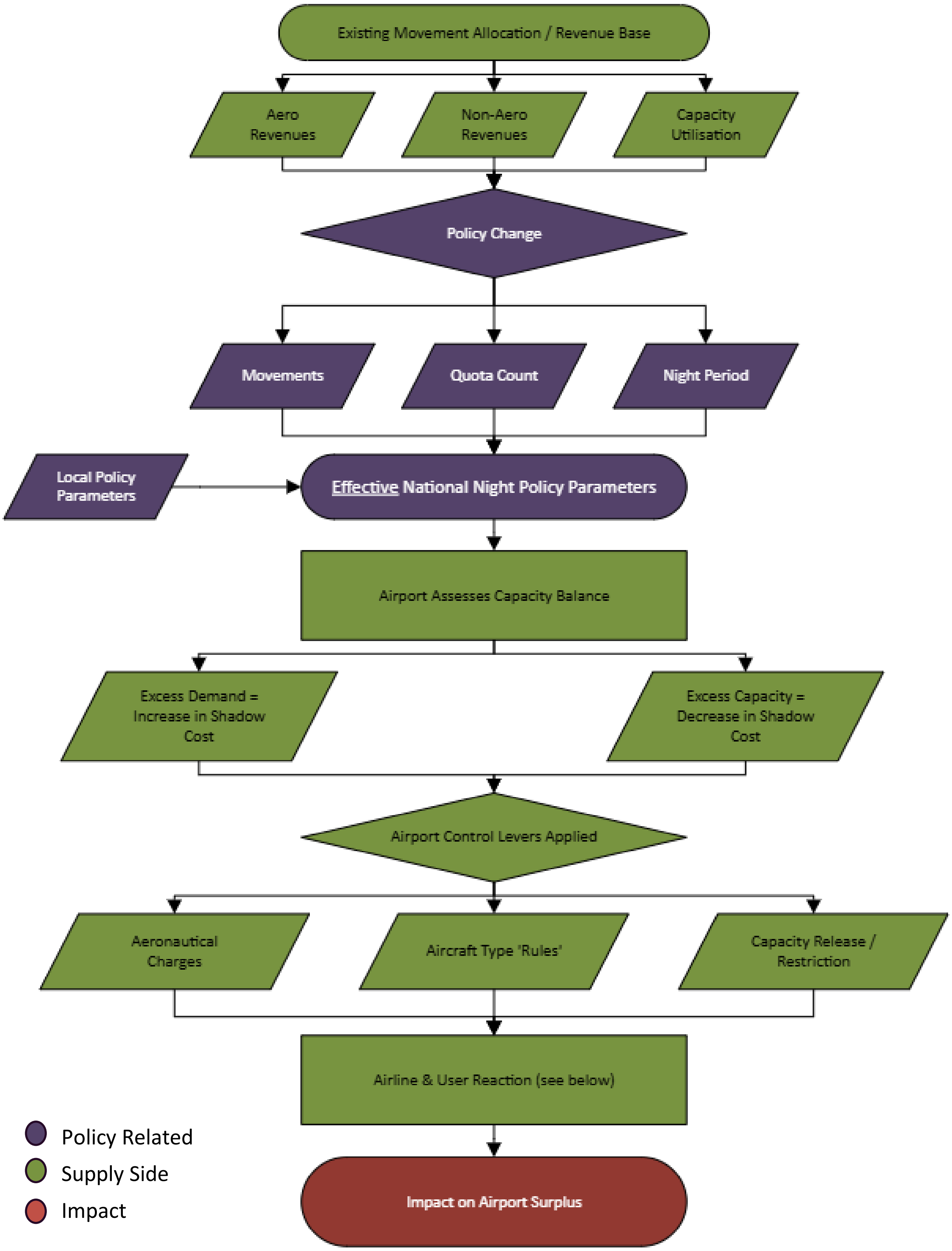
[3] In this report, the shadow cost refers to the implicit economic value of a night-period movement at a designated airport. It represents the opportunity cost of using one unit of the airport's constrained night-time capacity — that is, the value of the next-best alternative forgone when a movement slot, quota allowance or QC capacity is used. Shadow costs rise when demand for night movements approaches or exceeds the available regulatory limits, and fall when there is spare capacity.

– The overall cost of access for users.

Figure 3.1: Airport Reaction Mechanism



Airline Decision-Making

3.4 The airline flow chart sets out how individual carriers, passengers or cargo, evaluate whether to continue operating night-time services under revised conditions:

- **Assess Existing Value of Each Night Movement:** Airlines begin by considering each night-time movement's profitability, combining:
  - Origin-and-Destination (O&D) revenue from the affected flight and linked flights[4] through the day;
  - Network connectivity revenue; and
  - Direct operating costs for the affected flight and linked flights through the day.
- **Policy Change:** The policy change alters the shadow cost of the slot (for example, through movement limits changes, aeronautical charges or QC limits). The airline assesses whether the resulting margin remains acceptable for them to continue operating that service.
- **Decision Process:**
  - If **acceptable**, the airline continues the operation.
  - If **unacceptable**, the airline tests sequential options:
    - Retiming the flight within acceptable tolerances (noting that these tolerances include the consideration of the whole line of flying for the day and / or the timings at the opposite end of the route).
    - Substituting aircraft type or adjusting capacity.
    - Shifting operations to another base or airport.
    - Cancelling the flight or reducing the frequency of operation (for instance, reducing from daily operations to four days a week).
- **Outcome:** These decisions lead to potentially:
  - Changes in operating costs (resulting in changes in fares).
  - Changes in network.
  - Changes in flight schedules and equipment mix.
  - Redistribution of traffic between airports.
  - Adjustments in aircraft utilisation and network efficiency.

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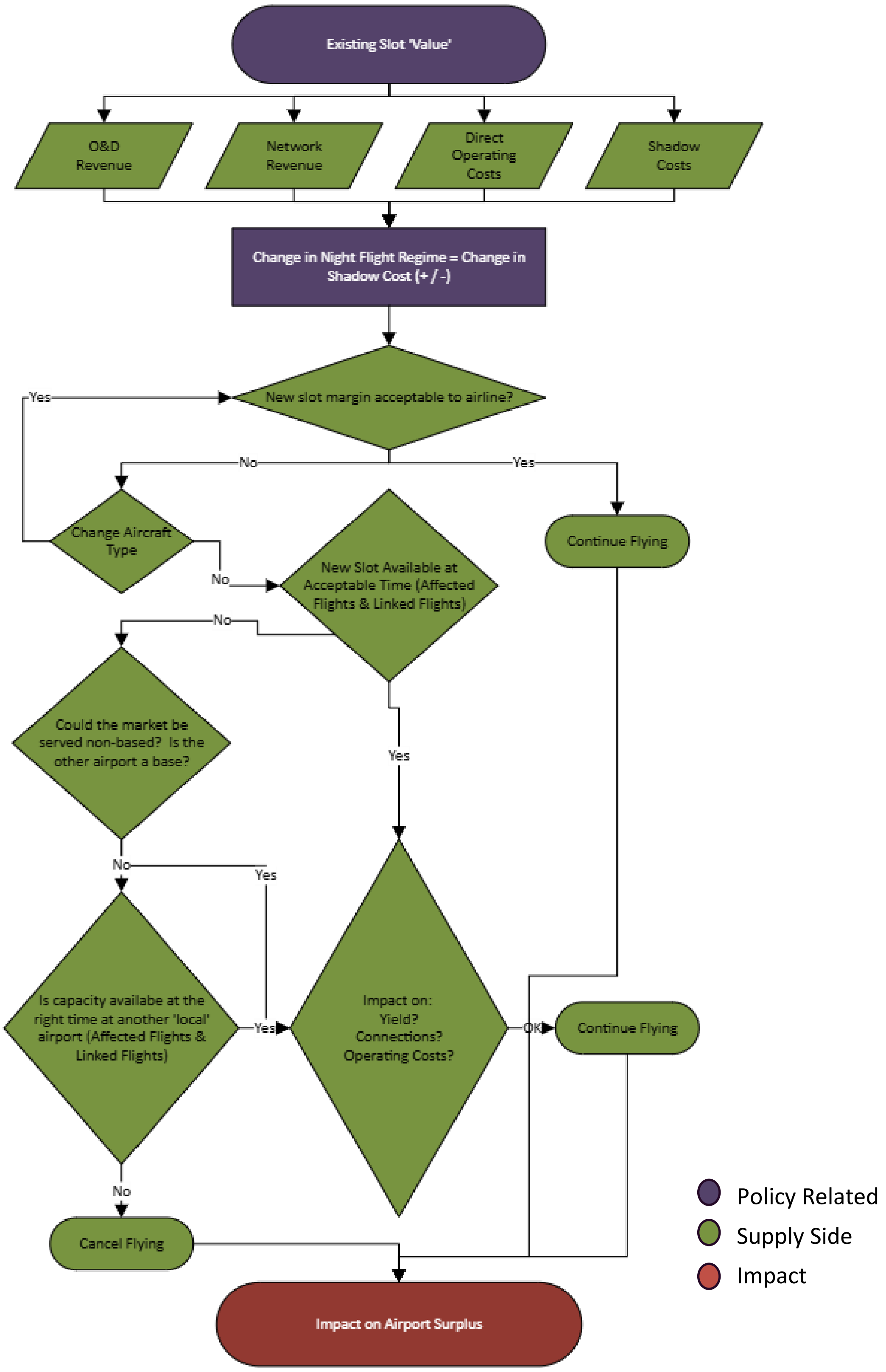
[4] A linked flight is any subsequent or preceding service whose revenue or operating cost is affected by changes to a night-period movement. A night-time arrival or departure can influence other flights in the same aircraft rotation or network schedule. For example, the loss of a night arrival may reduce transfer flows and therefore lower the revenue of a later outbound flight. Similarly, the removal of an early-morning departure for a low-cost carrier can reduce aircraft utilisation across the day, increasing the unit operating costs of later rotations operated by the same aircraft.

- **Feedback Loop:** Airline decisions affect and are influenced by passenger and cargo demand responses. The approach captures this iterative adjustment between supply and demand.

Figure 3.2: Airline Decision Making Flow



3.5 While the decision flow described in Figure 3.2 applies in general to all airlines, the way each operator responds in practice varies substantially according to its business model, network structure, and cost base. Evidence from the accompanying literature review[5] and stakeholder consultations shows that sensitivities to night-time restrictions differ sharply between hub carriers, low-cost and leisure operators, regional airlines, and cargo carriers.

3.6 To capture these differences, the analysis segments the airline market into distinct operational groups, each with characteristic motivations and constraints. This segmentation underpins the behavioural parameters used in Stage 2 modelling and ensures that responses to night-flying policy are represented realistically rather than as a uniform industry average.

Segmentation of the Airline Market

3.7 As summarised in the literature review, airline business models exhibit materially different sensitivities to early-morning/late-evening access. This section defines a refined segmentation and highlights the key factors that influence each segment's decision whether to continue, retime, relocate, or cancel night-period flights. It expands the generic flow shown in Figure 3.2 (Airline Decision-Making Flow) and provides the behavioural granularity that will underpin Stage 2 model parameterisation. Table 3.1 sets out the intended airline market segments to be modelled in Stage 2 alongside a brief description of why night and shoulder periods matter to these airline groups. These descriptions draw primarily on the accompanying literature review. Input from airline discussions has been used to help interpret operational practices, but the behavioural characterisations have been validated against published evidence and are not based solely on operators' stated preferences.

Table 3.1: Airline Segmentation

Segment	Short description	Typical examples (UK context)	Why nights/shoulders matter
FSC – Hub Home-Based	Network carriers operating a primary UK hub.	British Airways (LHR)	Depend on early-morning night/shoulder arrivals to form first arrival banks for transfer traffic, corporate demand and belly-cargo flows. Late-evening night/shoulder departures support final outbound waves and provide resilience for late-running long-haul services.
FSC – Hub Foreign-Based Short-Haul Feeders	European hub carriers operating short-haul spokes into their home hubs using aircraft overnighting in the UK.	KLM, Lufthansa, Air France	Require very early-morning departures from the UK (often falling in the night window) to feed first hub banks. Late-evening arrivals enable aircraft to night-stop in the UK and operate these early waves.
FSC – Hub Foreign-Based Long-Haul Carriers	Non-EU hub airlines operating long-haul services between home hubs and the UK.	Emirates, Qatar Airways, United, Delta	Use early-morning arrivals to connect into long-haul hub banks, meet premium demand and support bellyhold cargo flows; rely on late-evening departures to align with global overnight schedules and maintain aircraft utilisation.
Long-Haul Point-to-Point	Non-hub long-haul services with strong O&D focus.	Virgin, JetBlue, Norse Atlantic	Early-morning arrivals maximise same-day O&D value and rotation efficiency. Late-evening departures extend destination dwell times and support long-sector aircraft turnrounds.

[5] York Aviation for Department for Transport (2025) - The Socio-Economic Impacts of Night Flying: Literature Review

Segment	Short description	Typical examples (UK context)	Why nights/shoulders matter
LCC – Base	Low-cost carrier with crew base at airport.	easyJet, Ryanair (base)	The model relies on first-wave departures, many of which are scheduled at or just after 06:00 and may require activity in the night shoulder. Late-evening returns complete full daily rotations for scheduled activity and provide delay recovery.
LCC – Non-Base	LCC operating rotations without a night stop.	Various	Can need late-evening/night arrivals to position aircraft for next-morning departures from their home base. Early-morning departures from the UK are less common but may still fall into shoulder periods on longer rotations.
Leisure / Charter	Seasonal programme flying.	TUI, Jet2	Early-morning departures support double-rotation patterns on long Mediterranean/Canaries sectors. Late-evening arrivals allow completion of these double turns during peak season and provide resilience on delay-prone summer schedules.
Regional / Feeder	Short-haul connectors into hubs.	Loganair	Early-morning departures/arrivals are critical to meet first hub banks; limited flexibility means even small retiming can break connectivity. Late-evening flights maintain feed into final hub waves and preserve network integrity.
All-Cargo – Integrators	Time-definite express networks.	DHL, UPS, FedEx	Early-morning departures carry the outbound wave after the overnight sort. Late-evening arrivals bring in feeders and inbound material for processing; most of the integrator cycle is anchored in the night window.
All-Cargo – General Freighters	Scheduled/ad-hoc cargo airlines.	Qatar Cargo, Cargolux	Prefer early-morning departures for alignment with trucking cut-offs and downstream connections, and late-evening arrivals for runway access and time-zone-efficient turnrounds; some flexibility exists but efficiency is reduced if shifted.

3.8 Across all airline segments, night-time and shoulder-period operations play a structurally important role in maintaining viable schedules, connectivity, and asset utilisation. Early-morning services—many of which fall within or immediately adjacent to the night period—are essential for forming first-wave arrival and departure banks, feeding European and global hubs, supporting long-haul inbound corporate demand, and maximising aircraft and crew productivity, particularly for hub carriers, long-haul operators, LCCs and leisure airlines. Late-evening operations provide corresponding value by enabling final outbound waves, accommodating late-running inbound services, positioning aircraft for next-day rotations, and supporting the overnight processing cycles required for air-cargo integrators and freighter operators. While the specific operational dependencies differ by business model, the literature consistently shows that both early-morning and late-evening access are integral to network efficiency, schedule resilience and the economic functioning of passenger and freight markets. Segmenting the airline market allows the behavioural model to reflect the fact that carriers face very different operational, commercial and regulatory constraints, ensuring that responses to night-period policy changes are represented realistically rather than as a single industry average.

3.9 Table 3.2 then summarises how the key drivers of airline decision making affect the different market segments and then, Table 3.3, provides a qualitative assessment of each segment's sensitivity to different factors. Night-flying policy can move in either direction — becoming more restrictive (e.g., longer night period, lower movement or noise quota) or less restrictive (e.g., shortening the night period, additional movements, or higher noise quota). Airlines respond through the same mechanisms in both cases, but the direction of change reverses. The table below summarises the most likely responses for each airline segment under both types of policy change, drawing directly on the operational logic set out in *Figure 3.2 (Airline Decision-Making Flow)*. It should be noted that the responses are indicative of what airlines will try to do. This will be heavily influenced by available slot capacity. These patterns reflect the evidence summarised in the literature review regarding how loss of first-wave access affects both passenger and cargo networks.

3.10 The main operational decision drivers affected by night and shoulder restrictions relate to connectivity, aircraft productivity, schedule resilience and cost. Increased restrictions shorten the usable operating day, compress arrival and departure banks, and reduce the buffers available to absorb delays—leading to weakened hub connectivity, missed first-wave departures, lower utilisation, higher shadow costs and QC-related penalties, and reduced viability for time-critical cargo services. Fewer restrictions generally has the opposite effect: restoring early-morning and late-evening flexibility strengthens hub-bank integrity, improves rotation efficiency, reduces curfew-related cancellations, and enhances both passenger and freight connectivity. The degree of sensitivity varies by business model, with hub carriers, regional feeders and cargo operators most exposed to arrival-bank timing; LCCs and leisure carriers most affected by utilisation constraints; and integrators and freighter operators most dependent on overnight windows.

Table 3.2: Decision Influencers by Segment

Decision Driver	Effect of More Restrictions	Effect of Less Restrictions	Most Sensitive Segments
Arrival-bank alignment (pre-07:00)	Early arrivals lost; connectivity and transfer yields fall.	Additional early capacity restores hub-bank integrity and increase inbound connectivity.	FSC Home-Hub; Regional/Feeder; FSC Foreign Short-Haul.
Departure timing to hubs	Later end to night restrictions delays first-wave UK departures, missing foreign hub banks[6]..	Earlier departures or late-night capacity improves same-day connection opportunities.	FSC Foreign Short-Haul.
Rotation length / aircraft utilisation	Shorter operational day; aircraft productivity and utilisation fall.	Longer operating day; more rotations, higher efficiency, lower unit cost.	LCC Base/Non-Base; Leisure/Charter.
Quota Count penalty or noise charge	Increased per-movement cost; some flights become unprofitable.	Lower QC penalties reduce costs; encourage quieter aircraft substitution or additional operations.	All, especially LCC and FSC Home-Hub.

[6] "Hub banks" refer to the coordinated waves of arrivals and departures at a hub airport that are timed to maximise passenger and cargo connectivity. Inbound flights are scheduled to arrive within a defined window, allowing passengers, baggage and freight to transfer efficiently onto a subsequent outbound wave departing shortly afterwards. This banked structure enables airlines to offer a large number of viable connections with minimal transfer time and is a core feature of hub-and-spoke network design.

Decision Driver	Effect of More Restrictions	Effect of Less Restrictions	Most Sensitive Segments
Shoulder capacity[7] availability	Congestion in 06:00–07:00 limits retiming options.	More flexible slot availability improves on-time performance and reduces shadow costs.	All passenger segments at LHR/LGW/STN.
Belly-cargo revenue	Later arrivals reduce same-day cargo delivery windows.	Earlier arrivals restore high-value cargo connections.	FSC Hub; FSC Foreign Long-Haul; Long-Haul P2P.
Crew duty / curfew buffers	A longer night period reduces the available buffer before curfew, so even small upstream delays can push inbound or return flights into the restricted period. Even if airlines retime schedules to avoid night-period costs, the compressed operating window leaves less slack to absorb delays, increasing the likelihood of curfew breaches, cancellations, or aircraft being left out of position.	Greater schedule resilience, with more buffer time to absorb delays, reducing the risk of curfew breaches, cancellations, and aircraft or crew being stranded overnight..	LCC; Leisure; Regional.
Base presence / maintenance flexibility	Reduced ability to reposition aircraft; longer ground times.	Improved rotation planning and maintenance efficiency.	LCC Base
Airport incentives / slot rules	Higher shadow price discourages expansion.	Lower slot cost or added movements attract new services.	All; especially LCC and Leisure.
Competitive displacement risk	Loss of UK night access pushes traffic to continental hubs, resulting in additional trucking of road freight into the UK..	Improved night flexibility draws traffic from EU competitors.	FSC Foreign Long-/Short-Haul; All-Cargo.
Programme rigidity (seasonality)	Charter peaks constrained; missed demand in summer season.	Extended shoulder hours enable fuller utilisation of seasonal fleet.	Leisure/Charter.
Service promise (time-definite)	Some time-critical services withdrawn.	New or restored time-critical routes become viable.	All-Cargo Integrators; Just in Time cargo.

[7] Shoulder capacity, in this context, refers to the time periods immediately before and after the NQP.

Table 3.3: Expected Behavioural Response by Airline Segment Under More Restrictive or Less Restrictive Night-Flying Conditions

Airline Segment	Typical Behaviour with More Restrictions	Typical Behaviour with Less Restrictions	Indicative Rationale
FSC – Home-Hub	Retimes early arrivals into day period; marginally reduces frequency if connections lost. Very much dependent on available capacity. May redistribute its own slot portfolio to accommodate higher value services in the event of constraint	Restores early arrivals to strengthen morning connection banks and recover transfer yields.	Hub connectivity and long-haul transfer timing drive schedule decisions.
FSC – Foreign Short-Haul Feeders	Retimes or cancels first-wave UK departures that feed early hub banks; may reduce overnighting.	Advances first-wave departures; increases overnighting aircraft in UK to improve connectivity to continental hubs.	Morning connectivity with home hub is critical; small timing changes can have large effects.
FSC – Foreign Long-Haul Carriers	Reduces or retimes late-night UK departures; may consolidate to continental hubs.	Adds late-night departures or early arrivals to optimise aircraft duty cycles and global connections.	Dependent on worldwide hub coordination and utilisation efficiency.
Long-Haul Point-to-Point	Consolidates marginal flights; lower aircraft utilisation.	Adds new or reinstated early/late flights; improves same-day business travel.	Driven by O&D demand and aircraft turn time economics.
LCC – Base	Loss of first departure typically makes entire based aircraft unviable; aircraft and crew redeployed to other bases; all rotations by that aircraft lost. If capacity is available in Slot 1, likely to retime but otherwise withdraw aircraft	Adds rotations or introduces new based aircraft using additional early or late capacity; restores previously removed capacity.	Highly dependent on maximising aircraft utilisation; first-wave slot underpins full daily schedule.
LCC – Non-Base	Cancels marginal services if curfew prevents positioning; may relocate aircraft to other base.	Adds or reinstates sectors enabled by extended shoulder period; improved operational flexibility.	Limited overnighting makes curfews binding; timing dictates network efficiency.
Leisure / Charter	Loss of early or late slots breaks double-rotation patterns; aircraft redeployed; day capacity drops sharply.	Adds second daily rotations or longer programmes when shoulder hours extended; lowers seat prices.	Programme economics depend on achieving two full rotations per aircraft per day.
Regional / Feeder	Retimes or cancels early-morning sectors, reducing hub connectivity.	Restores first-wave departures, strengthening bank integrity.	Small fleets; timing essential to maintain transfer reliability.
All-Cargo – Integrators	May shift sorting operations to continental hubs; UK throughput falls.	Repatriates / maintains sorting activity in UK; adds overnight frequency if required.	Overnight window central to time-definite delivery promise.
All-Cargo – General Freighters	Retime to shoulders or relocate to other airports.	Increase UK frequencies or move services back from EU hubs.	Sensitive to runway access and trucking windows.

3.11 In summary:

- Increased Restrictions: airlines first try to retime within the permitted period; if this breaks critical rotations or banks, they relocate or cancel services. For utilisation-driven models (LCC base and leisure), loss of the first departure slot usually triggers removal of the entire based aircraft, not just one rotation — causing a disproportionate drop in daily capacity and passenger volumes.

- Fewer Restrictions: airlines reverse the sequence — restoring early or late flights, adding rotations, and redeploying aircraft back to the airport as improved operating windows make full utilisation viable again.

3.12 The overall effect is non-linear: a single lost or gained early-morning slot can represent multiple flights and hundreds of seats because of cascading impacts through aircraft scheduling. These patterns reflect the evidence summarised in the literature review regarding how loss of first-wave access affects both passenger and cargo networks.

4. Demand Side Reaction

Introduction

4.1 The demand side reflects how passengers and cargo users respond to changes in flight availability, timing, and cost. The reactions of these users determine the extent of welfare loss or gain within the economy.

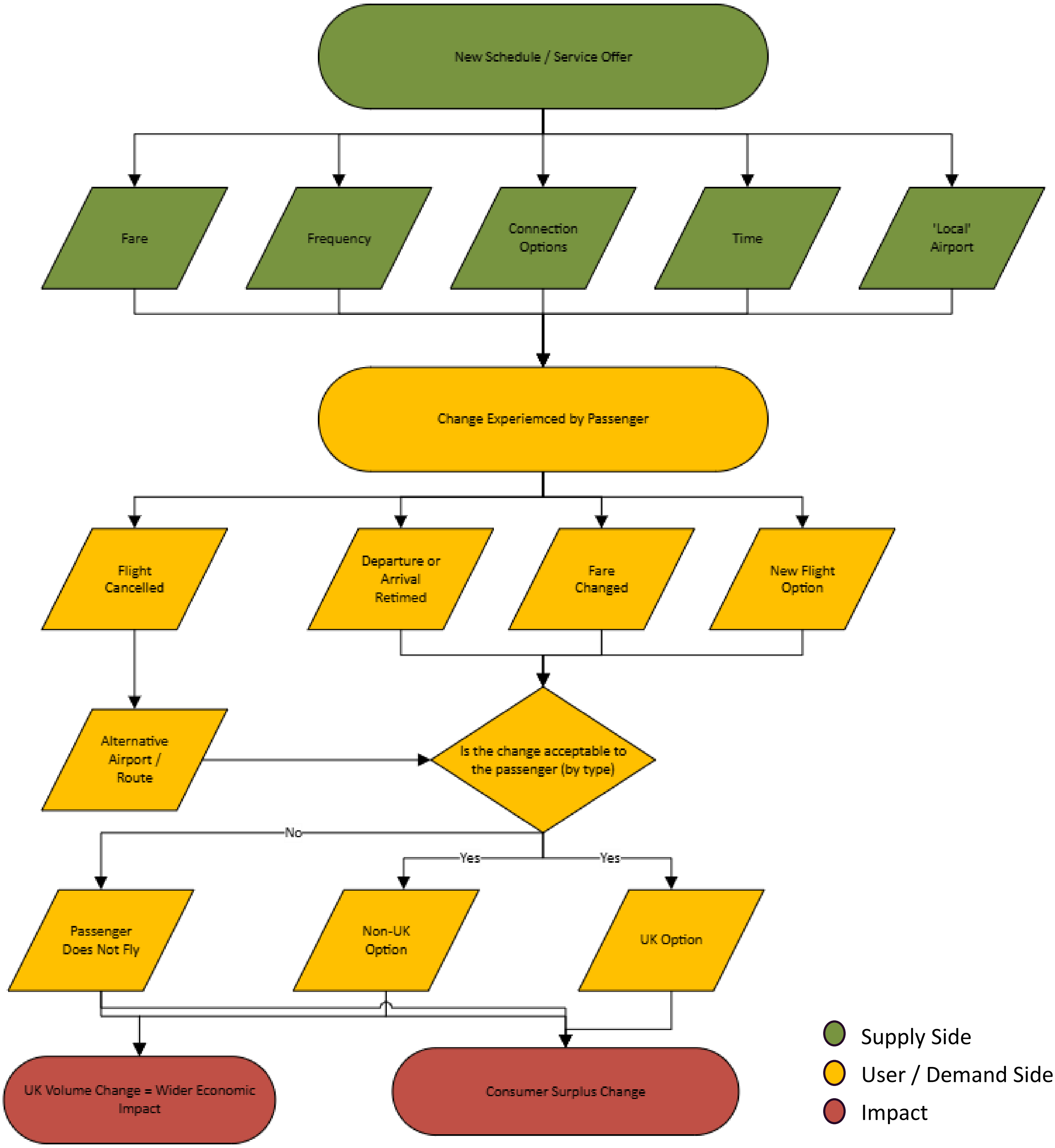
Passenger Reactions

Overview

4.2 Figure 4.1 describes the sequence of decisions passengers make when faced with a change in flight schedules or fares arising from new night-flying restrictions:

- **Experience of Change:** A passenger may encounter:
  - Cancellation of a flight or a new flight option.
  - Retimed departure or arrival.
  - Fare change due to capacity constraints or release.
  - Change in airport or connection availability.
- **Evaluation of Acceptability:** Passengers assess whether the new option remains viable based on:
  - Price tolerance (fare increase threshold).
  - Time tolerance (acceptable schedule deviation).
  - Connection feasibility (for transfers).
- **Behavioural Responses:**
  - Accept retimed or repriced option.
  - Switch to an alternative airport or carrier.
  - Change mode of travel.
  - Abandon the trip entirely.
- **Passenger Segmentation:** To reflect differing sensitivities, passengers will be segmented into:
  - Business O&D – high value of time, lower price elasticity.
  - Leisure O&D – lower value of time, higher price elasticity.
  - Transfer – dependent on coordinated schedules; highly sensitive to connectivity changes.

Figure 4.1: Passenger Demand Reaction



- **Outputs**:
  - Change in passenger volumes and airport choice.
  - Change in average generalised cost (fare + time + convenience).
  - Resulting change in **Consumer Surplus**, consistent with TAG methodology.

Passenger Segmentation

4.3 Night-flying policy influences passengers primarily through changes in schedule convenience, fares, and connectivity. However, different traveller types have very different tolerances for these changes. The flowchart above presents a generic view. The segmentation below identifies key passenger categories and the variance in the factors that drive their decisions to retime, reroute, switch mode, cancel travel or take up a new flight opportunity.

Table 4.1: Passenger Segments and Characteristics

Segment	Typical Profile	Time Sensitivity	Price Sensitivity	Key Reasons for Flying at Night / Early Morning
Business – O&D (Point-to-Point)	Corporate or independent travellers making single-leg journeys.	Very high	Low	Maximises working day; early departures enable same-day meetings.
Business – Transfer	Business passengers connecting via hub airports (UK or foreign).	Very high	Low	Needs alignment with onward flights; vulnerable to missed connections.
Leisure – Short-Break / VFR	Visiting friends or relatives; weekend or short leisure trips.	Moderate	High	Seeks lowest fares; accepts off-peak or early departures to maximise time away.
Leisure – Package / Charter	Inclusive-tour travellers on organised programmes.	Low-to-moderate	Moderate	Night/shoulder flights extend holiday duration and enable double aircraft rotations; strong cost focus.
Leisure – Holiday (Longer Duration)	UK residents taking week-plus holidays, often to Mediterranean or long-haul destinations.	Moderate	Moderate-to-High	Prefers early outbound and late inbound flights to maximise resort time; price-conscious but values convenient timing.
Inbound Tourists / Long-Haul Premium Travellers	Overseas visitors and long-haul business-leisure mix (e.g. North America, Asia).	Moderate	Low-to-Moderate	Overnight long-haul arrivals preferred for same-day onward travel or meetings; values convenience and service quality.
Transfer via Non-UK Hub	UK residents or overseas travellers connecting through EU or Middle-Eastern hubs.	High	Moderate	Highly sensitive to UK schedule changes that disrupt wave connectivity.

4.4 Table 4.2 then considers the various passenger decision drivers in the context of the passenger segments set out.

Table 4.2: Passenger Decision Influencers under More Restrictive or Less Restrictive Night-Flying Conditions

Influencer	Effect of Increased Restrictions	Effect of Fewer Restrictions	Passenger Segments Most Affected
Schedule change (departure / arrival time)	Less convenient flight times; reduced ability to make meetings or connections.	More convenient early or late options improve productivity and trip planning.	Business O&D; Business Transfer; Inbound / Long-Haul Premium.
Fare / package-price change	Higher fares or holiday prices as capacity and utilisation falls.	Lower fares or package prices as utilisation improves.	Leisure Short-Break / VFR; Leisure Holiday; Package / Charter.
Connection reliability	More missed or longer connections; increased travel stress.	Improved reliability and shorter connection times.	Business Transfer; Inbound / Long-Haul Premium.
Airport choice / accessibility	Passengers divert to alternative UK or EU airports.	Greater availability at preferred UK airport reduces diversion.	Leisure Short-Break / VFR; Business O&D.
Alternative mode availability	Modal shift to rail or car for short-haul.	Recovery of passengers from rail to air.	Short-Break / VFR.
Flight duration / overnight rest	More disruptive timings; reduced sleep.	Restored overnight options; improved sleep pattern.	Long-Haul Holiday; Inbound / Premium.
Trip cancellation / stimulation	Some discretionary travel suppressed.	New or longer-duration trips stimulated by lower fares and better timings.	Leisure Holiday; Package / Charter.

4.5 Table 4.3 then considers the 'most likely' passenger responses to more or less restrictive night flying conditions.

4.6 Overall, there are a number of key points:

- A more restrictive Night Flight Regime generally raises travel costs and reduces convenience, lowering consumer welfare.
- A less restrictive Night Flight Regime improves choice and pricing, producing welfare gains, especially for leisure and holiday markets that respond to cost and schedule flexibility.
- Package / Charter passengers are not highly price-elastic individually, but their overall availability and seat supply are very sensitive to the operating window because the tour operator's economics depend on completing two rotations per aircraft per day.
- Business and inbound segments gain most from earlier arrivals and later departures that improve connectivity and allow more productive use of time.

Table 4.3: Likely Passenger Responses under More Restrictive or Less Restrictive Night-Flying Conditions

Passenger Segment	Response with More Restrictions	Response with Fewer Restrictions	Indicative Rationale
Business – O&D (Point-to-Point)	Retimes or pays higher fare; limited cancellation.	Gains from improved timings; may increase trip frequency.	High value of time; low fare elasticity.
Business – Transfer	Missed or longer connections; some leakage to foreign hubs.	Restored early arrivals strengthen hub banks; higher throughput.	Dependent on connectivity; large welfare gain from improved timing.
Leisure – Short-Break / VFR	Retimes or switches airport; some modal shift to rail.	Potentially lower fares and more options stimulate new travel.	Flexible timing; high price sensitivity.
Leisure – Package / Charter	Programme compresses; fewer double rotations; slightly higher prices but demand relatively stable.	Added early / late flights enable second daily rotations; seat supply expands, and package prices fall.	Moderate price sensitivity; strongly utilisation-driven economics.
Leisure – Holiday (Longer Duration)	Some reduction in frequency or choice; prices rise modestly.	Lower fares and improved convenience encourage more bookings.	Medium value of time; responsive to overall cost and convenience.
Inbound Tourists / Long-Haul Premium Travellers	Slightly less convenient arrival times; minor fare impact.	Early arrivals and late departures improve itinerary quality and inbound tourism spend.	Moderate-high time value; limited price sensitivity.
Transfer via Non-UK Hub	More passengers connect through EU hubs as UK connectivity weakens.	Traffic returns to UK hubs; shorter total journey time.	Sensitive to schedule reliability and total elapsed time.

Cargo User Reactions

Overview

4.7 Cargo users—exporters, importers, manufacturers, consumers and logistics clients—depend on air cargo for fast, reliable, and secure transport of goods.

4.8 When the Night Flight Regime changes alter flight timings, availability, or costs, these users experience changes in the service they purchase rather than in how they operate aircraft. Their reactions depend on how these service changes affect delivery speed, reliability, and overall logistics performance. It should be noted that, based on the accompanying literature review and discussions with stakeholders, for express and integrator services, it is unlikely that relaxation of night restrictions would notably change the service offered given the tight integration with existing logistics networks and time tolerances. It would simply guarantee the maintenance of existing service levels into the future.

4.9 The flowchart in Figure 4.2 summarises how cargo users respond when the quality, timing, or price of air-cargo services change:

- **Experience of Change:** Night Flight Regime changes that restrict night operations can affect users through four main service dimensions:
  - Price Change – cargo rates may rise as operators face higher costs or reduced capacity.
  - Delivery Timelines – later departures or earlier cut-off times may extend overall transit duration.

   - Delivery Guarantees – reduced frequency or smaller buffers may lower reliability or "next-day" certainty.

   - Pick-up / Drop-off Thresholds – changed flight schedules alter when goods must be ready for collection or delivery.

- These changes alter the value of service to the user—measured in terms of timeliness, predictability, and cost.

- **Decision Process:** Cargo users evaluate whether the revised service still meets their operational and commercial needs. Is the new service acceptable? Users assess whether later deliveries, higher charges, or reduced reliability can be absorbed without disrupting production, inventory, or customer commitments.

   - If the change is acceptable, they continue to ship, possibly accepting a more expensive, re-timed or lower-quality service. This feeds into a change in consumer surplus. This change may or may not involve the original UK airport or indeed another UK airport. Acceptable routings could involve trucking from the UK to a continental hub or, for transfer cargo, simply changing the hub airport through which it flows to a non-UK option.

   - If the change is not acceptable, they will cancel shipment altogether (e.g. where late delivery renders goods obsolete or contractual penalties apply or delivery times can no longer be guaranteed).

- The outcomes and economic implications of these reactions can be summarised as follows:

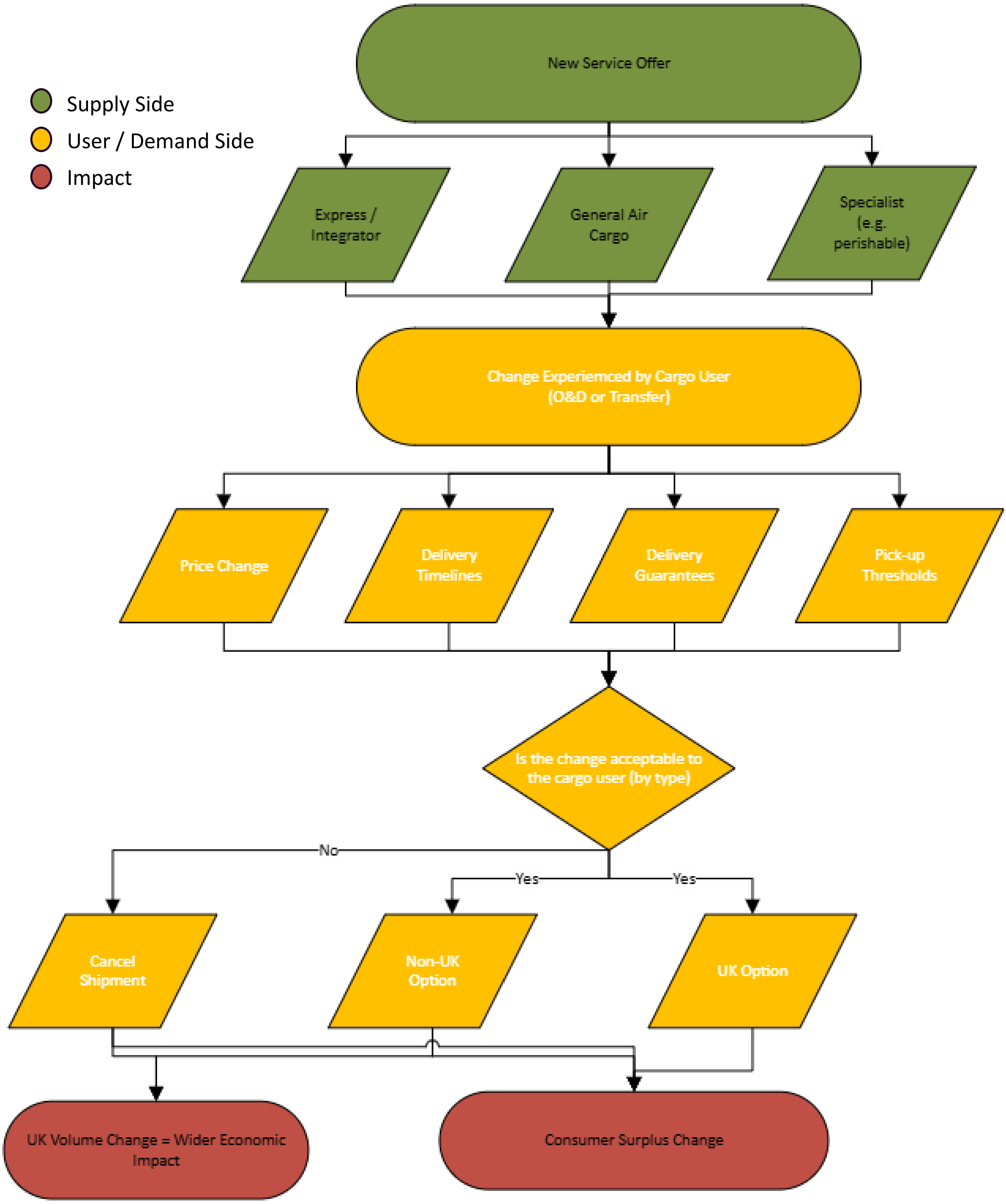
   - **Continued UK Routing** – cargo still flows through UK airports, but users may experience lower utility from higher prices or longer delivery times. This is as a reduction in Cargo User Surplus (analogous to consumer surplus).

   - **Non-UK Routing** – transfer cargo is displaced to overseas hubs, lowering UK throughput, potentially reducing connectivity as flights become unviable, and impacting on associated GVA. O&D cargo experiences potentially longer delivery times and lower quality of service (delivery guarantees or pick up thresholds), which impacts on Cargo User Surplus.

   - **Cancelled Shipment** – high-value or time-sensitive exports/imports are lost entirely, reducing UK trade, potentially affecting downstream industries and the wider economy.

4.10 The magnitude of each pathway determines the overall socio-economic impact of night-flight restrictions on the cargo market.

Figure 4.2: Cargo User Reactions



Cargo User Segmentation

4.11 Air-cargo users are a diverse group, ranging from global express integrators' clients moving time-critical parcels, to manufacturers shipping bulk goods or perishable produce. Changes to night-flying policy affect them primarily through service quality — timing, reliability, cost and delivery guarantees — rather than through simple price differences. The flow chart above again seeks to provide a generalised overview of decision making. The tables below consider cargo users in a more granular fashion within the overall framework. They define the main cargo-user segments, explain why they rely on the night period, and shows how both increasing and reducing restrictions influence their behaviour.

Table 4.4: Cargo-User Segments and Characteristics

Segment	Typical Goods / Shippers	Service Requirement	Time Sensitivity	Price Sensitivity	Dependence on Night Operations	Why Night / Early Morning Matters
Express / Time-Definite	Parcels, e-commerce, documents, medical samples.	Delivery by next working day (often by 09:00).	Very high	Low–Moderate	Structural – operations built entirely around overnight hubs.	Early morning: Early-morning arrivals into the UK deliver the overnight sort output in time for 07:00–09:00 delivery commitments. Late evening: Late-evening departures from the UK feed the hub in time for overnight sorting, preserving late cut-off times for shippers and maintaining next-day delivery guarantees.
Just-in-Time (JIT) Manufacturing Components	Automotive, aerospace, electronics, high-tech.	Delivery within hours; penalties for delay.	Very high	Moderate	Very high	Early morning: Early-morning arrivals provide critical components before production start-up, avoiding costly line stoppages. Late evening: Late-evening departures allow factories to ship end-of-day output to the hub for immediate overnight processing and delivery within hours.
High-Value / Perishable Goods	Pharmaceuticals, seafood, cut flowers, fresh produce.	Rapid, predictable delivery with temperature control.	High	Moderate	High	Early morning: Supports same-day distribution into cold-chain logistics and retail/wholesale markets. Late evening: Preserves freshness and shelf life by enabling late cut-off times before export uplift.
General Scheduled Cargo	Consumer goods, mail, spare parts.	Regular but not urgent service; predictability valued.	Moderate	High	Moderate	Early morning: Early-morning arrivals enable goods to enter national distribution centres at the start of the day, supporting predictable next-day or same-day delivery cycles. Late evening: Late-evening departures maximise use of aircraft capacity and meet customer cut-off times for consolidated shipments entering overnight handling networks.
Bulk / Low-Value Cargo	Textiles, industrial inputs, low-margin goods.	Cost-driven; tolerant of delay.	Low	Very high	Low	Early morning: Early-morning arrivals can support low-cost early delivery into domestic distribution centres where required. Late evening: Late-evening departures may be preferred for cost reasons—lower charges, easier access, or to

Segment	Typical Goods / Shippers	Service Requirement	Time Sensitivity	Price Sensitivity	Dependence on Night Operations	Why Night / Early Morning Matters
						align with off-peak trucking to the hub.
Chartered / Project Cargo	Oversized or ad-hoc loads for projects or relief.	Variable; one-off operations.	Low–Moderate	Moderate	Low–Moderate	Early morning: Early arrivals can facilitate rapid onward movement to project sites or relief-distribution networks at the start of the working day. Late evening: Late departures provide flexible operating windows for oversized or ad-hoc missions, taking advantage of quieter airspace, stand availability, and lower opportunity costs.

4.12 Different cargo-user segments rely on night and early-morning operations for distinct but often critical reasons. Express and time-definite networks are structurally dependent on late-evening departures to meet shipper cut-off times and on early-morning arrivals to meet 07:00–09:00 delivery commitments. JIT manufacturing flows similarly depend on overnight uplift and first-wave arrivals to avoid production delays. High-value and perishable goods use late departures and early arrivals to preserve freshness and maintain cold-chain integrity. For general scheduled cargo, night operations maximise aircraft utilisation and enable goods to reach distribution centres at the start of the working day. Bulk cargo uses night periods mainly for cost and access advantages, while chartered and project cargo benefits from the scheduling flexibility that quieter late-evening and early-morning windows provide. Overall, the table illustrates that although the intensity of dependence varies, night and shoulder operations underpin the reliability, timeliness and economic viability of a wide range of cargo markets.

4.13 Table 4.5 below considers these different segments in terms of the key decision drivers on cargo users.

Table 4.5: Decision Influencers under More Restrictive or Less Restrictive Night-Flying Conditions

Influencer	Effect of More Restrictions	Effect of Fewer Restrictions	Segments Most Sensitive
Delivery-time reliability	Greater risk of late or missed deliveries; possible contract penalties and customer loss.	Improved reliability and schedule integrity; enhanced customer confidence and retention.	Express / Time-Definite; JIT; Perishables.
Transit or delivery time	Longer overall delivery times; higher logistics cost and reduced competitiveness for UK exports.	Shorter end-to-end times; improved supply-chain performance and export appeal.	All time-sensitive segments.
Availability of next-day international delivery products	Loss or downgrading of overnight and next-day delivery services; express products withdrawn or rerouted via continental hubs.	Restoration or introduction of full next-day international services through UK airports.	Express / Time-Definite; High-Value Goods.
Cut-off and pick-up times	Earlier cut-offs limit late-day production and e-commerce orders.	Later cut-offs allow same-day manufacture and late-evening order fulfilment.	Express; JIT; High-Value Goods.
Cargo rate / operating cost	Rates rise as capacity tightens, or detours lengthen routes.	Rates fall with greater capacity and improved utilisation.	All, particularly General & Bulk cargo.
Alternative routing via EU hubs	Displacement to continental hubs; UK trade and jobs lost.	Repatriation of volumes to UK hubs; stronger domestic throughput.	Express; JIT; High-Value.
Modal substitution potential	Shift to slower surface or maritime modes.	Recovery of air volumes from surface modes.	General & Bulk cargo.
Customs / administrative burden	Extra handling and paperwork if re-routed abroad.	Simplified processes and reduced cost when handled in-country.	Express; General cargo.
Inventory cost of delay	Firms hold more stock to buffer uncertainty, raising working-capital costs.	Lower stockholding; faster inventory turns and cash flow.	JIT; Perishables.
Spoilage / obsolescence risk	Perishables or high-tech goods lose value if delayed.	Fresher products; longer market life.	Perishable; High-Value.
Network coordination / cascade effects	A missed overnight leg disrupts multiple downstream connections and domestic deliveries.	Restored overnight leg re-enables entire delivery chain.	Express; JIT; Perishables.

4.14 Night and early-morning operating constraints have wide-ranging implications for cargo shipments, affecting reliability, speed, cost, and market competitiveness. Increasing restrictions reduce delivery-time reliability, lengthen end-to-end transit times, bring forward shipper cut-off times, and can lead to the loss or downgrading of next-day international services—often forcing displacement of volumes to continental hubs, increasing inventory costs, and raising the risk of spoilage or obsolescence for time-critical goods. Fewer restrictions generally reverses these effects: it enhances schedule integrity and customer confidence, shortens delivery times, enables later cut-offs and fuller next-day product offerings, and lowers operating costs through improved utilisation. The most sensitive segments are express and time-definite services, JIT manufacturing flows and perishables, where the entire logistics model depends on tight overnight coordination, but high-value goods, general cargo and bulk flows also experience material impacts through pricing, routing and modal-choice effects.

4.15 Table 4.6 sets out the most likely responses for the different cargo user segments based on the decision drivers.

Table 4.6: Likely Cargo-User Responses under More Restrictive or Less Restrictive Night-Flying Conditions

Segment	Response with More Restrictions	Response with Fewer Restrictions	Indicative Rationale
Express / Time-Definite	Some international express traffic and sorting activity may consolidate at East Midlands or other UK airports with greater night flexibility. Some volumes could divert to continental hubs (e.g., Liège, Leipzig) if UK capacity becomes insufficient. Longer delivery times for certain routes; selective reduction in next-day coverage.	Greater flexibility allows expansion of next-day and overnight international products from UK hubs (especially East Midlands and Stansted). Enhanced ability to coordinate with continental and intercontinental sort centres.	Express networks rely on dependable overnight windows; moderate restrictions lengthen delivery cycles but do not immediately remove UK capability.
Just-in-Time Manufacturing Components	Some shipments retimed to day hours or switched to road for shorter distances. Firms may hold additional buffer stock or accept minor production delays.	Restored overnight uplift enables true just-in-time delivery; reduced inventory costs and greater production efficiency.	Highly time-critical components depend on predictable overnight replenishment.
High-Value / Perishable Goods	Slight delays reduce freshness or delivery confidence; some exporters use EU hubs to maintain early-morning arrivals. Costs rise modestly due to longer transit or alternative routings.	Earlier arrivals and later departures improve product quality, export reliability and market reach.	Time-sensitive exports gain significantly from restored overnight reliability.
General Scheduled Cargo	Retimed to daytime flights where possible; moderate rate increases and longer door-to-door times.	Increased capacity and improved scheduling reduce rates and improve service reliability.	Moderately time-sensitive and price-elastic; adapts to available capacity.
Bulk / Low-Value Cargo	Shifts to cheaper surface or maritime modes if night restrictions raise costs; minimal impact on supply chains.	May return partially to air when rates fall or extra capacity becomes available.	Predominantly cost-driven; flexible in timing.
Chartered / Project Cargo[8]	Some specialist or ad-hoc operations rescheduled around curfews or transferred to alternative airports.	Greater slot flexibility improves responsiveness for oversized, humanitarian, or project cargo.	Low frequency but high individual value; benefits from less restrictive constraints.

4.16 Overall, there are a number of points to note:

- **Increased Restrictions:** tends to redistribute express activity within the UK rather than eliminate it, with East Midlands Airport (EMA) in particular absorbing displaced flows. However, this does come at a potentially significant cost in terms of delivery times and service quality. International express operators may still divert a share of their traffic to continental hubs if UK capacity becomes a binding constraint, resulting in longer delivery times and service downgrades.

[8] Project cargo refers to large, heavy, high-value or technically complex shipments—often oversized, out-of-gauge or requiring specialised handling—that are moved for major infrastructure, energy, construction or industrial projects. These shipments are typically arranged on a charter or ad-hoc basis, require bespoke routing and equipment, and may involve coordinated transport across multiple modes.

- **Reduced Restrictions:** enables integrators to expand next-day and overnight services from London airports, improving reliability and restoring full product coverage. High-value and perishable exports particularly benefit from improved timing and connectivity.

4.17 These effects are reflected in the Cargo User Surplus through changes in service cost, delivery time and reliability, and in Wider Economic Impacts via higher UK-handled trade and productivity.

5. Integrating with TAG Welfare Analysis

Introduction

5.1 The behavioural analysis in Sections 3 and 4 describes how airports, airlines, passengers and cargo customers might respond when night-flying rules are changed — whether those rules become **more restrictive** (longer night periods, lower quotas, fewer slots and additional charges or penalties) or **less restrictive** (short night periods, extra quota, lower penalties and additional slots).

5.2 This section explains how those physical and operational changes are converted into **economic values** under the Department for Transport's *Transport Analysis Guidance (TAG Unit A5.2 – Aviation)*.

5.3 In simple terms:

- Sections 3 and 4 describe what happens when rules change.
- Section 5 describes *what that means economically* — how the costs and benefits flow through to passengers, shippers, operators and the public purse.

Overview of the Economic Components

5.4 TAG divides impacts into three main components that apply directly to night-flying policy and scope of this research. These are set out in Table 5.1.

Table 5.1: TAG Components for this Research

Component	What It Measures	Who It Affects
User Welfare (Δ CS)	How much value passengers and cargo users gain or lose from changes in fares, travel times, and reliability.	Travellers, shippers and their customers.
Producer Welfare (Δ PS)	How airline and airport profitability changes when utilisation, costs or revenues shift.	Airlines and airports.
Government Revenue (Δ GR)	How public-sector receipts such as Air Passenger Duty and corporation tax rise or fall.	HM Government and local authorities.

5.5 Each component can increase or decrease depending on whether the Night Flight Regime is made more or less restrictive. The framework is symmetrical and neutral — the same model measures both directions of change.

From Behaviour Changes to Socio-Economic Welfare Impacts

5.6 Every behavioural reaction described earlier in this report feeds into one of these economic components. Table 5.2 summarises these behavioural effects in a simplified way and the corresponding consequences.

Table 5.2: Examples of Behavioural Change Match to Economic Consequence

Behavioural Output	Example	Example of Economic Consequence
Airlines add or withdraw early/late rotations.	Low-cost carrier removes first-wave flight or adds it back.	Changes aircraft utilisation → Change in Producer Surplus.
Passengers retime, reroute, or cancel trips.	Business traveller loses early arrival; holidaymaker gains extra flight choice.	Alters fares, journey times and convenience → Change in User Welfare (passengers).
Cargo users experience longer or shorter delivery times.	Express network loses or restores next-day service.	Changes cost, time and reliability → Change in User Welfare (Cargo).
Traffic shifts between UK airports or to EU hubs.	Integrator consolidates at EMA; some parcels move via Liège.	Alters operator costs and UK throughput → Change in Producer and Government Revenue.

User Welfare (Δ Consumer Surplus)

5.7 User Welfare measures how air-service users — passengers and cargo shippers — experience the change in value between the before and after policy change position.

5.8 The change is calculated using the standard "rule-of-half" relationship from TAG A5.2:

$$\Delta CS = 0.5 \times (Q_0 + Q_1) \times (GC_0 - GC_1)$$

5.9 Where:

- *Q* = volume of travel (passengers or tonnes) and
- *GC* = generalised cost per trip or shipment, combining money, time and reliability.

Passengers

5.10 For passengers, the **generalised cost (GC)** captures the total perceived cost of a journey:

$$GC = Fare + (VOT \times \Delta t) + SDP + RP$$

5.11 Where:

- **Fare** = average ticket or package price;
- **VOT** = Value of Time for that passenger type (from TAG Databook);
- **Δt** = change in total travel or connection time;
- **SDP** = schedule-delay penalty for less convenient timing;
- **RP** = reliability penalty reflecting increased risk of delay or cancellation.

5.12 These different elements and the assumptions around them will be developed as the models are built in Phase 2. However, broadly:

- **Fares** are derived from airline pricing behaviour. When utilisation drops (e.g. one fewer daily rotation), unit costs rise, and fares increase. When utilisation improves under a loosening, airlines can spread costs over more flights and reduce fares. For package holidays, the effect appears as a change in total package price rather than airfare alone.

- **Travel and connection times -** Calculated from schedule data and the flight-retiming model. For instance, a lost early arrival may push a transfer passenger into a later outbound bank, adding an hour or two to the total journey; a restored early arrival removes that delay.

- **Schedule-delay penalties** represent the "inconvenience cost" of having to travel at a non-preferred time. TAG suggests valuing these delays at twice in vehicle time.

- **Reliability penalties** - estimated from curfew-related cancellation rates or missed-connection probabilities. Consistent with WebTAG and PDFH guidance, unreliability is valued using standard delay-time multipliers, typically 2.4× for general passengers and around 3.0× for business passengers, reflecting their higher disutility of unplanned delay..

5.13 In summary, what this means is:

- A **more restrictive** Night Flight Regime leads to higher fares and longer or less reliable journeys. Business and transfer passengers lose most value; leisure passengers face reduced choice.

- A **less restrictive** Night Flight Regime could lead to lower fares depending on circumstances, better timings and improved reliability. Short-break and holiday markets expand, while inbound tourists enjoy earlier arrivals and longer stays.

5.14 The outcome for each segment is a change in *GC*; these are aggregated across passengers to give total change in consumer surplus.

Cargo Users

5.15 For cargo, the same concept applies but the variables reflect logistics performance. The generalised cargo cost (GCC) is:

$$GCC = Cargo\,Rate + (VCTTS \times \Delta T) + RP_f$$

5.16 Where:

- **Cargo Rate** = average shipping cost per kg or tonne;
- **VCTTS** = Value of Cargo Travel Time Savings (by segment);
- **ΔT** = change in door-to-door delivery time;
- **RP_f**= reliability or service-level penalty.

5.17 These different elements and the assumptions around them will be developed as the models are built in Phase 2. However, broadly:

- **Cargo-rate effects** - From operator costs: when QC limits fall or capacity tightens, rates increase slightly; when capacity expands, competition and efficiency reduce them.

- **Transit-time changes** - From flight-schedule differences. Loss of an overnight leg may extend delivery by 6–24 hours; a restored leg shortens it. Time changes are multiplied by each segment's VFTTS[9] (very high for express, lower for bulk cargo).

- **Reliability and next-day availability** - The model framework checks whether next-day or overnight products remain feasible. If not, a discrete "loss-of-service" penalty is applied; if restored, the penalty is removed.

- **Inventory and cut-off effects -** Later or earlier pick-up times affect how long goods sit in storage. Costs are valued using standard inventory-holding rates (per hour or per day of extra stock).

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[9] See the accompanying literature review for discussion of cargo values of time.

5.18 In summary, what this means is that:

- **More restrictions** lead to longer delivery times, higher rates, reduced next-day coverage. Express and JIT segments are most affected.
- **Fewer restrictions** lead to restored overnight reliability, lower cost, and renewed competitiveness for UK exporters.

5.19 The total change in cargo-user welfare is then:

$$\Delta CS^C = 0.5 \times (T_0 + T_1) \times (GCC - GCC_1)$$

5.20 Where T is the cargo volume handled through UK airports.

Why These Effects Matter

5.21 For both passengers and cargo, the impacts are often amplified by network interdependence:

- Losing one early-morning flight can remove an entire aircraft's rotations for the day, reducing seat supply and pushing up fares.
- Missing a single overnight cargo leg can delay thousands of parcels or stop a production line waiting for imported components.

5.22 Conversely, restoring those flights can unlock multiple downstream benefits — more travel opportunities, lower average costs and higher service reliability. These cascading effects are built into the behavioural model's probabilities and feed directly into the user-welfare results.

Producer Welfare (Δ Producer Surplus)

5.23 Producer Welfare reflects how profitable the aviation industry becomes under the new Night Flight Regime — combining airlines and airports.

$$\Delta PS = \sum_i \left(\Delta\Pi_{\{a,i\}} + \Delta\Pi_{\{p,i\}}\right)$$

5.24 Where $\Delta\Pi_a$ = change in airline net profit and $\Delta\Pi_p$ = change in airport net operating surplus.

Airlines

5.25 Changes in airline profitability can be set out as:

$$\Delta\Pi_a = (1+t)\sum_i \left[\left(R_{\{1,i\}} - C_{\{1,i\}}\right) - \left(R_{\{0,i\}} - C_{\{0,i\}}\right)\right]$$

5.26 Where:

- **Revenue (R)** = fare or yield × passengers + cargo revenue + ancillaries.
- **Cost (C)** = fuel + crew + maintenance + airport charges + fixed overheads + shadow/QC costs.

5.27 Shadow and QC costs enter the framework through airline operating costs and hence fares and cargo rates. They are included within the Cost term C for producer surplus and are not added separately to user generalised costs, to avoid double counting.

5.28 In the event of a more restrictive Night Flight Regime:

- Some early or late flights become uneconomic; low-cost and charter carriers may remove entire based aircraft, losing multiple daily rotations.
- Revenues fall and fixed costs are spread over fewer flights, reducing margins.

5.29 Under a less restrictive regime:

- More rotations per aircraft; lower average cost per seat; higher utilisation and yield recovery.
- Airlines can price more competitively and still maintain or improve profit.

5.30 The segmentation of airline business models also strengthens the welfare analysis, as producer surplus and fare responses differ materially between segments such as hub carriers, LCCs and integrators.

Airports

5.31 Changes in airport profitability can be set out as:

$$\Delta\Pi_p = (1+t)\sum_i [\left(R_{1,i}^{aero} + R_{1,i}^{nonaero} - C_{1,i}\right) - \left(R_{0,i}^{aero} + R_{0,i}^{nonaero} - C_{0,i}\right)]$$

5.32 Where:

- **Aeronautical revenue (R^{aero})**= landing, passenger and noise-related charges.
- **Non-aeronautical revenue ($R^{nonaero}$)** = retail, car parking, property and cargo handling.
- **Costs (C)** = staffing, maintenance, utilities, energy and compliance.

5.33 With more restrictions:

- Fewer flights reduce both aeronautical and retail income.
- Staffing and utility savings offset only a fraction of this loss.

5.34 With fewer restrictions:

- More flights and passengers boost both revenue streams.
- Costs rise modestly with night staffing and energy use but less than proportionally, increasing net surplus.

Sector Balance

5.35 Landing fees, handling charges and other payments exchanged between airlines and airports are internal transfers within the aviation sector. When producer surplus is aggregated at the national level, these transfers cancel out—an increase in airport revenue is matched by an equivalent increase in airline cost, and vice versa. The net effect therefore reflects only the genuine gain or loss to the sector as a whole, rather than double-counting money that merely moves between operators.

Government Revenue (Δ GR)

5.36 Changes in traffic and profitability also affect what the Exchequer receives. TAG A5.2 treats these "Public Accounts" separately from welfare so that fiscal and consumer effects are not double-counted.

5.37 The most immediate channel is Air Passenger Duty (APD). When the Night Flight Regime becomes more restrictive and this results in fewer passengers travelling, APD receipts decline; when it becomes less restrictive, the opposite occurs. It should be noted that in circumstances where changes in the Night Flight Regime only result in retiming or displacement, there is no impact on volume and consequently no impact on APD.

5.38 For business passengers, TAG A5.2 sets out the following effect:

$$\Delta GR_{business} = (1 + t)\sum(APD_1 P_1 - APD_0 P_0)$$

5.39 Where *t* = indirect-tax rate adjustment (TAG A1.1) and *P* = passenger numbers.

5.40 For UK-resident leisure travellers, TAG recognises that there is also an indirect-tax effect. If people spend less on flying, they tend to spend more on other taxed goods, and vice versa. Therefore, the following formula applies for leisure passengers:

$$\Delta GR_{leisure} = (1 + t)\sum(APD_1 P_1 - APD_0 P_0) - t \times \Delta\big(Other_{Consumption} s\big)$$

5.41 Therefore, if increased restrictions discourage flying, part of the lost APD is offset by higher VAT and excise receipts elsewhere in the economy as a result of higher domestic spending. If reduced restrictions encourage more flying, some of the APD gain is offset by reduced spending — and therefore less tax — on other items. This logic ensures that the public-finance effect reflects **net** tax revenue, not gross flows.

5.42 The overall effect on Government Revenue can be summarised as follows:

- **More restrictions** leads to lower APD and corporation-tax receipts; partial offset from higher domestic spending.
- **Fewer restrictions** leads to higher APD and profit taxes; partial offset from lower domestic spending.

5.43 These fiscal effects do not affect user or producer welfare directly but are important for assessing the overall impact on government revenue and public budgets.

Overall Socio-Economic Welfare Effect

5.44 Table 5.3 below summarises the nature and direction of the above effects.

Table 5.3: Summary of Socio-Economic Welfare Effects

Policy Direction	User Welfare (Δ CS)	Producer Welfare (Δ PS)	Government Revenue (Δ GR)	Typical Narrative Outcome
More Restrictive	↓ – Passengers face higher fares and fewer options; cargo takes longer or costs more.	↓ – Airlines lose rotations; airports earn less.	↓ – Less APD, partly offset by more VAT on other goods.	Activity shifts away from the night period. This results in a loss of economic efficiency, as airline operations are impaired and consumers experience degraded options for travel or cargo shipping.
Less Restrictive	↑ – Travellers enjoy better timings, lower fares and restored next-day deliveries.	↑ – Higher utilisation and throughput raise profits.	↑ – More APD and profit taxes; small offset from reduced other spending.	Connectivity and service quality improve; overall welfare rises.

Conclusions

5.45 This framework describes the full chain of cause and effect within a TAG 5-2 compliant framework:

Policy change → Behavioural response → Service change → Economic value.

5.46 It allows both costs and benefits of altering night-flying policy to be expressed in a consistent monetary format. By combining realistic behavioural assumptions with the formal TAG equations, it provides an approach that is transparent, balanced and easy to interpret —so that policymakers can clearly see who gains, who loses, and by how much, when the UK's Night Flight Regime is adjusted.

6. Assessing Wider Economic Impacts

Introduction

6.1 Changes to the Night Flight Regime affect more than aircraft schedules, user experience, airline profitability or airport finances. By altering when and how effectively the air transport system operates, they also influence patterns of connectivity, access to markets, and the functioning of supply chains. These effects extend beyond the immediate aviation sector and private user welfare, creating the potential for impacts that are felt more widely across the economy. This section outlines how such wider-economic impacts (WEIs) arise and how they are assessed.

6.2 Night and shoulder-period operations play a particular role in this system. Early-morning arrivals and late-evening departures support same-day international business travel, sustain overnight express-cargo networks, and enable efficient fleet utilisation for passenger and charter operators. When these movements are restricted, some of these connectivity and productivity benefits are reduced; when they are available, the network functions more efficiently. These changes in connectivity have knock-on effects that can spread well beyond the aviation sector itself — affecting supply chains, business performance and regional competitiveness. It is this economy-wide transmission mechanism that we refer to in this section as the basis for wider economic impacts. These mechanisms correspond to the channels identified in the academic and policy literature summarised in the literature review.

6.3 This section explains how these wider economic impacts will be assessed. It first sets out the mechanisms by which aviation connectivity supports productivity and growth, and then describes the two complementary analytical approaches that will be used in Stage 2 to estimate them. Together these approaches will capture both the national-level impact on UK output and the regional pattern of effects across local economies.

How Air Connectivity Supports the Economy

6.4 Air transport contributes to the economy through several interlinked channels:

- Business efficiency and trade - Reliable, well-timed air links allow firms to serve global markets, meet clients face-to-face, and move high-value goods quickly. Night flights enable overnight delivery cycles and next-morning meetings that expand effective working hours across time zones.
- Attraction of investment - Businesses deciding where to locate regional or international offices prefer places with strong global access. Restrictions on early or late flights can reduce overall connectivity, making locations less competitive for such investment.
- Logistics and supply-chain performance - Overnight cargo movements keep production lines running and enable same-day e-commerce fulfilment. A delay of even a few hours can disrupt just-in-time manufacturing or reduce the competitiveness of UK exporters.

6.5 These channels raise the productive potential of the economy rather than simply shifting spending from one sector to another.

Key Considerations in Developing the Approach

6.6 In developing the analytical framework for considering WEIs in this context, we have considered a number of overarching issues:

- The application of standard TAG Wider Economic Impact metrics and their suitability to the current research;
- How to avoid or at least minimise double counting between welfare impacts and wider economic impacts;
- Why the wider economic impact approach can effectively assess net gains or losses for the economy.

Application of Standard TAG WEI Metrics

6.7 In the case of night-flying policy, the standard TAG WEI metrics are not directly applicable. TAG's agglomeration, labour-supply and imperfect-competition uplifts are designed for domestic transport interventions that change local generalised costs and therefore influence workplace access, commuting behaviour and firm location. Aviation, however, is an international sector whose wider effects operate through a different set of transmission mechanisms: trade, global business connectivity, supply-chain timing, and the efficiency of international networks. These mechanisms are not well captured by the standard TAG WEIs and applying them here would risk both conceptual mismatch and double counting.

6.8 Furthermore, the macro-productivity relationships used in Section 6 already encompass many of the channels that standard TAG WEIs are designed to represent. TAG WEIs capture the effect of connectivity on productivity through domestic labour-market and agglomeration channels, while our approach models changes in international connectivity that feed through to output via observed macro-elasticities. Applying TAG WEIs in addition would effectively overlay general-equilibrium uplifts on top of measured productivity effects, leading to double counting. For these reasons, the TAG WEIs are not directly deployed; instead, a tailored approach that reflects the distinctive international nature of aviation is used.

Avoiding or Minimising Double Counting between Welfare Impacts and WEIs

6.9 Welfare effects and wider-economic impacts reflect different conceptual perspectives: the former measure changes in user and producer surplus, while the latter capture how connectivity affects the wider production capacity of the economy. In practice, however, there is potential overlap—particularly because improvements in connectivity that reduce user generalised costs also contribute to productivity through macro-channels. To minimise double counting, we adopt two safeguards.

6.10 First, WEIs are applied only to the element of connectivity change that represents a structural alteration in how well the UK is connected to international markets—rather than the direct time or cost changes already captured in the welfare analysis. In the welfare model, users experience improvements or deterioration in journey time, schedule delay, reliability, fares or cargo rates. These are private benefits (or disbenefits) and are fully accounted for in consumer and producer surplus. If the same components of improved connectivity were then used as the basis for wider-economic modelling, the productivity uplift would effectively be applied twice: once through user welfare and again through the WEI elasticities.

6.11 To avoid this, the WEI calculation is based on the change in effective international connectivity after netting out the components directly valued in welfare. In practice, this means using only those aspects of the connectivity in an index that reflect:

- changes to the timing of flight banks (e.g. the presence or absence of early arrivals and late departures).
- changes to the availability of international links that affect firms' access to export markets, supply-chain integration or coordination across time zones.
- changes in the reliability or resilience of network structures that influence the predictability of tradeable business operations, and
- changes in the breadth or depth of international market access that are not reducible to simple time or fare changes.

6.12 These elements represent the "structural" component of connectivity—i.e. the part that changes the economic relationships firms can form, the markets they can reach, or the supply chains they can operate—rather than the private cost savings already included in welfare. This assists in ensuring, as far as possible, that WEIs reflect only the additional productivity implications of altered connectivity, and do not revalue the same time and cost changes twice.

6.13 Second, welfare impacts and WEIs are presented as separate results, with no attempt to combine them into a single figure. This recognises that, despite efforts to control for overlap, some residual double counting may be unavoidable due to the complexity of connectivity channels. Transparent reporting allows decision-makers to interpret each component appropriately and avoids overstating net economic benefits.

Why The Wider Economic Impact Approach Can Effectively Assess Net Gains or Losses for The Economy

6.14 The WEI approach used here is grounded in empirically observed macro relationships between international connectivity and economic output. Increases in early-morning arrivals and late-evening departures strengthen the effective connectivity of UK airports, improving access to global markets, enhancing the timeliness of supply chains and enabling more efficient coordination of internationally traded services. These channels translate into productivity gains that, when connectivity improves, produce net positive wider-economic impacts. These studies are considered in more detail in the accompanying literature review[10].

6.15 Conversely, increasing night-flying restrictions can weaken these same channels. Reductions in the availability or quality of early-morning and late-evening operations lower the effective connectivity of the UK within global networks, eroding competitive position, reducing the timeliness of trade flows and increasing the costs of doing business internationally. The macro-elasticities therefore give rise to net negative WEIs when connectivity is diminished.

6.16 In this framework, WEIs are not assumed to be positive; rather, they reflect the net change in the economy's productive capacity, whether favourable or unfavourable. This provides a balanced,

[10] York Aviation for Department for Transport (2025) – The Socio-Economic Impacts of Night Flying: Literature Review

evidence-based assessment of how changes in the Night Flight Regime can influence economic performance independently of user welfare.

Analytical Framework

6.17 To capture these impacts systematically, the study will use a two-pronged framework:

- Prong 1 – Connectivity–Productivity (Macro) - Measures how overall UK productivity changes with air connectivity. It considers effects on the national economy;
- Prong 2 – Regional Catalytic (Percoco-Type Micro) - Examines how air-traffic changes influence local employment and output. It considers regional / airport catchment level (aggregating to national total).

6.18 Both approaches rest on robust empirical evidence but differ in scale and data requirements. The first provides an aggregate national perspective; the second offers a spatially detailed picture that can also be summed to give a national total. The use of this two pronged approach recognises that there are inherent uncertainties in examining the wider economic impacts of changes in the aviation market. By considering these effects from different perspectives and using different approaches, the intention is to identify a plausible range for effects and, thereby, mitigate uncertainty.

Prong 1 – The Connectivity–Productivity Approach

Conceptual Basis

6.19 A wide body of international and European research has examined the relationship between air connectivity and economic performance. While many studies identify a positive association between connectivity and productivity, the strength and direction of causality varies across time, place and methodological approach. Recent work—including meta-reviews and European regional studies—highlights that improvements in air connectivity can contribute to productivity in some contexts, but in others connectivity primarily responds to underlying economic growth rather than driving it. This reflects the mixed but informative evidence base summarised in the literature review.

6.20 Connectivity in this analysis is treated as a multi-dimensional concept: not just route counts, but the timing, frequency, resilience and global reach of services that influence how effectively firms can access international markets, coordinate supply chains, and maintain cross-border business relationships. Changes to these structural features of connectivity may support economic activity in some regions and sectors, while having limited or no effect in others. The approach used here therefore applies published elasticities cautiously and only to the portion of connectivity change that reflects structural network effects.

Method Outline

6.21 Stage 2 applies a structured, connectivity–productivity framework to assess potential wider-economic impacts. The steps are:

- Construct a multi-dimensional connectivity index for each UK airport, using the ACI Europe NetScan methodology as the starting point[11]. NetScan measures an airport's direct, indirect and

[11] SEO Economics for ACI EUROPE (2014) – Airport Industry Connectivity Report. Appendix H.

hub connectivity by combining route availability, frequency, capacity, and the quality of timing—including the extent to which services enable viable onward connections. For this assessment, the index is extended in two ways: first, by explicitly recognising how night and shoulder-period movements support first-wave global connectivity; and second, by applying additional weighting to destinations according to their economic importance (for example, major business centres, trading partners, or hubs with significant global reach). This produces a measure of "effective connectivity" that better reflects the economic relevance of different links, rather than treating all routes, passengers or capacity as equivalent.

- Use the behavioural model to estimate how each policy scenario alters this measure of "effective connectivity", capturing changes in structural network quality rather than direct time or cost savings already included in the welfare analysis.
- Apply published connectivity–productivity elasticities, drawing on the literature that finds heterogeneous and context-dependent relationships rather than universal effects. These elasticities provide an indication of how changes in structural international connectivity may translate into changes in regional or national productivity, while recognising the range of estimates and uncertainties documented in recent studies.
- Translate the resulting productivity change into an indicative change in GVA and employment using Office for National Statistics ratios, noting that these estimates represent broad macroeconomic effects rather than activity in any specific sector.

6.22 This approach provides an accessible top-down indication of the potential economy-wide implications of changes to night-period connectivity, while remaining consistent with the more nuanced findings of the evidence base and avoiding double counting with welfare effects.

Integrating Cargo

6.23 Cargo is incorporated into the connectivity index to reflect the role of air freight in enabling international trade, supply-chain reliability and access to high-value markets. Building on the ACI/NetScan framework, the index is extended to include cargo-specific dimensions: (i) the presence and frequency of dedicated freighter services, (ii) belly-hold capacity on passenger routes, (iii) the timing of flights relative to overnight sort operations and early-morning delivery windows, and (iv) measures of route reliability for time-sensitive shipments. Destinations are further weighted by the economic significance of the goods typically moved on those routes. In particular, express, JIT and high-value/perishable flows—representing a large share of the UK's export value—receive proportionately greater weight than bulk or low-value cargo, which is less sensitive to timing and connectivity. This produces an integrated measure of cargo connectivity that captures both the network structure available to shippers and the economic value of the trade it supports, ensuring that freight contributes appropriately to the wider-economic impact assessment.

Prong 2 – The Regional (Percoco-Type) Approach

Conceptual Basis

6.24 The second strand examines how changes in air-traffic activity affect **regional economies**. It draws on the empirical framework established by *Percoco (2010)* for Italy and on more recent refinements explored by OXERA, York Aviation, and others that adapt this to the UK context.

6.25 The premise is that airports act as **economic gateways**. Changes in flight frequency, timing, or reliability alter the effective distance between a region and its markets- influencing local business activity, employment, and productivity.

How the Method Will Be Implemented

6.26 The regional approach complements the macro connectivity–productivity analysis by providing a second, more spatially granular lens through which to assess wider-economic impacts. It also reinforces the safeguards set out earlier in this section. Whereas the macro approach focuses on structural changes in international connectivity, the regional model isolates the portion of air-traffic variation that is determined by underlying economic and demographic fundamentals. This helps separate the demand that arises because areas are economically strong from the demand that arises because connectivity has changed. As a result, the approach reduces the risk of double counting with welfare effects and improves causal interpretation by ensuring that only the exogenous, policy-relevant component of air-transport activity feeds into the wider-economic assessment.

6.27 Percoco's (2010) study of Italian provinces employed a two-stage regression framework to examine how airport activity relates to regional economic performance. The first stage estimated the determinants of air transport demand, identifying the portion of observed traffic that can be explained by underlying economic and demographic conditions rather than by airport expansion itself. The second stage regressed regional employment and productivity on this predicted (rather than actual) traffic level, allowing the model to distinguish between the part of airport activity driven by economic fundamentals and the part that may generate wider economic effects. By using predicted demand as an explanatory variable, the approach reduces reverse-causality bias and helps isolate the extent to which changes in air connectivity are linked to changes in regional economic outcomes.

6.28 In this assessment, the approach will proceed in the same manner:

- In **step 1**, estimate air-transport demand across UK sub-regional geographies using economic drivers (e.g. GVA, wages, industrial structure), demographics, education and skills indicators, measures of tourism intensity, the prevalence of high-value or time-sensitive manufacturing, and indicators of air-service accessibility (such as workload units weighted by surface access time across all UK airports). This stage identifies the portion of air-traffic variation attributable to exogenous characteristics rather than to policy-driven changes in connectivity.
- In **step 2**, regress employment and productivity in each area on the **predicted** air-transport demand from step 1. Because the predictor is derived from exogenous variables rather than observed traffic volumes, it provides a quasi-instrumental measure that mitigates simultaneity—i.e. the tendency for economic growth to increase air traffic at the same time as air traffic may support growth.

6.29 Using this framework, changes in the accessibility of airport services—such as those arising from adjustments to night-period operations—can be linked to the structural component of air-transport demand for each sub-region. These predicted changes then feed through to estimated impacts on productivity, allowing the model to produce an internally consistent assessment of how policy-driven connectivity changes may affect local and national economic performance. The two-stage structure helps address causality concerns by ensuring that the WEI calculation is based on the exogenous, policy-relevant component of air-traffic change rather than on observed traffic trends that may themselves be a consequence of economic growth. Summing results across all areas provides a national estimate, while the spatial granularity also supports distributional analysis.

Handling Cargo

6.30 Cargo enters the model framework through two complementary routes:

- Observed tonnage, where airport data are available; and
- Demand potential, where regional cargo activity is estimated using export profiles, industrial mix and proximity to logistics nodes.

6.31 This ensures that regions involved in manufacturing or e-commerce are properly represented even if detailed tonnage data are incomplete. It should be noted that while a detailed spatial view of passenger demand in the UK can be developed from CAA Passenger Survey data, the same is not true for cargo demand. We will continue to explore the potential to access geographic data with industry but in its absence, we will revert to Percoco's original method for estimating demand potential in Italy.

6.32 In Percoco's original study for Italian provinces, detailed origin–destination air-passenger or cargo data were not available. Stage-1 demand therefore had to be inferred indirectly. Percoco constructed predicted demand using an econometric model in which provincial air-traffic volumes were explained by exogenous regional characteristics—such as GDP per capita, population, employment structure, education and skills, industrial composition—and by an accessibility index reflecting each province's distance or travel time to all airports in the national system. This produced a predicted level of air-transport demand driven solely by underlying economic and demographic fundamentals, independent of observed aviation activity, which was then passed into Stage 2 to estimate effects on productivity and employment.

6.33 If appropriately detailed geographic cargo-flow data for the UK cannot be secured, we would adopt the same principle for air freight. In this case, predicted cargo demand would be modelled using regional economic characteristics related to time-sensitive production and trade (e.g. high-value manufacturing intensity, export orientation, logistics employment) together with an airport-accessibility index. This ensures that regions with strong underlying demand for air-cargo services are properly represented even in the absence of comprehensive shipment-level data.

Interpreting the Results

6.34 The two approaches will yield complementary perspectives that are summarised in Table 6.1.

Table 6.1: Summary of the Two Approaches to Wider Impacts

Aspect	Connectivity–Productivity (Macro)	Regional Catalytic (Micro)
Scale	UK-wide	Regional (aggregated to national total)
Primary Output	% change in GDP / GVA	Change in regional employment & GVA
Cargo Integration	Weighted in connectivity index	Explicit regional cargo variable
Captures Substitution Between Airports	Implicit	Explicit
Overall Net UK Impact	Yes (via elasticity to national connectivity)	Yes (via national aggregation)

6.35 The macro approach shows how connectivity improvements translate into higher productivity across the UK as a whole. The regional approach shows how those gains are distributed spatially and how traffic may shift between airports while still yielding an overall national effect.

Conclusions

6.36 The wider-impact framework therefore provides two complementary lenses:

- A macroeconomic view linking changes in overall air connectivity, including night operations, to national productivity and GDP, integrating cargo directly into the measure.
- A regional catalytic view examining how changes in night-period activity at individual airports influence productivity in surrounding areas, with results aggregated to show the total UK effect.

6.37 Both approaches estimate **net economic gains or losses**, not transfers between sectors, and are carefully defined to avoid as far as possible any overlap with the user- and producer-welfare effects presented in Section 5.

6.38 Together they will give a rounded understanding of how a more or less restrictive Night Flight Regime influences not only the aviation market itself but also the wider performance and competitiveness of the UK economy.

7. Conclusions and Next Steps

Overall Conclusions

7.1 The modelling framework developed in this report provides a complete analytical chain from policy change to economic outcome. It captures both direct welfare effects—the value of changes in fares, time and reliability for passengers and cargo users, the financial outcomes for airlines and airports, and the resulting tax effects for government—and wider productivity effects—the impact of altered connectivity on national and regional economic performance.

7.2 A key strength of the approach is the explicit segmentation of airline business models, which avoids treating the aviation sector as homogeneous and ensures that policy impacts are assessed in a way that reflects how different operators actually use the night and shoulder periods.

7.3 The approach is carefully structured to avoid double counting. Section 5 reports the direct welfare effects on users and producers, capturing all changes in fares, schedule delay, reliability, costs and profitability within the aviation market. Section 6 then assesses only the additional, economy-wide productivity effects that arise from structural changes in international connectivity, applying elasticities solely to those components not already valued in welfare. To maintain analytical clarity, welfare and wider-economic impacts are presented as separate results, recognising that—even with safeguards—some overlap between channels cannot be entirely eliminated. Presenting the two components distinctly ensures transparency for decision-makers and avoids overstating the overall economic consequences of changes to the Night Flight Regime.

7.4 The dual emphasis on macro and regional analysis ensures that results are both comprehensive and locally relevant. The macro connectivity–productivity approach provides the overall scale of the impact on UK GVA, while the regional Percoco-type model shows where those effects are likely to be felt most strongly and distinguishes between displacement across UK airports and genuine gains or losses to the country as a whole. Cargo is fully integrated into both approaches, recognising its outsized contribution to export value and supply-chain reliability.

7.5 Overall, the framework provides DfT and policymakers with a transparent, evidence-based means to weigh the economic consequences of night-flying decisions alongside environmental and social considerations. It establishes a sound foundation for the quantitative work to follow.

Next Steps for Phase 2

7.6 Following this methodology report, this study has moved from framework design to implementation and testing. The main tasks were:

- Data collection and baselining – Compiling detailed flight-schedule data, night-quota and noise-classification information, airline and airport characteristics, passenger segmentation, fares and values of time, cargo tonnage and time-sensitivity data, APD receipts, and regional economic indicators (employment, GVA, exports).
- Behavioural model build – Implementing the airport, airline, passenger, and cargo decision frameworks developed in Section 4, using parameters derived from literature and stakeholder consultation.

- Welfare estimation – Applying TAG A5.2 formulas to compute user and producer surplus changes and fiscal impacts for each policy scenario.
- Wider-impact modelling –
  - *Macro connectivity–productivity approach:* constructing connectivity indices, applying published elasticities and estimate the associated change in national GVA.
  - *Regional Percoco-type approach:* defining instrumental variables and demand base, estimating catalytic elasticities, applying scenario changes to derive regional GVA and employment effects, and aggregating to a UK total.

7.7 The developed model provides the quantitative evidence base needed for a full socio-economic appraisal of night-flying policy options. It demonstrates, in measurable terms, how night-time access influences the UK's connectivity, competitiveness and wider economic performance.

7.8 Using the model, the study has then moved on to:

- Scenario and sensitivity testing – Examining a wider range of policy scenarios relating to night flight policy, including changing restrictions on different components of the Night Flight Regime e.g. variations in night-period length, quota levels and movement limits.
- Reporting and communication – Presenting results as transparent ranges with national totals, regional maps and segment-specific breakdowns, clearly separating direct welfare and wider productivity effects. The Socio-Economic Impacts of Night Flying: Model Output Report is published alongside this document.

8. Appendix A: Stakeholder Consultations

8.1 A wide range of air transport industry stakeholders were consulted as part of Phase 1 of the project. An initial list of stakeholders was identified by the Department for Transport, which was then supplemented with some additional organisations identified by York Aviation.

8.2 Consultations were undertaken via semi-structured interviews with stakeholder personnel. Where appropriate and helpful to the study, stakeholders were asked to supply supporting evidence and data to support their positions and opinions. It should be noted that the great majority of these interviews and any subsequent data provided were subject to non-disclosure agreements and, hence, while the information has informed this work, a detailed summary of these discussions cannot be provided here. Instead, where these discussions have been used to inform the methodology this is highlighted within the text. Similarly, general conclusions from these discussions are highlighted within the Literature Review Report. These consultations have primarily been used to add depth and specifics to themes and patterns already identified through the Literature Review process. In particular, they have been used verify behavioural reactions of different airline models and to inform assumptions around commercial performance at different times of day.

8.3 The organisations consulted as part of the study were:

- Airlines UK
- Airports UK
- British Airways
- British Business and General Aviation Association
- DHL
- Easyjet
- Fedex
- Gatwick Airport
- Heathrow Airport
- IAG
- International Air Transport Association
- Jet2.com
- Manchester Airports Group
- Ryanair
- Tui
- UPS
- Virgin Atlantic

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