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Manston Airport Air Freight Hub

Reviving strategic transport infrastructure to maximise Global Britain's trading potential

Applicant's response to Arup Assessor's Draft Report

Appendix 4

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ACI
AIRPORTS COUNCIL INTERNATIONAL

Developing Cargo at Airports

How airport operators can develop successful cargo strategies

July 2021

This guide has been prepared by Netherlands Airport Consultants (NACO) and ACI World. The research incorporates inputs from global airports and air cargo industry experts.

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PREFACE

Throughout the COVID-19 pandemic, the value of air cargo to airports, airlines, governments, shippers, and consignees has become more evident in the response to the global crisis but also through significant growth in e-commerce generated by government-imposed restrictions and lockdowns. Not only did the demand for cargo increase due to the changes in the retail environment, but now as the industry moves into the recovery phase, it is critical for the pharmaceutical industry, that relies on air transport for delivery of time-sensitive medical supplies, particularly vaccines. The airline business model has been forced to change overnight with the restrictions on passenger movements across borders. Equally, the previously available cargo capacity - in particular belly capacity, has substantially changed therefore pushing the industry to rethink its strategies so as to be able to meet the demand.

Many airports already have well-established track records in cargo, driven by a local level strategy which has been coordinated with airport stakeholders and community. Throughout the pandemic, these airports have managed to sustain or even grow the cargo segment of their revenue streams to a certain extent. This has proven crucial in providing liquidity for the airport operators and in some cases even ensured the longer-term solvency of these organisations.

Coming out of the pandemic, as airports look to ensure long-term financial sustainability through the diversification of their revenue streams, cargo is an important area to be explored. The development of a clear, well-thought-out cargo strategy, including a cargo master plan, is essential to growing this segment of airport's portfolios. As part of this strategy, it is critical to understand the market potential, the regulatory environment, as well as the operational needs for new or increased cargo operations. A clear cargo strategy will help further the airport's understanding of the current landscape and opportunities as well as build a robust business plan for the future.

With a view of providing ACI member airports with guidance on diversification of revenues streams allowing for long-term financial sustainability, ACI teamed up with NACO to develop this short guide exploring one of the most interesting strategic options available. The intention of this document is to allow airports that are not currently significantly involved in cargo to better understand the opportunities that may lie within the development of this market segment and help those airports that currently have extensive cargo operations with the re-formulation of their cargo strategy, where relevant.

This guide has been developed leveraging NACO's extensive expertise and understanding of the air cargo market, and equally integrates the experience and lessons learned of a number of ACI airport members from across all regions. These inputs, which are highly appreciated, have been invaluable to establishing a comprehensive landscape of the cargo value chain and understanding of the key elements that should be looked into and included in an airport cargo strategy.

KEY FINDINGS:

- **Air cargo is an engine of economic growth**

  There is a newfound importance for air cargo and willingness from aviation stakeholders to invest in or contribute to its development. The role that air cargo fulfilled during the pandemic has created a positive momentum. In the words of one of the airports interviewed: *"cargo engages"*.

- **Cargo development needs strong collaboration**

  The air cargo supply chain involves many stakeholders and as such, leads to challenges when developing cargo. Conversely, there is an opportunity for airports to lead their *cargo ecosystem* and orchestrate joint efforts. Airports that are on the forefront continuously ask themselves how they can support their stakeholders to develop their cargo business.

- **Access to cargo data is critical**

  As the document demonstrates, understanding the cargo context is critical for airports to build their development plan. Fact-based and data-driven insights are important in building an understanding of the value of cargo to the airport, its clients, and the broader economy.

- **Airports must have a vision for cargo**

  Leading cargo airports have internally aligned on what cargo means for them and what their ambition is. They play to their strengths and build their strategy accordingly. When benchmarking with other airports, it is important to note that not all strategies are universally applicable.

- **Airports must plan their infrastructure carefully**

  Analysing demand & supply dynamics and building a business case for new infrastructure development are essential steps. So is considering inputs from cargo operators and other stakeholders. Although there may be uncertainty about traffic forecasts and cargo trends, the airport's challenge is to balance various inputs and build a flexible infrastructure that adapts to future operations.

- **…but it is not 'just about the infrastructure'**

  Whilst quality infrastructure is certainly an asset, there is a wide range of aspects that airports need to manage to realise their cargo potential. Network connectivity is among the key criteria to developing cargo. Some other aspects may in fact not be within the airport's direct scope of control but may be significantly impactful – such as facilitation and policy support.

- **Innovation and Digital opportunities exist**

  Digitalisation has been one of the most promising opportunities for the industry to increase transparency and reduce inefficiencies. As aviation faces an impeding challenge in the form of Net-Zero commitment, there is a need to chart the path for air cargo, using the latest technology and industry-wide collaboration.

A JOURNEY TOWARDS THE AIRPORT CARGO STRATEGY

Cargo: A Lifeline for Aviation

Perhaps never in modern times has air cargo received so much attention. Cargo's contribution to revenues of airlines and airports has been praised as one of the very few silver linings the aviation industry has experienced since the COVID-19 crisis hit the sector. More importantly, the support provided to economies throughout the global lockdown and supply chains has been invaluable.

According to ACI, cargo traffic declined in 2020 by (only) 9%[1]. Compared to a passenger demand shortfall of 64%, it might appear that cargo avoided a crisis. Yet these statistics hide two major challenges.

Firstly, while the global cargo growth returned to positive territory in December 2020 compared to 2019 levels, it is not the case in all markets. Many trade flows involving Asia Pacific, North America and Europe have started recovering from the historic lows. However, other regions are experiencing lagging recovery due to their reliance on belly capacity – namely Africa and the Middle East.

Secondly, recovery is constrained by the availability of cargo capacity. Whilst full-freighter aircraft utilisation has significantly increased, it is not sufficiently offsetting the large loss of belly cargo capacity. Going forward, given uneven economic recovery and different success levels in the roll-out of vaccinations, we can expect capacity issues to linger and with that, somewhat unstable cargo markets.

An Opportunity for Airports?

Overall, cargo has proven once again that it is resilient – just as it withstood several crises over the last 50 years.

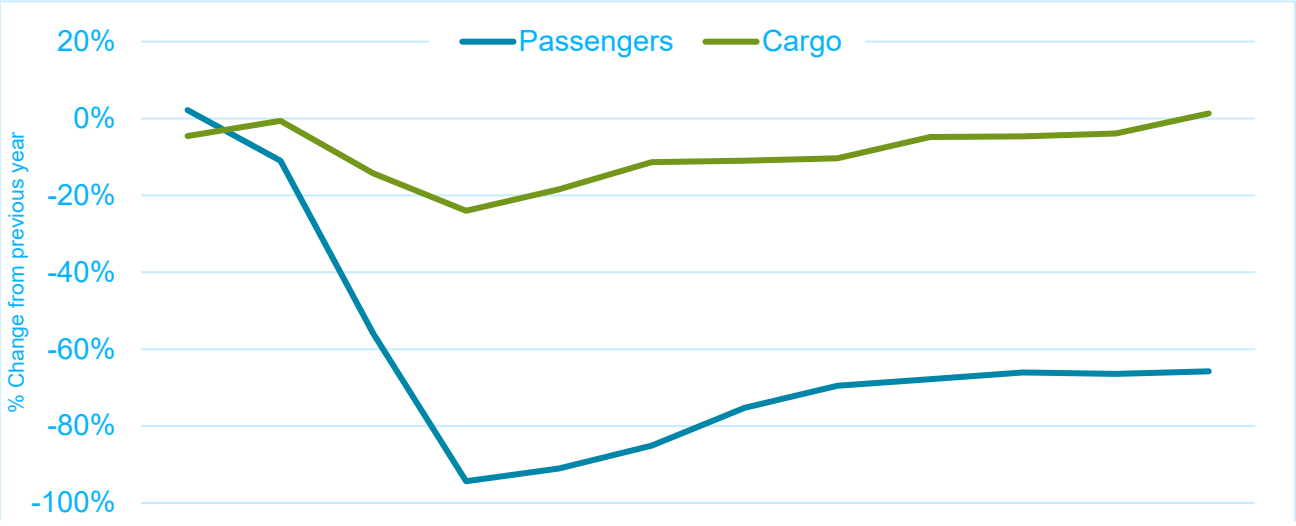
In light of the recent developments, many airports are asking how they can capitalise on cargo's resilience. The answer is not straightforward, and it will probably depend on many circumstances. Some of these factors are not even within the airport's control – which makes the process even more complex.

There is however one consideration that applies to most airports: developing cargo takes time and effort.

When looking at the images of chartered passenger aircraft full of cargo shipments ('*preighters*' as they are now known), the spike in e-commerce delivery and the bustling cargo facilities worldwide… one may be forgiven for thinking that all this activity and progress happened overnight.

In reality, to arrive to this point, most airports have spent years – if not decades, developing facilities, improving their processes and organisation, attracting airlines and collaborating with local stakeholders. Some opportunities will require agility and quick thinking, but most will require long-term investments and relationship building. As this guide will demonstrate, many aspects need to come together to develop cargo. This makes it a complex but worthwhile journey.

FIG. 1 **EVOLUTION OF AIRPORT TRAFFIC[1], 2020 VS. 2019**



[1] Source: ACI World, World Airport Traffic Dataset 2020

A Guide for Developing Cargo at Airports

Earlier this year NACO and ACI collaborated to develop a short article on *Cargo Development and Strategies for Airports*. This stems from the need for airports to understand their cargo potential and diversify their revenue streams. This guide is a follow-up to the article, where we propose to elaborate on the practical steps that airports can undertake to materialise their cargo potential.

To that effect, we introduce three high-level phases as shown in Figure 2:

A. *Understand the Current Situation*
B. *Define a Cargo Vision & Plan*
C. *Set Up Capabilities & Infrastructure*

Each one of these phases includes a practical step-by-step approach.

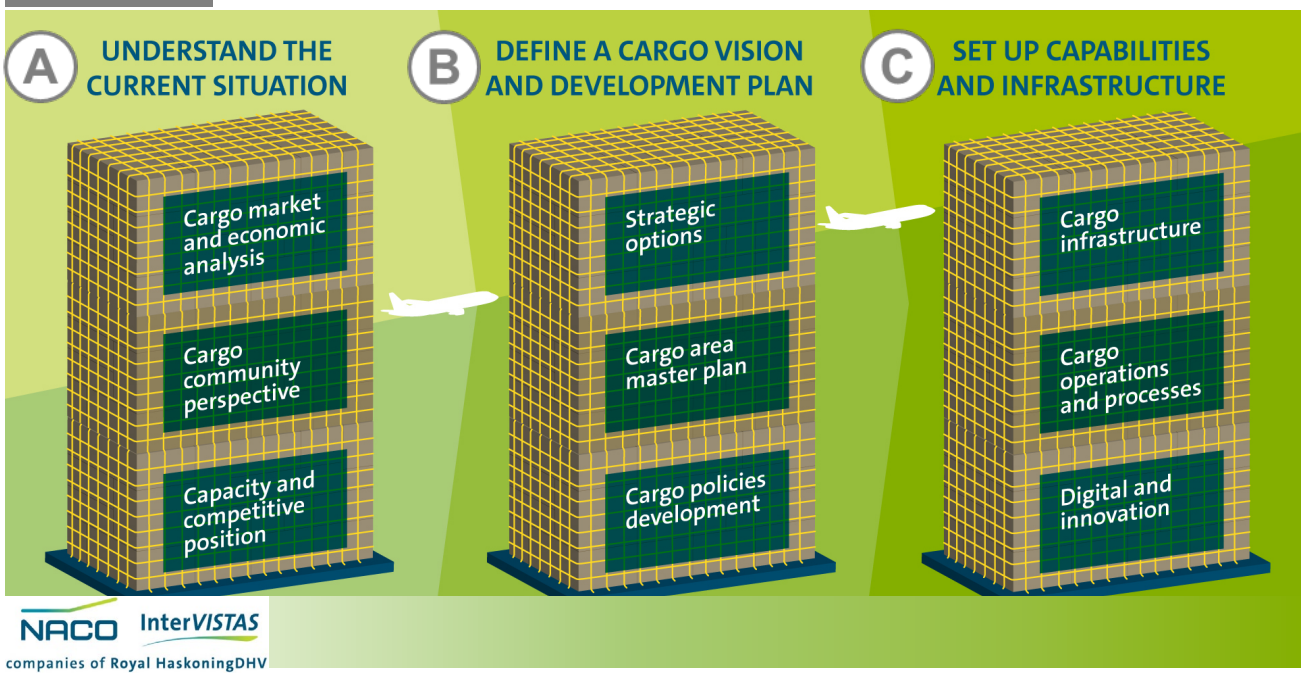
While it is difficult to generalise the process of building a cargo strategy, this document focuses on guiding principles. The actual steps may vary by airport operators. Some may know their context well and are already past the first phase. Others may want to focus on specific steps only.

This document also includes practical examples of strategies that other airports have pursued. These are meant for inspiration and should not be seen as universally applicable recommendations.

We would like to thank the airport operators that we have interviewed in this process. We appreciate their trust and passion when sharing their cargo story. In turn, we hope that this guide provides useful support and inspiration when embarking on your own cargo journey!

The NACO and ACI Team

FIG. 2 A JOURNEY TOWARDS THE AIRPORT CARGO STRATEGY



A. UNDERSTAND THE CURRENT SITUATION

When it comes to developing cargo, airports are often focused on applying "best practices" from leading hubs. Whilst learning from great examples is logical, knowing the local cargo context is a fundamental first step towards an airport's cargo strategy. It is important for any airport embarking on such journey to *play to its strengths* and tackle its specific challenges – which supposes a deep understanding of the airport's cargo drivers.

Through our experience and interviews with airports, we have observed that – unsurprisingly, cargo contexts vary significantly and may make comparisons misleading. For instance, an airport with strong export demand should not follow the same journey as an airport with strong transit flows. Nor can every airport become a transshipment hub. For these reasons we highlight the need to start from analysing the facts.

1. Cargo Market Trends

The cargo market is highly dynamic and constantly affected by global and local economic trends. Industrial developments, demand for commodities, consumption levels, regulations and delivery types are constantly impacting the airports' cargo activities. Furthermore, the pandemic has accelerated e-commerce shipments growth, fuelled by an evolution in consumer behaviour globally. Supply chain disruptions put additional pressure on air cargo to deliver. At the time of writing, uneven airline recovery paths have made it difficult to predict belly capacity growth at many airports.

In summary, understanding and anticipating cargo trends is what keeps many airport cargo managers 'awake at night'. While it may appear overwhelming, foreseeing these developments is essential to capture opportunities in an ever-dynamic cargo market. We suggest prioritising these trends based on their expected impact and the airport's ability to act on them.

For instance, one airport was facing an impeding risk of demand shortfall due to relocation of local manufacturing, which has a potentially high impact but there was little that the airport could do about it. In another example, an airport we interviewed noticed increased demand for multimodal delivery (air-sea) which prompted proactive collaboration with the neighbouring port operator.

Naturally, these trends will largely vary with some having a global impact while others are specific to the airport's region or country.

OBJECTIVES

1. Review global, regional & local cargo trends
2. Evaluate value and impact on the economy
3. Map views and requirements of stakeholders
4. Analyse relevant cargo market segments
5. Analyse the airport's competitive position

2. Economic Analysis

Understanding cargo's value to an airport may not be as straightforward as it appears. Pre-pandemic, revenues that cargo generated were somewhat limited compared to other services, at most airports. We estimate that overall, cargo represented less than 10% of airport's annual revenues in 2019, mainly in the form of facility and land rental. This has completely changed during the pandemic crisis, as a result of resilient cargo traffic and sustained downfall of passenger revenues. One airport mentioned that cargo 'kept the lights on' during the pandemic with a share of 17% of aeronautical revenues, up from 2% before the pandemic.

Yet beyond the 'direct' value that cargo may provide to the airport's revenue, there is significant 'indirect' value that cargo generates. Such value comes in the form of supporting local industries, creating employment opportunities, and enabling global trade. Air cargo can be of strategic importance to local economies.

For this reason, many airport operators have set out to understand cargo's economic impact. For instance, one airport we interviewed explained that a crucial part of their strategy journey was for them to compare the economic value created by cargo against that created by passenger traffic. The results were eye-opening and helped the organisation better align on the positioning of cargo as a strategic business. In another example, an airport managed to secure joint funding of a new cargo facility with the government contributing to more than half of the investment. In this same instance, policy makers have also expressed their interest in financially supporting certain new cargo routes, as they valued the potential it could generate for the region's air exports and local economy.

> "Our focus on cargo started with analysing the added value of cargo traffic to the airport and economy. This was necessary to align internally."
>
> Large European Cargo Airport

Overall, a deep understanding of cargo's value and its potential creates alignment – both internally and with the airport's stakeholders.

3. Stakeholders' Perspective

The air cargo value chain involves a high number of stakeholders. Up to 9 or 10 companies and entities can work together to deliver a single shipment. As such, developing cargo can prove highly complex and will depend on the quality of collaboration across the value chain. Airports should strive to consider the whole *cargo ecosystem* when developing their strategies. Whilst approaches to cargo will vary, we have observed throughout our interviews that airports which have succeeded in developing a lasting cargo strategy are those that see their role beyond that of a landlord.

In practice, these airports keep open, frequent, and transparent communication with their stakeholders – involving them in major decisions or simply, keeping a pulse on local developments. Formal communication forums commonly known as *cargo communities* are useful platforms to tackle common pain points and ensure continuous collaboration. In addition, one-to-one meetings with stakeholders can help the airport validate growth plans and test strategies. Figure 3 shows an example of key requirements that airports typically exchange on with their stakeholders.

Many will agree that cargo is a *people business*, as success relies on relationships and joint efforts. With that in mind, development strategies need to encompass stakeholders' requirements and gather their support.

4. Cargo Demand and Supply Data

While analysing their markets, airports should identify cargo market segments that they can act upon. For instance, a large hub may segment its flows into import, export and transshipment. Another cargo gateway might distinguish outbound cargo originating within the airport's city, versus shipments that are trucked from a wider catchment area. These categories reflect different strategies for the airport to act upon and monitor over time.

FIG. 3 AIRPORT CARGO 'ECOSYSTEM' AND EXAMPLES OF KEY STAKEHOLDER REQUIREMENTS

Note: indicative requirements; source: airport interviews; NACO-InterVISTAS analysis

To keep a pulse on its markets, one of our airport cargo clients built a demand & supply data dashboard. Demand encompasses cargo traffic size and growth versus that of neighbouring airports. In addition, it monitors performance of different markets that the airport is connected to. As such, trends in traffic performance can be contextualised and underlying dynamics are uncovered. In addition, commodity data is highly relevant to many airports in sizing demand for special cargo handling (perishables, pharmaceuticals, etc.).

Cargo capacity data has proven to be valuable for airports to understand how their available capacity may have recovered compared to competitors. Growth in route capacity will help Air Service Development (ASD) understand opportunities to grow the cargo network and attract additional air operators. Furthermore, analysing demand and supply levels will help uncover over- and under-served routes and related opportunities. Other relevant data points include economic indicators, air cargo rates and industry surveys. In general, such cargo data can be scarce and imperfect compared to passenger traffic data; however, there are some standard data sources that can help airports get a handle on their cargo situation.

5. Competitive Position

Benchmarking the airport's cargo performance can prove difficult in light of a general lack of cargo data across a wide range of parameters. For example, airports might resolve to compare tonnage growth, but data of throughput time – often a key differentiator, is usually not available. In such instances, qualitative information can help fill the gaps. Airline and Freight Forwarders can also provide meaningful feedback for the airport to assess its position, based on their experience operating wide networks.

To help airports consider their competitive position, we propose to evaluate three key aspects: *connectivity and air capacity* is often (one of) the most important strength(s) that an airport can boast. Proposing a diverse range of routes, airlines, frequencies, size, and quality of capacity help freight forwarders develop their business. Secondly, *ground handling and warehousing* activities are key for airlines to maintain high service levels. Thirdly, the strength of the *end-to-end logistics* chain is a key differentiator. Figure 4 shows an indicative example where a regional airport benchmarks its cargo performance against that of a large neighbouring gateway. The exercise can help the airport define its market position and for example, focus on service quality instead of volume.

FIG. 4 CARGO CRITERIA AND AIRPORT BENCHMARK (ILLUSTRATIVE)

> As we develop our cargo strategy, we choose to focus on special cargo handling and quality freighter capacity, to differentiate from the competition.
>
> Regional Airport in North America

B. DEFINE A CARGO VISION AND DEVELOPMENT PLAN

Once facts are collected and context is understood, airports should (re-)state their cargo vision and establish a plan. Part of this exploration is introspective: weighing in different priorities and committing resources for cargo specifically. Another part is outward-looking: where expected demand growth and other external constraints can limit the scope of development options. This process leads to the development of what is commonly known as a *cargo master plan*.

The objective of the master plan is to capture future opportunities and mitigate challenges, all while reducing exposure to (financial) risks. In the case of cargo development, airports face challenges namely due to the lack of control and unpredictability of traffic. So how can airports set up effective cargo development plans?

OBJECTIVES

1. Define vision and objectives
2. Forecast cargo demand growth
3. Evaluate strategic options
4. Size facilities and produce a master plan
5. Plan for regulatory and policy aspects

> "Cargo was always a side topic until a few years ago. Part of the change was triggered by Real Estate recognising that the value was beyond landing fees."
>
> European Airport

1. Cargo Vision

For some airports, cargo is a strategic area capturing significant investments; for many others, cargo is considered a 'byproduct'. Naturally, there is no 'one size fits all' answer to how airports should consider cargo. It depends on the market potential and context (see step A). Perhaps the only wrong answer is *not* having a position on cargo at all or never asking the question in the first place.

It is important to set a cargo vision and commit to a certain level of ambition. There are many competing priorities at an airport. Knowing where the organisation stands on cargo helps to actively manage it. For instance, one airport we interviewed has always recognised the importance of cargo and as such, sets aside agenda time in board meetings for that purpose. If cargo generates 10% of the airport revenues, why not allocate *at least* 10% of management's time to the subject?

Similarly, there is no definitive model when it comes to how airports manage cargo internally. We have spoken to large hubs with dedicated cargo teams of around ten staff including account managers, operations managers, and data analysts. We have also met with smaller airports with only one or two staff partially allocated to cargo.

The internal organisation should fit the type of ambition the airport has for cargo. This organisation should equally be agile and adaptable, so as to cater to varying demand and market dynamics. There is one principle that often proves effective, which is ensuring that multiple internal stakeholders have knowledge about cargo. For example, one airport cargo manager told us that their collaboration with Real Estate was successful, because they were up to speed on cargo. It is after all, a multi-discipline area; containing the topic to a few staff may not enable its full potential.

2. Cargo Traffic Forecast

Cargo growth has been relatively stable in the years leading up to the pandemic crisis, yet *the devil is in the average.* Some markets have fared better than others. Products fell in and out of fashion. Supply chains shifted between air and sea freight. Trade barriers affected cargo flows and caused a gradual shift. All in all, forecasting cargo growth has been a difficult job...

When it comes to making cargo projections, the airport should start with the objective in mind. Demand projections are often associated with facility sizing, but there are other potential objectives: many airports seek to know how markets will develop and what routes they should add or prioritise. Additionally, they would like to foresee what industries will fuel the growth, including potential new commodities that may one day replace current shipments. These objectives call for different approaches to forecasting in terms of granularity, time frames and inputs.

Effectively forecasting cargo requires analysing a wide range of economic indicators beyond GDP and that may include import & export orders, industrial production growth, employment rates, currency exchange or interest rates. Furthermore, belly cargo growth is linked to passenger traffic growth, in particular for widebody flights. Lastly, in the case of transshipment, growth is mainly dependent on strategies of the home carriers and their available aircraft capacities. Timeframes will also vary: facility planning may require a top-down 20-year projection, while air service development may need a shorter-term bottom-up forecast.

To summarise, there is a large number of parameters requiring careful analysis and tailored methodologies. The objective is to provide a guiding projection to be monitored and updated every few years.

3. Strategic Options

Airport should not contain their cargo strategies only to aspects that they can *control* – like real estate but go beyond to parts they can *influence* – like operations. As we explain in step 5 of section A, there are 3 areas that airports can explore:

- **Connectivity and air capacity** – with different approaches for either freighter or belly operators. Airports have a critical role to play in attracting the right operators and developing routes. One airport told us that they proactively helped airlines set up business cases for new routes and navigate local regulations. This helped to overcome the fact that they did not have the same exposure as large hubs.

- **Ground handling and warehousing** – ensuring sufficient handling capacity requires airports to update, expand or rebuild their facilities. Additionally, airports should strive to resolve operational issues. Although this aspect is often out of their control, it is key for their customers and stakeholders.

- **End-to-end logistics** – acknowledging that developing cargo at the airport hinges on broader aspects, such as the availability of logistics services and the proximity to demand clusters. Once again, while it does fall outside of the airport's scope, there are examples of airports we talked to who successfully worked with their local governments and economic promotion partners to stimulate trade flows – for instance by attracting logistics hubs and distribution centres.

Deciding among these initiatives relies on 'cost & benefit' analyses, in particular for facility-related strategies. Besides financial benefits, intangible benefits such as service level improvement are equally valuable. Moreover, airports should also consider how cargo benefits other stakeholders, which is essential in safeguarding the long-term position of the airport. One airport explained how new developments are usually tested within small focus groups including a selection of local stakeholders, like freight forwarders, ground handlers and airlines.

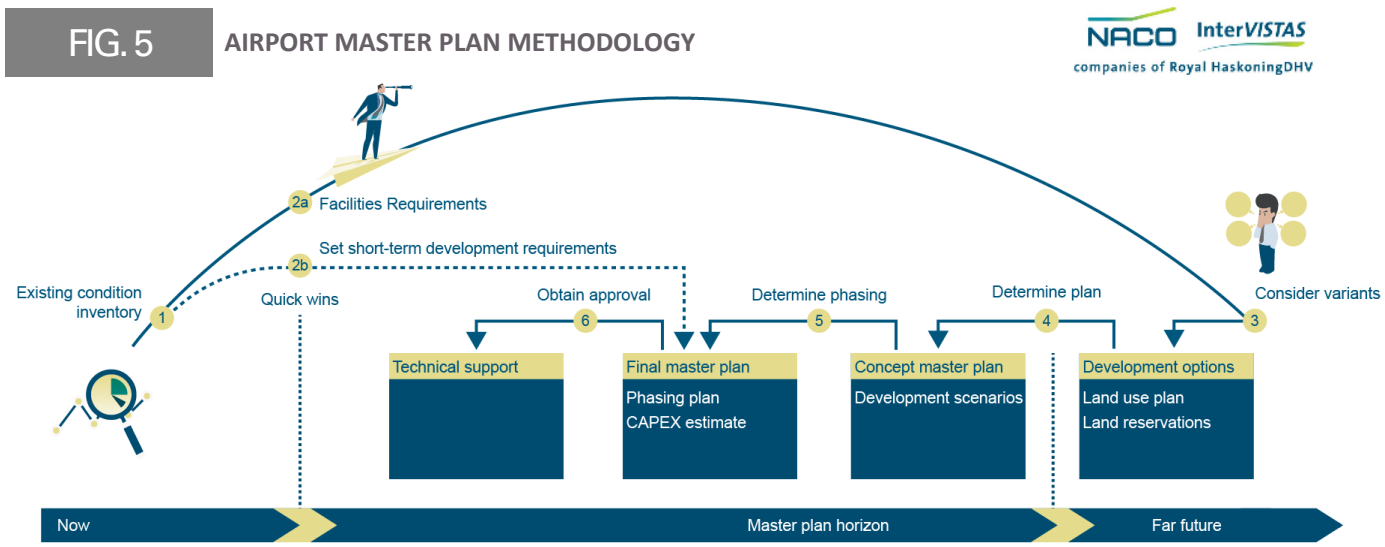
> My advice for other airports is to engage with their cargo clients and help build a clear business case. Explain the value of operating at the airport and the growth potential.
>
> South American Airport

4. Cargo Master Plan

To support the chosen strategy and move towards execution, airports develop master plans (see Figure 5). The same applies to cargo where planning is built backwards from the desired end state. Some airports will include cargo in their overall airport master plan, while others will prefer to conduct a specific study reflecting their ambition (see point 1).

The main challenges when developing a cargo master plan lie in accurately sizing the land or facilities needed, considering the airport's overall needs – in particular for airside access and apron capacity which may be scarce. As such, the cargo land use plan may be constrained by the land reservations made for other purposes. Coming out of the pandemic, this can cause significant issues, due to the discrepancy between the cargo and passenger recovery paths.

FIG. 5 AIRPORT MASTER PLAN METHODOLOGY



Source: NACO-InterVISTAS research

For instance, one airport we interviewed was experiencing cargo capacity issues and needed to move on with an expansion project. However, the expansion was tied to a passenger terminal redevelopment, which had to be halted because of the pandemic crisis. Other airports worldwide may come to face similar challenges, where cargo traffic is outpacing capacity, but a slow aviation recovery may limit opportunities in the short term.

To mitigate these risks, airports should strive to remain as flexible as possible. For instance, by reserving land specifically for cargo expansion – to the extent possible. That way, cargo growth will not depend on other capital projects which may or may not be delayed. Working together with cargo ground handlers on an appropriate phased expansion will also ensure co-ownership of the project and reduce risk for both parties.

FIG. 6 OVERVIEW OF AIR CARGO OPERATIONS RIGHTS

Note: scope is defined by legal rights stipulated in each BASA. Source: NACO-InterVISTAS research

Cargo site selection should also consider process-related constraints, which include having efficient landside access and airside access flows – between the facility and the aircraft. This also varies on whether full-freighter or belly cargo is more/less prominent at the airport. Moreover, multiple cargo facilities may be needed, related to various types of cargo (e.g. general vs. express/mail) and the cargo communities' needs (e.g. ground handlers, freight forwarders, integrators, etc.).

Building business cases and analysing financials is central to the cargo master plan. Several airports we interviewed explained that they regularly assessed available processing capacity and built the case for a potential expansion. Inclusion of the communities needs and clients' inputs are critical in these projects.

5. Regulatory and Aeropolitical Aspects

Air cargo operations are subject to the rights provided in Bilateral Air Transport Agreements (BASA), which are signed by national governments for the purpose of allowing air services (both passenger and cargo) to be operated between their respective territories. Although some multilateral initiatives have been advanced by MALIAT countries[2], and more recently by the Latin American Civil Aviation Commission (LACAC), multilateral frameworks are not common.

The scope of air cargo operations – both current and potential – is defined by the legal rights stipulated in each BASA, which is based on the preferences of each country (see Figure 6).

It is important for airports to understand how the rights provided in each BASA may influence and/or contain the success of current air cargo services, including airports' ability to attract potential new services. Based on experience and global case studies, aeropolitical and regulatory factors tend to influence cargo development and growth strategies in unforeseen ways. In some cases, country restrictions on traffic and route rights may deter new air cargo services and affect the long-term competitiveness of airports. In other cases, the inability of air carriers to connect with other modes of surface transportation without restrictions may limit the ability of airports to promote themselves in international markets or in certain air freight segments.

Airport management can benefit from higher levels of aeropolitical and regulatory awareness on three fronts. First, airport decision-makers can better define the actual roots of competitive advantage or disadvantage of their airport vis-à-vis other airports in the same or neighbouring countries. Second, airports can better structure their incentive programmes by offering targeted aeropolitical support and/or regulatory relief as well as other exemptions to current or potential air cargo

[2] Brunei, Chile, Cook Islands, Mongolia, New Zealand, Samoa, Singapore, Tonga, and the United States

operators. Third, and perhaps most importantly, senior management can benefit from having a full picture on whether direct engagement with government entities and other stakeholders should be considered as part of their short- and long-term commercial strategy.

The development of a sound aeropolitical and regulatory strategy should include the identification of allies, enablers, as well as current or potential adversaries at the national, local, and supra-national levels. It should also include the identification of potential partners to protect or attract new cargo services. These partners will typically have an interest in tourism and regional economic development. It should also address the various obstacles – legal, operational, commercial, regulatory, to name a few – affecting the growth and development of air cargo services.

Channels of engagement may include sub-national governments in charge of regional economic development, national authorities with jurisdiction over transportation and civil aviation or municipal entities responsible for environmental policy and enforcement of environmental regulations. As a best practice, it is also recommended to monitor air cargo and trade development initiatives led by regional and international economic development organizations. Partnerships with influential transportation or e-commerce companies with significant political leverage can equally be beneficial to advance towards the airports' cargo ambition.

> Our regulatory agencies are very business minded. That is one of the reasons that makes customs operations more efficient: regulatory obstacles can be avoided.
>
> Large Asian Airport

C. SET UP CAPABILITIES AND INFRASTRUCTURE

The third step covers the implementation of the cargo development plan and building capabilities that create a lasting benefit. For many airports, cargo implementation mainly refers to developing ground infrastructure. However, other aspects can be equally important, such as the cargo operations and the supporting *digital* infrastructure.

Naturally, a successful implementation will require active involvement of the airport's stakeholders, such as engaging the entire community. This will result in consistency in delivering the cargo vision, even across aspects that the airport operator may not directly control.

OBJECTIVES

1. Define the cargo operating model
2. Design cargo facilities
3. Review cargo operations
4. Improve efficiency through innovation
5. Future-proof operations

1. Cargo Operating Model

There are various operating models available for airports to develop cargo facilities. These range from relatively simple models to more integrated models (see Figure 7). Defining the ideal model requires an understanding of the risks that the airport operator is willing to be exposed to, and the extent of the appetite to invest in cargo.

Leasing the land may be the simplest form of development, where the airport would transfer most financial and operational risks to a cargo operator or a real estate developer. These tend to be relatively long-term contracts with steady revenue. On the other hand, it may not maximise opportunities for the airport and can 'lock' the land for a period of time.

A more common approach is where the airport would own the facility and leases it to the cargo operator. This ensures that the airport has a stake in cargo (through the assets) while its clients would focus on cargo operations. During our research, one airport noted how they had a vested interest in cargo but still wanted to provide freedom to their customers to optimise their operations. As such, the airport owns the building, but the interior – including cargo handling equipment, is completely installed and controlled by the cargo operator.

Some airport operators do perform (cargo) ground handling and thus have a 'hands-on' approach to cargo. However, for many others it may not be realistic to start cargo ground handling due to limited know-how, available resources and costs of operation. An 'in-between' model is where the airport would partner with the cargo operator to ensure sharing risk and reward.

FIG. 7 RANGE OF CARGO OPERATING MODELS (ILLUSTRATIVE)

Source: NACO-Inter*VISTAS* research

These models illustrate some possibilities available for airports and may not be exhaustive. Other variations may exist, and their relevance will depend on the airport's specific context. For instance, one airport we interviewed explained how it was important for them to implement multiple models with diverse risk profiles, as a combination of land and facility lease. Whichever solution(s) the airport designs, it remains important for the airport to consider inputs from its customers and stakeholders.

2. Cargo Infrastructure

There are different types of cargo facilities, depending on their business functions and type of cargo processed. For the airport, these tend to be classified in three categories:

- **Cargo Terminal (also known as 1st line)** – representing an interface between landside and airside and operated by Ground Handling Service Providers (GHSP) with a primary function of processing cargo as fast and efficiently as possible.
- **Forwarder Facility (2nd line)** – consisting of a warehouse within the airport's premises but typically with no direct airside access. Freight Forwarders (FF) focus on managing end-to-end cargo flows, potentially including cross-docking.
- **Logistics Park (3rd line) –** warehouses and distribution centres off-airport but within trucking distance.

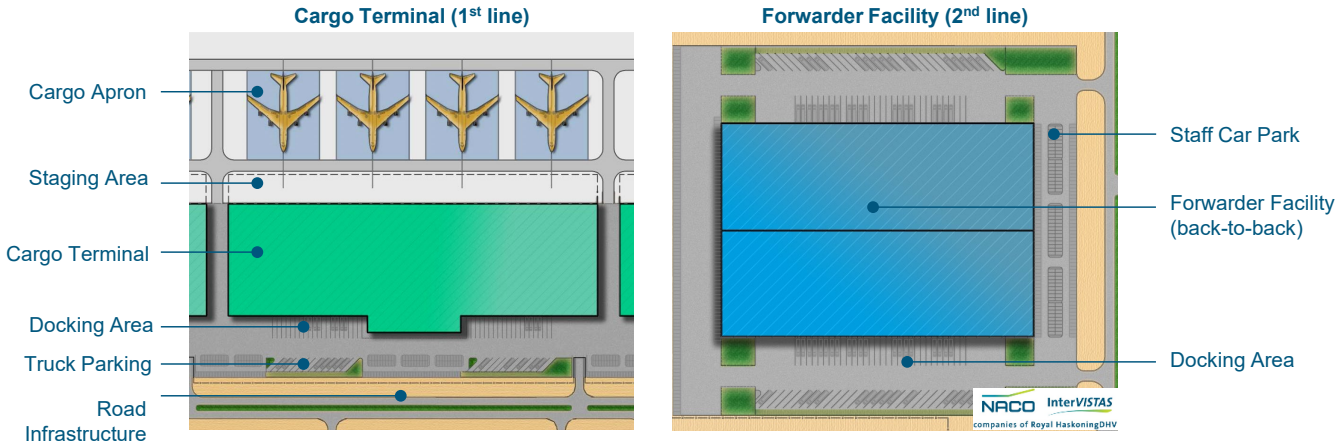
In their infrastructure development, airports focus on the first and second lines (see Figure 8). Third-line facilities play a significant role in attracting cargo flows but are typically off airport land – for example, within a Free Trade Zone (FTZ). In this case, leading cargo airports strive to work with local municipalities to develop joint opportunities.

> "Having significant land on the first line is a key strength compared to other airports in the region. We also plan to develop second-line facilities in the future."
>
> European Airport

Designing cargo facilities requires finding a balance between multiple factors, which collectively fulfil the airport's cargo objectives, including:

- **Capacity** – the ability to process cargo traffic in line with the airport's projections is a primary design factor. For one airport we interviewed, land and facility availability were a key selling point when attracting high-growth carriers/operators.
- **Productivity** – to prevent future capacity issues, it is important to maximise cargo processed within a given space (in annual tonnes per m2). This does not only free up valuable airside land for the airport, but it can also reduce operating cost for GHAs. One airport explained that although they had a typical real estate model with their clients, i.e. revenue driven by square meters, they introduced a clause to incentivise both parties to maximise productivity. The airport started a project to upgrade their facilities which will increase capacity by 30%.
- **Flexibility** – increasing productivity might lead operators to seek automated solutions, but this will in turn decrease flexibility. For instance, one airport we interviewed was experiencing strong increase in small packages, which was not compatible with their large automated equipment. To cater to unexpected demand changes or growth volatility, airports should seek to find an optimal trade-off between productivity and flexibility.
- **Special Products** – catering to special cargo handling requires dedicated facilities, such as rooms for: pharmaceuticals, other perishables, dangerous good, valuables, live animals, etc. Express cargo also requires dedicated processes and equipment.

FIG. 8 1ST AND 2ND LINE FACILITY DESIGN ELEMENTS (ILLUSTRATIVE)



Note: not to scale
Source: NACO-InterVISTAS research

- **Other factors** – the list of design factors and their relevance will vary and may include staff well-being, sustainable operations, etc.

These design factors are integrated in a conceptual design which shows the required functions within the cargo facility and reserves space for each subsystem (see Figure 9). The design goes into greater level of detail for each of the processes, such as: import, export and transshipment – as well as sub-processes of special cargo handling, staff itineraries, etc.

3. Cargo Operations and Processes

While most airports may not have a 'hands-on' role in their cargo operations, it can be extremely valuable to contribute to the improvement of cargo operations. One reason is that improving efficiency will reduce the need for future infrastructure expansion (see point 2). Another reason is that the quality of operations can be a key differentiator for airports.

Customs operations, for example, can significantly influence the airport's cargo reputation. One airport we interviewed shared how their 'business-friendly' customs office constantly engages with the local cargo community in the form of a satisfaction survey, to understand where improvement opportunities might lie. Another airport relies on data provided by customs to monitor operations and resolve potential delays.

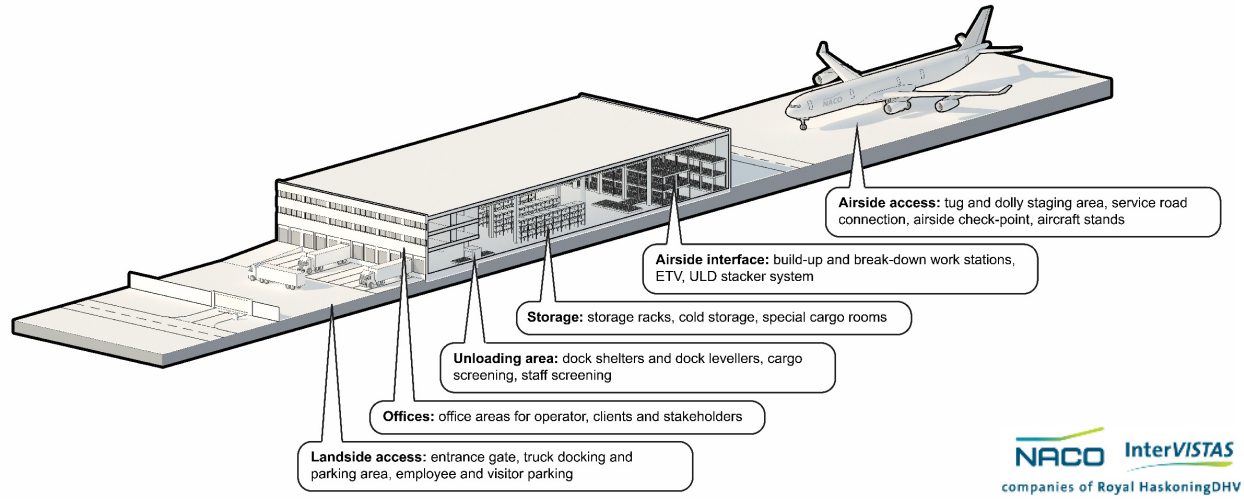
Security protocols represent another potential risk of bottlenecks in case of unexpectedly high traffic. Leading airports to use digital tools, such as camera-based detection, to streamline the process.

> "To add capacity, we look at the needed investment and the demand levels. We involve the cargo community in these assessments."
>
> Large Asian Airport

The speed and predictability of ground handling operations is a key factor which can be measured in terms of 'throughput time', representing the end-to-end processing time required for cargo to be ready to fly (outbound) or to be picked up (inbound). In many instances, measuring and monitoring such data can prove challenging given the lack of automated processes. During our research, an airport operator shared how they trialled imposing soft Service Level Agreements (SLAs) based on throughput time, cargo driving time and other operational KPI. Local GHSPs were open to applying these new metrics and keen on exchanging data, which in turn improved the overall client satisfaction at the airport.

Because cargo operations are complex and involve many stakeholders, there is a role for the airport operator to drive joint improvement programmes. For example, one airport we spoke with took the lead in implementing pharma cargo certification (Center of Excellence for Independent Validators in Pharmaceutical Logistics, CEIV) by exploring the value created to stakeholders and coordinating with the industry body in charge of this programme (International Air Transport Association, IATA).

FIG. 9: **HIGH-LEVEL FUNCTIONAL LAYOUT FOR A CARGO TERMINAL (ILLUSTRATIVE)**



Note: not to scale
Source: NACO-InterVISTAS research

In the current situation, managing cargo operations can be extremely challenging during and following the pandemic - where cargo volatility is at its highest and the cargo mix is evolving. Also, GHSPs and other airport stakeholders may be under cost pressures, which will limit investment possibilities. For these reasons, it is now even more critical for airports to explore opportunities to support their cargo operations, which can be in the form of data exchange, process certification or simply facilitation.

> Although we are not directly involved in pharma certification, our role was to orchestrate the efforts between the local community and IATA. It is important to assess the value upfront.
>
> Large Asian Airport

4. Innovation and Efficiency

Innovation is a key opportunity for cargo to increase its efficiency and emerge stronger from the pandemic crisis. Complex operations involving many parties could gain from data sharing, while manual and paper-based processes would benefit from digital tooling.

During our research, several airports shared that they are (or have considered) implementing a Cargo Community System (CCS) to increase efficiency and collaboration. Such systems organise data exchange across the end-to-end cargo chain, which increases transparency and efficiency. One airport explained how one of their largest freight forwarders analysed that moving its processes to a CCS would increase its capacity by 50%, therefore delaying infrastructure expansion by about 5 years. On the other hand, another airport shared that they did not need a CCS since it was mostly working with cargo integrators who were already exchanging operational data with the airport. The value of the system will indeed largely depend on the airport's context and its cargo operations.

Overall, exploring the value and building the business case is critical to a successful digitalisation project. In the case of data exchange, the value is jointly shared among stakeholders. For that reason, it can be challenging to establish a business model and move forward. The airport operator, given its central role, can act as a facilitator and build the case for its stakeholders ensuring value is in line with the companies' investments - even when the value is fragmented across multiple companies.

Truck dock management systems are an example of such digital solutions that improve efficiency. At some airports, volatile truck arrival times and operational delays can create bottlenecks and cascading capacity issues. Exchanging data on truck arrival times and managing their traffic upstream can lead to significant improvements. For example, one airport we interviewed found out that truck docking-related issues resulted in a hidden cost of cargo handling amounting to US$ 7-8 million per year. Furthermore, it can reduce unnecessary landside traffic and related CO2 emissions. Once the value has been established and quantified, it became easier for stakeholders to understand the problem and to contribute to this joint programme.

Digitalisation can also play an active role in improving operations within the cargo terminal. For instance, exchanging data between the airline and the ground handler can enable forward planning, which is critical to manage peaks. A better use of cargo communication systems and integration with the Warehouse Management Systems (WMS) is needed to enable such improvement.

5. Future-Proof Operations

The global aviation industry is poised for change and air cargo is no exception. Digitalisation ushers in a new era of opportunities for the cargo industry to improve efficiency and contribute to more sustainable practices. Automating processes, removing paper trails, setting up reliable data exchange and optimising processes are just some of the ways in which digitalisation can help increase load factors, reduce truck movements and contribute to the path towards Net Zero.

In a recent survey by The International Air Cargo Association (TIACA, April 2021) across air cargo stakeholders worldwide, most respondents claimed that "sustainability does matter within the air cargo industry". Furthermore, 75% of these companies have a sustainability strategy in place. The majority also stated that the topic was more important today than ever before.

In this evolving context, airports should explore what their role could be in this industry-wide effort. Once again, the complexity lies in the end-to-end cargo chain which involves many stakeholders and thus will require a concerted effort. Since many airports are committed to Net Zero targets and are actively working on a roadmap to reach it, it may be reasonable to allocate resources on joint cargo sustainability programs. For instance, some airports have explored joint cargo distribution models to streamline delivery of shipments between GHSPs and freight forwarders, leading to carbon emissions reduction. Other airports are trialling the use of electric vehicles on the airside, which can benefit cargo operations as well in the future.

Cargo can also be a pioneer for the development of new solutions, in particular in the Urban Air Mobility (UAM) and Unmanned Air Vehicle (UAV) sector. Given safety challenges related to passenger transportation, unmanned cargo flights

may be the first to be trialled before carrying passengers in the future. Several companies have rolled out promising pilots for a variety of use cases - for instance: delivering pharmaceutical shipments to remote areas. The implications on the airport can be in terms of infrastructure (implementing new facilities in the airport system), in terms of operations (working with Air Traffic Control to integrate unmanned vehicle movements into the air traffic flows), or in terms of regulation (creating the right regulatory framework to support these innovations).

There is no shortage of cargo challenges that airports need to consider. Cargo facilities should be planned and designed in such a way that they can flexibly adapt to the needs of future operations, whether in terms of delivery modes (*e.g., unmanned vehicles*), nature of cargo (*e.g., growth of e-commerce*) or type of operations (*e.g., sustainable operations*).

As charted out in this paper, planning for air cargo facilities requires not only short-term actionable insights today but also long-term strategic foresight, planning and collaboration.

A WORD FROM THE AUTHORS

We sincerely hope that this document proves useful to airport operators worldwide who are considering developing their cargo business. Please reach out should you have questions or feedback.

We are fully cognisant that there are many nuances that this report may not directly answer and that it is impossible to generalise and create a blueprint which would be relevant to all airports. For that, our aim is to provide advice and guidance on where airports can *start* with the development of their cargo strategy and the issues they need to consider. It is up to each airport to devise their overall plan and next steps.

We would like to express our deepest appreciation to the airport operators that participated in this research and to all cargo managers at airports who actively strive for the continuous improvement of the cargo industry worldwide.

About NACO-InterVISTAS

Since 1949, NACO has provided integrated and multi-disciplinary airport planning and design services for 600 airports in more than 100 countries. Together with our sister company InterVISTAS, we offer data-driven strategy, planning, operations improvement and infrastructure implementation. Our dedicated cargo team has considerable experience working with airports, airlines, ground handlers and other stakeholders in improving their cargo businesses.

About ACI

Airports Council International (ACI), the trade association of the world's airports, was founded in 1991 with the objective of fostering cooperation among its member airports and other partners in world aviation, including the International Civil Aviation Organization, the International Air Transport Association and the Civil Air Navigation Services Organization. In representing the best interests of airports during key phases of policy development, ACI makes a significant contribution toward ensuring a global air transport system that is safe, secure, customer-centric and environmentally sustainable. As of January 2021, ACI serves 701 members, operating 1933 airports in 183 countries.

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INTERNATIONAL

DHL EXPRESS UNCOVERS NEXT WAVE OF E-COMMERCE GROWTH

Press Release: Bonn, March 30, 2021

- **Whitepaper predicts online B2B increase of more than 70% by 2027 to US$ 20.9 trillion (2019: US$ 12.2 trillion)**
- **Covid-19 pandemic drives digital transformation and significantly accelerates B2C and B2B E-commerce growth**
- **DHL Express closed FY2020 with best result in its history (EBIT: €2.7bn, +34.9% yoy)**

Today, DHL Express, the world's leading international express service provider, released a new Whitepaper " *The Ultimate B2B E-commerce Guide: Tradition is out. Digital is in*". The study predicts strong growth for the B2B E-commerce market in the coming years: by 2025, 80% of all B2B sales interactions between suppliers and professional buyers will take place in digital channels. The impact of the Covid-19 pandemic on the pace of digitalisation and the purchasing behaviour of technology-savvy millennials, who are now of an age to be the professional B2B decision-makers, are the main drivers of this global E-commerce growth. What is predicted for the future of the B2B sector, has already been visible in the significant B2C E-commerce rise over the last years, where DHL Express experienced high growth rates particularly during the holiday peak seasons (e.g. Easter, Christmas) and mega shopping days (e. g. Black Friday, Cyber Monday). In total the B2C E-commerce volumes within the DHL Express network increased in 2020 by approximately 40%, compared to 2019.

This positive business development is also reflected in the FY2020 financial results of the company: With a total revenue of €19.1 billion (+11.9% year-on-year) and EBIT of €2.7 billion (+34.9%) the Express division of Deutsche Post DHL Group closed 2020 with the best result in its more than 50 years history. With its worldwide network and breadth of industries served, DHL Express was able to accommodate fast-changing trade flows. Furthermore its presence in more than 220 countries and territories helped consumers and businesses to stay connected by enabling them to trade around the world – also during the Covid-19 pandemic.

"Even in times of worldwide shutdowns, globalization has shown its resilience, fuelled by digitalization and the power of global trade", says John Pearson, CEO of DHL Express. "These trends have led to an ever growing number of consumers to shift their shopping activities online. The pandemic has accelerated this development like never before, with a sharp rise in businesses selling their goods in the global marketplace. E-commerce and global logistics thus provided the key to unlock local shutdowns, keep economies running and mitigate the impact of Covid-19 for many of our customers."

Acceleration of E-commerce growth through Covid-19

It was not only B2C E-commerce that was growing due to ongoing digitalisation and changed shopping behaviour of consumers. In 2019, before the pandemic, global sales on B2B E-commerce sites and marketplaces had already increased by 18.2% to reach USD 12.2 trillion[1], outpacing the market size of the B2C sector. Through Covid-19 and the resulting acceleration of digitalisation, this global B2B E-commerce volume is estimated to reach USD 20.9 trillion by 2027[2].

"We have been facing the pandemic for over one year now", says Michiel Greeven, Executive Vice President Global Sales at DHL Express. "A year that showed how nearly a decade of digital evolution happened in just a few months' time, with online shopping and cross-border shipping as the new normal. And this is true not only for B2C retailers, but also in terms of B2B E-commerce as companies started recognising that online selling platforms are crucial for their business success, today and in the future. As a result, there will also be an additional need for global Express shipping and DHL Express is well positioned to support all B2B companies on their journey."

Huge potential in B2B E-commerce also driven by Millennials

The Whitepaper, compiled by DHL Express, uncovers factors driving the growth of the global B2B E-commerce market: besides general trends such as globalisation and digitalisation, a new technology-oriented generation of millennials is starting to make its mark. Already, millennials account for 73% of all professional B2B purchasing decisions. As digital natives, their experiences in the B2C-sector translate to high expectations when making B2B transactions, pushing companies to invest in digital solutions, such as selling platforms, while offering great growth potential.

"If B2B businesses want to make the most out of the new cross-border and E-commerce opportunities they need to start adapting to the changing buying behaviours. Especially with the upcoming generation of millennial as B2B decision-makers, who are further driving the digitalisation of the sector. B2B customer experiences have to be more aligned with the digital B2C experiences. As international E-commerce specialists, we have the know-how and insights to support businesses to adapt to the ongoing changes and unleash their full potential" says Leendert van Delft, Vice President Global Sales Programs and Global E-commerce.

DHL Express is investing to continue to meet high customer demands

In 2020 DHL Express delivered 484 million shipments in total for its customers (B2C and B2B) around the globe, around 9% more per day than in 2019. To adapt to this significant growth of its network, DHL Express continues to invest annually more than €1 billion in new state-of-the-art facilities around the world to multiply its sorting capacity (+65% since 2013), hires new employees (+10,000 year-on-year) and adds new freighter aircraft to its fleet (+20 units year-on-year). In this context, DHL Express recently announced the purchase of eight more Boeing B777 wide body freighters and a partnership with Smartlynx Malta to add two Airbus A321 to its fleet. With these measures, DHL Express ensures that its worldwide customers can benefit from the global E-commerce boom.

[1] **Statista**
[2] **Researchandmarkets**

10 November 2021, 05:01 GMT

Boeing and Airbus Are Launching Cargo Planes That May Face Crowded Skies

Supply chain chaos has fueled demand for freighter aircraft. But the new models will be competing with converted passenger jets.

By Julie Johnsson and Charlotte Ryan

▲ An Air Canada Airbus A330 passenger aircraft, reconfigured for cargo. PHOTOGRAPHER: CHRISTINNE MUSCHI/BLOOMBERG

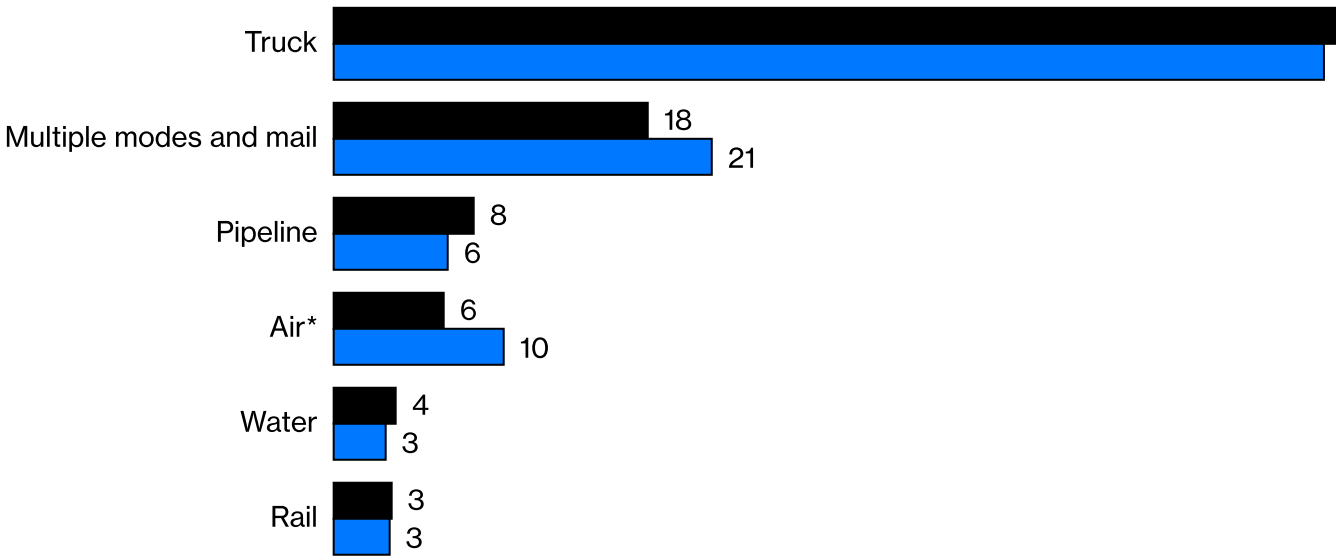
When the world's air carriers, aerospace manufacturers, and leasing companies gather for the Dubai Airshow in the fall, much of the attention in recent years has been given to the seemingly endless appetite for new planes by homegrown carrier Emirates Airlines and its Gulf competitors. But when this year's show opens on Nov. 14, the spotlight will be on air freighters.

Because of the dramatic growth of e-commerce, the pickup in demand for both consumer and industrial goods as the pandemic eases, and supply chain turmoil that's shown the downside of total dependence on ocean shipping, cargo carriers and logistics companies are turning to air freighters. These behemoths can quickly transport huge amounts of freight while bypassing port tieups, shortages of ocean containers or rail cars, and the current dearth of long-haul truck drivers. And aircraft owners are eager to add more of them to their fleets because the prospects for freight growth are encouraging. Plane lessor Avolon Holdings Ltd., for example, forecasts air cargo revenue will reach $150 billion this year, with traffic doubling over the next 20 years.

Share of U.S. Domestic and International Freight Value

By mode of transportation

☐ 2018 ☐ 2030 projection



*Includes truck-air transport.

Data: Bureau of Transportation Statistics

In Dubai, Airbus SE will be chasing customers for a cargo version of its A350 widebody passenger plane. Boeing Co. is also preparing to unveil the initial deal for an all-cargo version of its 777X widebody. But the announcement could come outside of the airshow if an expected launch customer, Qatar Airways, skips the event because of geopolitical tensions. Both planemakers have been schmoozing the same small circle of potential buyers, a group that includes FedEx, Lufthansa, Singapore Airlines, and DHL, according to people familiar with the efforts who asked not to be identified as the talks are confidential.

Just about every airworthy cargo craft has been pressed into service to meet surging demand for airborne shipping. Cargo titan Atlas Air Worldwide Holdings Inc. has snapped up 11 out-of-production 747-400s this year. And Amazon.com Inc. is shopping for used long-range cargo versions of Boeing's 777 and Airbus's popular A330 widebody, according to

people familiar with the matter, the latest evidence of the e-commerce giant's ambition to move products across borders itself.

Leasing companies are buying used passenger planes that can be stripped of their seats and overhead compartments and converted to freighter service. Last month, Avolon announced it will work with Israel Aerospace Industries Ltd. to convert 30 Airbus A330 passenger widebodies for use as freighters that will enter service from 2025 to 2028.

The sudden demand for aging behemoths like the 747 and the three-engine McDonnell Douglas MD-11, another large freighter spared from the scrapheap, creates uncertainty for the jets that are supposed to replace them. Boeing has already broken its record for annual freighter sales in 2021 and is looking to give lift to struggling 777X sales by launching a freighter version of the passenger jet. And Airbus is angling to take a slice of the market Boeing has long dominated by positioning its A350F cargo plane as an emissions-friendly choice that saves on fuel costs. Both could use these boosts at a time when the pandemic has slowed sales of large passenger airliners.

▲ Loading cargo on a converted Asiana Airlines Airbus A350. SOURCE: AIRBUS

Yet there's no guarantee the demand will still be there when the new planes arrive in a few years, after supply chain wrinkles are ironed out and travelers are once again trekking across the globe—with plenty of extra cargo space inside the bellies of the passenger planes they'll take. Airbus and Boeing may face a glutted market, especially if leasing companies crank up programs to convert more passenger jets into package-haulers.

"We see strong freight demand today and for the foreseeable future," says John Plueger, chief executive officer of Los Angeles-based Air Lease Corp. "But at the same time, a lot

more airplanes are going to be flying in three or four years' time."

For years, dedicated freighters had lost ground to passenger aircraft carrying goods along with people. Boeing's largest twin-engine jet, the 777-300ER, can carry 396 travelers on its main deck and the cargo payload of a midsize freighter down below. But with Covid, the drop in flying reduced such belly-freight capacity to a fraction of 2019 levels.

Danish container-shipping giant A.P. Moller-Maersk just ordered its first Boeing 777 freighters for an expanded foray into air cargo. And young and cheap 777-300ER and Airbus A330-300 airliners are being bought by aircraft lessors, hedge funds, and other financiers for cargo conversions as their leases expire.

Interest in conversions is so strong that existing slots to retrofit them are booked through 2025, says logistics consultant Brian Clancy. That's a concern for Air Lease as it studies whether to create its own freighter program. "I don't know what a normalized world is anymore, to be honest," Atlas CEO John Dietrich said on an earnings call this month.

At the Dubai show, Airbus will be closing in on initial orders for the A350F, according to people familiar with its plans. Those briefed on the jet describe a formidable market entrant with a 109-ton payload and the range to cruise the Pacific Ocean.

"We came to the conclusion with our customers that the A350 is a fantastic platform for a freighter version," Airbus CEO Guillaume Faury said in October. The jet's arrival will be timed to meet "the wave of replacements that is in front of us in 2025 onwards with the new regulations on carbon emissions."

Airbus doesn't have to sell a huge number to claim success, according to Agency Partners analyst Sash Tusa. Logging 10 orders annually, or 20 in a good year, is enough to change the economics of the underlying A350 program. "It's been a glaring gap in Airbus's portfolio not to have a freighter," he says.

Airbus's plane is expected to reach customers around mid-decade. It will face competition from repurposed 777 passenger models that are due to enter the market shortly, offering similar capacity and reliability for less than half the $160 million going rate for a new freighter, according to consultant Stephen Fortune.

A rebound in belly cargo in passenger planes could help preserve market equilibrium, says George Dimitroff, head of valuations for Ascend by Cirium. As airlines bring back their widebody passenger fleets, freight prices should drop. That will cut into the profitability of

older, fuel-guzzling freighters, eventually forcing them out of the system, he says. Cirium's database shows that 523 cargo planes now in service are candidates for retirement, about half of them older-generation 747s.

"There's lots of room for modernization," says Tom Crabtree, a Boeing regional director of air cargo. "And there's going to be increased pressure on the operators of older aircraft for more efficient or modern equipment."

But while new emissions rules that could ground many older freighters are set to take effect by the end of the decade, regulations can change. Boeing has already petitioned the Environmental Protection Agency to delay the rules' application to its current 767F widebody freighter program, arguing that financial uncertainty caused by the pandemic warrants more time being needed to upgrade or replace the program. And airframe makers sometimes simply misread demand, as Airbus did with the now-ended program for its mammoth A380 double-decker jumbo jet, which saw orders shrivel as international carriers lost interest in flying huge planes in their hub-and-spoke networks.

One of the forces fueling the conversion boom is the large number of cheap used planes. The manufacturers pushed widebody output to such heights last decade that "both the A330 and 777 have seen colossal collapses in market value," Dimitroff says. A Boeing 777-300ER that cost upwards of $150 million new a decade ago can be picked up for $20 million to be retrofitted as a package-hauler.

Is a similar glut looming for dedicated freighters, as new plane prices will likely be many multiples of the cost of used jets? "I'm not sure I want to label it as a bubble," Dimitroff says. "It's a potential risk of medium-term oversupply, but not something that can pop overnight." *–With Siddharth Philip, Kyunghee Park, and Ryan Beene*

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Airlines

What Global Economists Can Learn From Atlas Air

Madhu Unnikrishnan
November 8th, 2021 at 1:30 AM EST

Skift Take

Some of the pandemic's long-term economic effects are yet unknown. But one thing is certain: A consumer shift toward e-commerce accelerated and is most probably lasting. And air cargo companies are cashing in on the change.

— *Madhu Unnikrishnan*

Air cargo airline Atlas Air's billion-dollar quarter was more than just a bonanza for its shareholders. It illustrates the way global trade changed during the pandemic and continues to evolve. And it answers a more basic question: Will your holiday gifts arrive on time?

The short answer is no, they probably won't. Atlas, and other air shippers like it, are cashing in on a set of factors that no one saw coming early in the pandemic, but the sector can't supply the lift needed to keep the global supply chain humming.

The pandemic accelerated a structural shift in retail toward e-commerce. Populations stuck at home and prevented from shopping in grocery stores, malls, and other retail shops turned to e-commerce for daily necessities during lockdowns. And once those lockdowns ended, the habit stuck. Couple this with almost unprecedented savings among the world's middle classes, and the usual shipping lanes buckled.

And this is occurring as the global economy starts to heat back up. Manufacturers ran down inventories of raw materials and spare parts during the pandemic and are restocking to feed growing demand.

On top of that, maritime shipping found itself almost completely unprepared for the surge in demand. U.S. West Coast ports are jammed, with record numbers of container ships at anchor outside the ports of Long Beach, Los Angeles, and Oakland waiting for berths. This isn't the only vulnerability: The closure of the Suez Canal for several days due to the grounding of the Ever Given container ship earlier this year also proved the fragility of the supply chain and cost billions in lost trade; and Covid-19 continues to wrack the supply chain by periodically shuttering key ports in China and elsewhere in Asia.

Adding to the mess is a shortage of truck drivers and warehouse capacity in the U.S., so even when goods eventually are offloaded at ports, there's no guarantee they will get to their destinations on time. And on top of that, a global shortage of shipping containers means shippers are struggling to get their goods onto ships.

Maritime shipping's bottlenecks are causing a mode shift to air cargo, especially now that air freight costs only five times as much as maritime,

compared with 12 times more before the pandemic, International Air Transport Association (IATA) data show. Before the pandemic, perishable cargo, like fresh flowers, fruit, and seafood, went by air, as did lighter, high-value goods like electronics and microprocessing chips. Now, with maritime shipping's constraints, goods that ordinarily would have gone by sea are moving by air. And e-commerce packages, typically small and lightweight, are ideally suited to air shipment

But it's not all boom times for air cargo. Most air cargo isn't carried by freighter aircraft. Instead, the majority is carried in the belly-holds of passenger aircraft, alongside passengers' luggage. International passenger demand collapsed in April 2020 and only now is starting to show signs of life. Airlines around the world quickly pivoted to convert some of their larger passenger aircraft into temporary freighters (giving rise to the ungainly portmanteau of "preighters"), with United Airlines along operating about 10,000 cargo-only flights during the pandemic. This threw airlines a lifeline when passengers weren't flying. But even this wasn't enough. IATA data reveal that although air cargo demand has risen almost 10 percent over 2019, supply, or "capacity," has fallen by an equal amount compared with 2019.

Enter air cargo companies like Purchase, NY-headquartered Atlas. "I'm not suggesting things aren't going to moderate," its CEO John Dietrich said on the company's recent earnings call. "They will eventually from where we are today, but we feel good about the long-term prospects." Before the pandemic, belly-hold cargo accounted for about half of all long-haul freight capacity, but now more freight is carried on dedicated freighters, a trend

Dietrich believes will continue. And consumer behavior has shifted decisively toward e-commerce. Even if shoppers return to brick-and-mortar stores, retailers will need to move goods quickly to meet demand, Dietrich said.

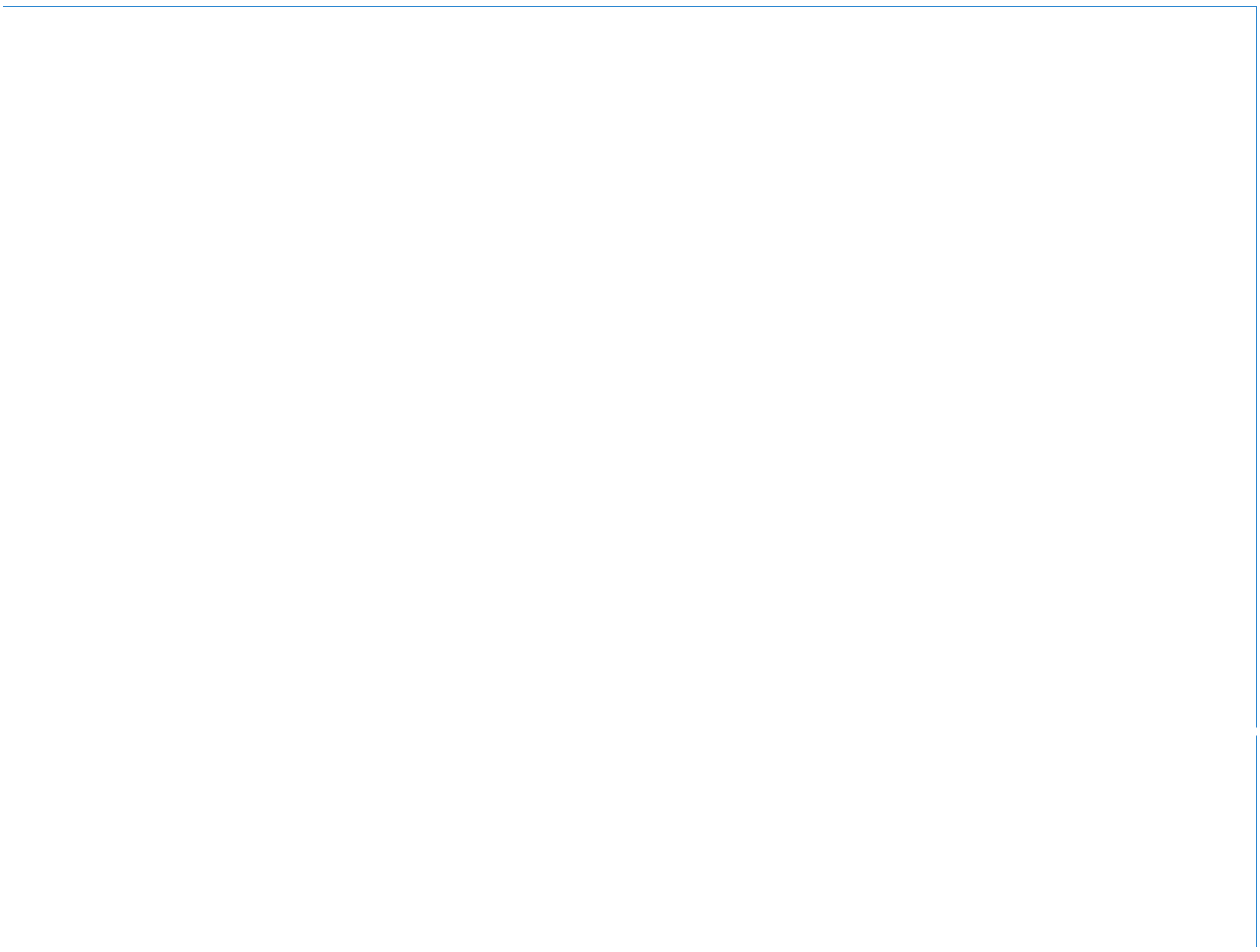
Moreover, the nature of passenger networks may have changed toward more point-to-point service, which is less optimized for air freight than hub-and-spoke networks, Dietrich said. More passenger service relies on the Boeing 787, which is designed for point-to-point flights. These two trends could shift even more cargo to companies like Atlas, Dietrich said. "We're watching it very closely."

Airlines like U.S. leisure carrier Sun Country and regional airline Mesa Air Group are rushing to buy freight aircraft, as are legacy airlines like Lufthansa and Qatar Airways. Even shippers are getting in on the game, like maritime behemoth Maersk, are ordering air freighters. Atlas will have to compete with new entrants like Maersk, but Dietrich took it as a sign of the overall strength of the air cargo business. Demand outstrips supply currently, and he sees no reason for this to abate soon.

"Atlas Air will continue to capitalize on excess airfreight demand in [the fourth quarter], with management guiding to nearly $1.1 billion in revenue," Cowen & Co. Helane Becker said in a note to investors.

So given the shift to air freight, why won't goods arrive in time for the holidays? It's a matter of scale. One Boeing 747-400 cargo aircraft can carry about 142 U.S tons of freight. By comparison, a 20-foot equivalent cargo container — the maritime and road freight standard — can be loaded with a

maximum of about 23 U.S. tons. And the largest container ships can carry almost 24,000 20-foot equivalent containers. In other words, consumers are advised to shop early.



Madhu Unnikrishnan
November 8th, 2021 at 1:30 AM EST

Tags: airlines, global economy

Photo credit: Atlas Air and other air cargo companies are cashing in on a structural shift toward e-commerce, but there's still no guarantee holiday gifts will get to stores in time. Atlas Air

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Maersk targets air cargo with Senator acquisition and freighter order

02 / 11 / 2021

By Damian Brett

Shipping giant AP Moller Maersk is expanding into the air cargo market with the acquisition of freight forwarder Senator International and the addition of five freighters.

The company, which owns the world's largest container shipping line Maersk Line, said it "intends" to acquire Senator International to "accelerate its product offering which integrates Logistics, Ocean, Rail and Air and expand its global air network".

Air Cargo News sister title DVZ reports that the deal is worth eight times the adjusted operating profit (EBITDA) expected for 2021, equating to an enterprise value of around $644m. The transaction is subject to regulatory approval during the first half of 2022.

Senator has an advanced airfreight operation centered around own controlled capacity using nineteen weekly **flights across its network with a dedicated air bridge with own controlled capacity.** [redacted]

"This focus on own controlled capacity is highly aligned with Maersk´s airfreight strategy," the shipping group said.

Maersk's ambition is to have approximately one third of its annual air tonnage carried within its own controlled freight network.

"This will be achieved through a combination of owned and leased aircraft, replicating the structure that the company has within its ocean fleet," the shipping group said. "The remaining capacity will be provided by strategic commercial carriers and charter flight operators."

Senator chief executive and shareholder Tim-Oliver Kirschbaum said: "Senator's own controlled air product started in 2016 and has proven to be a success story.

"By joining Maersk, we strongly believe that we will be able to deliver an even broader portfolio with own controlled air capacity as well as also in other modes of transportation. Senator´s customers and team will love it."

Maersk's aim is to increase its presence in the airfreight industry, combining its airfreight services with Senator's offering will "benefit customers through extended global routes and capacity".

Senator said: "For many customers operating in technology, Fast-Moving-Consumer-Goods, lifestyle, pharmaceuticals, and the automotive industry, airfreight solutions are a critical component of their supply chain.

"These industries have high demand for speed and delivery reliability, and high value cargo.

"Servicing a high demand for speed and delivery reliability is the core of Senator's business.

"Events like the pandemic and Suez vessel blockage have demonstrated that integrated logistics, including airfreight solutions, provides critical flexibility to manage supply chain disruptions."

Freighter orders

Meanwhile, the company has also announced that Star Air, its in-house aircraft operator, will purchase two new B777 Freighters to be delivered by Boeing in 2024 and leased three B767-300 Freighters which will be operational next year through Cargo Aircraft Management, the leasing arm of ATSG.

Boeing senior vice president of commercial sales and marketing Ihssane Mounir said: "We are delighted to welcome Star Air to the Boeing family of 777 operators and we look forward to many years of partnership as they continue to grow their air cargo division.

"The market leading efficiency and incredible range of the 777 Freighter will provide Maersk the flexibility to profitably operate the airplane across its large air freight network while helping to deliver on its sustainability objectives."

Maersk is committed to explore carbon neutral fuels for the Star Air operated fleet of aircraft in line with IATA guidance.

AP Moller Maersk executive vice president and chief executive of ocean and logistics Vincent Clerc said: "As a global provider of integrated logistics, Maersk is improving the ability to provide a one-stop-shop and end-to-end logistics capabilities to our customers.

"We have strengthened our integrated logistics offering through E-commerce logistics acquisitions, tech investments, expanding our warehouse footprint and, as a natural next step, we are now ramping up our airfreight capacity significantly and creating a broader network to cater even better for the needs of customers."

Star Air, which was founded in 1987 and is based at Copenhagen Airport, already has a freighter fleet of 15 aircraft:
12 Boeing 767-200 SF's, one Boeing 767-300BCF and two Boeing 767-300F

So far, the airline has primarily been using its capacities to serve other cargo airlines. Star Air's planes have long been flying from Cologne-Bonn Airport for the US integrator UPS.

Senator has more than 1,700 employees across a global network with 64 offices in 21 countries across Europe, the Americas and Asia.

It operates across three segments: Air freight (65% of 2020 revenue), Ocean freight (30% of revenue) and Logistics & Packaging (5% of revenue).

Its primary vertical is automotive – BMW is one of its major customers – with established and growing exposure within industrials, technology and pharmaceuticals.

In 2020, Senator reported revenues of $730m and adjusted EBITDA of $50m. For 2021, Senator is expected to raise revenues of $950m and adjusted EBITDA of more than $80m.

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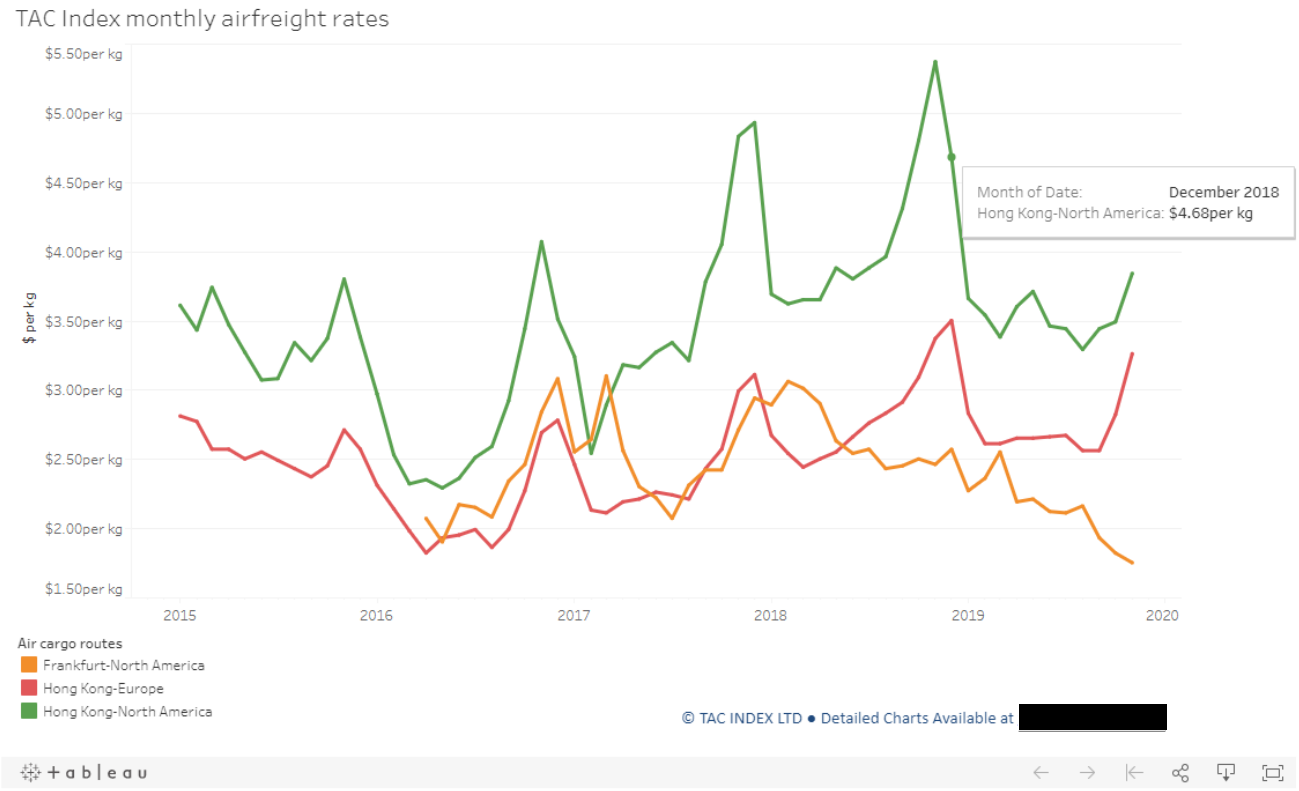

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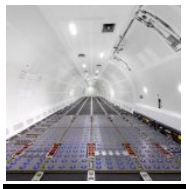

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News / Congestion hits air cargo flows – 'not seen things this b

© Typhoonski

By Alex Lennane 15/11/2021

Severe congestion across major airports appears to be hampering air cargo volumes.

Dynamic week-on-week global load factors fell 1.5%, in the week to 10 November, according to the latest research from Clive Data Services.

The same week saw a 5.5% fall in global capacity, which should indicate higher load factors – but it seems demand fell.

While, anecdotally, forwarders are reporting strong demand for air freight as the peak season takes off, the data suggests congestion on the ground is curbing volumes.

“There is a lot of congestion – in Melbourne, Baku and Chennai, as well as Europe and the US,” said one forwarder. “In fact, it seems to be any city with a large piece of tarmac that a plane lands on.

“And charters are currently being refused as congestion is not allowing them to be discharged.

“But there is definitely higher demand. That is happening. Sea freight disruption and schedule failure are creating distressed ocean freight, and conversion to air freight – whether to get consumer products into stores for Christmas or components for manufacturing – has accelerated.

“Even Fireman Sam couldn’t dampen this crisis. It’s what happens normally at this time of year, but on steroids.”

Clive data shows volumes out of Shanghai – which has been restricted during China’s International Import Expo, with permission for charters denied – fell 16%, while southern China volumes fell 12%. Hong Kong appeared to take up some of the slack, with volumes up 16%.

And volumes out of Europe fell 10%.

Niall van de Wouw, MD of Clive, said: “The congestion, which looks likely to be curbing growth, is the price the industry has to pay for the lack of

investment in, and appreciation of, cargo handling."

Airports across the US and Europe, notably JFK in New York, Heathrow and Frankfurt, are facing severe delays as handlers battle a shortage of labour. But according to Fraport, the operator of Frankfurt Airport, there are other issues preventing the fast processing of shipments.

"The character of freight transport has changed, with persistently high volumes becoming the new normal for both scheduled and charter traffic," explained a spokesperson. "In addition, there has been a huge increase in the volumes of small consignments, which are personnel- and time-intensive. The dynamics of aviation have been changing rapidly since the pandemic hit."

He added that scheduling had also been problematic for airports and handlers.

"With the restart of air services, the overall traffic structure has changed. Flights are not evenly distributed throughout the day, but converge in extreme peaks.

"At Frankfurt Airport, traffic peaks have become highly concentrated, particularly for passenger flights. But this can also affect cargo carried on passenger planes. These traffic peaks lead to concentrated deployment of ground handling staff, which can impact their availability at other times, the handling of freighters and cargo transport on the apron."

The congestion has been compounded by the shortage of drivers and handlers. The spokesman said: "The entire logistics industry and other service sectors are looking for more staff – not only airport operators. The off-airport movement of cargo is compounded by a shortage of thousands of truck drivers in European countries.

"With the restart of traffic in the summer, Fraport began recruiting and training about 400 new ground handling staff (baggage and ramp handling). In addition, we adjusted duty rosters, added additional shifts, ended short-time work for key operational staff and even re-deployed employees from other departments."

He added that handlers had been obtaining additional warehouse space, while Fraport made extra apron space available for temporary storage to relieve warehouses.

Frankfurt is also creating additional truck space at CargoCity South, and has launched a new digital import platform.

Forwarders, meanwhile, say they are struggling to convince their customers that air freight is currently a slow process – but at high cost.

“Can you highlight how truthfully bad it is?” one forwarder asked *The Loadstar*. “We’ve never seen this in 25 years. Some industrial customers are refusing to understand and keep bugging us to proceed with ‘seamless logistics’.

“It almost seems as if some ghost lobby is preventing media from highlighting how bad [the situation is] at European airports.”

Meanwhile, the opening of the US to European citizens has seen additional passenger traffic. Frankfurt saw 32 flights depart to the US on the day the market reopened, up from 22 on the same day in 2019.

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News / Transatlantic capacity opens up, but Heathrow 'screwe

By Alex Lennane 08/11/2021

In a move that could see significantly more transatlantic air freight capacity, the US today re-opened borders, allowing in fully vaccinated passengers from most of Europe, Canada and Mexico.

But severe congestion at Heathrow in the UK could limit movements.

IAG Cargo announced it would serve 21 destinations in the US from today, including New York, Austin, Miami, Philadelphia and Los Angeles, while services to Baltimore, Orlando Tampa and Las Vegas will begin on 15 November.

The carrier said the additional capacity had come in time for peak season, with e-commerce demand expected to grow in advance of Black Friday, Thanksgiving and Christmas.

It said it had also added capacity on its key shorthaul routes into Madrid, Heathrow and Dublin.

John Cheetham, chief commercial officer at IAG Cargo, said: “We are delighted to see the United States open up again to passengers and the impact this will have on cargo capacity. The full reopening of the transatlantic travel corridor is a pivotal moment.

“With peak season in full swing, one of our busiest trading lanes is linking the US, Europe and UK – this additional capacity will be of great benefit to so many of our customers.”

Last month, American Airlines announced new services between Heathrow and nine US destinations, while United also said it was adding transatlantic capacity.

However, the news may not have come at a good time for operators at Heathrow Airport. One UK forwarder told *The Loadstar* the airport was facing severe congestion.

“LHR transit sheds are absolutely in turmoil. Imports are taking up to five days to check in. One handler has admitted it is congested and can’t take

any more freight.

“Exports are queuing for hours to deliver, and then being turned away as there is no room to offload, so freight is missing flights.”

And, he said, he thought things would get worse before getting better: “It’s a major trauma to air freight, and now it is at a point where it is difficult to recover.”

He added that freight was piling up in remote warehouses – “it’s a mess, and the customers don’t like it”.

“How do you explain to a customer that we have managed to get their freight here at rates in excess of $10 per kilo, only for it to be delayed on arrival by between two and five days?

“LHR is not a good place to be from a cargo perspective currently.”

He said the problems looked likely to have been caused by there being too few staff and too much demand for the existing infrastructure.

“I’ve been talking with airlines, airline sheds and customers non-stop. It’s draining. But real.”

The Loadstar has contacted several companies for comment on the situation, but none was able to respond before publication.

To hear more about the air freight peak, listen to this clip from The Loadstar Podcast *by Brandon Fried of the US Airforwarders’ Association*

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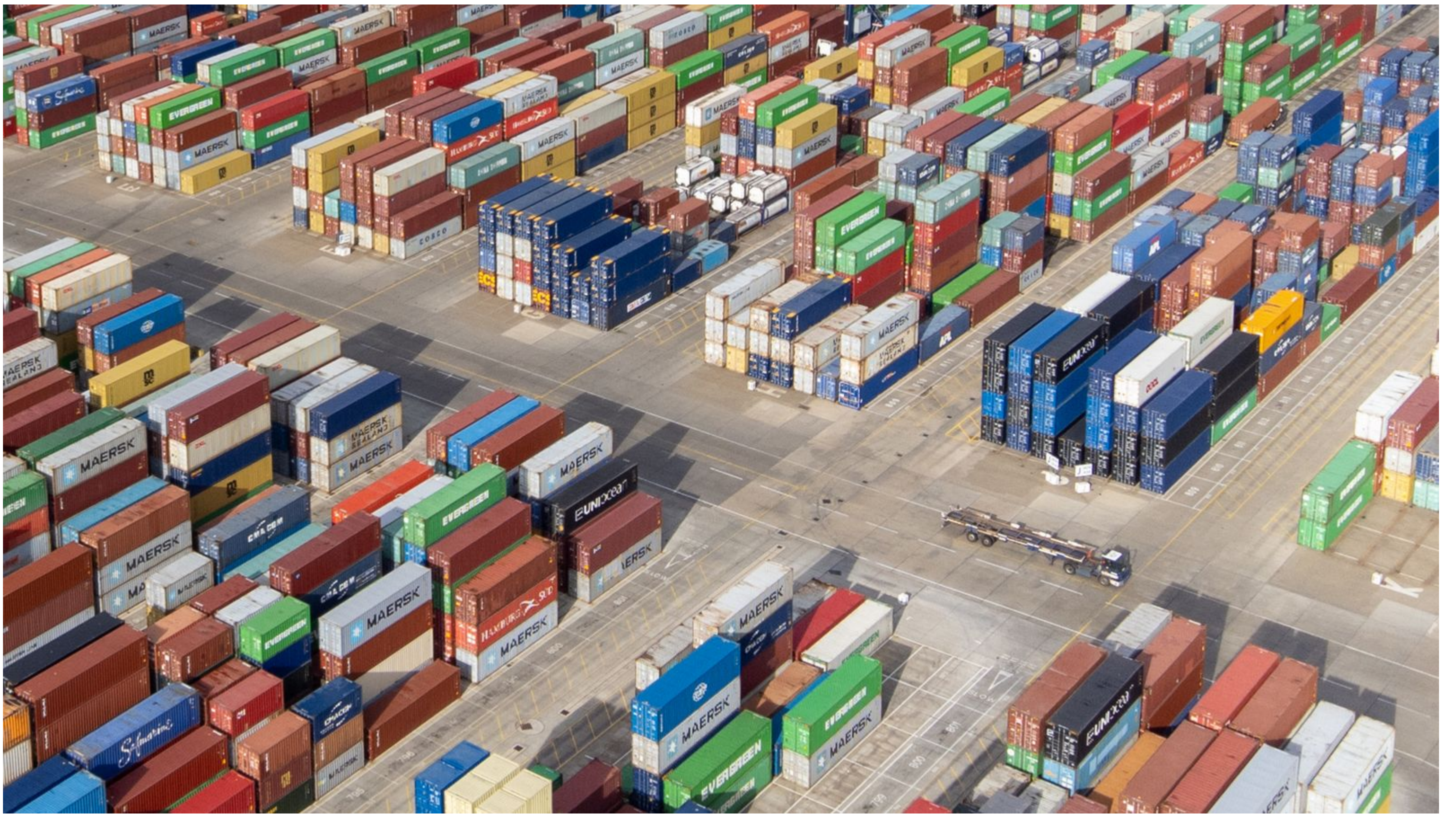
No end in sight to 'gigantic bottleneck' for global freight, shipping titan warns

The Danish company's boss said hundreds of its ships were laying idle outside ports around the world because they were unable to unload their goods due to a lack of lorry drivers and warehouse congestion.

John-Paul Ford Rojas
Business reporter @JPFordRojas

Tuesday 2 November 2021 14:57, UK



Last month, Maersk said it was diverting ships away from Felixstowe due to backlogs at the port

Maersk, the world's biggest shipping company, has warned there is "little visibility" about when bottlenecks in global supply chains will end.

The Danish group, which reported record quarterly revenues despite the disruption as its freight rates increased sharply, said current conditions were expected to continue at least until the first quarter of next year.

A lack of lorry drivers is preventing ships from offloading goods at ports around the world, with 300 container vessels currently laying idle, chief executive Soren Skou said.

Backlog at port causing supply chain pressure

"The whole system has become one gigantic bottleneck," Mr Skou added.

He said the biggest problem preventing containers from leaving ports is a lack of labour, particularly drivers of HGV vehicles in the US and Britain despite salaries having been raised "significantly".

Maersk, which handles one in five containers shipped worldwide, reported a 68% jump in revenue to a record $16.61bn in the third quarter, with bottom-line profits surging to $5.46bn compared with $947m a year ago.

It has been boosted by a surge in demand to transport freight as the world economy reopens after pandemic lockdowns - in some cases causing supply chains to buckle under the pressure.

Looking ahead, Maersk said savings built up by consumers in America and Europe would support more demand and although higher prices could take its toll on some spending, pressure for firms to rebuild stocks and the continued shift to online retail would keep up pressure on logistics.

The company added that supplier delivery times "remain lengthy, and there is little visibility into when capacity constraints, including landside bottlenecks in trucking and warehousing, will abate".

Maersk handles one in five containers shipped worldwide

Maersk said that to meet the rising demand, it has added more capacity.

But congestion at ports meant that third-quarter container volumes were still 4% lower than in the same period in 2019 and slightly below the level last year.

"A too large proportion of our capacity is tied up lying waiting outside the ports," Mr Skou said.

The company now expects its shipping business to grow more slowly than global container demand.

It is aiming to expand its services to include more air and land-based freight.

Last month, **Maersk said** it was diverting one 80,000-tonne container ship per week away from Felixstowe, Britain's biggest commercial port,

due to backlogs.

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Europa Air & Sea predicts rising airfreight demand on transatlantic

29 / 10 / 2021

Andy Serpant, National Airfreight Manager, Europa Air & Sea

Logistics group Europa Air & Sea anticipates a “sharp recovery” in air cargo volume on the transatlantic route during the final months of 2021 and into 2022 as the US aviation passenger market reopens for business.

The pandemic and subsequent closure of borders to non-residents led to airlines cutting routes and frequency of flights to Europe. Without fare-paying passengers, the operating costs had to be supplemented by revenues generated by cargo which resulted in huge increases in freight rates.

Initially both US east and westbound rates were very inflated but the gradual easing of travel restrictions into the UK has meant that passenger revenues could again contribute towards flight operating costs, resulting in a reduction of eastbound rates.

The continuing ban imposed on UK travelers to the US has meant that the same did not apply to westbound flights, so cargo remained the sole revenue contributor towards flight costs.

However, the recent US Government announcement that these restrictions will be lifted in November means that British visitors can again travel to the US.

Andy Serpant, National Airfreight Manager, Europa Air & Sea, said: "As the major airlines' schedules are governed by passenger numbers, we expect to see an increase in capacity over the coming months.

"United Airlines is adding an additional daily flight to Newark in November and British Airways said they intend to increase flights to US destinations to just under 250 per week over the winter. While the airlines are still fixing their schedules on a month-by-month basis, the effect on freight rates remains to be seen, but I would expect a reduction as passenger numbers increase.

"This will be good news for UK exporters who have been put-off sending their goods to the US due to inflated freight costs.

"In summary, while there is still a degree of uncertainty in these testing times, we can be cautiously optimistic that the US market will start to slowly return to some sort of pre-pandemic normality."

Europa Worldwide Group, with sites in the UK, Hong Kong, and Belgium, has six divisions – Road, Air & Sea, Showfreight, Warehouse, Contact Centre and Continental Cargo Carriers.

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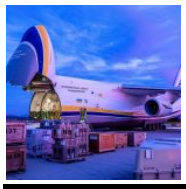

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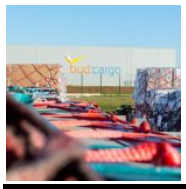

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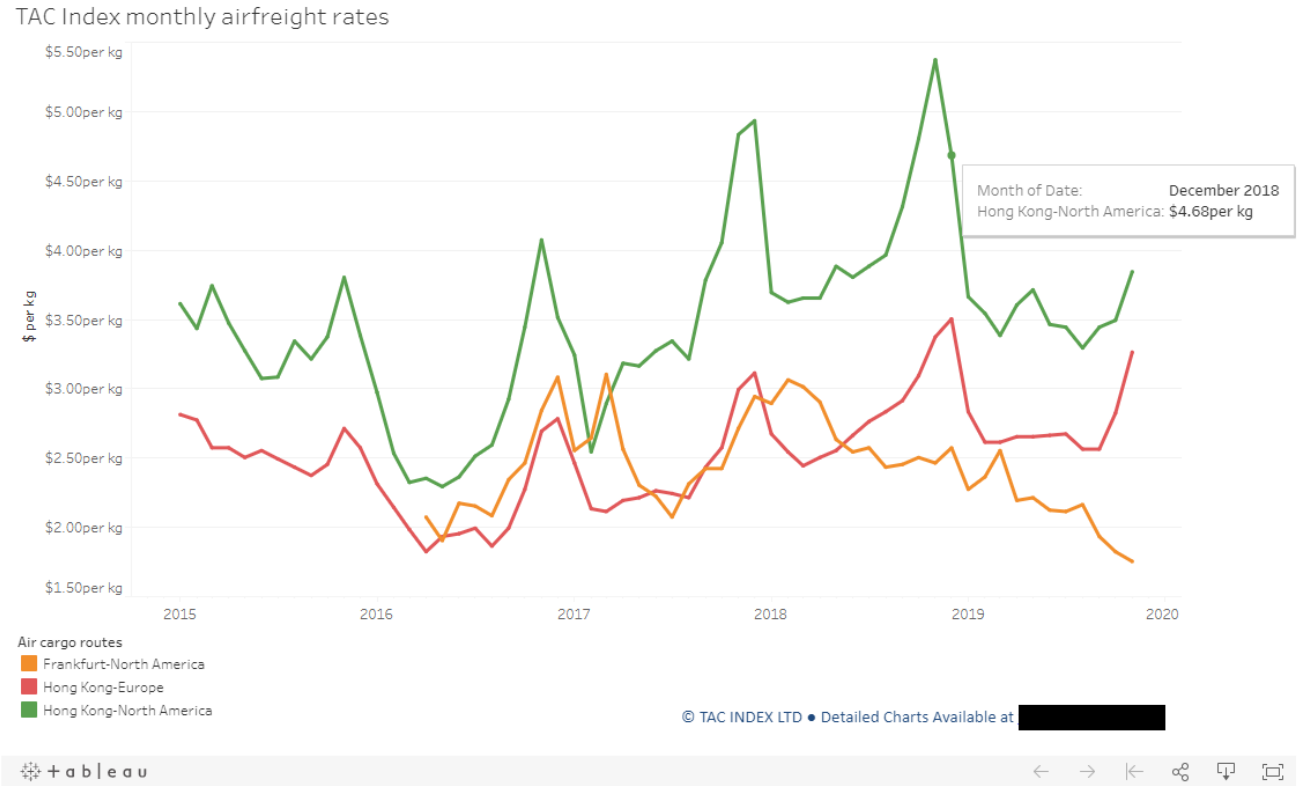

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- **Kuehne+Nagel Luxembourg's third contract logistics site leverages the central location in Europe for e-commerce**

Kuehne+Nagel is considerably expanding its contract logistics footprint with the opening of its latest fulfilment centre in Contern, Luxembourg, comprising 34.000m² of warehousing space. The opening ceremony was attended by Luxembourg's Prime Minister, Xavier Bettel, Kuehne+Nagel's Honorary Chairman, Klaus-Michael Kühne, and other political representatives. Marc Maurer of Swiss running gear brand On and Luc Provost of B Medical Systems, the CEOs of the two anchor customers of the new site, were also amongst the guests.

The expansion reaffirms Luxembourg as a strategic location for Kuehne+Nagel in the centre of Europe with easy access to the continent's most important consumer markets. From the Grand Duchy, Kuehne+Nagel meets the complex and dynamic supply chain needs of its customers through integrated value-added solutions – especially in the area of e-commerce fulfilment. This includes inventory management, picking, packing and shipping orders, managing returns, as well as value-added services.

Klaus-Michael Kühne: "Following a promising start 51 years ago, Kuehne+Nagel has been growing its multi-modal logistics solutions in Luxembourg continually and now further strengthens its function as a strategic contract logistics hub in Europe. This also underlines our confidence in the business location and the fruitful collaboration with the government of Luxembourg and the local authorities of Contern."

Tobias Jerschke, Managing Director of Kuehne+Nagel BeLux, adds: "The new fulfilment centre perfectly complements our existing e-commerce hub in Belgium, securing fast end-to-end lead times. At the same time, the warehouse roofs perfectly lend themselves to the biggest photovoltaic installation to date by Enovos – Luxembourg's main energy supplier. Supporting the green energy transition in the country underlines Kuehne+Nagel's strong commitment to sustainability as part of its ambitious Net Zero Carbon targets."

Kuehne+Nagel Luxembourg today employs over 700 people and has 100.000m² of warehousing space. In addition, the company has a historically strong presence in Road Logistics, Sea Logistics and Air Logistics (with an office at Findel airport) as well as an Integrated Logistics team managing regional and global contracts for 4PL customers with a focus on consumer electronics, industrial goods and pharma.

About Kuehne+Nagel

With more than 76,000 employees at 1,400 locations in over 100 countries, the Kuehne+Nagel Group is one of the world's leading logistics companies. Its strong market position lies in Sea Logistics, Air Logistics, Road Logistics and Contract Logistics, with a clear focus on integrated logistics solutions.

Dominique Nadelhofer
Global Head of Media
Communication (based
in Switzerland)

Elise Stynen
Communications BeLux

ACI EUROPE
10 Rue Montoyer (Box 9)
1000 Brussels, Belgium

The True State of the Industry: European Airports face dual challenge of recovery and decarbonisation in a complete business model reset

Geneva, 26 October 2021: ACI EUROPE today opened its 31st Annual Congress by setting out both the immediate and longer-term outlook for its 500 strong airport membership spanning 55 countries.

In a wide ranging *'State of the Industry'* keynote address, Director General Olivier Jankovec reviewed the impact of the COVID-19 crisis on airports – addressing financial and operational challenges, fast changing market structures, new business fundamentals and the imperative of business adaptation.

SYSTEMIC FINANCIAL WEAKNESS

With total revenues[1] and EBITDA[2] in H1 even lower than last year and a recovery in air traffic that is both cost-intensive and revenue weak, many of Europe's airports are set to post massive losses again this year. But with financial support from States limited and cost cutting opportunities all but exhausted, they had no other alternative than to resort to debt – a necessity to maintain acceptable liquidity levels and keep operating. European airport debt has ballooned, increasing by 200% compared to pre-pandemic levels.

INVESTMENT CRUNCH

Looking ahead, the prospect of seeing airports' earnings restored to pre-pandemic levels is a long way off. This is not just about the slow recovery in traffic volumes, but also about increasing pressure from airlines on airport charges and inadequate responses from regulators and governments over the level of these charges.

Jankovec said: *"Europe's airports are facing an investment crunch, which will hit their ability to finance decarbonisation and digitalisation - as well as needed capacity. The analysis we published just before the Summer revealed that airport revenues will remain insufficient to meet investment costs until well after passenger traffic has fully recovered - at least until 2032. The fact that 15 of the largest European airport operators have already cut down planned investment by nearly €14 billion between 2020 and 2023[3] is a warning bell."*

NEW MARKET STRUCTURE & DECARBONISATION IMPERATIVE

At the same time, the COVID-19 pandemic has turbo-charged market developments and societal changes that are redefining aviation.

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[1] Total revenues for Europe's airports in H1 2021 decreased by -65% vs. -52% in H1 2020 – compared to pre-pandemic (2019) levels. More information in European Airports Traffic & Financial Performance H1 2021 Update.

[2] Europe's airports EBITDA (aviation business) decreased by -121% compared to pre-pandemic (2019) levels. More information in European Airports Traffic & Financial Performance H1 2021 Update.

[3] Data from Moody's

Jankovec said: *"The rise and dominance of Ultra-Low Cost Carriers - led by Ryanair and Wizzair - combined with retrenched yet more agile network carriers, further hybridisation and the inevitability of airline consolidation will only mean one thing: unprecedented competitive pressures upon Europe's airports. This reality is in the making and make no mistake, it will impact all - from our mega hubs down to our smaller regional airports"*.

"These market developments blend with aviation's decarbonisation imperative, which Europe's airports have fully embraced together with their industry partners. There is no escaping the fact that decarbonisation will drive up costs and induce a slower pace of traffic growth than we have been accustomed to. For volume-dependent businesses like airports, this is a major challenge."

BUSINESS MODEL ADAPTATION

The result: airports need to adapt and future-proof their business model with the focus on transformation, de-risking and resilience. Perhaps the biggest challenge of all in taking the European airport business model to this next level is the delicate balance necessary between these three pillars – which are critically interdependent. The now-familiar mantra of 'build back better', wholeheartedly embraced by European airports in their net zero commitments, goes hand-in-glove with their need to safeguard revenue generation and access to financial markets. And both are reliant upon the airports' ability to transition to hyper-efficient and digitalised operations.

Jankovec said: *"The COVID-19 pandemic has put an end to the illusion that airports are risk-free businesses. They are now facing the dual challenge of recovery and decarbonisation – and they need to adapt their business model accordingly. With this will come a renewed societal relevance and acceptance which our airport community is more than ready to meet. But let's be under no illusion here, this will not be an easy journey ahead as we recover from catastrophic losses and glaring inadequacies in the financial and Governmental response framework which could have been deployed with very different results. Of the 780 airports in our footprint, less than 10 were profitable last year. That's a big mountain to climb."*

ENDS

For more information, contact:

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Director, Media & Communications
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Email: [redacted]

ACI EUROPE is the European region of Airports Council International (ACI), the only worldwide professional association of airport operators. ACI EUROPE represents over 500 airports in 55 countries. Our members facilitate over 90% of commercial air traffic in Europe. Air transport supports 13.5 million jobs, generating €886 billion in European economic activity (4.4% of GDP). In response to the Climate Emergency, in June 2019 our members committed to achieving Net Zero carbon emissions for operations under their control by 2050, without offsetting.

NASA Reveals Study Plan For 2040 Eco-Airliner

Guy Norris October 25, 2021

NASA's 2040-plus concept studies could build on work undertaken in earlier projects such as the single-aisle turboelectric with aft-boundary layer propulsor program.
Credit: NASA

As world leaders prepare to gather Oct. 31 at the United Nations COP26 climate change conference in Scotland, NASA is planning to launch a new technology initiative aimed at a future airliner with potentially zero environmental impact.

ONE IN A SERIES

Targeting concept studies for a 2040-plus entry-into-service (EIS) time frame, the project is in its formative stages and comes as the research agency gets set to issue proposals to industry for a nearer-term ultraefficient X-plane sustainable airliner technology demonstrator later this decade.

"We're already in conversations with industry, and we'll do a request for information probably later this fiscal year," says Jim Heidmann, Advanced Air Transport Technology (AATT) manager at NASA's Glenn Research Center in Cleveland. "A request for proposals is envisioned for [fiscal 2023]. Those are to define the technologies required for an aircraft in the 2040s, and part of it is, what do we need by then? Is it zero carbon emissions or is it zero environmental impact?"

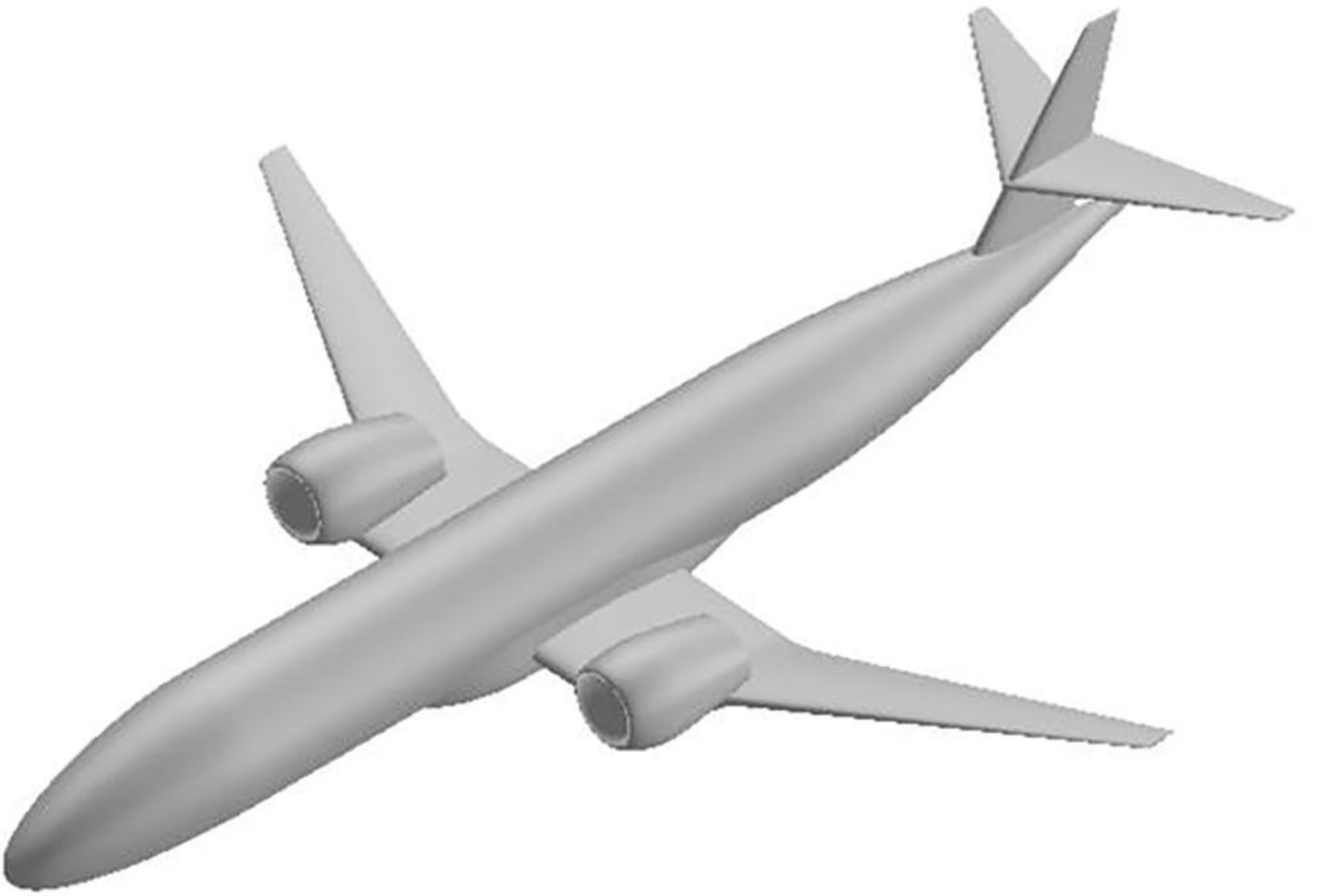
- Requests for proposals due in fiscal 2023
- Targeted at entry into service from 2040 onward

The long-term plan is intended to take a step further than the upcoming sustainable flight demonstrator (SFD) X-plane, which is expected to start flight tests in 2026 and is aimed at maturing key airframe-focused technologies for introduction of future single-aisle airliners by 2035. The X-plane forms an element of NASA's Sustainable Flight National Partnership (SFNP) plan with other agencies, industry and academia, and builds on a series of subsonic transport studies reaching back to the mid-2000s.

Outline targets for the new concept studies will leverage a multigenerational construct formulated at the creation of NASA's Subsonic Fixed Wing (SFW) project in the 2005-20 time frame. Dubbed N+, the concept helped identify and drive innovation for multiple time frames targeting noise, emissions and fuel burn. Nearer-term N+1 studies focused on concepts for a conventional tube-and-wing airliner with techno to transition to full-scale development in the 2015 time frame.

Targets for N+2, which aimed at entry into service in the 2020s, were set relative to a GE90-powered Boeing 777. These included a noise goal of –42 dB below Stage 4, landing and takeoff NOx emissions 75% below CAEP 6 limits and at least a 40% reduction in fuel burn. More ambitious goals were also set for N+3—an advanced airliner concept ready to enter service in the 2030s.

SFW, which is today known as the AATT project, also spun off the Environmentally Responsible Aviation (ERA) project, begun in 2010 to pursue integrated demonstrations focused on the N+2 service-entry period. Unlike earlier studies, ERA was notable for challenging industry and researchers to come up with concepts that simultaneously met tough noise, emissions and fuel goals rather than traded these parameters to meet overall mission targets.



The approach to the N+4 program will continue NASA's long-running subsonic concept work—including the agency's ERA program from 2009-15, one notional product of which is pictured. Credit: NASA

"Think of it as N+4—but we're calling it the 2040+ EIS concept studies project," Heidmann says. "Part of it is not just necessarily reducing fuel burning but looking at the bigger picture." These studies extend beyond the remit of new airframe, propulsion and systems concepts to include new areas such as hydrogen and other sustainable aviation fuels. "They are not going to be mandated, but it will be things that can get you to more ambitious environmental targets, as well as all the aircraft and engine technologies as we typically do," he adds.

The 2040-plus concept study plan "sets the stage for a whole other initiative," says Heidmann, who acknowledges the role the SFW/AATT and ERA constructs have played in paving the way for NASA's newest X-plane. "Let's push a little further and do this again. It's a nice model."

For the moment, no specific performance or emission-reduction goals are being revealed, though Heidmann says the targets outlined in NASA's Strategic Implementation Plan (SIP) for subsonic transports are aimed at approximately the 2040s time frame. These include cumulative noise reductions of as much as 52 dB below Stage 4; landing and takeoff NOx emissions of more than 80% below CAEP 6; cruise NOx emissions of more than 80% below best-in-class aircraft from 2005, and up to 80% lower fuel/energy consumption relative to the same 2005 standard.

"For this one we want to ask industry what is needed. We don't want to just march blindly into this," he adds. "We want to assess what's going to be required in the 2040s, and industry can help frame that for us in terms of what we're going to ask for those needs. I think firm targets are going to come out of those industry interactions."

That approach will allow for potential step changes in power, fuel and propulsion technologies to be integrated into the concept stu
"There could be a breakthrough on hydrogen or in some other technology. Batteries could make a major leap in capabilities, for exa
Heidmann says. "So, we want to be ready for what could be out there to make a big jump in reducing carbon emissions and environ

impact."

Boeing is proposing its TTBW concept for NASA's sustainable X-plane, which is due to fly in 2026. Credit: Boeing

Although hydrogen fuels and power-related technologies are likely to be studied in the 2040-plus program, NASA has not formalized its research approach for that arena. "There's a lot of interest, especially in Europe, and we're still kind of assessing what [that means]. We've seen the Airbus concepts," Heidmann says. "On the space side of NASA there are cryogenic capabilities in terms of tankage and so forth, so there are some capabilities we can leverage if that becomes an area of interest. We also want to talk about the infrastructure challenges with hydrogen, so that's something that we need to deal with."

The studies may also include more electrified and hybrid-electric concepts for larger aircraft, some of which may be explorable under the spiral upgrade capabilities being planned for the SFD X-plane. "However, that is still a challenge for larger aircraft," notes Heidmann. "Right now we're focused on single-aisle transports [with the SFD], but for the next one I think we're more open on what size class it should be," he adds. "It could be bigger, or it could be smaller. It could be whatever the market is demanding in that time frame. So, I think we're going to stay a little flexible on the class of aircraft for now."

The new N+4 work will also include participation from researchers involved in NASA's University Leadership Initiativ—a plan under universities receive NASA funding and take the lead in building their own teams and setting their own research agenda with goals tl complement the agency's Aeronautics Research Mission Directorate and its SIP.

The new study may also revisit aspects of more futuristic technologies first evaluated by NASA, Boeing and others in the SFW N+3 Advanced Concept Study starting as far back as 2008. These included multifunctional lightweight structures and electrified aircraft propulsion systems, as well as new shapes such as the high-aspect ratio Transonic Truss-Braced Wing (TTBW) concept studied with Boeing. It is this design that Boeing will propose for the sustainable X-plane contract.

Boeing also evaluated possible N+4 technologies in 2011 as part of its work with NASA on the Subsonic Ultra Green Aircraft Research (SUGAR) project. The broad-ranging effort also included studies of a 2040-era airliner design incorporating several advanced aerodynamic and propulsion technologies. These included liquefied natural gas, hydrogen, fuel cell and battery electric hybrids, low-energy nuclear, boundary layer ingestion, unducted fans and advanced propellers.

NASA says that, following a planned first flight in late 2026, the SFD research campaign will last for six months and be completed in 2027. Ground test and flight research data from the SFD will be used to measure the winning contractor's "vision system" performance relative to a set of midterm performance objectives set by NASA for future subsonic transport aircraft in the 2025-35 time frame.

These call for technology readiness levels of 5 to 6 (ready to transition to production development), for an aircraft capable of cumulative noise levels of 32 dB to 42 dB below Stage 4. Other targets for NOx emissions, fuel burn and energy consumption are in line with the SIP targets.

The agency has already outlined plans to conduct detailed studies of Boeing's high-efficiency TTBW configuration under the broader aims of the SFNP, but says the sustainable demonstrator configuration depends on the proposals it receives from industry. Under SFNP, NASA also plans to demonstrate a high-power hybrid-electric propulsion system for large transport aircraft; composites structures capable of being produced at 4-6 times the rate possible with current technology; and small-core turbine engines with high thermal efficiency. The X-plane would integrate these technologies and validate the benefits.

Plans for the 2040-plus concept studies and sustainable flight demonstrator emerge as NASA enters a period of increasing tempo for flight testing new propulsion systems and supersonic technology. In addition to the sustainable X-plane plan, the agency is working with industry teams selected for the Electric Powertrain Flight Demonstration program and is building up to begin flights in 2022 of the X-59 low-boom supersonic flight demonstrator and X-57 distributed electric propulsion demonstrator.

Editor's note: This article has bee updated to include new information about NASA's N+ concept studies.

[redacted]

[redacted]

COVID-19: Impact on air cargo capacity

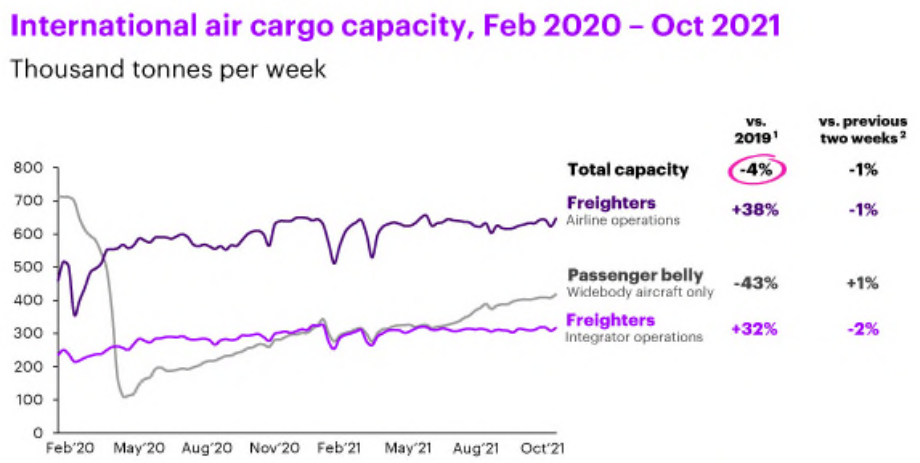
OCTOBER 25, 2021

The state of air cargo and global trade

The COVID-19 pandemic is a health and humanitarian crisis, and it is also an economic shock. We will be providing weekly updates throughout the COVID-19 crisis on air cargo capacity changes based on actual flight movements.

Global air cargo capacity decreased -1% compared to the previous two weeks

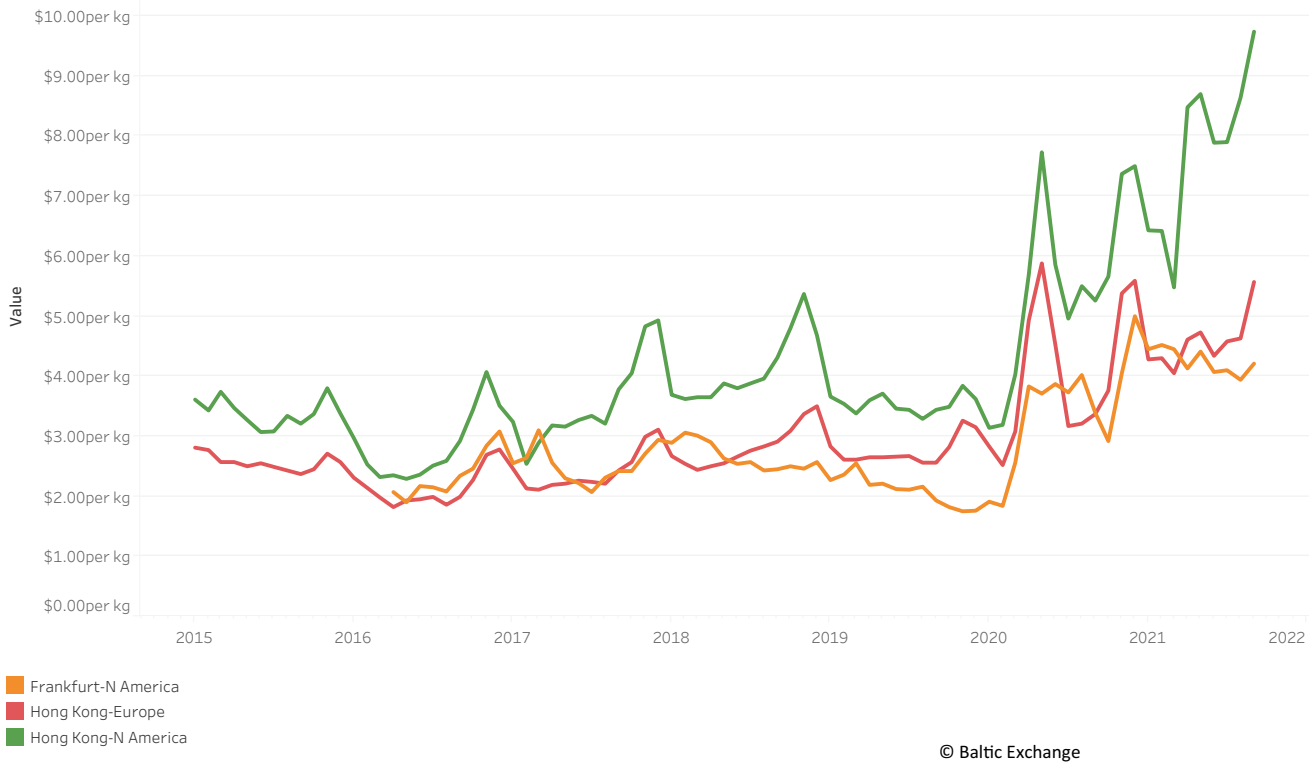
Widebody belly air cargo capacity continues its steady recovery, now at -43% vs. 2019.



Note: Direct international capacity only; All freighters and widebody passenger aircraft only; 1) Comparing the weeks of 4 Oct – 17 Oct 2021 to the same weeks in 2019; 2) Comparing the last two weeks available versus the previous two weeks.

Source: Seabury Cargo Capacity Tracking database, Seabury Cargo, Accenture analysis (October 2021)

Baltic Exchange Air Freight Index (BAI) powered by TAC Data



TEN CRITICAL INSIGHTS ON THE PATH TO A NET-ZERO AVIATION SECTOR

AVIATION INITIATIVE / OCTOBER 2021

MISSION POSSIBLE PARTNERSHIP

Clean Skies for Tomorrow

An initiative of the World Economic Forum

Supported by

Energy Transitions Commission

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PREFACE

Aviation, shipping and trucking are the backbone of our global transport sector. Together with concrete, steel, aluminium, and chemicals, these seven sectors are jointly responsible for 30% of greenhouse gas emissions and, without action, this share is expected to grow. The mission is clear. Humanity needs to cut emissions by 50% in this decade to limit the rise in global temperatures to 1.5°C and reach net-zero emissions by 2050 at the latest. By 2030, we must see entire value chains committing to and transitioning towards net-zero emissions, and systems in place to reliably track those commitments. The next wave of low-carbon technologies must be brought to market and deployed on a scale that will unlock cost reductions. Simultaneously, industries need to stop investing in and begin retiring carbon-intensive assets.

Catalysing these changes is the goal of the Mission Possible Partnership (MPP), an alliance of climate leaders focused on supercharging efforts to decarbonize these industries. Led by the Energy Transitions Commission, RMI, the We Mean Business Coalition, and the World Economic Forum, our objective is to propel a committed community of CEOs from carbon-intensive industries, together with their financiers, customers, and suppliers, to agree – and more importantly, to act – on the essential decisions required for decarbonizing industry and transport. MPP will orchestrate high-ambition disruption through net-zero industry platforms for seven of the world's most carbon-intensive sectors: aviation, shipping, trucking, concrete, steel, aluminium, and chemicals.

The aviation sector has initiated ambitious efforts. The International Air Transport Association (IATA) committed to achieve net-zero carbon emissions by 2050, and the Air Transport Action Group (ATAG) provides corresponding technology projections up to 2050.[1] The European Union's "Fit for 55" package includes a proposed blending mandate for sustainable aviation fuels (SAFs) through the ReFuel EU Aviation initiative. Similarly, the US administration aims to increase the production of SAFs to at least 3 billion gallons/year by 2030. And the proposed US Sustainable Skies Act aims to cut aviation's carbon emissions through tax credits for SAFs that demonstrate a reduction in greenhouse gas emissions of at least 50%. An increasing number of individual airlines and airline associations have also made commitments to reduce emissions, with more than 30 pledging to achieve carbon neutrality by 2050. Also partnerships between the private and public sector are emerging, like the UK's Jet Zero Council.[2]

The Clean Skies for Tomorrow Coalition (CST) provides a crucial global mechanism for top executives and public leaders, across and beyond the aviation value chain, to align on a transition to SAFs as part of a meaningful and proactive pathway for the industry to achieve carbon-neutral flying. The Clean Skies for Tomorrow Coalition is led by the World Economic Forum in collaboration with RMI and the Energy Transitions Commission.

The MPP, together with the CST, has developed a sector transition strategy that outlines how the aviation sector can phase out fossil fuels by 2050. It has the aim to inform decision-makers from the public and private sector about the nature, timing, cost and scale of actions necessary to deliver net-zero within the sector. Through this work, we hope to inspire and inform an accelerated transition to net-zero for the aviation sector and expediate innovation, investments, and policies to support the transition.

The following 10 critical insights are a preview of this sector transition strategy. Two sectoral pathways have been modelled to 2050: the aviation's current business-as-usual (BAU) pathway and a climate ambition pathway.

- In the BAU pathway, the aviation industry seeks the lowest total cost of ownership (TCO) for aircraft, implementing new technologies only if they offer an economic advantage or are mandated by government regulations.

- The climate ambition pathway assumes progressive technology assumptions (regarding costs, fuel production efficiencies, and for hydrogen and battery-electric aircraft also their market entry and potential range) and the sector's willingness to pay a premium of up to 20%-50% for emissions-reducing technologies.

Underlying assumptions for both pathways are provided at the end of this document. Additional pathways, including a midpoint between the two pathways shown, will be modelled as part of a future full report.

ACKNOWLEDGEMENTS

This report was codeveloped with members of the Clean Skies for Tomorrow community and the Target True Zero initiative. Although not all parties necessarily agree with each statement, the signatories below have formally endorsed the general thrust of the viewpoints expressed in this report. These companies agree on the importance of reaching net-zero emissions from the energy and industrial systems by mid-century and share a broad vision of how the transition can be achieved.

The fact that this agreement is possible between those industry leaders should give decision makers across the world confidence that it is possible to simultaneously meet the surging demand for aviation and reduce emissions from the sector to net-zero emissions by 2050. It also demonstrates that the critical actions required in the 2020s to set the sector on the right path are clear and can be pursued without delay, and that the industry is ready to collaborate with its value chain to achieve those goals.

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KLM Royal Dutch Airlines
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Neste
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Punjab Renewable Energy System Pvt. Ltd
San Francisco International Airport
Royal Schiphol Group
SkyNRG
Sounds Air
Surf Air Mobility
United Airlines
Universal Hydrogen
Virgin Atlantic Airways
VoltAero
Wright Electric
ZeroAvia

This report was prepared by the Mission Possible Partnership modelling and analytics team. The team was led by Faustine Delasalle (Energy Transitions Commission, ETC), Timothy Reuter (World Economic Forum), Robin Riedel (McKinsey) Eveline Speelman (ETC) and Lauren Uppink Calderwood (World Economic Forum). The analysis was coordinated by Elena Gerasimova (McKinsey) and undertaken by Carlos Agnes (ETC), Andrea Bath (ETC), Charlotte Bricheux (McKinsey), Axel Esque (McKinsey), Maximilian Held (ETC), Jason Martins (ETC), Adam Mitchell (McKinsey), Daniel Riefer (McKinsey), Austin Welch (McKinsey) and Maaike Witteveen (ETC), with input and guidance from the World Economic Forum's Laia Barbarà, David Hyde and Kevin Soubly, as well as RMI and the ETC. McKinsey & Company is a knowledge partner for the Mission Possible Partnership and provided fact-based analysis for this report.

We would like to thank the Clean Skies for Tomorrow Coalition and the Target True Zero Initiative, as well as other industry participants and experts, for their input.

SUPPORTED BY

Mission Possible Partnership (MPP)
Led by the ETC, RMI, the We Mean Business Coalition, and the World Economic Forum, the Mission Possible Partnership (MPP) is an alliance of climate leaders focused on supercharging the decarbonisation of seven global industries representing 30 percent of emissions – aluminium, concrete, chemicals, steel, aviation, shipping, and trucking. Without immediate action, these sectors alone are projected to exceed the world's remaining 1.5°C carbon budget by 2030. MPP brings together the world's most influential leaders across finance, policy, industry and business. MPP is focused on activating the entire ecosystem of stakeholders across the entire value chain required to move global industries to net-zero. Learn more at [redacted]

Clean Skies for Tomorrow Coalition
The Clean Skies for Tomorrow Coalition provides a crucial global mechanism for top executives and public leaders, across and beyond the aviation value chain, to align on a transition to sustainable aviation fuels as part of a meaningful and proactive pathway for the industry to achieve carbon-neutral flying. The Clean Skies for Tomorrow Coalition is led by the World Economic Forum in collaboration with the RMI and the Energy Transitions Commission. Learn more at [redacted]

Energy Transitions Commission (ETC)
ETC is a global coalition of leaders from across the energy landscape committed to achieving net-zero emissions by mid-century, in line with the Paris climate objective of limiting global warming to well below 2°C and ideally to 1.5°C. Our Commissioners come from a range of organisations – energy producers, energy-intensive industries, technology providers, finance players and environmental NGOs – which operate across developed and developing countries and play different roles in the energy transition. This diversity of viewpoints informs our work: our analyses are developed with a systems perspective through extensive exchanges with experts and practitioners. Learn more at [redacted]

The World Economic Forum
The World Economic Forum is the International Organization for Public-Private Cooperation. The Forum engages the foremost political, business, cultural and other leaders of society to shape global, regional and industry agendas. Learn more at [redacted]

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1 The goal of net-zero aviation by 2050 is possible.

The BAU pathway does not achieve net-zero by 2050 and generates almost 40 Gt CO_2e of cumulative emissions between 2022 and 2050. This means that aviation would use up 10% of the remaining global carbon budget, a significant mismatch to the industry's current contribution of approximately 2.5% of CO_2 emissions.[i] In the climate ambition pathway, approximately 25 Gt CO_2e of emissions between 2022 and 2050 are eliminated, phasing out fossil jet fuel entirely by 2050.[ii] To achieve these goals, it is critical that governments around the world continue to invest in SAF production for today's fleets as well as incentivize zero-emissions technological solutions such as electric and hydrogen.

[i] Global carbon budget of 400 Gt CO_2 to stay on a 1.5°C pathway with a 67% probability taken from [redacted]. Current greenhouse gas emission share of global aviation taken from **Hannah Ritchie,** [redacted]. Including the total climate impact of non-CO_2 climate forcers like NOx, contrails, and cirrus clouds would increase the climate impact of aviation substantially, as they amount to 66% of the total effective radiative forcing, see [redacted] These non-CO_2 climate forcers are not included in this analysis due to the high uncertainty ranges.

[ii] Even in this case, residual upstream emissions of ~0.15 Gt CO_2e will remain in 2050, see insight #8.

Exhibit 1: In a climate ambition pathway, fossil fuels are entirely phased out by 2050

The aviation sector's final energy demand by technology to 2050 in a BAU pathway (left) and a climate ambition pathway (right). On the current path (left), SAF allocation stems from the planned use of SAFs in the United States and the European Union. HEFA refers to hydroprocessed esters and fatty acids.

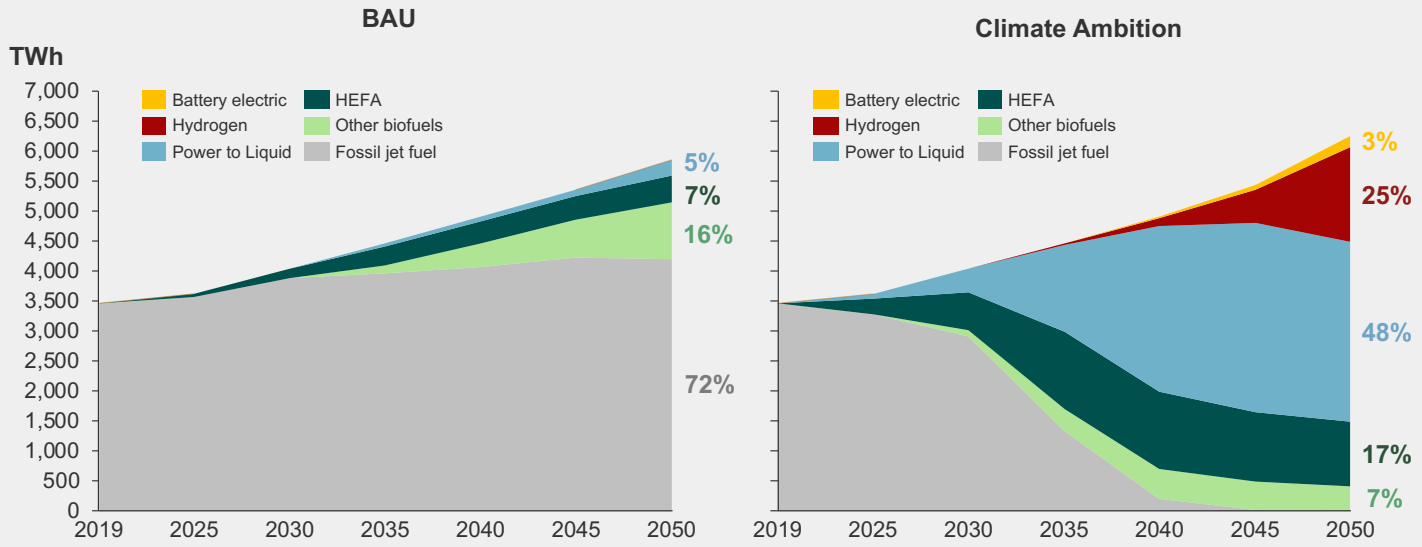
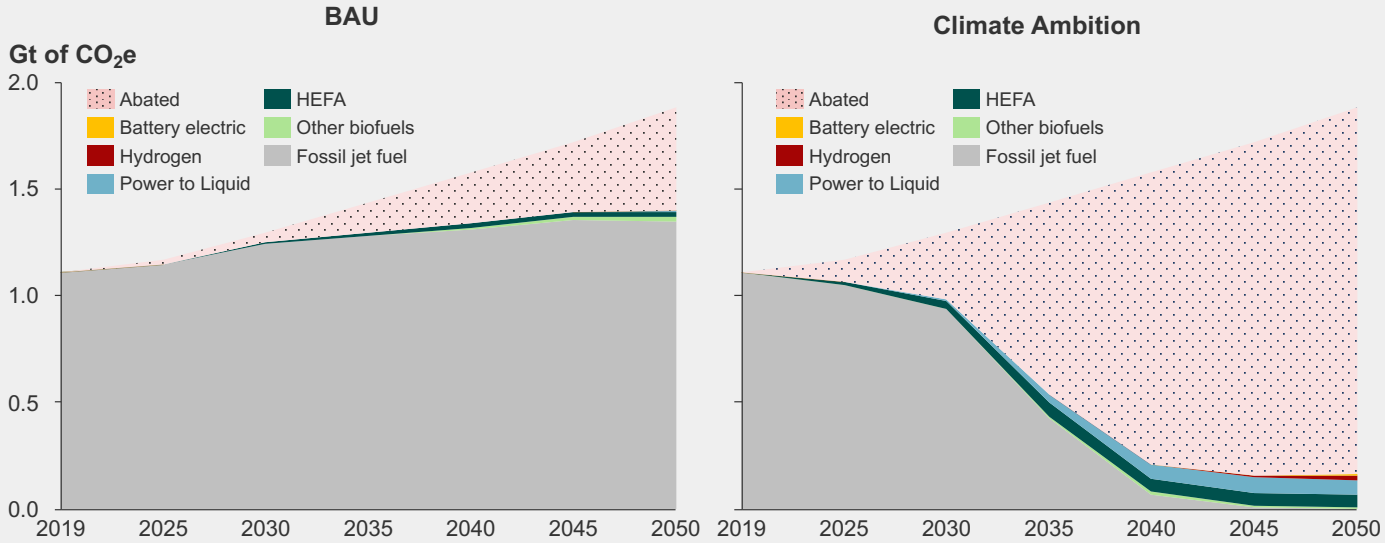


Exhibit 2: Climate ambition pathway would cut cumulative emissions by >60% compared with BAU

Aviation sector emissions by technology until 2050 in a BAU pathway (left) and a climate ambition pathway (right). Abated area shows emissions abated due to the use of renewable energy carriers compared to the use of fossil jet fuel. Remaining area represents CO_2e emissions from fossil jet fuel and residual lifecycle emissions of renewable energy carriers. In the BAU path, "abated" emissions stem from the planned use of SAFs in the United States and the European Union.

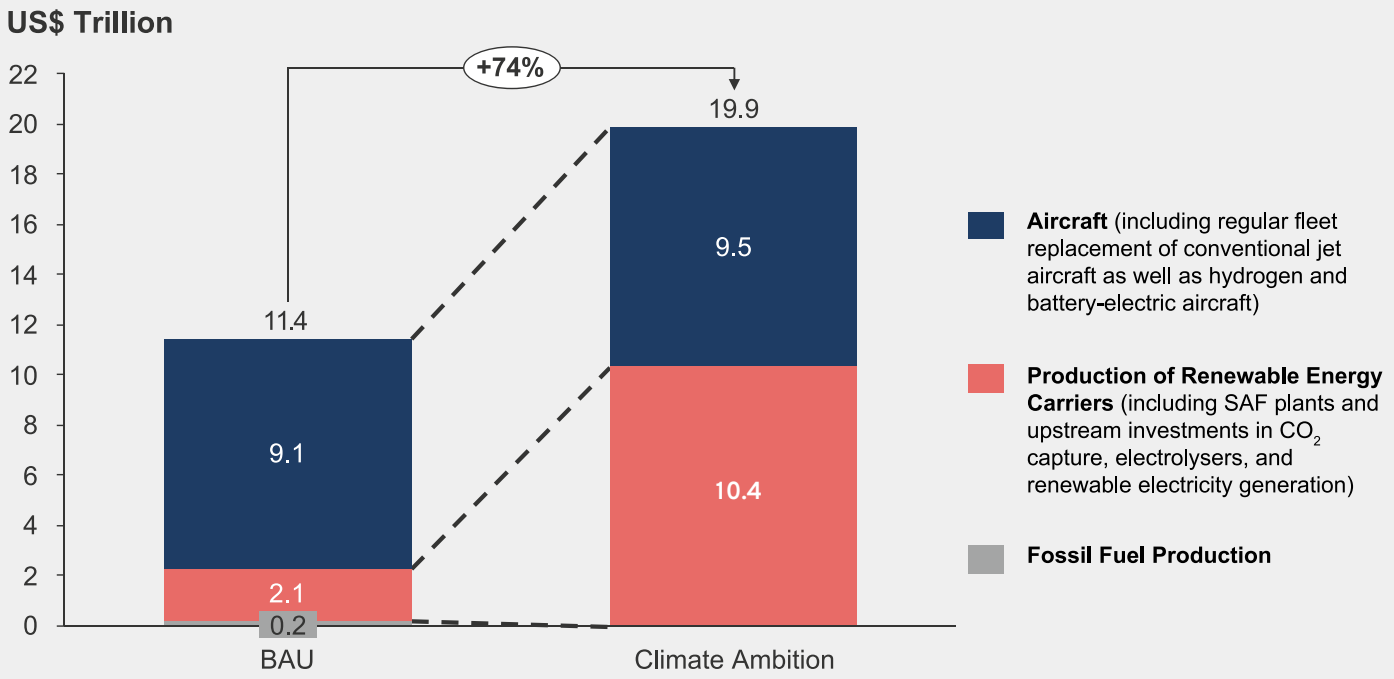


2 Phasing out fossil jet fuel by 2050 is likely to require additional annual investments of about US$300 billion compared with the BAU path.

Large-scale investments will be required across the full aviation value chain. In the aggregate, phasing out fossil fuels by 2050 in the climate ambition pathway will require an additional average investment of approximately US$300 billion each year in excess of BAU between 2022 and 2050. That includes the cost of developing and implementing disruptive technologies in aircraft, estimated at about US$15 billion per year above the BAU pathway. Most of the additional investments (on average US$285 billion per year) will be required to finance the production of renewable energy carriers.[iii] This includes SAF production and upstream investments like CO_2 capture, electrolysers, and dedicated new renewable electricity generation capacity, but excludes refuelling and recharging infrastructure at airports.

Exhibit 3: Majority of investments needed to phase out fossil fuels will finance renewable energy carrier production

Cumulative investments (between 2022 and 2050) required for the BAU and the climate ambition pathway. Renewable energy carrier production includes fuel production facilities for biofuels and e-fuels (e.g., Fischer-Tropsch synthesis), as well as upstream investments for electrolysers, CO_2 capture plants, and renewable electricity generation capacity.[iv]



[iii] Renewable energy carriers include sustainable aviation fuels (SAFs), hydrogen, and electricity for direct use in battery-electric aircraft. SAFs include biofuels (e.g., hydroprocessed esters and fatty acids [HEFA]) and power-to-liquids (PtL).
[iv] In the climate ambition pathway, investment costs for PtL are derived from a progressive assumption of low electricity costs and lower-cost solid oxide electrolysis.

3 Immediate action can unlock a reduction of ~1.5 Gt CO_2e by 2030 and lay the foundation for large-scale adoption of renewable energy carriers in the longer term.

Immediate action in the 2020s is necessary to enable the large-scale adoption of renewable energy carriers and can reduce cumulative emissions between 2022 and 2030 by ~1.5 Gt CO_2e compared with the BAU path. Concentrated R&D and investment in fuel production plants are necessary to support the market entry and scale-up of SAFs immediately and that of other technologies in the midterm.

Early action is necessary to catalyse learning curves and reduce initially high fuel costs. In addition, the industry should keep investing in fuel efficiency gains for conventional engines, along with improved airframe design, ground operations, air traffic management, and route planning. These measures are expected to improve efficiency by 2% each year in both pathways and should remain a priority for the industry, in conjunction with the development of novel technologies.

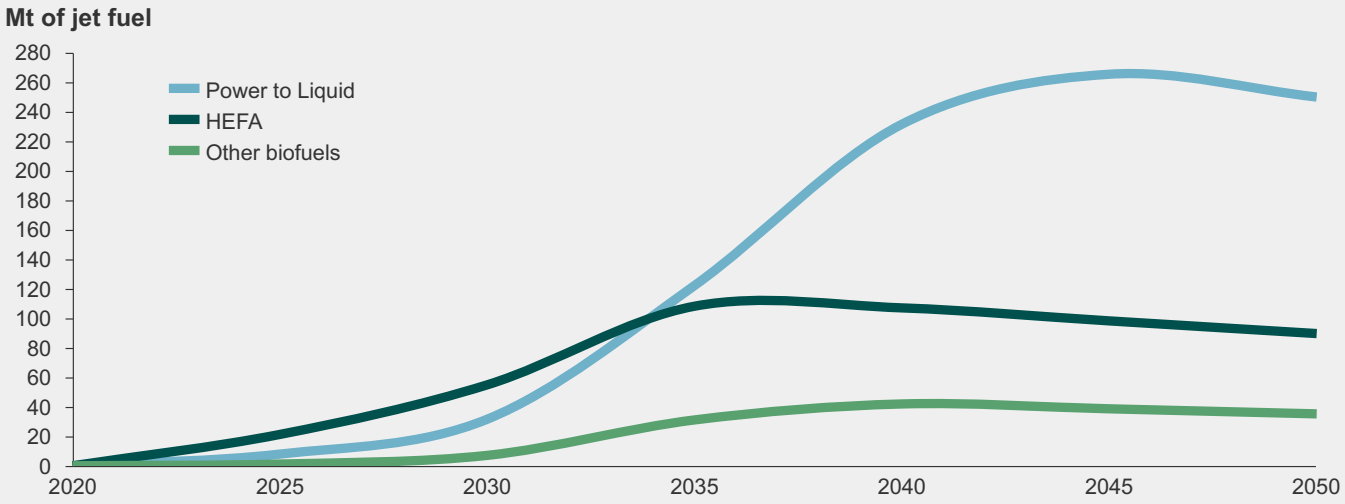
4 SAFs are the most viable short-term option for reducing CO_2e emissions, and the industry should ramp up production and adoption.

In the short term, SAFs are the only viable option to decrease emissions in the aviation sector, as they are compatible with current aircraft engines and airport fuelling infrastructure and they can power flights without any limits of distance.[v] In the climate ambition pathway, 25%–30% of the sector's energy demand in 2030 could be met by SAFs if required investments into production and infrastructure ramp up were made.

Potential constraints on SAF feedstocks, along with a relatively immature supply chain, result in SAF costs that are ~3x higher than fossil jet fuel prices today.[vi] By 2050, SAF production costs could decrease by ~20%–50%, without considering carbon pricing for fossil jet fuel. Power to liquids (PtL) are expected to play a crucial role in the future, as their feedstock is theoretically unlimited and they can offer CO_2e emissions reductions (on a life-cycle accounting basis) up to 100% compared with fossil jet fuel.[vii]

Exhibit 4: In the climate ambition pathway, power to liquids are projected to dominate SAF production after 2035

Ramp-up of aviation sector SAF production until 2050 in a climate ambition pathway. The decline in SAFs from 2045 to 2050 is due to an increasing share of hydrogen.



[v] Currently, most certified SAFs have an upper blending limit of 50%, but this is expected to be lifted before a system-wide SAF blending rate of 50% is actually reached.
[vi] Average of a range of SAF costs against fossil jet fuel at ~US$650/t in 2019.
[vii] With a fully decarbonized supply chain. [redacted]

5 Hydrogen-powered aircraft could cover up to ~25 % of the total energy demand in 2050.

Hydrogen propulsion technologies, including fuel-cell and combustion-powered aircraft, will be crucial for reducing CO_2e emissions for mid-to-long-haul flights. In a progressive projection, hydrogen fuel cell aircraft could power flights up to ~2,000 km already in 2030, and hydrogen combustion aircraft could power flights over all distances starting in 2035.[viii] In this case, hydrogen could cover up to ~25% of the total energy demand in 2050, and potentially replace a large share of SAF beyond 2050 due to costs lower than SAFs starting in the 2040s. Together, both types of hydrogen-powered aviation could reduce cumulative CO_2e emissions between 2022 and 2050 by up to ~2.5 Gt compared with the BAU path.

6 Battery-electric aircraft could become a viable option to reduce CO_2e emissions on shorter flights starting in 2030.

One of the industry's most disruptive technologies to reduce aviation's total climate impact, battery-electric propulsion, is forecast to enter the market starting in 2025 under ambitious projections.[ix] Considering future breakthroughs in battery technology, battery-electric aircraft might be able to power flights up to ~2,000km.

In the climate ambition pathway, battery-electric aircraft could represent ~3 % of the sector's energy demand in 2050 and reduce cumulative CO_2e emissions by ~0.5 Gt between 2022 and 2050 compared with using fossil jet fuel. Hybrid solutions, combining different propulsion technologies, will be crucial for enabling broader adoption and can combine novel propulsion and SAF in the future as a solution. To supply the future electricity demand, investing in charging infrastructure and renewable microgrids at the airport level could help alleviate pressure from the overall grid. Battery-electric regional aircraft for short-range flights and electric vertical take-off and landing (eVTOL) vehicles could create new markets.

[viii] Technology commercially available but not widespread in the fleet. Assumptions on hydrogen technology represent a progressive case and are based on consultations with a broad group of stakeholders including incumbent OEMs, engine manufacturers, airlines, airports, academic institutions, investors, and startups.
[ix] Technology projected to be commercially available but not widespread in the fleet.

7 Decarbonising aviation could require an additional 10,000 TWh of renewable electricity.

Decarbonising air transport has massive implications on the global energy system. If PtL and hydrogen are to dominate the energy mix in 2050, up to 10,000 TWh in additional renewable electricity production capacity would be required, comprising about 10% of the expected global electricity production in 2050.[3] This surge in demand for renewable electricity will likely coincide with the electrification of other sectors like road transport, an increased demand for hydrogen or hydrogen-derived fuels e.g. in the steel sector or for maritime shipping, and the overall transition of the power sector from fossils to renewables. In the face of competing demand, ramping up sufficient renewable electricity generation capacity—along with cross-sector collaboration—will be critical to decarbonise aviation and our global economy.

8 Negative emissions solutions can support the transition to net-zero but are not a replacement for an ambitious decarbonization pathway.

The climate ambition pathway projects wide adoption of renewable energy carriers by 2050, but it does not reduce emissions fully. The industry would still face residual emissions from fuel production of ~0.15Gt Co2e by 2050, which need to be mitigated by carbon dioxide removal solutions (either natural or technological). This would require an additional investment of about US$15 billion from natural climate solutions (NCS); bioenergy, carbon capture, and storage (BECCS); and direct air carbon capture and storage (DACCS) in 2050 alone.[x] NCS, such as conservation, restoration, and improved land management provide a ready-to-market option for carbon removal. But finding truly sustainable and measurable options can be challenging particularly given that NCS will be in high demand across other industries.[4]

Technology-led solutions will likely be necessary, such as DACCS, which can remove CO_2 directly from the air. Yet, DACCS is years away from market readiness at scale, requires large volumes of clean power, and is expected to stay two to three times more costly than NCS.[5] Thus, the transition to net-zero can be aided by a portfolio of negative emissions solutions. They should not be used as a tool for compensating the continued use of fossil fuel. However, they can be used in the near-term in case renewable energy carriers are not introduced to the market quickly enough.

[x] Based on a mix of NCS, BECCS, and DACCS with an average carbon dioxide removal cost of US$100/tonne of CO_2 taken from [redacted] Note that the additional investments for NCS, BECCS, and DACCS are not included in the investment figures provided in insight #2.

9 Market forces alone will not be sufficient to close the cost gap between fossil jet fuel and renewable energy carriers—governments need to support the transition through policies that explicitly incentivize sustainable aviation.

A tailored and robust set of policies—underpinned by recognized sustainability standards—will be needed to overcome the technological and economic factors that have been preventing renewable energy carriers from scaling. For example, the proposed SAF blending mandate in the European Union, or the proposed Sustainable Skies Act in the United States, are key steps to making SAFs commercially viable. Policymakers should aim to ensure feedstock sustainability, support R&D for new pathways to market, de-risk private investments for infrastructure, and stimulate demand through fiscal incentives and market mechanisms that appropriately price in the cost of jet fuels' CO_2e emissions.[xii]

Stringent emissions reduction targets can enable long-term planning horizons that can help de-risk investments into renewable energy carriers. Additional tailored policies can promote a global level-playing field and forge collaboration across the value chain for specific solutions through national and international consortiums.

10 All stakeholders across the value chain can benefit from moving early towards renewable energy carriers.

Aside from policy interventions, accelerating the transition to net-zero will only be possible with a focus on the full value chain. Proactive collaboration among all stakeholders can resolve chicken-and-egg-problems of supply and demand, de-risk transition technology projects, and fairly distribute incremental costs. In fact, all stakeholders can benefit from this full-value-chain approach.

Early-mover airlines can establish a reputation as climate leaders in their sector, while airports can benefit from lower noise and pollutant emissions from landing and take-off. Fuel producers can benefit from government R&D grants for novel technologies, and can achieve economies of scale by aggregating demand for electricity, hydrogen, and biomass from different sectors. Finally, policymakers may be able to encourage greater local production, decrease dependence on conventional fuel, and improve energy security.

[xii] An upcoming dedicated SAF policy toolkit report by the CST will provide more detail and nuance on potential policy measures (to create a SAF market at scale).

KEY MODELLING ASSUMPTIONS

Model overview

The model estimates in five-year time steps between 2019 and 2050 how demand is met by supply. Within a fleet turnover model, existing aircraft are retired when they reach a certain age and new aircraft enter the fleet to make up the retired aircraft and any demand increase. For new aircraft, the model selects its propulsion technology and energy carrier. For new and existing aircraft, it updates the blending rate of SAFs in every five-year step (assuming the maximum blending rates will reach 100% in the future). The two modelled pathways, their scope, and the model constraints are detailed below.

Pathways

	Business-as-Usual (BAU) Pathway	Climate Ambition Pathway
Selection criterium for renewable energy carrier	Lowest total cost of ownership (TCO)	Lowest CO_2e emissions within defined willingness to pay
Willingness to pay a premium[xiii]	No	Yes (20%–50%) Commercial segments: 20%–30% General aviation and public sector segments: 40%–50%
Availability of hydrogen and battery-electric propulsion systems	Conservative (First availability in: 2030 for battery electric and hydrogen fuel cell and 2040 for hydrogen combustion)	Progressive (First availability in: 2025 for battery electric and hydrogen fuel cell and 2035 for hydrogen combustion)
Levelized cost of renewable electricity (LCOE)	Conservative: based on offshore wind power	Progressive: based on solar PV power
Green hydrogen costs	Conservative: produced from offshore wind electricity and PEM (polymer electrolyte membrane) electrolysis	Progressive: produced from solar electricity and PEM electrolysis
Power-to-liquids technology costs	PEM electrolysis, point source capture of CO_2 in 2019, being fully replaced by direct air capture of CO_2 towards 2050.	Solid oxide electrolysis, point source capture of CO_2 in 2019, being fully replaced by direct air capture of CO_2 towards 2050.
Fossil fuel production investments	Investments in fossil fuel production include upstream and downstream investments in oil resulting from the increasing fossil jet fuel demand in this pathway. These have been estimated by calculating an incremental cost associated with increasing fossil jet fuel demand and the historical share of jet fuel investment per barrel of crude oil.	No additional investments in fossil fuel production are estimated. It is assumed all existing upstream, downstream, and refining capacities are able to meet the decreasing demand for fossil jet fuel in the coming decades.

[xiii] The Willingness-to-Pay more than the cheapest propulsion technology and energy carrier is defined on a total cost of ownership basis with a 20-year investment horizon.

Scope of transition strategy

	Topic	Assumptions
General	Operations included	Commercial (passenger + cargo), general aviation and public sector
	Boundary of aviation emissions[xiv]	Scope 1 and Scope 3 category 3 emissions (well-to-wake, WTW)
	Aviation demand growth (2019–2050)[xv]	3.8% p.a. (impact of COVID not modelled, 2019 as reference year)
Decarbonization levers	Assumed annual efficiency gains from conventional propulsion technologies	2% p.a.
	Renewable energy carriers considered	• Sustainable aviation fuels, hydrogen fuel-cell, hydrogen combustion, and battery electric • Hybrid technologies can play an important role beyond fully electric and pure hydrogen aircraft, but are not explicitly modelled
	Range of SAFs modelled	Biofuels: • Hydroprocessed esters and fatty acid (HEFA) • Other biofuels produced via gasification Fischer-Tropsch (G-FT), alcohol to jet (AtJ), pyrolysis, etc. E-fuels: • Power to Liquid (PtL)
	Investments considered	- Aircraft - Renewable energy carriers: • Production of HEFA, other biofuels, and PtL • CO_2 capture as feedstock for SAF production • Green hydrogen to power hydrogen aircraft and as feedstock for SAF production • Renewable electricity to power battery-electric and hydrogen aircraft and SAF production - Airport infrastructure investments are required for hydrogen and battery electric aircraft, but are not modelled in this iteration due to a lack of data granularity

[xiv] In line with [redacted]
[xv] Directionally in line with estimates of 4% from [redacted] and of 3% from [redacted]
[xvi] In line with Science-based target setting for the aviation sector, v1.0, SBTi, 2021 and with ICAO's aspirational goal until 2050, see [redacted]

Scope of emissions

- The model accounts for emissions from scope 1 (jet fuel combustion, "tank-to-wake") and scope 3 category 3 (production and transport of jet fuel, "well-to-tank").[xvii]
- The emissions of fossil jet fuel are based on CORSIA's lifecycle assessment (LCA) methodology at 89g CO_2e/MJ, or 3.83t CO_2e per ton of jet fuel consumed.
- New technologies have different abatement potentials compared with fossil jet fuel: HEFA (84%), other biofuels (75%–93%), PtL (93%), hydrogen (93%), and battery electric (95%).[6] These emission reduction factors are representing ambitious figures and could be smaller in their early market ramp-up.
- All emissions calculations account for the carbon dioxide equivalent (CO_2e) emissions of CO_2, CH_4, and N_2O from well-to-tank activities (scope 3) and CO_2 emissions from tank-to-wake activities (scope 1). Following ICAO's CORSIA methodology, CO_2e emissions of CH_4, N_2O, and H_2O from combustion are excluded.[7]
- The abatement potential of SAFs includes the impact of indirect land use change (ILUC) as estimated by ICAO. However, the reduction potential is limited to 100% versus emissions of the fossil jet baseline, following SBTi guidance.[8]
- The model does not account for the effective radiative forcing (ERF) of non-CO_2 pollutants like NO_x, contrails, and cirrus clouds. They are, however, estimated to have significant impact: taking those effects into account, aviation could have a share of about 3.5% of the "net anthropogenic ERF."[9] Recent insights point towards a considerable reduction of aviation-induced cloudiness through the use of SAFs.[10] This is not the case for a continued use of fossil jet fuel offset by DACCS.

Model constraints[xviii]

- Technology constraints are based on the availability of hydrogen and battery-electric propulsion at certain points in time, and for specific flight ranges.
- Feedstock availability is constrained for biofuels, based on regional availability of crops, woody biomass, and waste feedstocks.
- Announced blending mandates in the European Union and SAF production goals in the United States are reflected in all calculations.[xix]
- New technologies entering the market are limited by initial ramp-up constraints per origin-destination flow (values for five-year step): 5% blending share of the total for each SAF type and 15% of the total energy demand for hydrogen and batteryelectric aircraft.
- Afterwards, all technologies are limited by a maximum threefold capacity addition in each five-year step. For SAFs, this capacity addition is defined in the form of a blending rate of the total final energy demand.

Endnotes

[1] Net-Zero Carbon Emissions by 2050, IATA, 2021, and Waypoint 2050, ATAG, 2021,

[2] UK Department for Transport, 2021,

[3] Making Mission Possible, Energy Transitions Commission, 2020,

[4] Reaching Climate Objectives: the Role of Carbon Dioxide Removals, ETC, 2021.",

[5] The Case for Negative Emissions, Coalition for Negative Emissions, 2021, and Reaching climate objectives: the role of carbon dioxide removals, ETC, 2021,

[6] ICCT: CO_2-Based Synthetic Fuel: Assessment of Potential European Capacity and Environmental Performance, ICCT, 2017, Marta Yugo and Alba Soler, "A look into the role of e-fuels in the transport system in Europe (2030–2050)," Concawe, 2019, CORSIA Default Life Cycle Emissions Values for CORSIA Eligible Fuels, International Civil Aviation Organization, 2021,

[xvii] In line with **Science-based target setting for the aviation sector, v1.0, SBTi, 2021**.
[xviii] Detailed constraints and methodology to be shared along with the full report.
[xix] Even if, for example, European blending mandate has not been put in law yet.

[7] CORSIA Eligible Fuels – Life Cycle Assessment Methodology, International Civil Aviation Organization, 2019, [redacted]

[8] Dan Rutherford et.al., Science-based target setting for the aviation sector, v1.0, Science Based Targets Initiative, 2021, [redacted]

[9] Lee et al., "The contribution of global aviation to anthropogenic climate forcing for 2000 to 2018," Atmospheric Environment, vol. 244 (117834), 2021, [redacted]

[10] Voigt et al., "Cleaner burning aviation fuels can reduce contrail cloudiness," Communications Earth & Environment 2 (114), 2021, [redacted]

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ECONOMICS & FINANCE

NEWS

Aviation can supercharge the UK's economy post-Brexit

Joe Bates 7th July 2021

London Heathrow, desperate to speed up the return of safe international travel, today flagged up a new report by the Centre for Economics & Business Research, which claims that aviation needs to be at the heart of the UK's future economic growth.

The new research highlights how the UK could undergo an economic pivot post-Brexit, with non-EU trade potentially increasing by 20% over the next five years from nearly £473 billion in 2019 to £570 billion in 2025.

And according to the Centre for Economics & Business Research, aviation will need to be at the heart of this pivot.

The findings suggest that the value of trade through Heathrow to non-EU countries could increase by 11% by 2025, while trade with EU countries decreases by 7% over the same period.

Regions across the UK would benefit from these new trading links, with Heathrow playing a key role in opening up valuable new markets from the Asia Pacific and Australia to the US.

Indeed, the UK hub pulls no punches when it claims that "aviation is critical to the government's plans for a Global Britain post-Brexit".

It notes that Heathrow alone has the potential to facilitate "a £204 billion trade bonanza benefitting British businesses in every corner of the country, creating opportunities for the entire aviation sector and strengthening the UK's trade network".

However, it warns that this trade boost won't be realised unless the UK's aviation industry is supported by government policies and allowed to resume.

Industry figures for May show that some of the European competitors that benefitted from sector specific support during the pandemic, such as the Netherlands and Germany, are seeing the fastest growth.

Cargo tonnage at the UK's hub airport is still down 19% on 2019 levels, compared to both Schiphol and Frankfurt which have surpassed their 2019 levels, growing by 14% and 9% respectively over the same time period.

This research comes as Heathrow works with British Airways and Virgin Atlantic to launch trials that aim to help government and industry understand how to practically ease restrictions for fully vaccinated passengers, a move which is key for restarting travel and trade.

By capitalising on the country's vaccine dividend, the airport claims that ministers can help to deliver this economic stimulus for exporters across Britain, ensuring the UK retains its competitive edge as the country comes out of lockdown.

The Global Britain report reveals that:

- By 2025, the value of trade through Heathrow could grow to over £204bn (up from £188bn in 2019), representing 21.2% of the UK's total trade in goods and 14.6% of our trade in goods and services.

- The growth in trade could boost every part of the UK. Regions with high manufacturing propensities – including the Midlands and North East – are likely to benefit most from future trade agreements with fast growing economies around the world. Scotland and Wales could also benefit from increased trade in agriculture, forestry and fishing.

- Heathrow could help drive future Free Trade Agreements – with 46% of trade by value with CPTPP countries facilitated through the airport – while the airport is ideally placed to play a major role in deals with the US and Australia.

- Heathrow is a major facilitator of UK trade accounting for two thirds of all trade transported by air in the UK (by value), with this figure rising to over 75% for non-EU trade.

- While 90% of the UK's trade by volume is transported by sea, high value goods are transported by air. Heathrow is the UK's largest port by value, accounting for 21.2% of UK trade in goods by value in 2019.

The new research, says Heathrow, reaffirms the importance of the global hub airport model to the UK post-Brexit and to Britain's ambitious exporters which rely on aviation trade routes.

It argues that the hub model helps to drive trade growth, by pooling demand for global connections and providing more choice of destinations for passengers, businesses and entrepreneurs, exporters and importers.

Heathrow CEO, John Holland-Kaye, said: "Heathrow is well placed to supercharge the government's Global Britain ambitions and deliver a post-lockdown, post-Brexit economic stimulus worth billions of pounds.

"As the UK's only hub airport and largest port by value, we are ready to play a central role in creating economic opportunities for businesses across the country, facilitating new free trade agreements and serving as a vital link to our key trading partners.

"Ministers must seize the opportunity to secure this crucial economic boost by backing British aviation and its own vaccination programme by safely easing travel restrictions for fully vaccinated passengers from July 19th."

[redacted]

[redacted]

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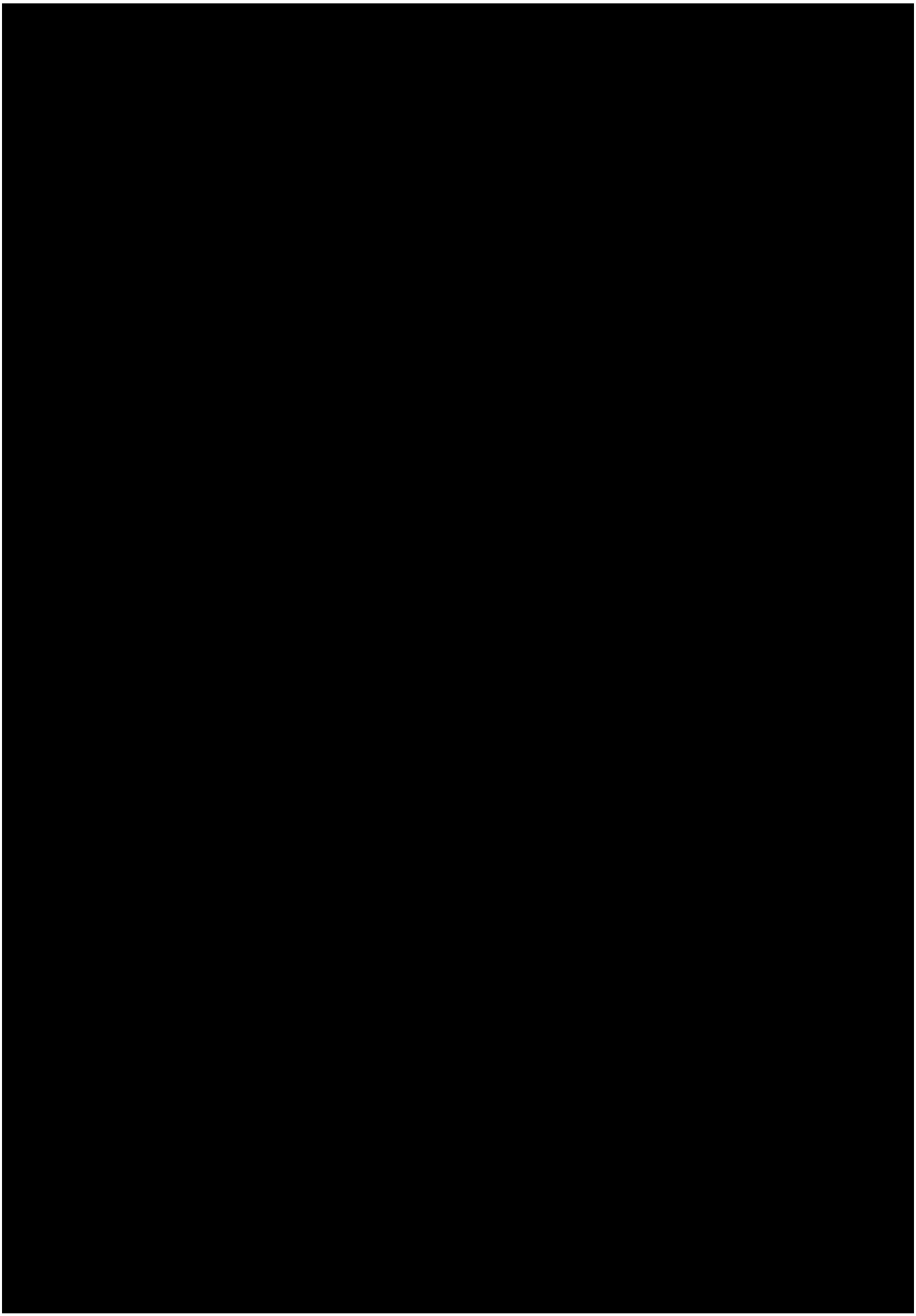

[redacted]

Trending

NEWS [redacted]

FAA looking for designers to create ATC towers of the future [redacted]

NEWS [redacted] PLANNING & DESIGN [redacted]

Newark Liberty prepares to start final construction phase of Terminal A [redacted]

AW4 2021 [redacted], LEADERSHIP [redacted], NEWS [redacted]

Bluer skies ahead [redacted]

NEWS [redacted], TRAFFIC [redacted]

Scoot to launch low-cost flights to Bangkok from London Gatwick [redacted]

ECONOMICS & FINANCE [redacted] PASSENGER FACILITATION [redacted], SUSTAINABILITY [redacted]

Airports look to future at ACI Europe's Annual Congress [redacted]

[redacted]

[redacted]

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South Sudan claims ownership of airspace and will collect air navigation fees

[redacted]

NEWS [redacted]

Bahrain International Airport: Ready to grow

[redacted]

AIRPORT REPORTS [redacted]

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AW3 2021 [redacted]

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July 7, 2021

eTurbo News – How Aviation could be Cornerstone of the UK's Global Britain ambitions

View this article here.

New research highlights how the UK could undergo an economic pivot post-Brexit, with non-EU trade potentially increasing by 20% over the next five years from nearly £473 billion in 2019 to £570 billion in 2025.

- New CEBR report highlights how aviation could be the cornerstone of the UK's Global Britain ambitions, helping industry deliver a £204bn trade bonanza which could benefit every corner of the UK.
- Heathrow, which already facilitates nearly half of all UK trade by value with CPTPP countries, is best placed to help UK firms pivot and grow trade with high value economies post-Brexit.
- Trade to non-EU countries through Heathrow could grow by 11% by 2025 with regions specialising in high value manufacturing, including the North East and the Midlands, set to benefit most as the UK establishes new trading relationships.

According to the Centre for Economics & Business Research, aviation will need to be at the heart of this pivot. The findings suggest that the value of trade through Heathrow to non-EU countries could increase by 11% by 2025, while trade with EU

Aviation is critical to the Government's plans for a Global Britain post-Brexit. Heathrow alone has the potential to facilitate a £204 billion trade bonanza benefitting British businesses in every corner of the country, creating opportunities for the entire aviation sector and strengthening the UK's trade network.

However, this trade boost won't be realized unless the UK's aviation industry is supported by Government policies and allowed to resume. Industry figures for May show that some of the European competitors that benefitted from sector specific support during the pandemic, such as the Netherlands and Germany, are seeing the fastest growth. Cargo tonnage at the UK's hub airport is still down 19% on 2019 levels, compared to both Schiphol and Frankfurt which have surpassed their 2019 levels, growing by 14% and 9% respectively over the same time period.

This research comes as Heathrow works with British Airways and Virgin Atlantic to launch trials that aim to help Government and industry understand how to practically ease restrictions for fully vaccinated passengers, a move which is key for restarting travel and trade. By capitalizing on the country's vaccine dividend, ministers can help to deliver this economic stimulus for exporters across Britain, ensuring the UK retains its competitive edge as the country comes out of lockdown.

The Global Britain report reveals that:

- By 2025, the value of trade through Heathrow could grow to over £204bn (up from £188bn in 2019), representing 21.2% of the UK's total trade in goods and 14.6% of our trade in goods and services.
- The growth in trade could boost every part of the UK. Regions with high manufacturing propensities – including the Midlands and North East – are likely to benefit most from future trade agreements with fast growing economies around the world. Scotland and Wales could also benefit from increased trade in agriculture, forestry and fishing.
- Heathrow could help drive future Free Trade Agreements – with 46% of trade by value with CPTPP countries facilitated through the airport – while the airport is ideally placed to play a major role in deals with the US and Australia.

- While 90% of the UK's trade by volume is transported by sea, high value goods are transported by air. Heathrow is the UK's largest port by value, accounting for 21.2% of UK trade in goods by value in 2019.

The new research reaffirms the importance of the global hub airport model to the UK post-Brexit and to Britain's ambitious exporters which rely on aviation trade routes. The hub model helps to drive trade growth, by pooling demand for global connections and providing more choice of destinations for passengers, businesses and entrepreneurs, exporters and importers.

Previous

Next

Supporting a Global Britain – The Economic impact of Heathrow Airport

A report for Heathrow Airport

July 2021

2021

Executive Summary

- In 2019, the value of trade going through Heathrow Airport stood at approximately £188bn, of which 56% came from imports.
- This was equivalent to 20.6% of UK trade of goods by value that year (and approximately 34.7% for non-EU trade).
- We forecast that by 2025 this will grow to over £204bn, representing 21.2% and 32.0% of UK trade of goods and non-EU trade of goods by value, respectively.
- Forecasts were carried out using Cebr's in house macro model, which is updated monthly.
- Passengers who entered the UK through Heathrow spent an estimated £16.6bn in the UK in 2019.
- Cebr estimates that, when international travel resumes, Heathrow passenger expenditure in the UK could rise by as much as 10% by 2025.
- From microchips to medical research, the data shows the high value industries that will be unlocked through this Heathrow trade route, with cargo worth more than £100,000 per tonne compared to £1,330 per tonne for shipping.
- Based on the composition of cargo passing through Heathrow in 2025, together with the geographic composition of the UK in 2021, it is estimated that regions including the Midlands, Wales and the North East could benefit most, since they are the most manufacturing intensive.
- Cebr's input-output modelling shows that Heathrow Airport is expected to contribute approximately £4.7bn to the UK economy and is set to support more than 140,000 jobs across its broad supply chain by 2025.
- Heathrow facilitates almost half of trade in value with current members of the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP), that the government is considering to join.

Overview of the study

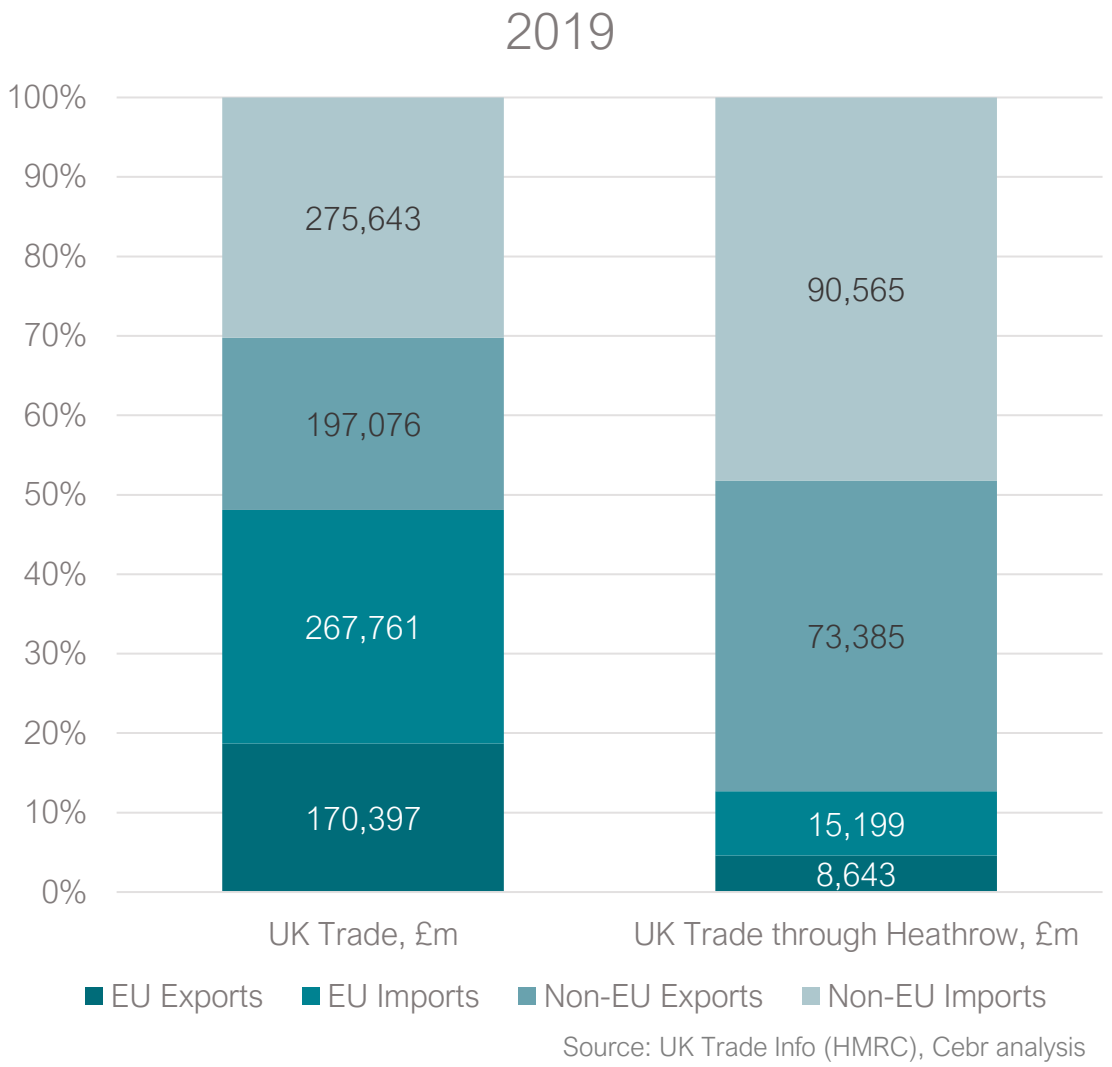
- Cebr has undertaken research to quantify the economic impact associated with Heathrow Airport.
- This includes a forecast analysis for a post-Covid, post-Brexit 2025, with 2019 as the baseline year. Forecasts were carried out using Cebr's in house macro model (March 2021).
- The report is broken down into three different modules:
  - ✓ Module 1 – Sectors and people: this looks at the sectors that rely on aviation trade routes to enable high value trade and business as well as the associated passenger expenditure in the UK that is directly supported by the airport. It also contains an analysis of the economic multiplier impacts of Heathrow Airport.
  - ✓ Module 2 – Value of Heathrow: this assesses the value of aviation trade routes through Heathrow, as well as how this compares to other trade routes into and out of the UK (namely, shipping).
  - ✓ Module 3 – Regional impact of Heathrow: this evaluates the impact of trade through Heathrow on the UK economy and which of the regions might be most impacted owing to the composition of trade facilitated by Heathrow.
  - ✓ Module 4 – Countries: this looks at the countries which will potentially provide the greatest opportunity for the UK economy through free trade agreements that rely on these trade routes through Heathrow.

Module 1:
Sectors and people

2021

In 2019, 35% of non-EU trade of goods passed through Heathrow

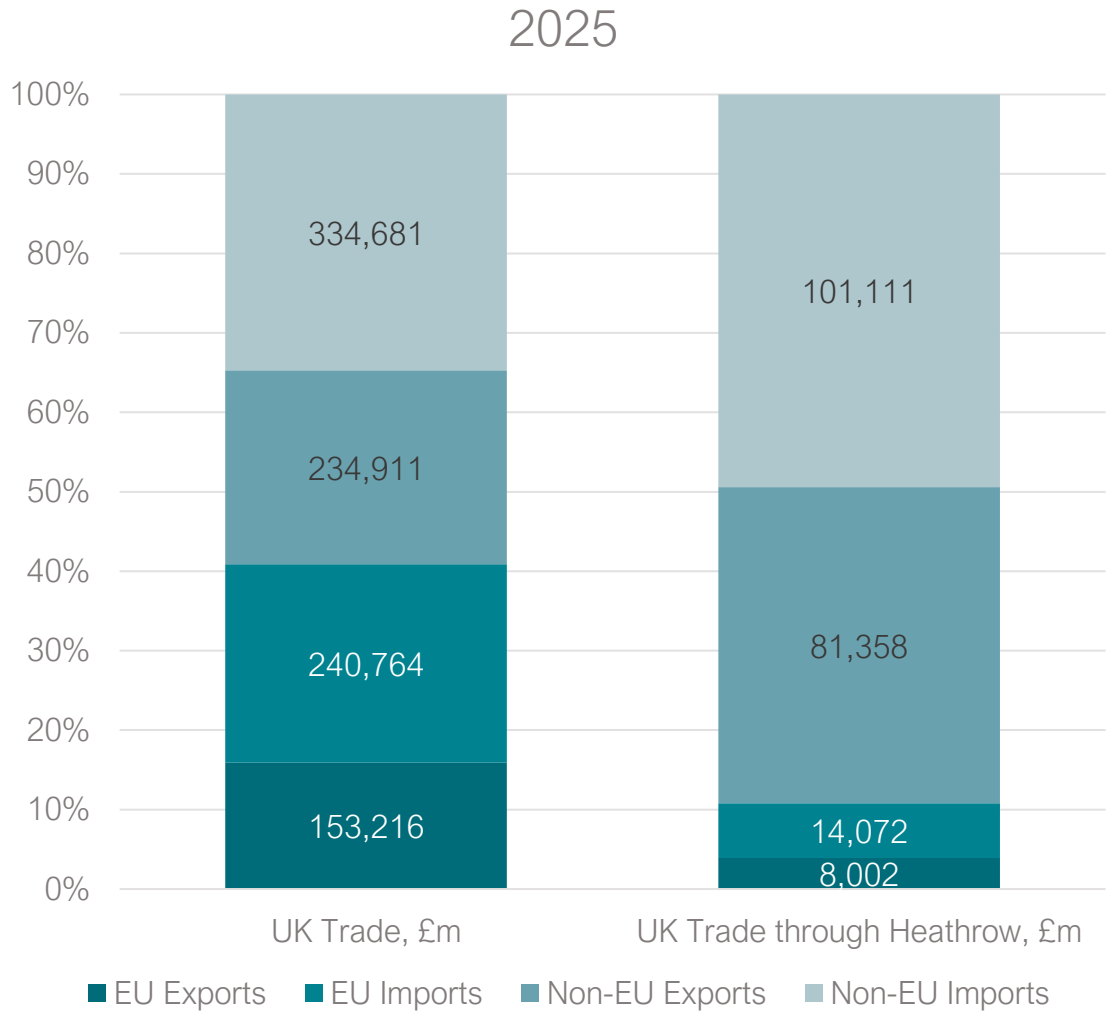
- Approximately £188bn worth of goods were transported into and out of the UK through Heathrow Airport in 2019.
- This represented 20.6% of all UK trade of goods, and just over 13.5% of all UK trade of goods and services in 2019. 34.7% of non-EU trade of goods passed through Heathrow, while we estimate that only 5.4% of EU trade was handled at Heathrow.
- The value of total trade through Heathrow figure is a Cebr estimate.
- While the figures for non-EU trade through Heathrow come directly from UK Trade Info data provided by HMRC, no such data exists for goods traded with the EU through Heathrow in 2019 - however, as a result of Brexit this data does exist for the first months of 2021.
- Using the EU trade figures from 2021, we calculated EU trade-specific Heathrow to UK ratios and we subsequently scaled these up for 2019.



Source: UK Trade Info (HMRC), Cebr analysis

Value of trade routes through Heathrow to non-EU countries is set to increase by approximately 11% by 2025

- The total trade through Heathrow is forecasted to increase to over £204bn by 2025, equivalent to a growth rate of 8.9% during this period. For trade with non-EU countries, the growth rate is forecasted to be approximately 11%, while trade with EU countries is expected to decrease by more than 7%.
- By 2025, the value of trade through Heathrow as a share of all UK trade of goods and goods and services is expected to grow to 21.2% and 14.6%, respectively.
- Cebr estimates that 32.0% of non-EU trade of goods and 5.6% of EU trade will be handled at Heathrow in 2025.
- Our forecast model is based on the assumption that Brexit and a 'Global Britain' policy will result in trade with the EU decreasing in favour of establishing stronger trade relationships with non-EU countries. Details of the methodology are presented in the Appendix.
- The projected trend is driven in large part by goods from the manufacturing sector, particularly those that can be considered "high value" manufacturing, such as microchips, medical equipment, industrial machinery equipment or man-made fibres.

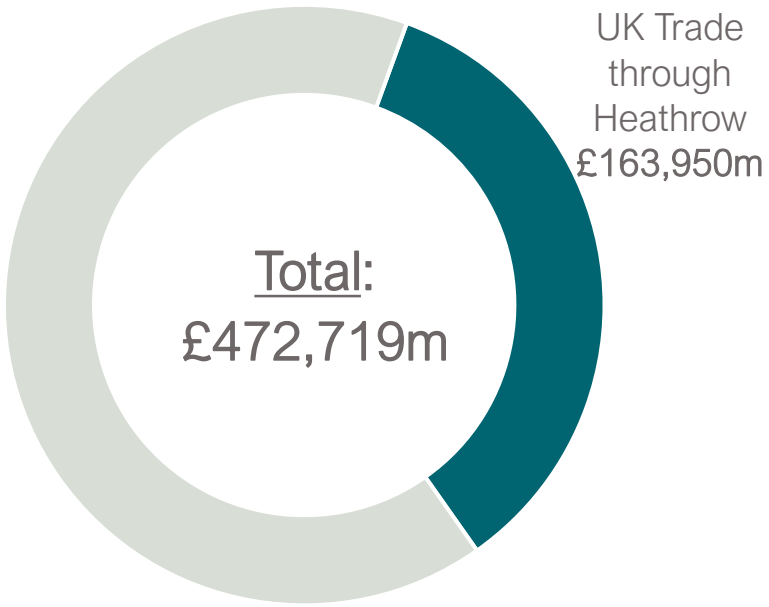


Source: UK Trade Info (HMRC), Cebr analysis

UK Trade with non-EU countries is set to rise by 20% over the next 5 years

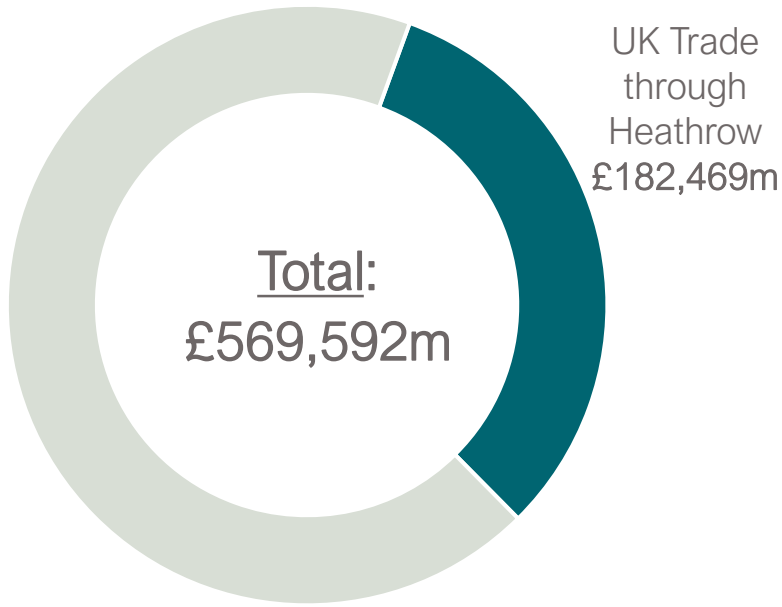
2019

UK Trade with non-EU countries



2025

UK Trade with non-EU countries



Heathrow is a major facilitator of UK trade of high value manufacturing goods

- Despite Heathrow's relatively low share of UK trade by cargo *volume*, it is a major transportation hub in the UK by *value*, owing to the type of goods that it facilitates the trade of, notably high value manufacturing goods.
- Over 90% of the UK's trade by *volume* is transported by sea[1] but due to the higher value cargo that is transported by air, Heathrow is responsible for over a fifth of the UK's trade of goods by *value*.
- Evidence from the Civil Aviation Authority reveals that almost two thirds of all trade transported by air in the UK was moved through Heathrow in 2019 with this figure rising to over 75% for non-EU trade.
- According to UK Trade Info (HMRC) data, Heathrow was the final destination for many of the non-EU trade routes into the UK.
- Amongst them, not only products belonging to the category of manufacturing, but also goods from the agriculture, forestry and fishing category, were identified.

Products passing through Heathrow, 2019	% of UK Exports	% of UK Imports	% of UK Trade
Live animals	57%	25%	51%
Medicinal and pharmaceutical products	52%	40%	49%
Professional, scientific, controlling instruments, apparatus	48%	35%	42%
Power generating machinery & equipment	38%	39%	39%
Rail, aircraft and ship transport equipment	33%	24%	29%
Crude animals & vegetable materials	24%	25%	25%
Dairy products & birds' eggs	16%	28%	17%

Source: UK Trade Info (HMRC), Cebr analysis

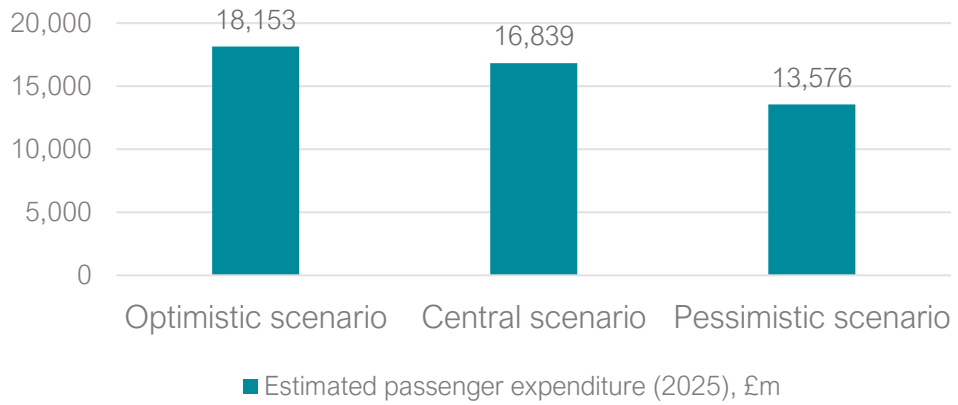
[1] Parliament. (2019). 'Chapter 7: Maritime transport'.

Heathrow passenger expenditure in the UK could rise by as much as 10% by 2025

- Passenger expenditure refers to the general spending done by passengers travelling through Heathrow into the UK. This may be in the form of accommodation, restaurants or other business and tourism activities.
- We estimate that, in 2019, passengers travelling into Heathrow spent a total of £16.56bn across the UK. Almost 50% of total spending is represented by passengers travelling from North America or Middle East. In particular, the biggest contribution from a single country comes from travellers from the US, who spent £3.74bn (23% of total spending) across the UK in 2019.
- We have projected passenger expenditure up to 2025, under three different "Covid-19 scenarios". Details of the methodology are presented in the Appendix.
- Under the most **optimistic scenario**, which forecasts the end of the pandemic's impact on aviation by Summer 2021, the total passenger expenditure is expected to rise by 10% over the next 5 years to £18.15bn.
- Under the most **pessimistic scenario**, which assumes a protracted health crisis and subsequent low passenger confidence, we expect a reduction in passenger expenditure of 18% to £13.58bn by 2025. This partly reflects the trend observed over the last twelve months, when passenger traffic numbers at Heathrow decreased by 72.7%.

Estimated passenger expenditure, 2019	£m
EU	2,856
Non-EU Europe	943
USA	3,743
North America (excluding USA)	474
Asia Pacific	3,517
Middle East	3,796
Africa	975
Latin America	254
Total	**16,558**

Source: IPS (VisitBritain), DfT, CAA, Cebr analysis



Source: IPS (VisitBritain), DfT, CAA, Eurocontrol, IMF, Cebr analysis

Heathrow could contribute around £4.65bn to the UK economy by 2025

- This section of the analysis is based on pre-pandemic figures and assumes that international travel will fully resume by 2025.
- Heathrow could contribute around £4.65bn to the UK economy by 2025. This figure does not include passenger spend and value of trade facilitated by the airport, which can be considered as additional "downstream impacts".
- Over 140,000 jobs are set to be supported by Heathrow and its broad supply chain by 2025. This figure is based on the more than 76,000 people working at Heathrow in 2019 for one of the 400 businesses that operate across the airport – 'Team Heathrow'.
- This analysis was carried out using an input-output model, which generates economic multipliers that quantify the total economic footprint of Heathrow Airport into three separate but interlinked impact layers.

(For a more detailed methodology note on how this is calculated, see the Appendix.)

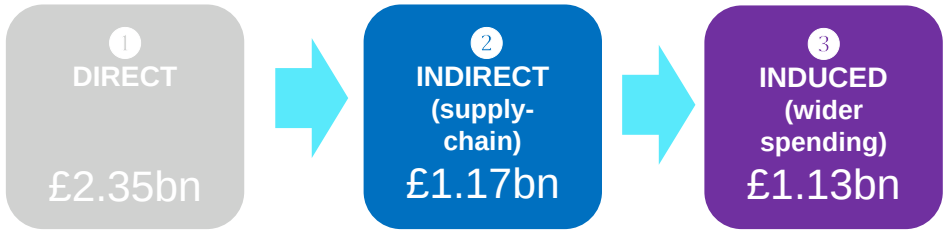
Heathrow Airport, 2025	Direct	Indirect	Induced	Aggregate
Turnover (£m)	3,127	1,463	1,364	5,953
GVA (£m)	2,351	1,173	1,125	4,650
'Team Heathrow' employees[2]	78,140	38,085	27,208	143,433
Heathrow employees	7,856	3,829	2,735	14,421
Compensation of Heathrow employees (£m)	386	196	136	717

Source: Companies House, Heathrow Airport, Cebr analysis

Gross Value Added (GVA) multipliers, 2025

Total Impact = 1 + 2 + 3 = 1.98

Aggregate Gross Value Added (GVA), 2025



Total Impact = 1 + 2 + 3 = £4.65bn

Source: Cebr analysis

[2] The same jobs multipliers were applied to the two employment figures. Cebr recognises the limitation of the analysis in that it does not offer an accurate picture of "Team Heathrow" employment's composition, which includes a broader range of jobs. This can result in an underestimation of the aggregate jobs impact as this does not account for a number of economic sectors that present more complex supply chains than airport services and operations.

Module 2:
Value of Heathrow

2021

The value of trade going through Heathrow is significantly higher than that of shipping and other modes of transport

- Our estimates show that the value per tonne of cargo going through Heathrow Airport is almost 80 times greater than the value of UK shipping trade routes, and about 10% higher than the value of UK aviation trade routes (excluding Heathrow).
- This was estimated by dividing the value of cargo per mode of transport by the respective cargo volume measured in tonnes.
- The data for cargo value is sourced from UK Trade Info data (HMRC), and the cargo volume data comes from Department for Transport (DfT) data releases and from the Civil Aviation Authority (CAA) for shipping and aviation, respectively. All data is from 2019.
- Because the UK was still part of the EU in 2019, the data for cargo value presented is only for non-EU trade; this meant having to estimate the overall trade volume figure wherever appropriate.

Mode of transport, 2019	£ per tonne
Heathrow	103,076
Aviation (excl. Heathrow)	93,812
Shipping	1,334

Source: UK Trade Info (HMRC), DfT, CAA, Cebr analysis

1 tonne = 1,000 kilograms

Module 3: Regional impact of Heathrow

2021

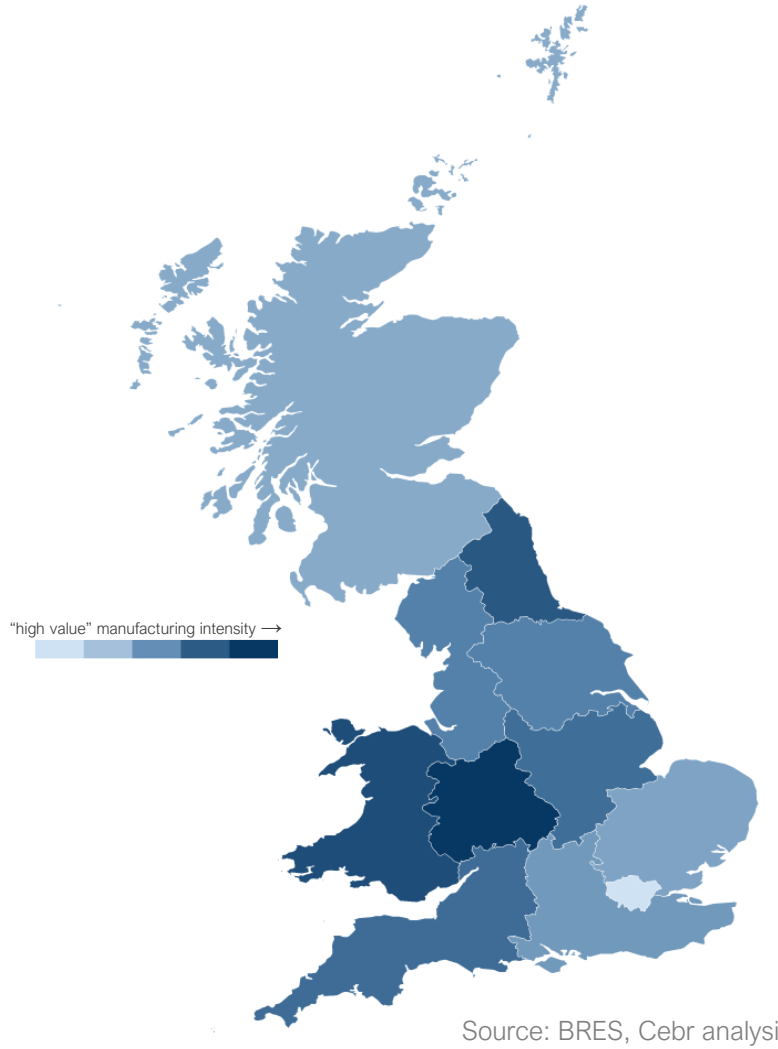
As a major hub, Heathrow offers significant benefits to regional economies

- Heathrow Airport is the only hub in the UK and a major hub in Europe. Hub airports like Heathrow are different in nature to regional airports serving point to point flights and are able to generate greater economic benefits.
- Due to its hub status Heathrow can serve a broad range of destinations, in particular making long haul destinations viable and profitable routes to airlines.
- Heathrow connects all UK's regions to worldwide destinations and markets, this connectivity supports not only London's economic activity but also regional economies by stimulating:
  - ✓ Trade;
  - ✓ Foreign direct investment; and
  - ✓ Tourism.
- As well as enabling more business travel and supporting UK tourism, flights operating at Heathrow also carry up to 20 tonnes of freight in the belly hold, opening up new opportunities for UK manufacturers to export their goods and services around the world, as well as enabling imports.

The Midlands, Wales and the North East could stand to benefit the most from future FTAs and trade policies

- Given the significant role Heathrow plays in the trade of "high value" manufacturing products, evaluating the "high value" manufacturing propensities for each of the regions is a good way to gauge which regions might be most affected by future FTAs which would change the trading landscape of the UK. In 2019, more than 80% of UK trade to non-EU countries concerned manufactured goods.
- By "high value" manufacturing propensity we mean how much more (or less) "high value" manufacturing intensive that particular sector is within each region compared to the UK average (which would be equal to 1).
- The Midlands, Wales and the North East depend more on "high value" manufacturing than Scotland and the South East, and therefore we would expect them to be amongst the regions most heavily impacted by future FTAs and trade policy.
- Other regions, such as London, are more likely to be unaffected by the gains associated with any potential growth in "high value" manufacturing due to future FTAs.

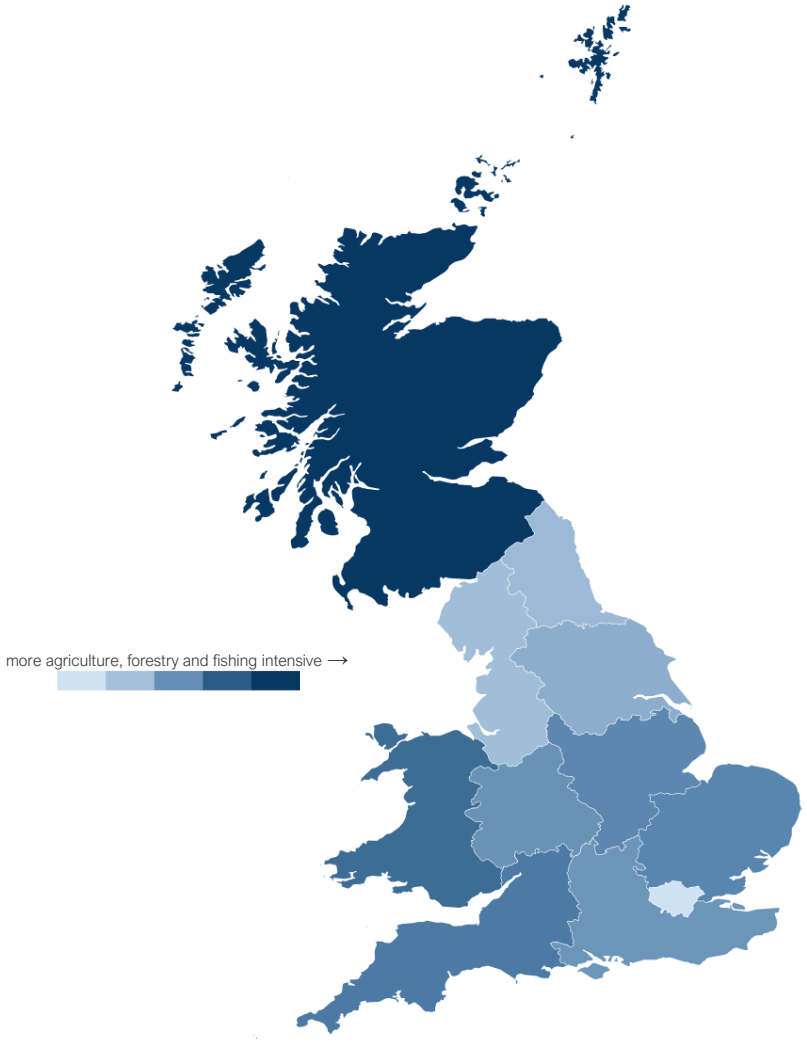
(For the full list of regional propensities and a more detailed explanation of methodology, see the Appendix.)



Source: BRES, Cebr analysis

Scotland and Wales could benefit from increased trade in agriculture, forestry and fishing

- Although agriculture, forestry and fishing only account for a marginal part of UK total trade (in 2019, they represented less than 5% of UK trade to non-EU countries), some specific products heavily rely on Heathrow routes.
- In 2019, 63.5% of fish, crustaceans and molluscs exported from the UK to non-EU countries and 27.5% of dairy products & birds' eggs imported to the UK from non–EU countries were handled at Heathrow.
- Regional propensities for this sector are very heterogenous throughout the country, suggesting that some regions could obtain bigger benefits from increased trade in agriculture, forestry and fishing.
- More specifically, Scotland and Wales depend more on the above sectors than the other regions, with regional propensities of 2.36 and 1.66 respectively.



(For the full list of regional propensities and a more detailed explanation of methodology, see the Appendix.)

Source: BRES, Cebr analysis

Module 4: Countries

2021

Heathrow facilitates almost half of trade in value with current CPTPP members

- The government's aim is to secure secure FTAs covering 80% of UK trade within the next three years, to become a truly Global Britain. Establishing Free Trade Agreements (FTAs) could further increase the value of trade between the UK and its respective partners by reducing tariffs and restrictions currently in place on UK exports.
- As a key part of its trade negotiations programme, the government has now formally launched negotiations to pursue accession to the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP).
- As of 2019, Heathrow facilitates 46.2% of trade in value with current CPTPP members. 30.9% of exports and 55.0% of imports from the UK to these countries pass through Heathrow.

Heathrow trade, 2019	Total, £m	% of UK Trade
Australia	8,429	64.9%
Brunei	28	43.4%
Canada	10,592	58.5%
Chile	36	23.4%
Japan	6,278	37.2%
Malaysia	658	19.6%
Mexico	1,598	44.2%
New Zealand	288	16.9%
Peru	82	13.0%
Singapore	3,282	37.6%
Vietnam	2,057	39.6%
Total CPTPP members	**33,653**	**46.2%**

Source: UK Trade Info (HMRC), Cebr analysis

“The UK will be a champion of free trade and will seek FTAs with like-minded democracies” – DIT (2020)

US

- The Government’s analysis shows a UK-US FTA could increase trade between both counties by £15.3bn in the long run and increase UK workers’ wages by £1.8bn. UK-US trade was valued at £220.0bn in 2019, of which almost 40% passed through Heathrow.
- Evidence from the literature reveals that the Midlands could benefit significantly from a UK-US FTA, with one in five of all exports from the region already going to the US. The North of England could also benefit by increasing exports of machinery, road vehicles and manufactured products to the US market.

Australia

- The FTA recently signed with Australia could increase UK exports to Australia by up to £900 million, according to recent government analysis. UK businesses traded £18.1 billion worth of goods and services with Australia in 2019.
- Furthermore, the UK was the second largest direct investor in Australia and the second largest recipient of Australian foreign direct investment (FDI) in 2019. The stock of UK FDI in Australia was £35.6 billion in 2018, while Australia invested £15.9 billion in the UK.
- Heathrow, as major hub for connectivity, plays a central role in boosting foreign investment.

Japan

- The government signed an FTA with Japan in October 2020, which could boost trade between the UK and Japan by over £15 billion and drive economic growth in the long run. Currently 37% of trade with Japan is handled by Heathrow, suggesting that over £5bn worth of additional trade with Japan could be facilitated by the airport.

Appendix

In house Cebr macro model assumptions

- The Cebr macro model forecast takes into account expectations about a number of economic indicators, including:
  - ✓ Economic growth;
  - ✓ Inflation;
  - ✓ Labour market conditions;
  - ✓ Consumer market conditions;
  - ✓ Trade policies;
  - ✓ Brexit;
  - ✓ Covid; and
  - ✓ Technological advancements and innovation.
- With specific regard to trade, the model considers that Brexit will be 'harder' than was originally assumed after the EU-UK Trade and Cooperation Deal was signed. Both exports to and imports from the EU will settle at a level that might be as much as 15% lower than would have been the case had Brexit not occurred. Furthermore, benefits from non-EU trade will only start to accrue slowly.
- This report used the March 2021 update.

Regional breakdown of inbound and outbound Heathrow passengers

- This is the total number of passengers that travelled through Heathrow Airport in 2019, as per Civil Aviation Authority (CAA) data.
- It includes UK residents travelling abroad via Heathrow, foreign travellers visiting the UK through Heathrow, and "transit" passengers – that is, passengers who are only passing through Heathrow as a layover stop to their final destination.
- By 2025 we expect the total number of passengers to exceed 83 million under the optimistic scenario, with some variations in the regional breakdown.
- The passenger numbers forecast for the other two scenarios is as follows: in the central scenario we expect this number to almost reach 78 million, and in the pessimistic scenario we expect this figure to exceed 63 million.

Inbound and outbound passengers through Heathrow by region, 2019	Total	Share
UK	4,840,337	6%
EU	27,462,189	34%
Non-EU Europe	5,648,380	7%
North America	19,031,973	26%
Asia Pacific	11,285,545	14%
Middle East	8,119,136	10%
Africa	3,091,504	4%
Latin America	1,382,506	2%
Total	**80,861,570**	**100%**

Source: CAA, Cebr analysis

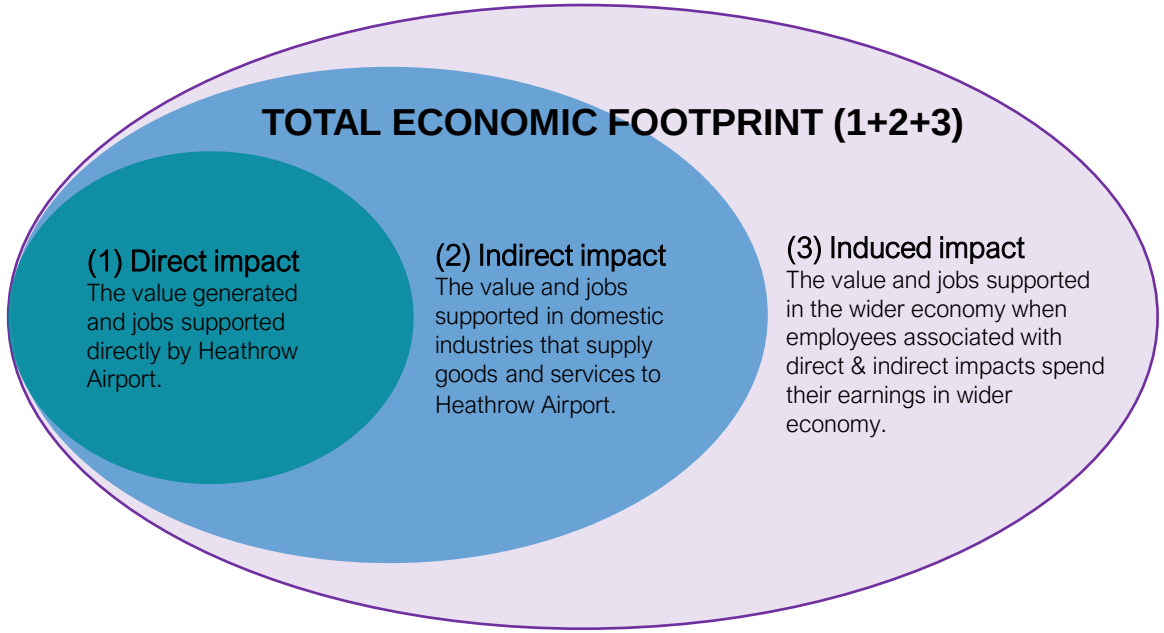
Heathrow passenger expenditure forecast: methodology and assumptions

- Passenger expenditure figures were estimated by calculating the proportion of inbound terminal passengers into Heathrow and, using average expenditure data from the International Passenger Survey carried out by VisitBritain, calculating the total spending by these passengers in the UK.
- The expenditure forecast analysis makes use of passenger forecast scenarios from Eurocontrol and world GDP forecast from the International Monetary Fund (IMF) Economic Outlook.
- In November 2020, Eurocontrol published forecasts of air traffic for 2019-2024 looking at three potential scenarios:
  - *Scenario 1. Vaccine Summer 2021: Vaccine widely made available for travellers (or end of pandemic) by Summer 2021.*
  - *Scenario 2. Vaccine Summer 2022: Vaccine widely made available for travellers (or end of pandemic) by Summer 2022.*
  - *Scenario 3. Vaccine not effective: Lingering infection and low passenger confidence.*[1]
- We have used Eurocontrol forecasts to extrapolate Heathrow passengers potential growth for 2019-2025 and world GDP as main driver of expenditure.
- The passenger forecast, together with the expenditure forecast, yields an estimate for the total spending by travellers coming into the UK through Heathrow in 2025.

[1] https://www.eurocontrol.int/publication/eurocontrol-five-year-forecast-2020-2024

Input-output model methodology note

- Our input-output models[2] establish the relationships between industries through supply chain linkages, as well as industries' linkages with government, capital investors and the rest of the world (through trade).
- The models produce three types of impacts (as seen in the figure on the right).
- They are consistent with the national accounting framework, and are based on the ONS supply-use tables.
- The supply-use tables provide the most detailed official record of how the industries of the economy interact with other industries, with consumers and with international markets in producing the nation's GDP and national income.
- Using the supply-use tables, we establish an explicit role for Heathrow Airport within our input-output models, which facilitate the estimation of indirect and induced multiplier impacts.



- These three impacts are then combined to convey the aggregate impact associated with Heathrow Airport in terms of turnover, GVA, employment, and the compensation of employees.

[2] The Leontief matrix multiplier approach is the standard method for mapping the wider footprint of a particular company or sector. It is based on the Nobel Prize-winning work of Wassily Leontief.

Regional propensities in the UK – full table & more detailed methodology

- Valuating the regional propensities for trade-intensive sectors is a good way of assessing which regions have the most to gain (or lose) from any future trade agreements where Heathrow might play a leading role.
- In essence, a regional propensity captures the relative intensity of a particular sector in a given region. For instance, the manufacturing propensity measures how much more (or less) manufacturing intensive a region is compared to the average (i.e. compared to the rest of the UK). A manufacturing propensity greater (smaller) than 1 means that particular region is more (less) manufacturing intensive compared to the rest of the UK.
- The table shows the relative intensity of manufacturing, high value manufacturing and agriculture for the UK regions and, therefore, which regions might have the most (and least) to gain from an FTA where Heathrow would play the role of major facilitator.

Regional propensity, 2019	Manufacturing	"High value" manufacturing	Agriculture
East	0.95	0.80	1.31
East Midlands	1.61	1.32	1.28
London	0.29	0.16	0.04
North East	1.27	1.53	0.59
North West	1.16	1.14	0.54
Scotland	0.84	0.73	2.36
South East	0.82	0.90	1.10
South West	1.09	1.34	1.46
Wales	1.40	1.63	1.66
West Midlands	1.46	1.85	1.14
Yorkshire and The Humber	1.42	1.14	0.76

Source: BRES, Cebr analysis

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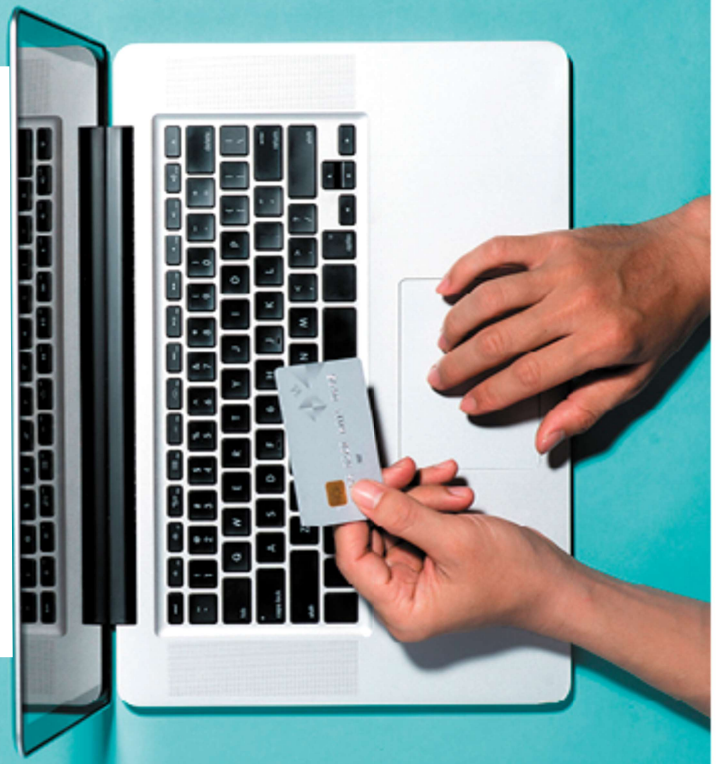
JUNE 2021

GLOBAL E-COMMERCE OUTLOOK

What is Driving E-commerce Growth in Different Markets?

CBRE



KEY THEMES EXPLORED

1 | RECENT GROWTH OF E-COMMERCE

2 | WHAT FACTORS ARE DRIVING E-COMMERCE?

3 | WHAT HAS BEEN THE IMPACT OF COVID-19?

4 | WILL E-COMMERCE CONTINUE TO GROW?

5 | WHAT WILL BE THE IMPACT ON LOGISTICS PROPERTY?

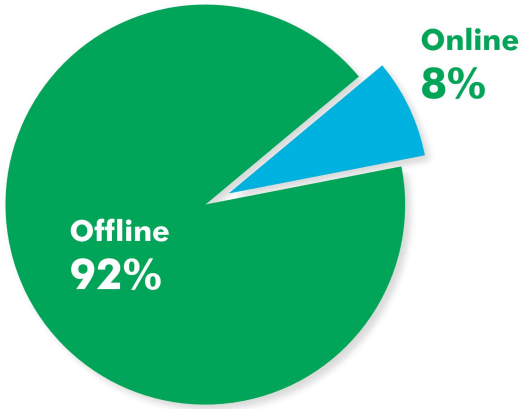
ANALYSIS PROFILE

- **43** markets were analyzed
- **27 factors driving e-commerce** were explored
- **Key 6 drivers were identified** that better explain e-commerce levels
- **Created an index** to measure the strength of these drivers in different markets
- **Produced a forecast** of e-commerce penetration rate per market and of additional logistics space required

01 RECENT GROWTH OF E-COMMERCE

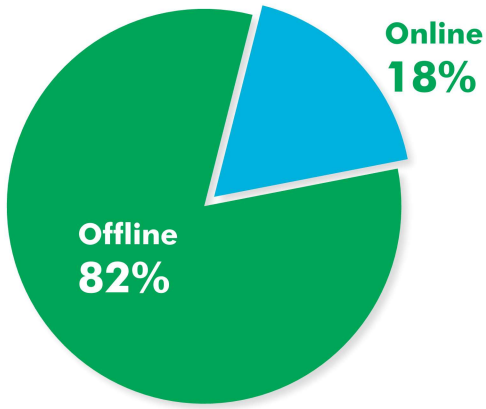
GLOBAL RETAIL MARKET SIZE

HOW BIG IS THE GLOBAL E-COMMERCE MARKET?



2015 — **$12.6 trillion**

- Offline: $11.6 trillion
- Online: $ 1.0 trillion



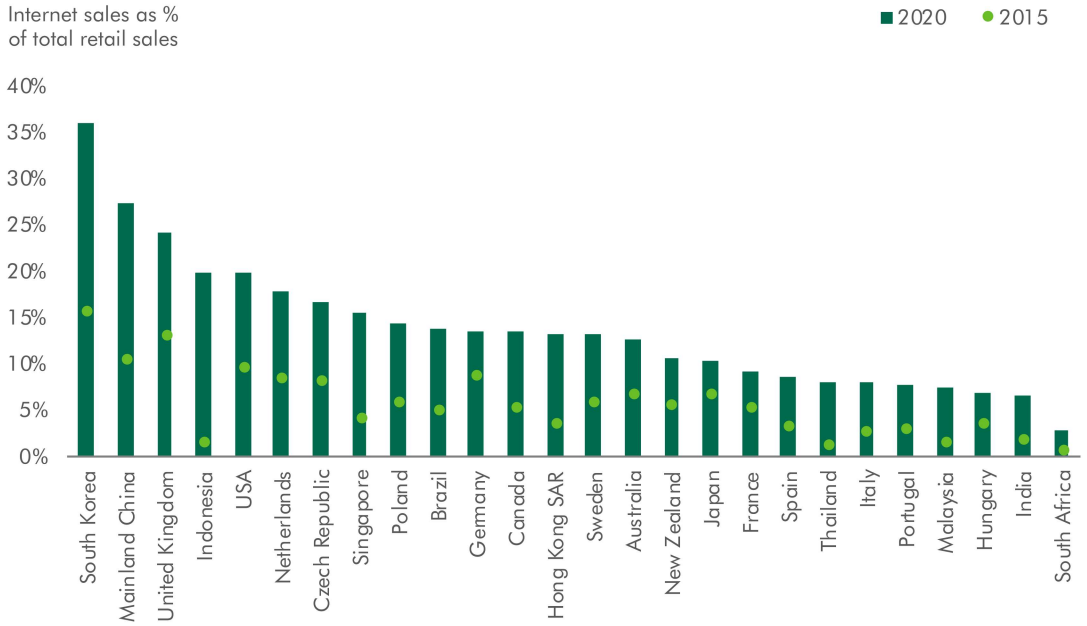
2020 — **$13.5 trillion**

- Offline: $11.1 trillion
- Online: $ 2.4 trillion

Source: Euromonitor, sum of the 43 markets included in the analysis. The full list is included in the Appendix. Fixed 2020 US $ values.

E-COMMERCE PENETRATION RATIO PER MARKET

FAST GROWTH DURING THE LAST 5 YEARS ACROSS ALL MARKETS



Source: Euromonitor.

02 WHAT FACTORS ARE DRIVING E-COMMERCE GROWTH?

E-COMMERCE DRIVERS: FACTORS LINKED WITH THE GROWTH OF E-COMMERCE

We explored **27 factors** and split the top ones into **four basic** categories

DEMOGRAPHY

- Urban population
- Population density
- Employment in services

USAGE

- Digital skills of the population
- Internet usage
- Mobile internet sales share
- Dominant e-commerce player

CULTURAL PAYMENT PREFERENCE

- Credit/debit card use
- Digital payments
- Online bill pay

INFRASTRUCTURE ACCESS

- Fixed broadband subscriptions in market
- Transport infrastructure
- Timeliness of shipments

SIX KEY E-COMMERCE PENETRATION DRIVERS

We identified **six factors** that **better explain** the different levels of e-commerce penetration among markets:

% OF URBAN POPULATION

MOBILE INTERNET SALES RATIO

DEBIT AND CREDIT CARD USE

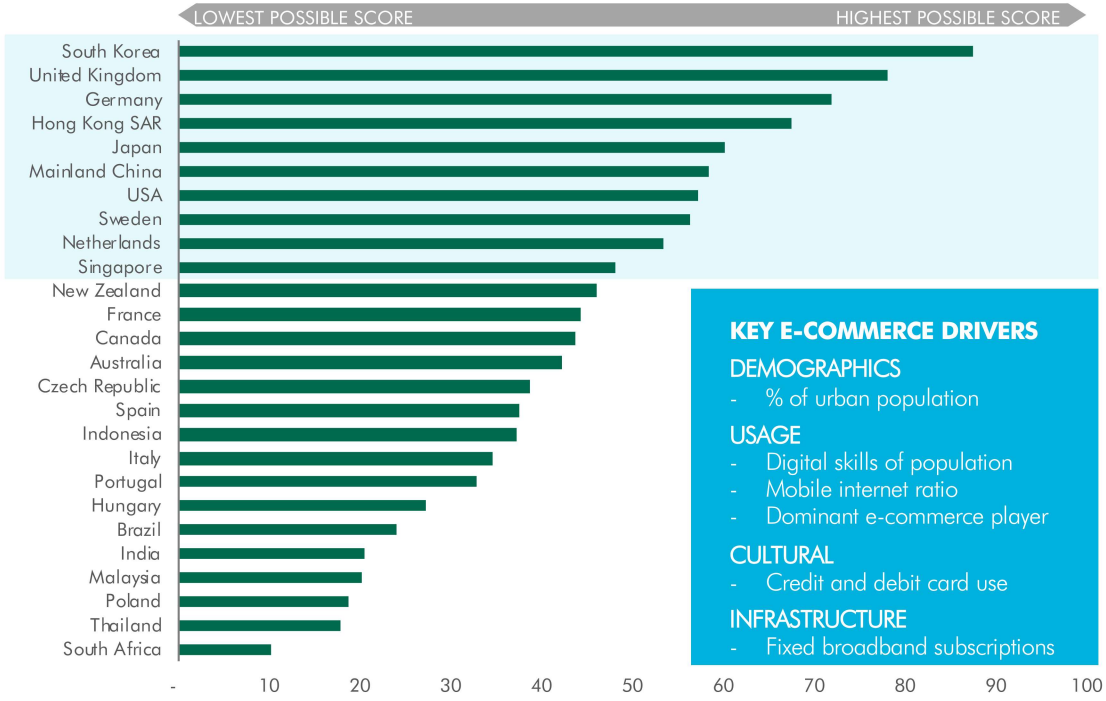
DIGITAL SKILLS OF POPULATION

DOMINANT E-COMMERCE PLAYER

FIXED BROADBAND SUBSCRIPTION / POPULATION

CBRE GLOBAL E-COMMERCE DRIVERS INDEX

We created an index that measures the strength of the presence of these six key e-commerce drivers in different markets.

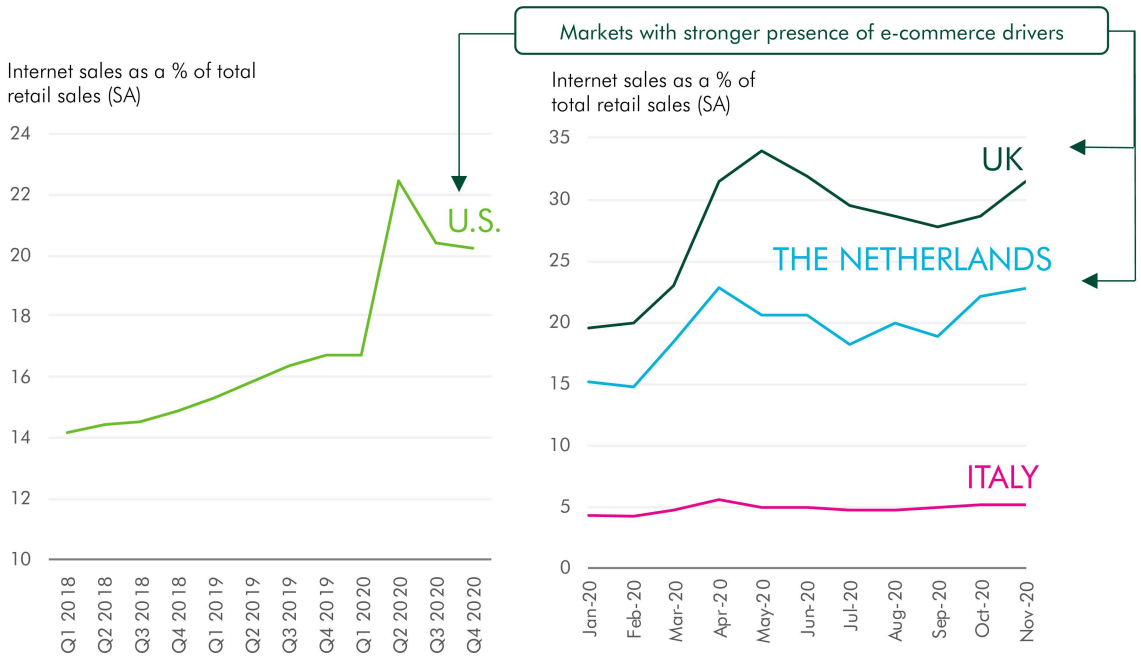


Source: CBRE Research.

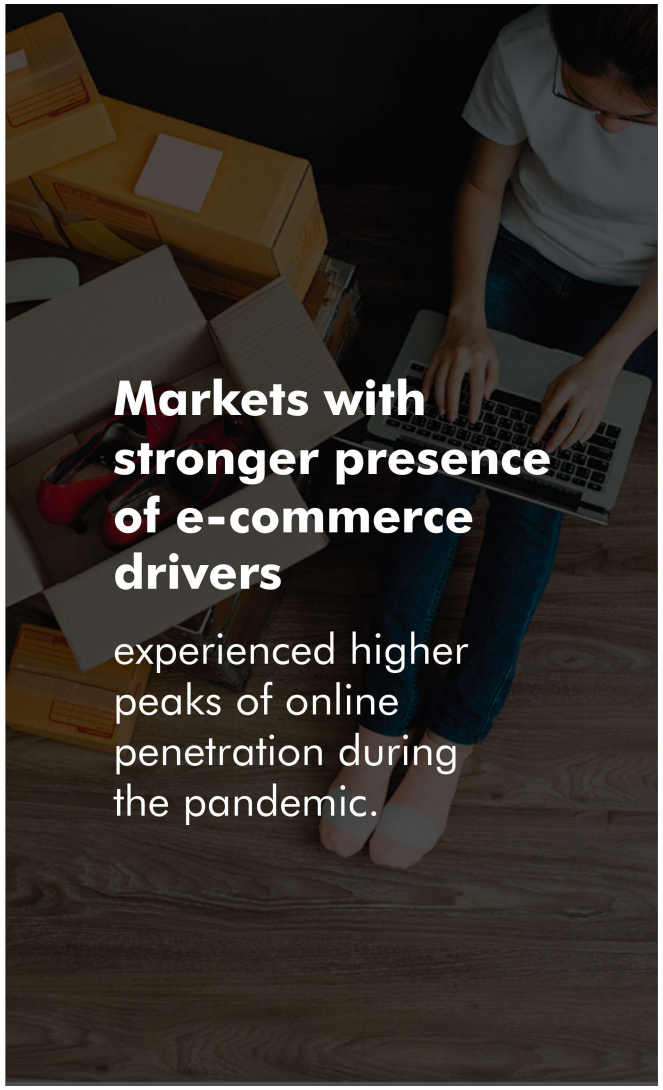
03 IMPACT OF COVID–19

INTERNET SALES HAVE INCREASED RAPIDLY DURING THE PANDEMIC WITH A LASTING EFFECT

EXAMPLES FROM THE U.S. AND EUROPE



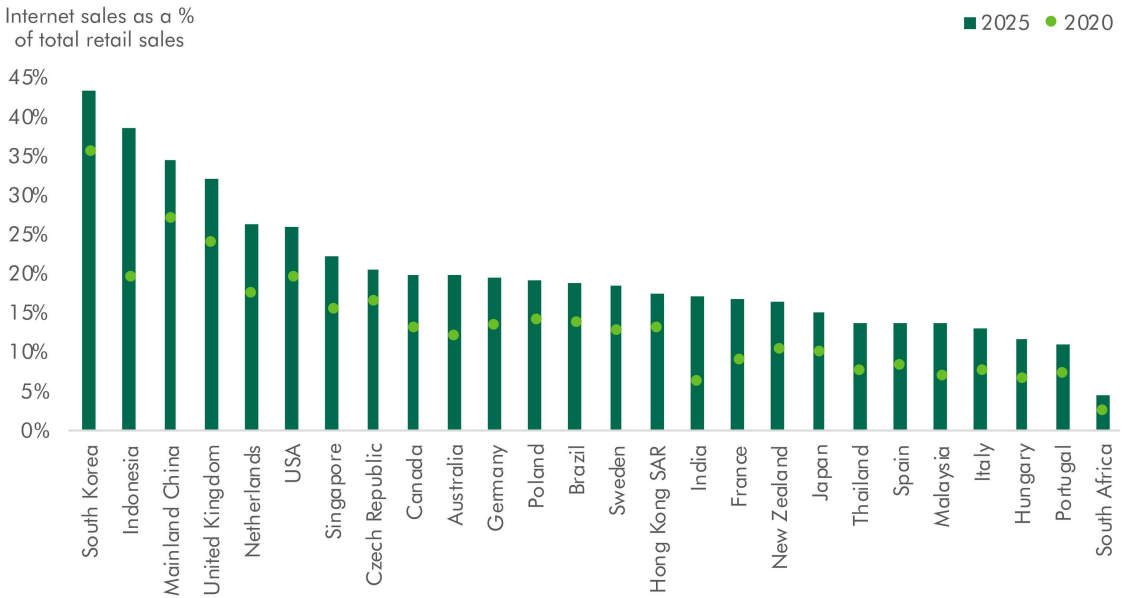
Source: Macrobond, Eurostat, US Census, CBRE Research.



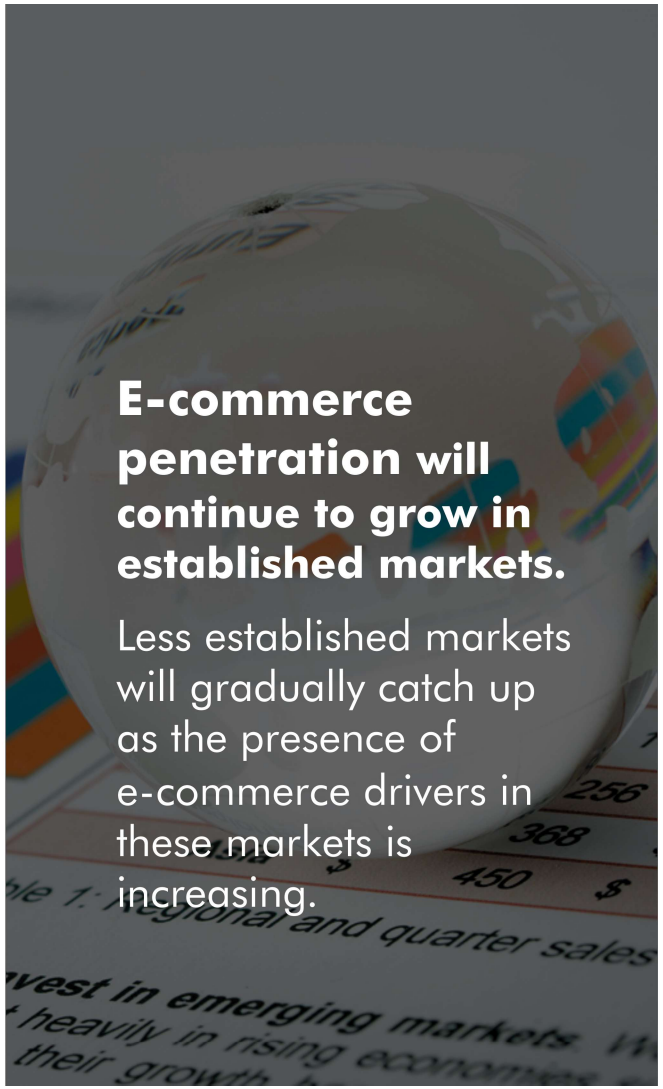
04 WILL E-COMMERCE CONTINUE TO GROW?

CBRE GLOBAL E-COMMERCE FORECAST

By predicting how the **six key e-commerce drivers** will evolve over time in different markets, we produced a forecast of **e-commerce penetration rate** per market.



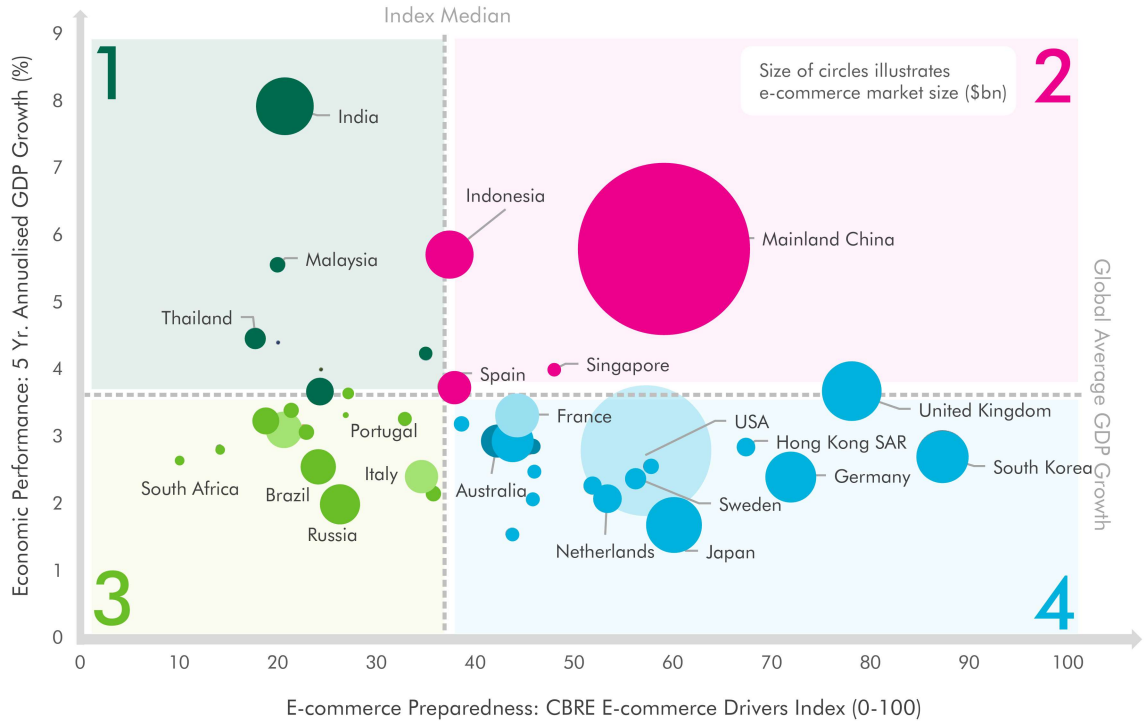
Source: Euromonitor, CBRE Research. We used data from Euromonitor for 2020 e-commerce activity in each country and a cross-sectional regression model to identify the variables that best explained cross-country differences in e-commerce penetration. To arrive at future values for the explanatory variables, we made some general convergence assumptions (lower scoring markets would converge on countries closer to their saturation values). Using these assumptions and the regression model, we predicted future e-commerce penetration rates for all markets. Final forecasts are a mixture of model-based projections and qualitative adjustments also based on feedback from local market teams.



05 IMPACT ON LOGISTICS PROPERTY

LOGISTICS PROPERTY SECTOR PERFORMANCE DRIVERS

Macroeconomic outlook and e-commerce preparedness driving logistics sector's performance and demand for space.



Source: Oxford Economics, CBRE Research, selection of markets illustrated. Size of the bubble illustrates the size of the e-commerce market ($bn).

QUADRANT 1

- Above global average economic growth supporting spend with lower levels of e-commerce penetration and presence of e-commerce drivers.
- Slower transition from traditional retail to e-commerce.
- Infrastructure supporting e-commerce less developed. Demand for logistics space lower but gradually increasing.

QUADRANT 2

- Above global average economic growth supporting consumption. Higher levels of e-commerce penetration and stronger presence of e-commerce drivers.
- Accelerated transition from traditional retail to e-commerce driving strong demand for logistics space.
- Stronger presence of established online retailers.

QUADRANT 3

- Below global average economic growth affecting consumption combined with lower levels of e-commerce penetration and presence of e-commerce drivers.
- Slower transition from traditional retail to e-commerce.
- Infrastructure supporting e-commerce less developed.
- Certain retailers acting as online market pioneers.

QUADRANT 4

- Below global average economic growth in an environment of high e-commerce penetration supported by strong presence of drivers.
- Accelerated transition from traditional retail to e-commerce driving strong demand for logistics space.
- Stronger presence of established online retailers.

LOGISTICS SPACE REQUIREMENTS GLOBAL FORECAST

ESTIMATED 5 YEAR SPACE REQUIREMENTS DUE TO THE GROWTH OF E-COMMERCE

GLOBAL

2020-25
Change

E-COMMERCE SALES

+$ 1.5 Trillion
- $3.9 Trillion in 2025
- $2.4 Trillion in 2020

LOGISTICS SPACE

Additional
138 million sq. m.
to support
e-commerce growth
over five years

Source: Euromonitor, CBRE Research. Aggregated estimates of the 43 markets included in the analysis. List of all markets included in the Appendix.
E-commerce sales forecast is based on our forecast of e-commerce penetration rate per different market, using 2020 data from Euromonitor as the base year.
Our calculation assumes an estimate of $1 billion of additional e-commerce sales requiring an additional 1million sq. ft. or 92,903 sq. m. of logistics space.

KEY POINTS

- E-commerce has rapidly grown globally over the past five years.
- Certain key factors including demography, usage, cultural and infrastructure factors are driving e-commerce growth.
- Due to COVID-19, internet sales in most markets rapidly increased in 2020 with a lasting effect.
- Markets with a stronger presence of e-commerce drivers experienced higher growth of e-commerce during the pandemic.
- E-commerce penetration will continue to grow in both established and non-established markets as the presence of e-commerce drivers gradually increases in all markets.
- Over the next five years globally, 138 million sq. m. of additional e-commerce-dedicated logistics space will be required to support the growth of internet sales worldwide.

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06 APPENDIX

APPENDIX: THE 43 MARKETS INCLUDED IN THE ANALYSIS

AMERICAS | APAC | EMEA

Australia
Austria
Belgium
Brazil
Canada
Croatia
Czech Republic
Denmark
Finland
France
Germany
Greece
Hong Kong SAR
Hungary
India
Indonesia
Ireland
Italy
Japan
Latvia
Lithuania
Malaysia
Mainland China
Mexico
The Netherlands
New Zealand
Norway
Poland
Portugal
Romania
Russia
Singapore
Slovakia
Slovenia
South Africa
South Korea
Spain
Sweden
Switzerland
Thailand
Turkey
United Kingdom
USA

Aviation Intelligence Unit
Think Paper #10 - 20 April 2021

EUROCONTROL

Flying the 'perfect green flight': How can we make every journey as environmentally friendly as possible?

European aviation has embarked on its most important trajectory for decades: the goal of achieving the ambitious target of carbon neutrality by 2050. The political will is there, with the European 'Green Deal' showing the way forward: the challenge is to make every journey as environmentally friendly as possible and aim to fly the 'perfect green flight'. This Think Paper takes the reader on a journey, looking at every aspect of a flight before, during and immediately after, to identify the main opportunities to improve aviation sustainability at each stage, the challenges that need to be tackled to get closer to that 'perfect green flight', and what we can do – now and in the medium term – to make that happen.

To identify where the greatest potential for improvement now and in the future lies, we ask:

- Why is it not always possible to fly a 'perfect green flight' today?
- Which measures have the greatest potential to improve the sustainability of aviation now, and in the future?
- What do we need to do to make every single flight greener?

The paper concludes that while various factors make flying 'perfect green flights' very complex, nevertheless a lot can be done now to make flights greener at every stage of a journey, and by every actor involved.

A perfect green flight in big numbers

- **25.8% less CO_2 emissions (4,286kg) per average wider-European area flight (16,632kg) by 2030 using current technology – a saving that will massively increase when emerging developments (electric, hydrogen or hybrid aeroplanes) enter into commercial service**
- **8%** of those reduced CO_2 emissions – **1,331 kg** – are based on **10%** Sustainable Aviation Fuel use – and more would yield even greater benefit
- **8.6-11.2%** of those reduced CO_2 emissions – up to **1,863 kg** – could be delivered by better use of fuel-efficient operational and technological solutions by all European ATM network stakeholders
- **7%** of those reduced CO_2 emissions – up to **1,164 kg** – can be provided by fleet modernisation now based on current types in service; this will increase as new, more fuel and emissions-efficient models are rolled out.

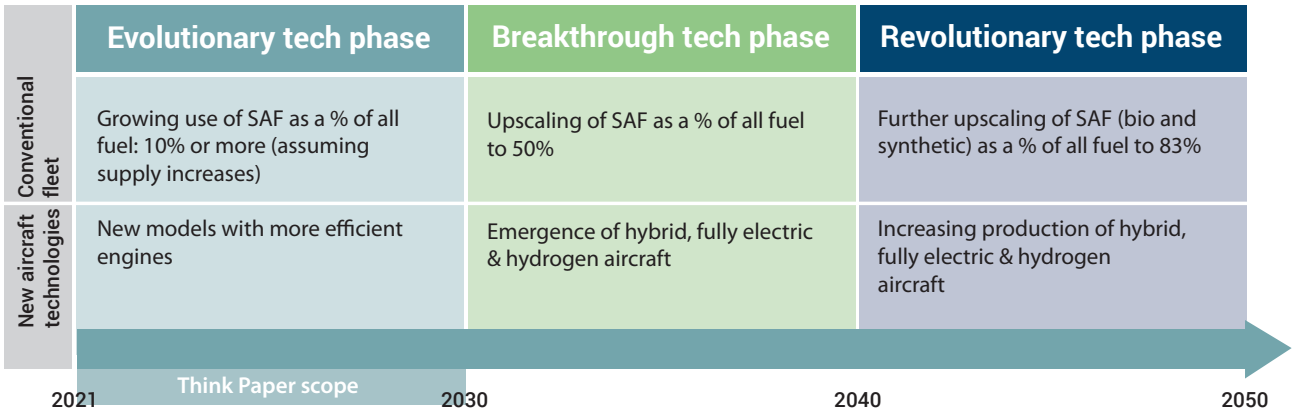
Main findings of this Think Paper

1. **A significant advance towards the "perfect green flight"** can be made by making better use of existing measures, and all actors working together: we estimate that per flight, **up to 4,286kg of CO_2 emissions (25.8%) could be eliminated by 2030 compared to 2019, out of an average 16,632kg of CO_2 for a total flight in the wider European area, and based on current technology.**

2. **Better use of fuel-efficient air traffic management improvements** could deliver 8.6%-11.2% (up to 1,863 kg) of those reduced CO_2 emissions per flight. To realise this benefits pool, accelerating the transition from SESAR R&D to deployment as well as improving the functioning and performance of the network to the greatest extent are crucial. This will require a network-centric cooperative decision-making (CDM) process with all network actors, as set out in the proposed recast Single European Sky (SES) package.

3. **Emerging aircraft technologies in the form of hybrid, fully-electric and hydrogen airplanes will transform aviation over the period 2030-2050, enabling aviation to meet its climate-neutrality goal by 2050. By 2050, these new airplanes will be increasingly prevalent on short to medium haul sectors**; while SAF use will predominate in the long-haul sector, with further upscaling of SAF production seeing 83% of fuel used being SAF, irrespective of any further technological developments.

FIGURE 1: AIRCRAFT TECHNOLOGIES & ENERGY TIMELINE 2021-2050



Source: EUROCONTROL

4. **Sustainable aviation fuel (SAF) is the most promising measure towards aviation decarbonisation right now.** 10% use of SAF by 2030 would deliver 1,331 kg or 8% in CO_2 saving – but today, use stands at just 0.1%. To hit this target, investment in SAF must be ramped up now, and a firm policy support target set incentivising its use. This would accelerate SAF uptake, leading to higher demand and a faster decarbonisation of aviation – permitting **more ambitious target setting** in the future. 20% SAF use by 2030 would represent a colossal challenge to meet – but would potentially deliver up to 16% in CO_2 saving per flight.

5. **Airlines can play a significant role in reducing CO_2 emissions, but greater incentives may be needed to balance economic considerations:**
   - modernising their current fleets to remove less efficient aircraft older than 15 years – which would save 7% or 1,164 kg in emissions; here, the pandemic has prompted an acceleration in fleet renewal, with many older aircraft types unlikely to return;
   - reducing 'economic fuel tankering', whereby aircraft carry more fuel than they need to reduce or avoid refuelling at their destination airport; this could save a further 89 kg or 0.54% of emissions;
   - working with airports to use Ground Power Units rather than aircraft Auxiliary Power Units on the ground, saving 0.3% or 50 kg;
   - optimising the fuel efficiency of their existing fleets, building on a massive 25% improvement over the last 15 years that has seen aviation prove more fuel efficient than cars at 3 to 4 litres per passenger 100km.

6. **More attention needs to be paid to noise and non-CO2 impacts,** such as contrail avoidance.

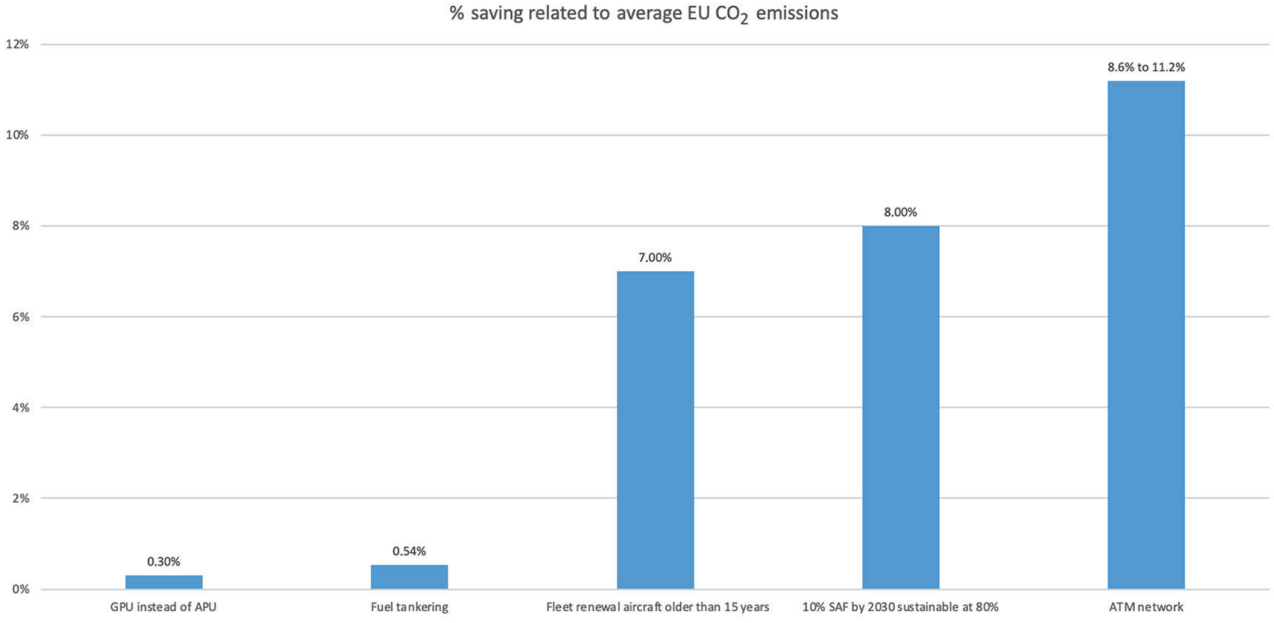
How much potential is there to 'green' every flight already?

Figure 2 summarises the potential savings in terms of CO_2 emissions that could be avoided on average per flight across the wider European (ECAC – European Civil Aviation Conference, 44 States including all 41 EUROCONTROL Member States) area by 2030. It shows that, by using a combination of existing measures more consistently, and without factoring in major technological leaps (e.g. hybrid/fully electric or hybrid/fully hydrogen-powered aircraft), a lot can already be done collectively to reduce CO_2 and non-CO_2 emissions from aviation using current technology.

We estimate that by 2030, up to 4,286kg of CO_2 emissions (25.8%) could be eliminated per flight compared to 2019 out of an average 16,632kg of CO_2 for a total flight in the ECAC area – a significant advance towards the "perfect green flight". And this potential saving is purely based on current aircraft technology: these reductions will massively increase when emerging developments (electric, hydrogen or hybrid aeroplanes) enter into commercial service.

The two most short-term promising fuel/CO_2 savings accelerators are air traffic management improvements including further use of the currently implemented continuous climb and descent operations (CCO/CDO), and Free Route Airspace (FRA), where air navigation service providers (ANSPs), airlines, airports, flight plan service providers and the EUROCONTROL Network Manager have a key role to play (from 8.6% up to 11.2%), and sustainable aviation

FIGURE 2: POTENTIAL CO_2 SAVINGS THAT COULD BE REALISED, KG/FLIGHT ACROSS THE WIDER EUROPEAN AREA



Source: EUROCONTROL

***Note:** Due to interdependencies, the sum of benefits does not always add up.*

fuel (SAF), which could deliver a 8% reduction in emissions based on just 10% use by 2030; this would however increase significantly if SAF were to become more widely used. The proposed recast SES package is central to the faster and wider adoption of these and other emerging solutions.

Next comes the renewal of the airline fleet, with the retirement of older, less fuel-efficient aircraft (over 15 years old) in favour of new, more fuel-efficient models, resulting in savings of **1,164 kg** of CO_2 emissions (7%).

Additional measures that also play their part in reducing CO_2 emissions are tackling the economic-environmental trade-off in "fuel tankering", whereby aircraft often carry more fuel than is needed on economic grounds generating on average 89kg of additional fuel burn (**0.54%** of CO_2 per flight); and the use of Ground Power Units rather than aircraft Auxiliary Power Units at airports (**0.3%** or **50 kg**).

The rest of this paper looks at each aspect of a flight to identify what measures are already partially or fully in place, and what their potential is to decrease emissions.

The initial findings of this paper will be tested, further harmonised and quantified by EUROCONTROL and partners in the ALBATROSS project,[1] which aims to quantify the benefits of "perfect green flights". A 2-year study launched by the SESAR Joint Undertaking under the EU's Horizon 2020 Research and Innovation programme, ALBATROSS will explore in real conditions the feasibility of implementing the most fuel/CO_2 efficient flights possible by conducting a series of live trials across Europe.

What additional decarbonisation potential will new aircraft technology bring?

The projected emissions savings outlined in this paper are based on existing technology, but we expect the picture to change significantly over the following 20 years up to 2050. New aircraft technologies are expected to accelerate progress and ensure that aviation meets the goal of climate-neutrality by 2050, as per the timeline (Figure 1) on the cover page. Nevertheless, the savings solutions proposed in this paper will still have a significant role to play in the near future in helping aviation decarbonise.

Between 2021 and 2030 only evolutionary technical developments are expected for commercial aviation, although the first hybrid-electric aircraft should be close to market introduction. Further efficiencies will be delivered by enhancements to existing aircraft models, but clearly increased SAF usage remains the most promising and realistic short-term solution for decarbonising aviation. Aircraft are already authorised to fly using 50% SAF, and certification to 100% SAF is expected in the coming years; however, the availability of SAF remains the main constraint in the short term, as this paper underlines with its assumption that SAF could account for 10% or more of all fuel used by 2030.

The picture is set to change significantly in the decade up to 2040, when we expect breakthrough developments via the progressive introduction of hybrid, fully-electric and hydrogen aircraft in the short to medium-haul segments. We expect SAF production to have ramped up, providing 50% of all fuel used by conventional airplanes, with particular relevance for the long-haul segment.

The phase 2041-2050 is what we term the "revolutionary tech phase", with hybrid, fully-electric and hydrogen aircraft predominating in the short to medium-haul segments. In the long-haul sector, further upscaling of SAF (bio and synthetic) production should reach up to 83% of fuel used, irrespective of any technological developments, as predicted in the Destination 2050 report.

Pre-flight: Airlines' business choices are crucial

Airlines need to embed environmental efficiency in their values and operating procedures. Fuel conservation and thus CO_2 reduction should be a priority objective. Every airline should have an ongoing fleet modernisation programme, replacing older models with newer, less fuel-consuming and quieter models, alongside a fuel conservation policy.

Aircraft performance degrades over the airframe lifecycle, requiring a strict fleet maintenance programme[2]. Airbus data indicate that as airframes and engines age, aerodynamic and performance deterioration tends to increase fuel burn and emissions, increasing the drag of an aircraft by up to 2% over 5 years[3]. Airlines should assign aircraft to city-pairs according to the most efficient fuel conservation and load factors.

By analysing the distance flown, fuel consumption, and ageing degradation of engines and airframe of a sample of more than 23,000 aircraft in service in 2019, we find that replacing them with more modern aircraft models would save about 7% of current CO_2 emissions based on replacing aircraft older than 15 years with new models; here, the pandemic has already triggered this. Furthermore, fleet renewal has an additional advantage of helping stabilise average noise levels at today's major airports by 2030. This 7% fleet renewal will provide an additional decarbonisation boost to aviation, complementing natural fleet renewal and fuel efficiency improvements. Here, it is essential to underline that this saving assumes fleet renewal based on current technology, whereas over

the next years, ever more fuel and emissions-efficient types will enter into service such as electric, hydrogen and hybrid aircraft.

Airlines should also consider setting up robust flight emissions offsetting programmes, as some major European airlines are already starting to do.

Pre-flight: Passenger choices have an impact

Passengers have their own role to play in greening flights, from how they travel to the airport, to potentially which carrier they use, and in some cases which airport they decide to fly from. Having more accurate, up-to-date information on the environmental performance of aviation, and airlines in particular, would enable passengers to factor this into flight selection, encouraging airlines to develop stronger, more ambitious policies on these issues. The "Environmental Labelling Scheme" that EASA, the European Union Aviation Safety Agency, is committed to developing with Member States, industry and non-governmental organisations should certainly help in this respect.[4]

The passenger's environmental responsibility goes further. Among other things, s/he can select the greenest means of transport to and from airports, travel light, select the class of seat with the lowest environmental share (this however may depend on business choices made by airlines for that specific city-pair: an economy seat has half the environmental impact of a premium seat, 4 times less than a business seat, and 8 times less than a first class seat), or offset his/her own share of the flight climate impact, when the airline does not have a compensation system already in place.

Passengers may not always be able to choose their departure/arrival airports, but where they can, they **should be attentive to their environmental performance.** Significant advances have been made by many European airports: 52 already qualify as carbon-neutral as reported by ACI through its Airport Carbon Accreditation system, and many more are engaged in reducing their environmental footprint. The latest independently verified carbon reduction (2018-2019) achieved by European airports in the Airport Carbon Accreditation programme is 133,621 tonnes of CO_2 – a 7% decrease in emissions under their direct control.[5]

Pre-flight planning: Significant scope for reduced fuel and emissions

Considerable progress has been made by airport operators (AOs), ANSPs and the EUROCONTROL Network Manager (NM) to improve the safe flow of air traffic in all phases of flight, balancing demand and capacity, improving demand accuracy and predictability management, enhancing capacity or congestion management, increasing information exchange, all enabled by cooperative decision-making (CDM).

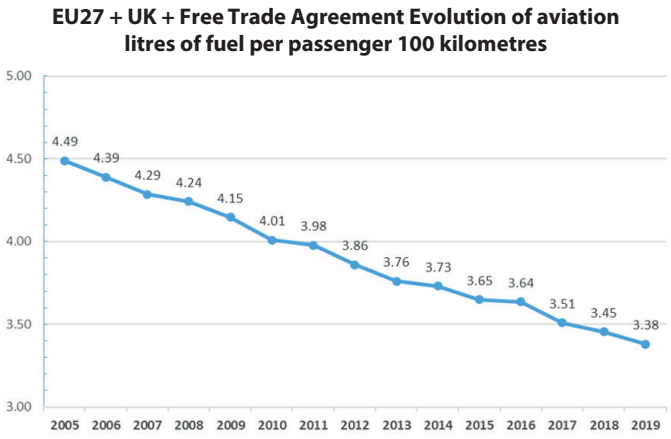
Some airlines already share data with ANSPs and the EUROCONTROL NM to help them optimise their operations. This improves traffic capacity management, increases fuel conservation and lowers the environmental impact in terms of noise and fuel/emissions reductions. This should increase to maximise the potential benefits to aviation.

In a recent fuel efficiency study[6] EUROCONTROL estimated the **fuel inefficiency of the ATM network in 2019 to be between 8.6% and 11.2% from take-off to landing** for flights within Europe.

Carrying unnecessary extra weight increases the quantity of fuel burned in flight, as an ICAO study[7] emphasises: *"The extra fuel burn attributable to additional weight carried on board an aircraft is typically of the order of 2.5 to 4.5 per cent of the additional weight, per hour of flight, depending on the characteristics of the aircraft. For example, 500 kg of extra weight for a ten-hour flight could result in the additional consumption of 125 to 225 kg of fuel and an increase in CO_2 emissions of 390 to 710 kg."* Therefore, it is of the utmost importance to minimise non-essential items on-board, such as paper, water, cups, waste, etc., and ensure necessary items are as light as possible.

Given the above efficiency gains, the payload of each flight (passengers plus cargo) should be maximised to optimise the **fuel-per-passenger ratio, which has steadily improved over the last 15 years** as per Figure 3. **Aviation is now more fuel efficient than cars at 3 to 4 litres per passenger 100km**, reflecting a massive

FIGURE 3: EVOLUTION OF AVIATION LITRES OF FUEL PER PASSENGER 100 KMs



Source: EUROCONTROL

FIGURE 4: NET SAVINGS DUE TO TANKERING VS. EXTRA CO_2 EMITTED

	Extra fuel burnt (tonnes/year)	Cost to transport extra fuel (M€/year)	Extra CO_2 emitted (tonnes/year)	Cost of purchasing CO_2 allowances (M€/year)	Net saving = Tankering saving - [Extra fuel + CO_2 cost] (M€/year)
Full tankering	160,000	88	504,000	10	217
Partial tankering	126,000	69	397,000	8	48
Total tankering	**286,000**	**157**	**901,000**	**18**	**265**

Source: EUROCONTROL Think Paper #1

25% improvement by airlines since 2005. This reflects steadily improving passenger load factors, which pre-pandemic stood at 82.5%[8],rising up to 97% for low-cost airlines.[9]

The fuel needed for a flight depends on the final payload; therefore, refuelling processes should end up close to final load-sheet delivery, in order to minimise any unnecessary additional fuel to be loaded and avoid CO_2 emissions.

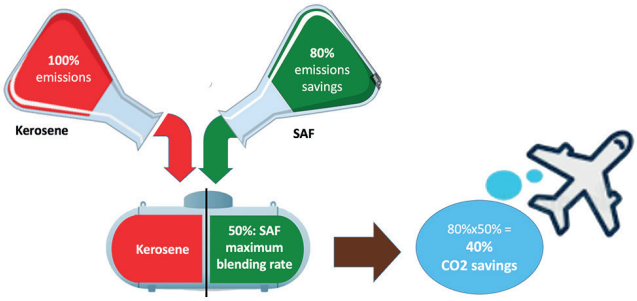
Incentives will need to be put in place to encourage airlines not to practise economic fuel tankering, whereby aircraft carry more fuel than they need for their flight in order to reduce or avoid refuelling at their destination airport, when the negotiated fuel price and the cost of fuel services at the departure airport are significantly lower than at the destination airport.

In 2018, as per Figure 4, we estimated that 21% of short and medium-haul flights in Europe were performing fuel tankering, representing a net saving of **265M€** per year to the airlines, but burning **286,000** tonnes of additional fuel burnt (equivalent to **0.54%** of the whole jet fuel used in Europe), or **901,000** tonnes of CO_2 per year (see EUROCONTROL Think Paper #1 for more details). [10]

The most important recent development on the aviation sustainability front is sustainable aviation fuel (SAF). Continuing to burn 100% fossil fuels on every flight should be avoided by replacing part of the standard fossil jet fuel used in aircraft by a sustainably-produced alternative fuel whose carbon impact is reduced by up to 80% over its lifecycle. [11, 12]

For now, SAFs are only certified to account for a maximum of 50% of an aircraft's fuel load[13], although trials are underway to demonstrate that it is already possible and safe to power cargo and commercial flights with 100% SAFs, in the hope of speeding up certification[14]. Therefore, based on a 50% blend, **SAF has the potential to reduce CO_2 emissions from aviation by up to 40%, as Figure 5 shows.**

FIGURE 5: SAF EMISSIONS SAVINGS



Recent "perfect green flight"[15] trials by Braathens,[16] DHL,[17] and KLM[18] show that collaboration between all parties is crucial to achieve maximum savings and substantially reduce CO_2 emissions, by around 46% for the regional flight trial in Sweden compared to standard regional jets. While difficult to draw conclusions in terms of maximum possible fuel savings, these trials clearly show that combining existing operational improvements with fuel-efficient aircraft can deliver real savings. However, they also show that the level of readiness for sustainable SAF is not yet satisfactory.

Using SAF as much as possible would be a considerable step forward towards aviation sustainability and is probably the technical solution that could be deployed most rapidly without modifications to existing systems and aircraft.

However, today SAF accounts for **less than 0.1%** of the roughly 300 million tonnes of EU aviation fuel consumption.[19] **It is vital to ramp up SAF production, and availability at major airport hubs, to reduce the cost of SAFs, currently 3 times higher than fossil jet-A1 fuel, and to incentivise their adoption.** The Destination 2050 report[20] estimates that, with proper incentives, 6% of fuel used could be SAFs by 2030; IEA's Sustainable Development Scenario[21] anticipates around 10% in 2030 and 19% in 2040; while some countries such as Norway and Finland are already targeting up to 30% of SAF by 2030.[22]

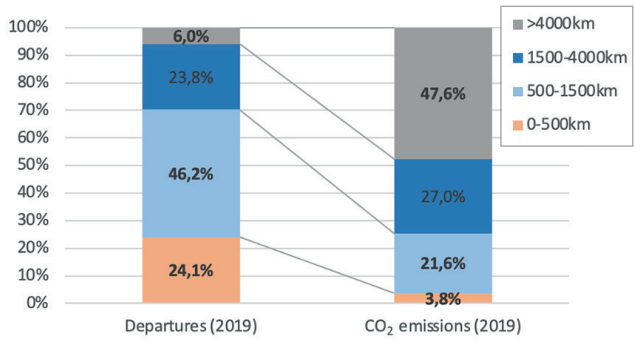
A firm policy support target of 10% SAF by 2030 could lead to higher demand than initially expected and a faster decarbonisation of aviation. This would accelerate SAF uptake, leading to higher demand and speeding up aviation decarbonisation – permitting **more ambitious target setting** in the future. 20% SAF use by 2030 would represent a colossal challenge to meet – but would potentially deliver **16%** in CO_2 saving per flight, leading, with the other measures proposed, to **34%** in CO_2 emissions savings per flight (**5,617kg** of CO_2).

SAFs can also improve aircraft fuel efficiency by 1-3% and can reduce SOx and particulate matter (PM) emissions by 100% and 90% respectively, according to SAF producer SKyNRG,[23] reducing the likelihood of contrail formation.

Rather than flying only the most economically beneficial route, AOs and ATM should also consider the most environmentally friendly route and cruising flight levels, taking into account weather conditions, air traffic constraints but also the possibilities offered by dynamic ATM (such as FUA, the Flexible Use of Airspace, which permits military airspace to be crossed by civil aircraft when not in use).[24] This means balancing delays, fuel burn and route charges.

SAF is also fundamental to reducing long-haul flight (>4,000km) emissions, which account for the bulk of flights in the wider European area, as Figure 6 shows.

FIGURE 6: % OF FLIGHT VERSUS CO_2 EMISSIONS IN 2019



Departures: Scope for improvement

From leaving the gate to taxiing onto the runway, there are a series of measures that could be optimised to make every flight greener.

The first is with passengers. Non-transit passengers arriving late to the gate cause small delays that may add complexity to managing departures. Airlines that opt to speed up en-route flight to compensate for delays and missed slots increase fuel burn and thus emissions.

The second is shared by airlines and airports. Moving an aircraft using its own auxiliary power unit (APU) burns more fuel in most cases than using a mobile GPU (ground power unit) for that purpose. This is non-negligible: according to United Continental,[25] APUs use **150 to 400+ kg** of fuel per hour, while GPUs provided by the airport use less than **20 kg** of fuel per hour. It is estimated that **0.3%** fuel savings could be realised (Destination 2050). APUs also generate more noise, more pollution, and increase aircraft maintenance costs.

The third lies with air traffic control (ATC). Each minute taxiing with engine on burns 3 to 10kg of fuel,[26] so ATC should prioritise minimising ground delays for aircraft with engines already running and facilitate engine-off taxi solutions. Some ATC and airport processes significantly influence the performance of the aircraft from the very beginning of the flight. From best practices for stand allocation, the use of Fixed Electrical Ground Power and Pre-Conditioned Air, to the flexible use of taxiways to minimise taxi time, the use of A-CDM[27] to avoid long queues at the holding points, to the optimisation of runway throughput to avoid delays. When A-CDM was implemented at 17 airports in Europe, over 102,700 tonnes of CO_2 per annum was saved, on top of over 2.2 million minutes of taxiing time and €26.7 million in fuel.[28]

The fourth is using at airports semi or fully electrical aircraft towing systems. These can be hooked or mounted onto the front wheel of the aircraft and used to tow the aircraft between the gate and the runway. This brings immediate environmental benefits: **delaying engine start-up can reduce fuel consumption during taxiing by 50-85%**.[29] Where this is not possible for logistical reasons, where airports have limited manoeuvring areas or budgets, and only when safety permits, "reduced engine taxi" is the best option for reducing fuel burn and noise.

Finally, ATC may be able to grant access to use a runway that minimises flight time, where local current conditions permit, as well as optimising the taxi route from stand to runway.

Take-off: Optimising Continuous Climb Operations can make a significant contribution to emissions

The take-off phase offers a number of potential improvements that can be followed by air traffic controllers (ATCOs) and airlines, of which CCO – Continuous Climb Operations – brings the most important environmental benefit.

ATCOs should, as far as possible, clear flights to climb, avoid unnecessary level-offs and permit CCOs which are more fuel-efficient. A 2018 EUROCONTROL study showed that optimising

the climb and descent (CCO and CDO) phases could deliver fuel savings of up to **350,000 tonnes** per year for airlines. This corresponds to over **a million tonnes of CO_2** and **€150 million in fuel costs**. Another EUROCONTROL study carried out during COVID-19 has shown that the average time in level during descent has been reduced by 33%, suggesting that a 30% CDO target could be reasonable once traffic returns to normal.[30]

Fuel saving measures implemented during the departure, take-off, landing and arrival phases also minimise aviation's impact on local air pollution resulting from the emission of several non-CO_2 species.

Rolling take-offs save fuel, so ATCOs should try to seamlessly deliver take-off clearances to avoid aircraft stopping on the runway. Using the shortest departure route (SID) also minimises track miles flown.

In this flight phase, it is necessary to find the right trade-off between **noise impact** and fuel/emissions savings. As long as noise limits are not exceeded, the crew should be able to choose the best Noise Abatement Departure Procedure (NADP) to fly according to the aircraft, weight and weather conditions of the day. NADP 2 will save fuel while not significantly increasing noise in some sensitive areas. NADP 1 reduces noise for areas close to the departure end of the runway by delaying the acceleration climb speed until 3,000 feet is reached. For example, Boeing claims[31] that the fuel saved by flying a NADP2 procedure vs a NADP1 procedure is 67 kg , about 1%, on a Boeing 737-800 with winglets, and 197 kg on a Boeing 777-200ER, about 0.3%.

Ideally, flights should take off in optimum configuration using minimum flaps to save fuel, while following a balanced approach to avoid increasing the level of noise over the sensitive areas that may surround an airport. Reduced flap take-off improves fuel consumption by reducing drag, for example saving between 10kg (737-800wl) and 70kg (747-400) on take-off according to Boeing.[32]

En-route: the flight phase with the greatest impact on fuel consumption/CO_2

Cruising is typically the longest flight phase and has the greatest impact on fuel consumption/CO_2. Here, there are **a number of measures that can be taken to make flights greener.**

It is a common misconception that aircraft could always fly the most direct route between two airports, minimising fuel consumption by following an optimised flight profile, with unrestricted climb, fuel-efficient airspeeds, optimum cruise levels, uninterrupted descent profiles, and so on. In reality, other factors intrude, such as economic considerations, weather and safety considerations (aircraft have to take off and land with a headwind, as well as en-route weather considerations). There may be a lack of airport infrastructure or airspace capacity constraints (whether on holiday or on business trips, everyone wants to leave at the same time). Airspace fragmentation reduces efficiency; not all aircraft have equally modern equipment; air traffic in en-route areas and especially in the terminal manoeuvring areas (TMAs) close to airports may be complex, and military zones may need to be avoided, increasing flight time and fuel consumption.

There is also the natural complexity of a European network that, pre-COVID, saw on average 25-35,000 flights every day, with the all-time record of 37,228 flights set on 3 July 2019 – creating bottlenecks that often require re-routings to ease capacity constraints.

Nevertheless, there are a series of improvements that can be made. On-board systems like the Flight Management System (FMS) ensure that the crew can aim to **fly using the optimum values of speed and cruise level**. FMS's should be updated with the latest wind and atmospheric condition information, and the crew should fly at a speed corresponding to the best Specific Range (maximising the distance flown for a given amount of fuel), on minimal drag configuration whenever possible, and strive to maintain an optimum altitude.

In defining an optimal trajectory, ATC can help by offering a **better optimisation of the 4D trajectory** (horizontally and vertically) and **minimising the adoption of hard ATM constraints** such as permanent RAD restrictions[33] that affect the AOs. Where there is an unavoidable need to set such hard constraints, consideration should be taken to apply more flexible solutions such as dynamic RAD constraints that can be lifted depending on the traffic situation. Flying the 4D commercial trajectory selected also ensures optimal capacity management for the network as a whole. It is important to note that the greenest option is not

always the most direct route: flights can be planned using wind-assisted routes, and a direct route would move the aircraft away from these benefits.

Key to efficient capacity management is **Free Route Airspace** (FRA), including cross-border FRA. Since its introduction in 2014, FRA is estimated to have saved airlines more than **2.6 million tonnes** of CO_2, around 0.5% of total aviation emissions.[34] FRA projects are now in place across 3/4 of European airspace, bringing the region's flight efficiency targets within grasp. EUROCONTROL estimates that accelerating the use of FRA, particularly in the core area of Europe, could lead to huge emissions savings, cutting fuel burned by **3,000 tonnes of fuel/day**, and reducing CO_2 by **10,000 tonnes/day**, resulting in more efficient routings of up to **500,000 nautical miles** and **€3 million** less in fuel costs.[35] FRA helps overcome efficiency, capacity and environmental challenges by helping reduce fuel consumption and emissions, while improving flight efficiency. At the same time, it paves the way for further enhanced airspace design and ATM operational concepts.

FIGURE 7: AO CONSIDERATIONS ON THE WARSAW (EPWA)-ROME (LIRF) ROUTE

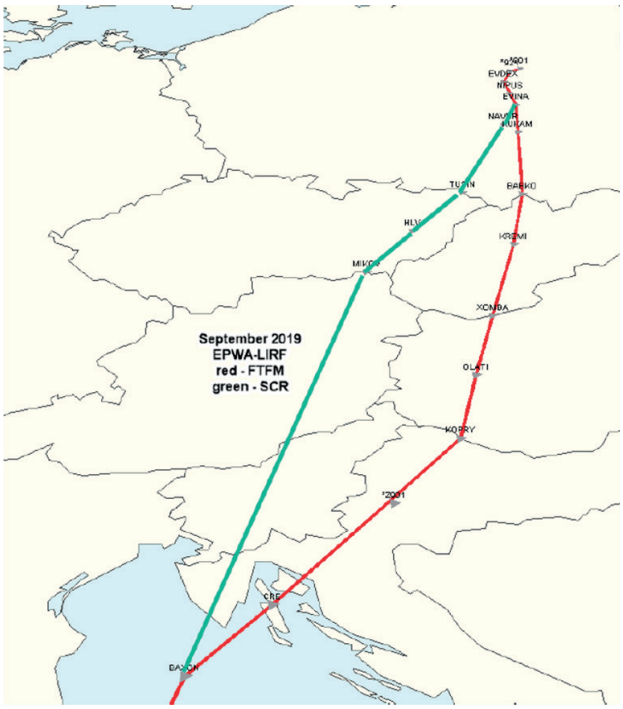
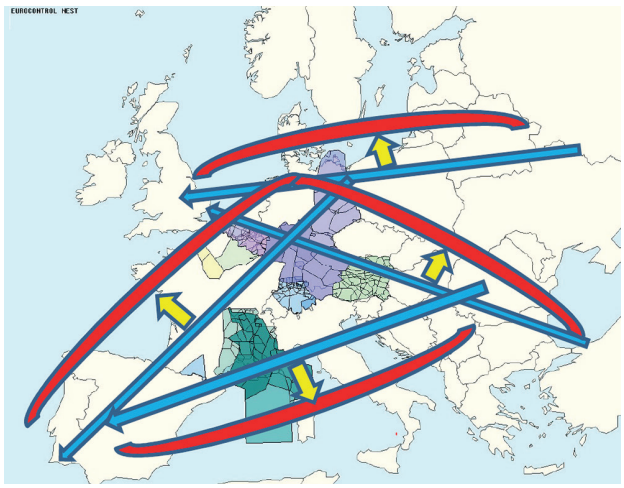


FIGURE 8: eNM SHIFTING OF TRAFFIC FLOWS TO OFFLOAD CONGESTED ACCs



In many cases, ATC could also facilitate a "more" optimum trajectory by **allowing the available capabilities of the aircraft to play a role.** For example, only the aircraft's FMS will be aware of the optimum 'top of descent' point, which can be downloaded to ATC by datalink. This will avoid the need for inefficient early descents, and is currently being researched by SESAR.

A new and promising area of research into making flying greener is **contrail avoidance**. Depending on ambient atmospheric conditions, in particular under low temperatures and when the air is moist enough, flight contrails can evolve into contrail-cirrus clouds. **Recent scientific publications attribute more than 50% of aviation's contribution to global climate change to non-CO_2 emissions, with the biggest factor being contrail and contrail-induced cirrus clouds.**[36] It is foreseen that ATCOs could implement avoidance measures especially when the additional fuel burn and the corresponding CO_2 emissions remain within acceptable limits. Live trials are underway at EUROCONTROL MUAC to assess the reliability of detecting these areas.

However, there are also a number of factors that make it more difficult for aircraft to fly as 'greenly' as possible. Financial considerations can lead airlines to deviate from the shortest constrained route (SCR), as Figure 7 shows, when a less direct route (in red) is cheaper to fly due to cheaper airspace route charges. In the example, the SCR route (in green) would have shaved off 15 nautical miles and 115kg less fuel (3.6%) compared to the less direct route flown – but the flight planned, which was actually flown, cost €109 less.

Capacity and scalability issues across the network also pose problems for delivering greener flights. Pre-pandemic, capacity had become an increasing issue, leading the EUROCONTROL NM to ramp up cooperation with all partners to find solutions. Summer 2019 saw the eNM/S19 initiative (Enhanced NM/ANSP Network Measures for summer 2019), which deployed a number of capacity-enhancing

measures, shifting traffic flows to offload congested ACCs as per Figure 8[37]. Reroutings or level caps to alleviate constrained area control centres, or tactical measures, such as to reduce the impact of unexpected bad weather, all reduced en-route delay by around 12% between 2018 and October 2019 across the European network, increasing predictability and punctuality. Without the eNM measures, en-route delay per flight in summer 2019 could have reached twice the level of 2018 – but at the same time, saw an additional tonnes 16,000 of CO_2 emissions[38], with an impact on fuel burn on the city pairs affected by the RAD measures since the start of the summer.

Here, the recast SES package, which includes the idea of mechanisms to modulate route charges at Union-wide level as a means of improving environmental performance, will clearly support improvements in environmental performance and incentivise greener flights.

Another constraint to flying 'greener' is that airlines may also choose to burn fuel faster by speeding up to make up for accumulated delays before take-off, unless they have a clearly defined policy.

New ideas could also help make flights greener. In Oceanic airspace, having two aircraft flying in formation envisaged in Airbus' innovative **Fello'Fly project** is a promising concept from Airbus that **could save between 5 to 10% of fuel for the rear flight of each pair of flights.**[39]

Terminal Manoeuvre Area (TMA) – a potential source of significant environmental improvements

The **TMA**, which is at the convergence of arrival and departure flows, **may be a source of significant flight inefficiencies,** particularly in dense and complex TMAs serving one or more large airports, where traffic flows have to be strategically separated to ensure the highest possible level of safety. This may also be the case for TMAs subject to many airspace and environmental constraints, typically when located within the "core" European airspace. A 2015 NATS study[40] showed that **80% of remaining inefficiencies are within 40 nm of airports.** A current EUROCONTROL study indicates that in the TMAs of Europe's 27 major airports, excess flight time exceeds **33k hours** in 2019.

Another source of inefficiency arises from the need to optimise ground infrastructure, in particular runways. For airports with high traffic demand, runway capacity may constitute the main bottleneck, and in some cases, operations have been developed over years to ensure maximum pressure is guaranteed, and avoid losing any slots (e.g. arrival aircraft holding).

In the 1990s the introduction of performance-based navigation (PBN) enabled more efficient design of the route structure in the TMA, facilitating shorter routes, segregation of flows, and avoiding densely populated areas. Arrival managers (AMAN and recently extended AMAN) help ATC to meter arrival traffic by speed adjustments in upstream sectors prior to entering the TMA, which significantly reduces extra transit time and holding. ATC should facilitate CDO thanks to S-shape vectoring with distance-to-go or point merge, to optimise vertical profiles and avoid long level-offs at low altitudes. As with the cruise segment, the crew needs to have the information available to update FMS calculations to have a better chance to land on the shortest arrival procedure (STAR); implement a CDO, with a potential 10% fuel saving and 40% noise reduction; and land on the optimal runway with minimum flap configuration,[41] if landing distance permits. Reverse thrust should be limited to safety cases.

New initiatives continue to improve the situation. "Dynamic TMA" enables an agile adaptation to variation in traffic demand by activating the appropriate set of route structure designed for a given level of traffic. The systematic use of target time at metering points and on arrival also reduces extra time in the TMA, involving the flight crew more actively. Other possible trade-offs between maximising runway pressure and minimising flight inefficiency can also be explored.

Landing – room for more efficiency

More efficient taxi-in during ground operations means, as for departures, minimising the use of engine thrust and brakes, choosing the shortest route, using reduced engine taxi techniques such as using a single engine on arrival, delaying the start of the APU, and shutting it off as soon as possible. Stand allocation, Arrival Manager, A-CDM and green airport processes can also reduce emissions in this final flight phase.

Conclusion

Raising awareness on sustainability is essential at all levels and involves all actors combining forces. At EUROCONTROL, we actively promote sustainability solutions, helping actors reduce noise, CO_2 and non-CO_2 emissions, with particular focus on accelerating the implementation of innovative solutions through the SESAR programme, and supported by our operational services. Through our unique applications/models (IMPACT, Open-ALAQS, R-NEST), we assess the impact of aviation on the environment at all levels; we train aviation actors on environmental concerns, operations, and assessments; and we raise awareness via Think Papers and Aviation Sustainability Briefings.

In this Think Paper, we identify solutions that exist and can be optimised immediately to accelerate aviation's journey towards carbon neutrality at every stage of a journey. All can contribute, and all require continued cooperation between the various aviation actors – which include passengers and policy-makers as well as airports, airlines, aircraft, manufacturers and ANSPs. Every flight can aim to be as green as possible, and every flight can become greener by following the various measures detailed in this Paper.

Main findings

1. Making better use of existing measures can take a significant advance towards the "perfect green flight", which could save up to 4,286kg of CO_2 emissions (25.8%) per flight out of an average 16,632kg of CO_2 for a total flight in the wider European area (ECAC). This is based on existing aircraft technology, and would significantly increase with the uptake of emerging technological solutions.

2. Better use of fuel-efficient air traffic management improvements through increased collaboration between all actors, and speedier implementation of SESAR solutions, could deliver 8.6%-11.2% (or 1,863 kg) of those reduced CO_2 emissions per flight. A more effectively functioning European network, as the recast SES legislation intends, should trigger airspace optimisation and boost the uptake of much required ATM solutions.

3. Emerging aircraft technologies in the form of hybrid, fully-electric and hydrogen airplanes will transform aviation over the period 2030-2050, enabling aviation to meet its climate-neutrality goal by 2050. By 2050, these new airplanes will be increasingly prevalent on short to medium haul sectors; while SAF use will predominate in the long-haul sector, with further upscaling of SAF production seeing 83% of fuel used being SAF, irrespective of any further technological developments.

4. Sustainable aviation fuel (SAF) is the most promising measure towards aviation decarbonisation right now. 10% use of SAF by 2030 would deliver 1,331 kg or 8% of that CO_2 saving. 20% SAF would deliver itself a huge 16% or 2,661kg – but major challenges need to be tackled to ramp up use from today's 0.1%.

5. Airlines can play a significant role in reducing CO_2 emissions by modernising their fleets, reducing 'economic fuel tankering', working with airports to use Ground Power Units rather than aircraft Auxiliary Power Units, and optimising the fuel efficiency of their existing fleets; here, greater incentives may be needed to balance economic considerations in some cases.

6. More attention needs to be paid to noise and non-CO_2 impacts, such as contrail avoidance..

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EUROCONTROL

SUPPORTING EUROPEAN AVIATION

Future of Retail

ARUP

This report is a product of collaboration between Arup Foresight, Research and Innovation, and retail experts across Arup. We would like to thank all authors and experts for their contributions and dedication.

Foresight, Research and Innovation is Arup's internal think-tank and consultancy which focuses on the future of the built environment and society at large. We help organisations understand trends, explore new ideas, and radically rethink the future of their businesses. We developed the concept of 'foresight by design', which uses innovative design tools and techniques in order to bring new ideas to life, and to engage all stakeholders in meaningful conversations about change.

For more information, please email foresight@arup.com or retail@arup.com

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Contents

Executive summary

The retail sector continues to experience significant change as shifting customer preferences, new technologies and sustainability pressures impact the environment in which retail operates.

Retail is an increasingly competitive sector with heightened price sensitivity amongst well-informed, smartphone carrying consumers. It has also become increasingly complex, reflecting a wider range of channels being used by consumers to browse and make purchases. Retailers have to cater to a variety of shoppers including the growing cohort of elderly customers as well as digital natives, the so-called 'Generation Z'. Customer loyalty in this fast moving environment will be a primary focus for many retailers. The key to success will be a richer and more nuanced understanding of the customer as a unique individual with a specific set of interests, needs and desires.

This report considers a range of trends that are impacting the retail sector. The aim is to help designers, developers and retailers better understand and prepare for the forces shaping the retail environment.

1 New technologies create a seamless experience

While omnichannel has become a required retail strategy, the next step for retailers is a focus on Total Retail. Retailers are harnessing nascent technologies such as artificial intelligence, virtual reality and connected devices to create a seamless experience. While traditional retail spaces look to technology to entice shoppers to the store, online companies are incorporating bricks and mortar stores to offer more diverse services.

2 Physical stores still key to Total Retail strategy

As physical stores are still an important aspect of the retail environment, retailers will need to assess whether digital infrastructure in stores will be sufficient to meet future demand. Flexibility to provide for changing layouts and uses is an increasingly important factor, as retailers are integrating different activities and offerings within the traditional store, with an increased focus on experience.

3 Mobile will be at the centre of e-commerce

Customers increasingly use their mobile devices to browse, compare and pay for goods and services. Retailers will continue to invest in m-commerce platforms as well as in apps and third-party solutions. The growth of mobile payments will continue, driven by consumer demand for speed and convenience. Contactless and automatic payment options could do away with traditional tills, enabling new configurations in retail spaces.

4 Increasing demand for transparency and sustainability

Many consumers are becoming increasingly aware of the whole product journey, and are demanding details on how products are sourced, manufactured, distributed and managed at the end of their useful lives. This means that forward-thinking retailers should place transparency and sustainability high on the agenda. Sustainability programmes can make business sense too.

The customer

Rise of the middle class

According to the OECD, the global middle class (those who earn between US$10 and US$100 per day) will double to nearly five billion by 2030, constituting about 63% of the world's population. Most of this growth will come from emerging markets, particularly in the Asia Pacific region.[1] By 2030, middle class consumers will spend US$51 trillion a year, up from US$21 trillion today. It is yet to be seen how automation may affect low skilled workers, many of whom have recently moved into the middle class.[2] It is also important to note that those at the lower end of the middle class are still poor by developed country standards, so much of the growth in spending will occur at the upper end of the scale.

The greater spending power of the global middle classes is likely to lead to more consumption, which will give rise to challenges including the further depletion of resources, as well as contributing to climate change. Middle class consumption is often associated with an increase in spending on discretionary goods and services including motorisation and air travel, so how people choose to spend their money will have a big impact on the environment.

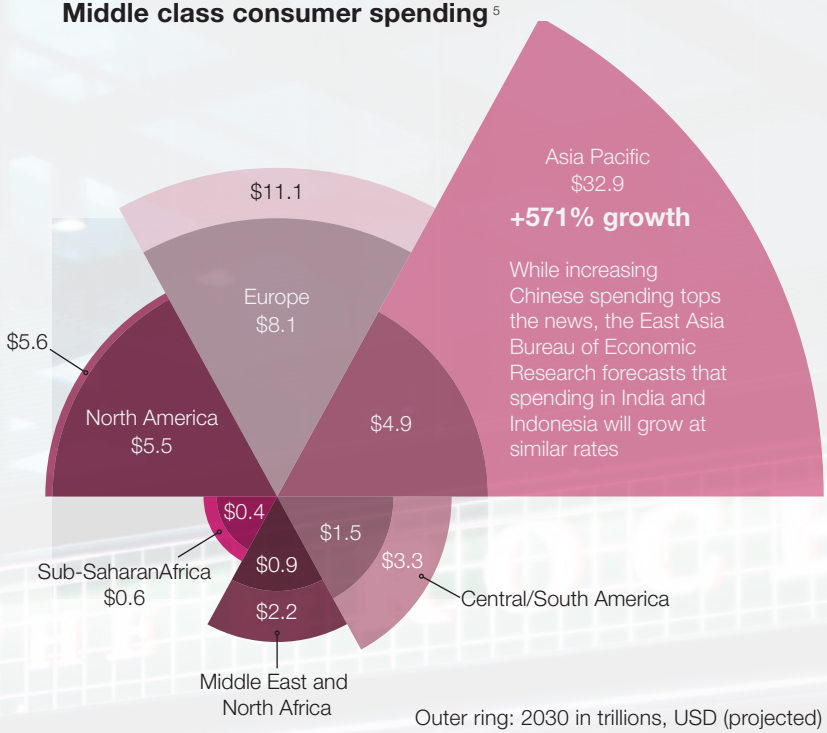
Discretionary spending varies from region to region, affecting the success of different retailers. The average Chinese consumer spends US$7 a day, with half spent on food and clothing and 9.2% allocated to recreation; the average American however spends US$97 a day, with 17.3% spent on recreational activities.[3] Online shopping is particularly successful in China, where online sales reached US$752bn in 2016, a growth of 26.2% from 2015.[4]

Multi-generational

Retailers are turning their attention to two growth areas: seniors (or the Silver demographic, aged 65 or older) and today's youth market, known as Generation Z (roughly born between 1995 and 2010).

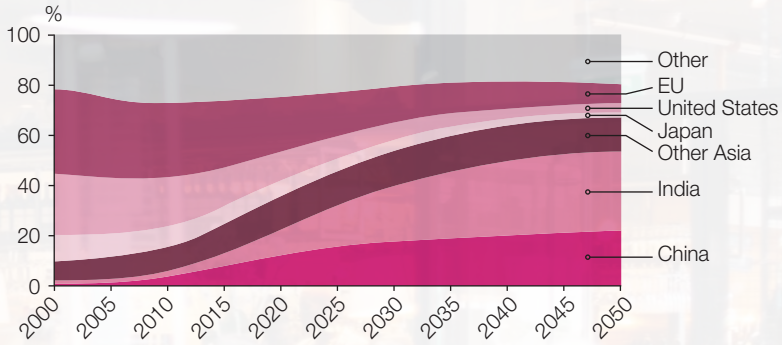
Due to rising life expectancy and declining fertility rates in some parts of the world, the global population is ageing. In 2015, 12% of the global population was aged 60 or over,

Middle class consumer spending [5]



Outer ring: 2030 in trillions, USD (projected)
Inner ring: 2009 in trillions, USD

India and China make waves in global middle class consumption [6]



but by 2050, this age group will account for 20% of the population (2.1bn people, up from 900M currently).[7]

Ageing populations will have an impact on the design of products, services and retail environments. In Japan, for example, where the spending power of the older population continues to increase, shopping experiences are designed with older people in mind, from slower moving escalators to clearer signage for those with visual impairments. In the UK, where the number of people aged 65 or older is projected to reach 15.5m by 2030, it is thought this ageing cohort could benefit health, DIY and home maintenance retailers, which tend to attract the spending of the elderly. Physical fitness, care navigation and vital-sign monitoring are other areas that may benefit.[8] Older shoppers also tend to be more demanding than younger generations.[9] Retailers will need to consider facilities for the elderly, such as seating and rest spaces, alongside their approach to high-tech omnichannel connectivity.

US$15 tn

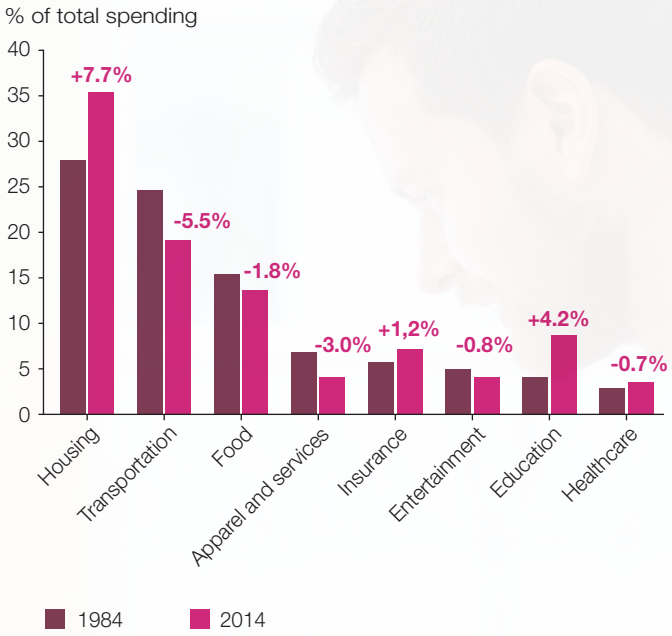
the global spending power of those aged 60 or over by 2020, up from US$8 trillion in 2010.[10]

At the same time, retailers need to be aware of the shifting preferences of younger generations who have different attitudes to brands and different ways of interacting with retail environments. Generation Z, those born after Millennials, tend to be unimpressed by technology since they have grown up with it. They are digital natives who expect everything on demand, and who tend to have shorter attention spans. By 2020, Generation Z will account for 40% of all US consumers; while they currently have less disposable income, they have more time to spend online and in-store, and in seeking purchasing advice.[11] Many choose to shop via particular marketplaces such as Depop, accessed largely via mobile phone, or through Facebook groups such as The Basement.

This emerging generation of shoppers will want to see retailers embrace the latest technologies both online and in-store, and will be attracted to those retailers and retail environments that perform well in an on-demand, 24/7 economy. Social media also drives the behaviour of this demographic. Many young people seek out experiences that will deliver the most popular posts on Instagram or Facebook, so experiences are becoming more sought after than products.[12]

Millennials, meanwhile, are set to become the first generation to earn less than their predecessors over the course of their working lives.[13] This means they may experience a lower standard of living than Generation X (roughly defined as anyone born between

Expenditure of people under 25[14]



1965 and 1980), and will have less disposable income to spend on discretionary items.

Millennials value access to experience over ownership. Rent the Runway and Chic by Choice are luxury clothing rental services that hire out designer clothing at a fraction of the cost of buying the same items as new. The services introduce high-end brands to a younger demographic and drive sales through post-rental purchases (90% of customers go on to buy, according to Chic by Choice).

Economic and political factors influence generational spend. In the UK, Millennials will have each spent £25,000 more on rent by the age of 30 than Generation X. [15] In the US, people under 25 are now spending more on housing, education, healthcare and insurance than in the past, and less on apparel, services and entertainment. [16]

Loyalty is king

While digital technologies are allowing customers instantaneous access to information to make purchase decisions, they are also eroding brand value. As a result, the value of a loyal customer base is becoming more important than the value of the brand. [17] In an age of the well-informed, price-sensitive consumer, existing and new repeat customers are crucial to future success.

Due to the near-ubiquity of online access, customers are as well informed, and often even better informed, than many shop floor assistants. In the future, staff will need to be as knowledgeable as the smartphone-carrying customer, or technologically savvy enough to point them to the correct information online. As a result, processes and operational protocols will need to be established to ensure that staff are recognised for their help in enabling online purchases.

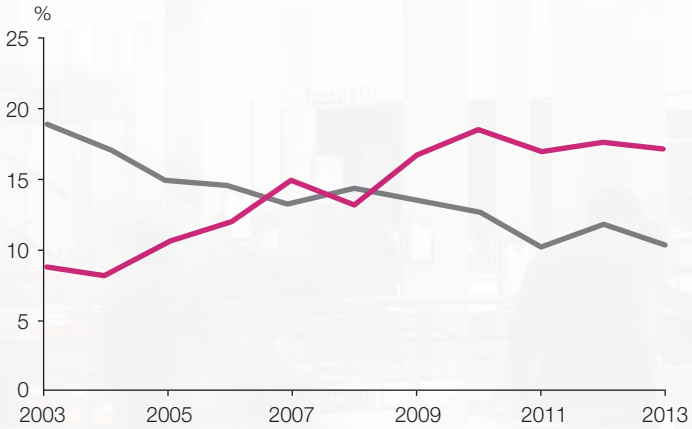
In order to generate more loyalty among customers, retailers are using a variety of technological aids. For example, a growing number of available datasets, loyalty reward data, purchase histories and online browsing data are being used to build a more complex and granular understanding of customers. By interrogating a wealth of personalised data, retailers are able to generate a much more complete picture of consumers, both at an individual and collective level. This will lead to more nuanced customer segmentation, taking into account income and demographic fragmentation as well as individual preferences, decision-making patterns and behaviours. This will improve the quality of a retailer's engagement with customers and encourage long-term loyalty.

The interpretation of consumer data will be further enabled by advances in artificial intelligence (AI) and predictive analytics. Ultimately, we may see personalised messaging based on our moods, preferences, behaviours and location.

The declining value of brands and the rise of customer relationships [18]

Percentage of **enterprise value**

(Purchase price of acquired business for 100% of shares plus interest-bearing debt minus cash acquired)

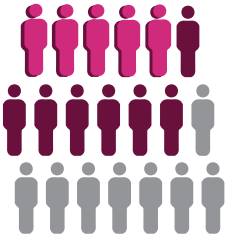


Brand value

Brands, trademarks, trade names, product names, banners and mastheads, publishing titles, domains, and other similar items owned by the acquired businesses.

Customer value

Gauge of the worth of existing repeat customers who are known in person.



In the UK it is estimated that

one-quarter

of retailers are already using facial recognition tech, including

six out of ten

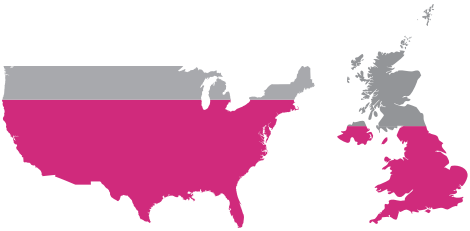
fashion retailers. [19]

Technologies such as facial recognition mean that shop assistants can identify important existing or potential customers before the customer reaches the point of sale (known as *clienteling*). Japanese technology giant NEC and California-based FaceFirst, provide systems that use cameras to identify people as they enter the store. The system scans a database of images for a match, alerts sales staff to the identity of the customer, and offers suggested cues for interaction. However, such a breach of anonymity might not appeal to all shoppers.

These developments enable stores to understand more about their customers, in a similar way to online channels. As retailers learn more about each of their customers, they'll be able to offer tailored promotions and benefits that more accurately reflect what each individual values most at any given time. These can be communicated to the customer via the most appropriate and effective channel.

A barrier to the take up of customised offers sent to mobile devices in-store however, is that some technology solutions like beacons (low power transmitters that can detect when a user's smartphone is nearby), require consumers to turn on Bluetooth and opt-in to receive "push" notifications. Consumers could also be persuaded to download a store's branded app as a route to promotions and benefits.

CloudTags has approached the problem by allowing customers to engage with merchandise both physically and digitally in-store. Shoppers can browse the real product range in-situ, as well as the digital catalogue on specially installed 'CloudBlock' screens. By simply touching the 'CloudBlock' screen, and then touching the screen of their personal device, customers can transfer their browsing history and complete the purchase at a later date. This removes the need to sign-up, create an account or download a specific app.



70% of Millennials in the US and **62%** of Millennials in the UK say they would appreciate a brand or retailer using AI technology to show more interesting products. [20]

Personalisation

While personalisation has been around for a while in retail, the mechanisms are becoming more sophisticated, enabled by new technologies and increased access to customer data.The North Face is one brand that has been experimenting with AI and deep learning algorithms by working with an online tool called the Fluid Expert Personal Shopper. Powered by IBM's Watson cognitive computing technology, the tool is an intelligent recommendation platform that mimics talking to an in-store expert. It uses natural language processing capability to enable customers to have a more intuitive search experience. [21]

"Visual listening" is another AI-related area being explored by retailers. This uses algorithms to examine photos on online platforms like Instagram and Facebook, to better understand what consumers are saying about different brands.

Many of the larger brands are looking to AI to help improve customer service. According to a survey commissioned by Interactive Intelligence, customers value a swift response to questions above any other area of customer service. [22] AI can help boost response times by utilising chatbots to respond to customer inquiries, point them to reviews and even make product suggestions. Clothing brand H&M, for example, is utilising the technology to recommend outfit choices.

Total retail

Beyond omnichannel

While omnichannel has become a required retail strategy, the next step for retailers is a focus on Total Retail.[23] Total Retail places the customer at the heart of a single strategy, rather than pursuing separate strategies for different channels. More than ever before, connected customers are looking for seamlessness and consistency across a growing number of touch points along their shopping journeys. These touch points include in-store, online (via desktop PC, laptop, tablet or smart television), mobile or smartphone (and associated apps), social media and catalogues. Customers will be agnostic about which channel they use, and retailers will need an overarching strategy that blurs the boundaries of online and offline experiences.

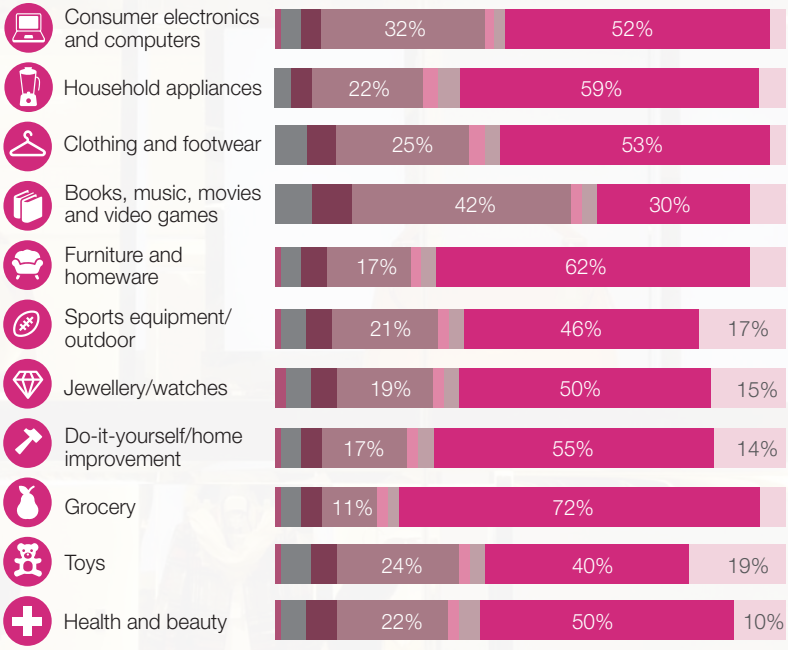
Startups like Shopify have identified a maturing market for omnichannel delivery, offering retailers a range of services that help businesses expand their e-commerce sales channels including cloud-based point of sale (POS) and mobile systems, handling everything from marketing to payments and shipping.

"We know that about 60% of our customers buy both online and in shops, so the approach is to make it absolutely seamless for them to move from one to the other – the art of sales is consistent across channels."

–Andy Street, CEO, John Lewis[24]

The physical store is still a critical step in the purchase journey[25]

Q: which method do you most prefer for buying your purchases?



Case study

Schuh

Footwear brand Schuh is a good example of a company that has fully embraced an omnichannel retail strategy. Its website receives around 2M unique visits and 22M page impressions per month, the largest traffic of any footwear specialist. The site offers real-time stock information, and customers can collect from their local store within an hour of placing an order, subject to stock availability. The company also links to social media, offers live help via messaging or video, and provides easy-to-use in-store navigation. [26]

US$4.058 tn

Expected retail e-commerce sales by 2020, accounting for 14.6% of total retail spending that year. [27]

Meanwhile, as part of an omnichannel strategy, Amazon has recognised the value of bricks and mortar retail spaces. The move to open physical grocery and book stores enables the retailer to attract new customers who don't necessarily want to buy these items online, or service their existing customer base who would appreciate the ability to shop in-store. This gives customers more options, while also enabling more efficient logistics by delivering orders to a central location.

E-commerce sales reached an expected US$1.9 trillion in 2016, or 8.7% of total retail spending worldwide; [28] spending in China and the US accounted for two thirds of this total. [29] Global e-commerce spending as a whole is expected to reach 14.6% of all sales by 2020. [30] Consequently, in-store remains the most valuable retail channel.

The main reasons for shopping in-store are driven by factors that are often unique to the physical in-store experience, for example the ability to handle merchandise and gauge product fit and suitability, together with the option to take possession of a product immediately. These factors do not generally apply to e-commerce channels. However, a wave of new services and concepts are seeking to challenge the natural advantages that physical stores have enjoyed to date. For example, Russian fashion retailer Lamoda delivers items to customers' homes, allowing them 15 minutes to try on their choices. Its own couriers operate both as trained advisors and mobile stores. Shoppers pay only for what they want to keep, and the rest is returned to the store or warehouse.

"Customers will follow the path of least resistance."

- Tom Ollerton, Innovation Director, We Are Social. [31]

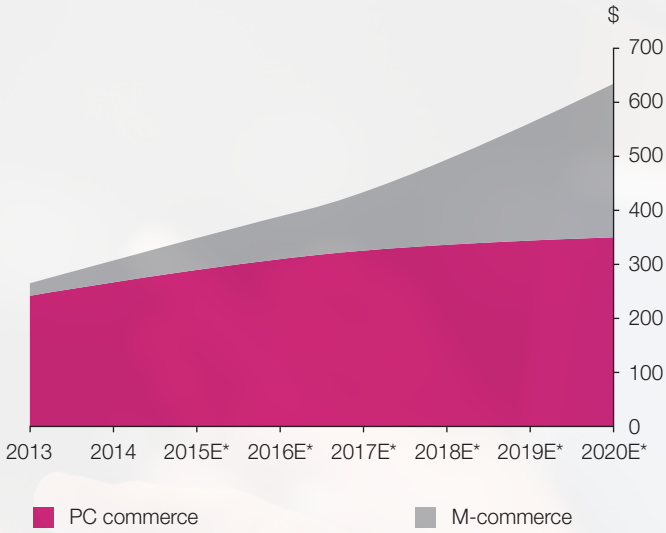
Mobile and on the go

Retailers will continue to invest in mobile commerce (m-commerce) platforms as well as in apps and third-party solutions. It is forecast that m-commerce will keep growing, reaching US$284bn in 2020, or 45% of the US e-commerce market.

Mobile payments will also grow; in 2017 it is expected that 70% of all mobile users in the US will make a mobile payment, and by 2020 mobile payments will account for US$503bn in sales. [32] The growth of contactless transactions will also continue, driven by consumer demand for speed and convenience. Becoming "payments agnostic" will be important to cater to a growing range of payment options, all of which are vying to create friction-free experiences for the time-poor customer. In the US, research shows that consumers are spending more time on mobile retail apps than on mobile shopping websites. [33]

In addition to apps, retailers will rely on third-party solutions, including social media companies. Having been disengaged from e-commerce in the past, social media has now fully embraced it. Many companies, such as Pinterest, Instagram, YouTube and the Chinese messaging platform WeChat, have added "buy" buttons to posts and advertisements, driving retail sales and removing extra steps from the purchasing process.

Forecast: mobile share of e-commerce [34]



Close to **60%**

of smartphone users research products from their handset before making an online purchase. [35]

By 2018, **30%**

of global e-commerce sales will come from smartphone users. [35]

This innovation has given rise to *social selling*, whereby the opinions of popular influencers and key opinion leaders drive retail spend via their posts on social media and blogging sites. Brands like Burberry and Tommy Hilfiger already benefit greatly from the influence of certain celebrity bloggers, some of whom have more than one million followers, via the microblogging site Weibo.

New channels keep appearing. The wearables market is growing quickly, with new entrants and a greater variety of products. Wearables could soon change the way consumers interact with and purchase products, enabling seamless payment and targeted advertising.

Conversational computing is also making a mark on the world of retail, allowing voice orders to be recognised and processed by smart computing devices. Amazon's Echo, the web-connected speaker, can follow verbal commands that include e-commerce purchases. The product, designed as a smart hub for domestic use, houses a virtual assistant called Alexa. Alexa can understand and process an order for pizza, thanks to a third-party application developed by takeaway pizza chain Domino's. [37]

Mobile retail app usage surpassed mobile web visits in the first quarter of 2016, growing more than **70%** year-on-year. [36]

Subscription-based purchasing

Time-poor shoppers can be easily overwhelmed by too much choice, both online and in large format stores. This helps explain the rise in subscription services such as the Dollar Shave Club, the quirky US-based company that delivers razors and other personal grooming products to customers in the post. Similar subscribe and save services curate products for customers, making it easier for customers to discover and choose products, thereby saving time and preventing choice fatigue.

Amazon identified an opportunity to cater to a similarly time-poor customer, with the launch of Amazon Dash. The company offers its Amazon Prime customers a range of wi-fi enabled push-buttons, each representing a different branded product from toilet paper to washing-up liquid. These buttons can be affixed to white goods and appliances, or on kitchen or bathroom walls. Users press the button to quickly re-stock commonly used household products. Fairy, Durex, Gillette and

Case study

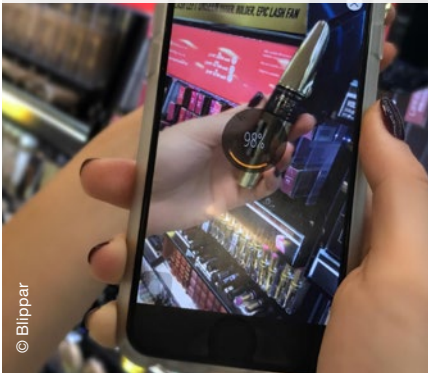
Amazon Go

© Amazon

Amazon is proposing to use mobile payment to underpin a new bricks and mortar grocery store with no checkouts. Amazon Go will be powered by a range of technologies including computer vision, machine learning and AI to track the items a customer picks up. Customers can then fill their shopping bag and leave the store without going through a checkout process as payment will be taken automatically from their Amazon account.

Case study

Blippar



© Blippar

Blippar is an app that uses image recognition, augmented reality and computer vision technology to bring products to life through smart devices. One of the largest retailers in the UK, Argos, made its Christmas catalogue available via Blippar, allowing readers to “blip” (scan) the pages of the catalogue to instantly buy items. Over 21,000 customers shared the campaign on social media, and more than 929,000 interactions were recorded over a 10-week period. Other brands that have used Blippar include Walmart, P&G, Nestle, Disney, L’Oreal and Sony.

"Today, when you discover in the shower that you have run out of hair conditioner, you can order a new bottle through Amazon Prime then and there. And tomorrow, when you're watching a streamed movie or browsing Pinterest, you will able to point and click on a character's suit or tie and buy it right away – without ever going to a retailer's site."

– Walter Reinartz, Harvard Business Review. [38]

Pedigree are among the firms included in the service's UK debut. Amazon is also rolling out an Amazon Dash Replenishment Service (DRS) in some markets. The cloud-based platform enables connected Internet of Things devices to automatically re-order certain supplies when they run low.

Just as time-poor customers have more choice through subscription-based services or technologies such as Amazon Dash, so do cash-poor customers through payment services such as Afterpay. Afterpay is fully integrated with participating store checkout systems, offering interest-free payment plans for purchases made online or in selected stores at no additional charge, allowing customers to spread their payments over four fortnightly instalments.

Photo: station-based retail offers convenience to millions of passengers, as well as local workers and residents.


© Graham Gaunt

The store

"The battle to create the modern retail experience, between traditional retailers with a long, successful history of high street store building and new digital entrants built around the internet and mobile technology, is finely poised."

– Kees Jacobs, Consumer Goods & Retail Lead, Insights & Data Global Practice, Capgemini Consulting [39]

Relevant

Despite the global growth of e-commerce, most retail transactions are still carried out in-store. In the future, the physical store will remain an important aspect of retail strategy but it will need to transform in order to be successful. Physical stores will need to integrate more effectively with new technologies, and the distinction between physical and digital will blur. The shopping process will be faster and more engaging, with new ways to pay and a growing number of checkout-free stores. Physical stores will focus more on the customer, and will need to offer surprising and engaging experiences, that offer something that online shopping cannot. [40] Retailers should focus on a Total Retail strategy as physical stores won't survive in isolation.

Experiential

As in-store shopping tends to be something of a chore for many, or an intensely social activity for the younger demographic, those retailers that can provide stimulating in-store

Left: the design of physical stores will provide compelling and enjoyable retail environments.

experiences will attract footfall. This will be especially true as e-commerce continues on its growth trajectory.

Some brands are addressing this by introducing a degree of experimentation or entertainment into the physical retail environment. Muji has opened a flagship location in Manhattan, which contains an interactive embroidery station and an "Aroma Lab" where consumers can mix their own aroma diffusers.[41] Gucci has extended its luxury offering into the food and beverage sector by opening its first restaurant in Shanghai. The move demonstrates how, in the shift of focus from product to fine-dining, sensory experience can reinforce a widely recognised, mature brand.

Retailers are having to work harder to draw people to the physical store, and they're doing this by providing compelling environments and experiences that can't be enjoyed online. When done well, these events can bring products to life, generate or reinforce customer loyalty, and drive future sales.

Grace and Thorn is a London-based florist that offers in-store classes where customers can try their hands at creating some of the company's signature flower arrangements. Participants are offered chilled Prosecco during classes such as the Renegade Flower Sessions and Terrarium Tuesdays, all delivered to a hip hop soundtrack.

Experiences continue to be an important differentiator for stores, especially for consumers who typically spend a lot of time online or engage in showrooming (the act of comparing prices of items in-store and online). Some stores are experimenting with in-store robotics, to add an interactive and fun dimension to physical shopping. SoftBank in Japan has introduced a 1.2m tall (4 ft) humanoid robot that acts as a personal stylist and salesperson. The robot, called Pepper, can speak eight languages fluently and can follow up with customers via email and text message after their visit.

Digitised

Digital technology is fast transforming the physical, in-store environment. The result is a gradual obfuscation between offline and online channels. There has been bold experimentation in the "off-on" spectrum's centre ground, where physical meets digital. For example, Perch is an interactive platform that unites digital technology with physical products. When a customer picks an item from a shelf, an interactive display is activated behind the product. This acts as a dynamic product spotlight, engaging the customer with relevant animation, sound and rich media. There is a trend towards the greater digitisation of physical spaces in order to create interactive, responsive environments.

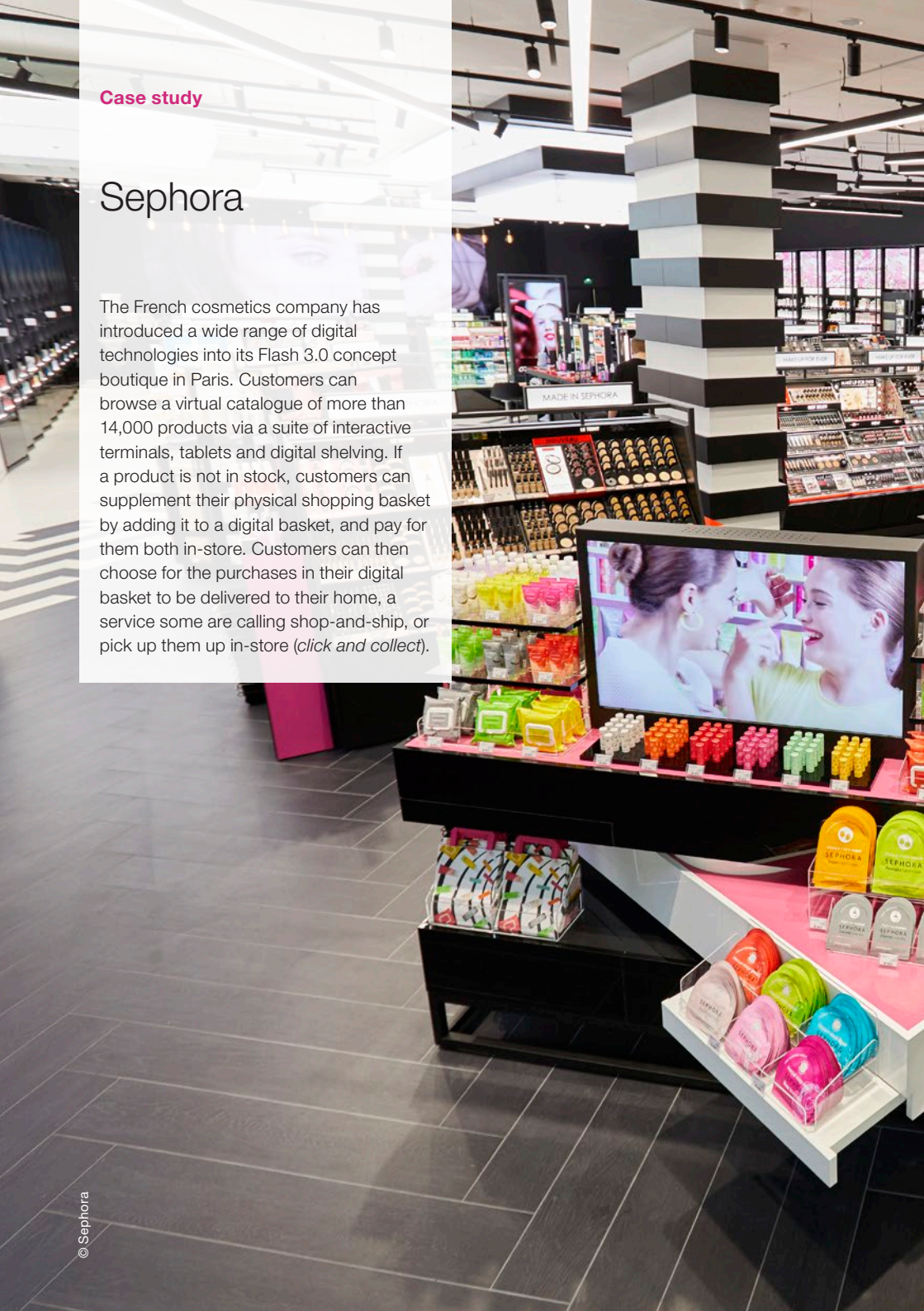
Emerging technologies promise to add a highly emotive and experiential

Photo: the Panasonic Centre in Osaka, Japan integrates new technology with the physical environment.

Case study

Sephora

The French cosmetics company has introduced a wide range of digital technologies into its Flash 3.0 concept boutique in Paris. Customers can browse a virtual catalogue of more than 14,000 products via a suite of interactive terminals, tablets and digital shelving. If a product is not in stock, customers can supplement their physical shopping basket by adding it to a digital basket, and pay for them both in-store. Customers can then choose for the purchases in their digital basket to be delivered to their home, a service some are calling shop-and-ship, or pick up them up in-store (*click and collect*).



dimension to shopping in-store. Virtual, mixed and augmented reality offer brands the opportunity to develop immersive, multisensory services that engage customers and brand enthusiasts at a deeper, more visceral level. In the US, Ralph Lauren is testing interactive mirrors in some of its fitting rooms. These "smart" mirrors allow shoppers to request different sizes, adjust the lighting conditions, browse additional items and interact with a live sales assistant.[42]

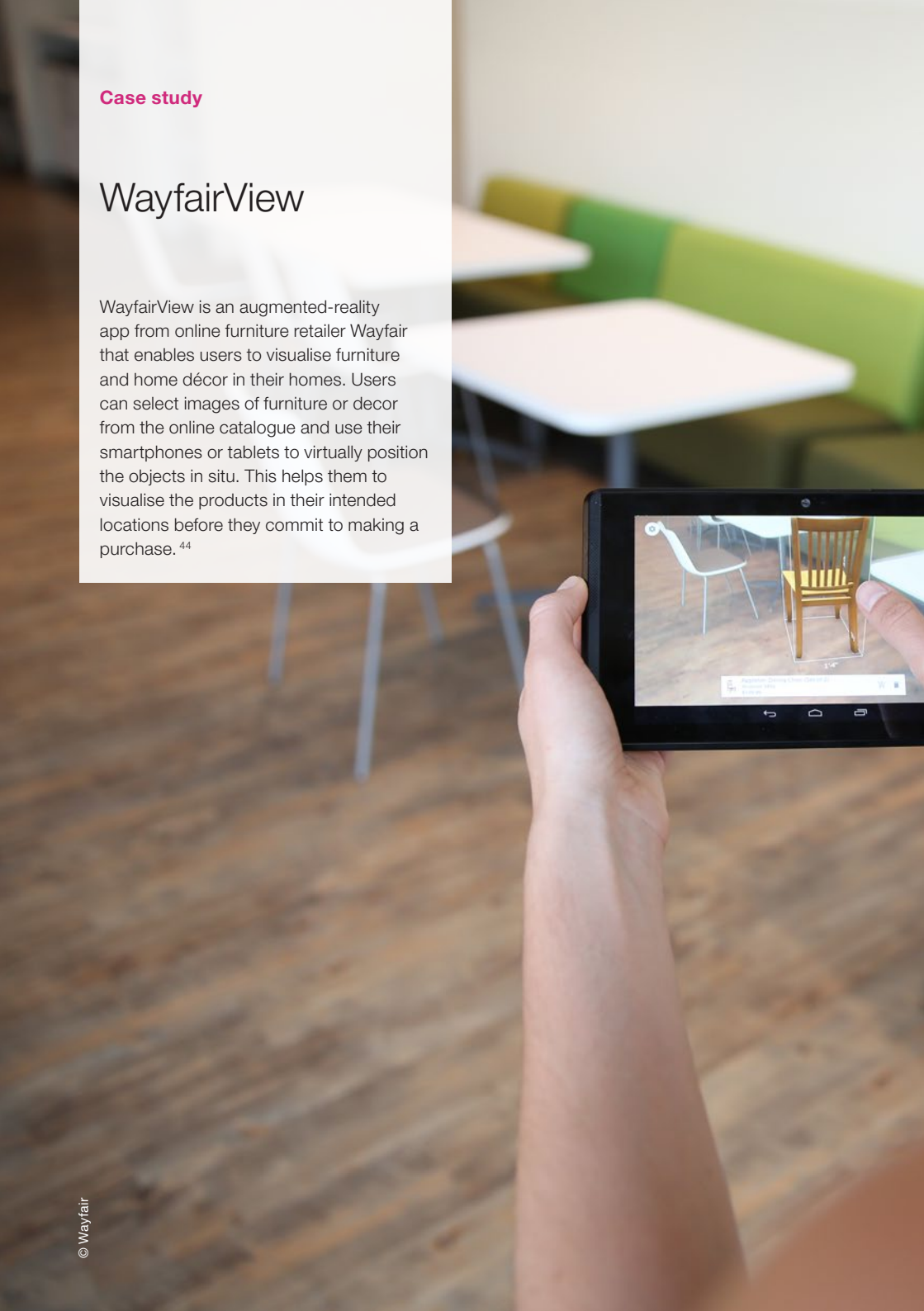
"The real question retailers have to ask themselves isn't whether they can afford to transform the in-store experience, but can they afford not to?"

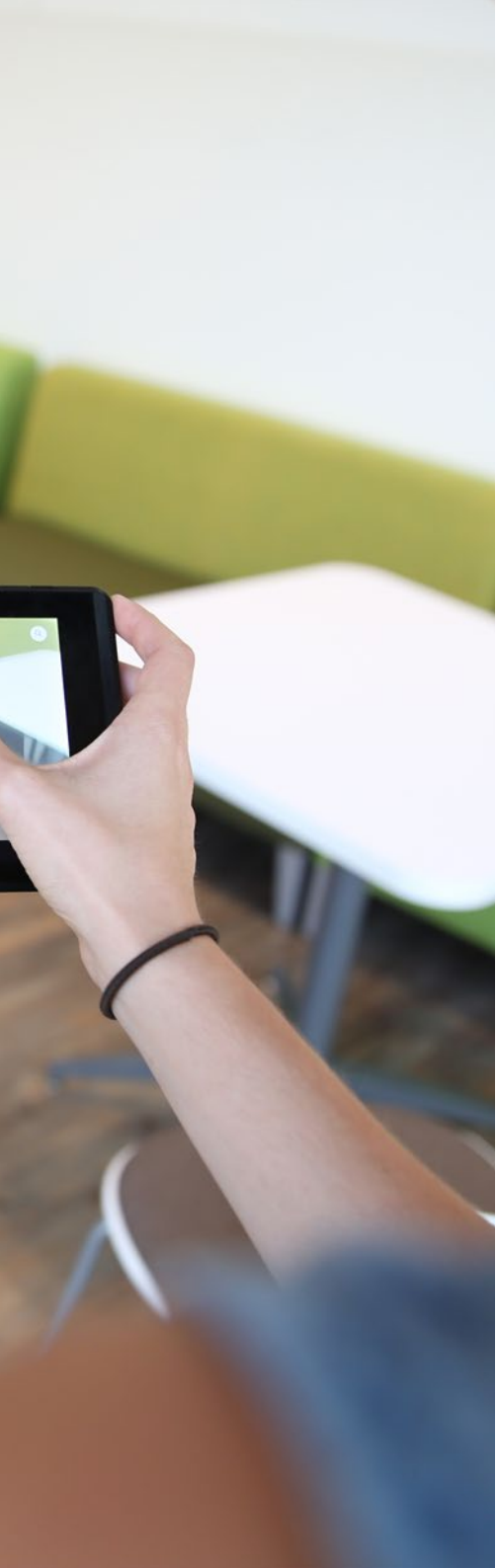
– Mike Petevinos, Global Head of Consumer Products & Retail at Capgemini Consulting.[43]

Case study

WayfairView

WayfairView is an augmented-reality app from online furniture retailer Wayfair that enables users to visualise furniture and home décor in their homes. Users can select images of furniture or decor from the online catalogue and use their smartphones or tablets to virtually position the objects in situ. This helps them to visualise the products in their intended locations before they commit to making a purchase. [44]





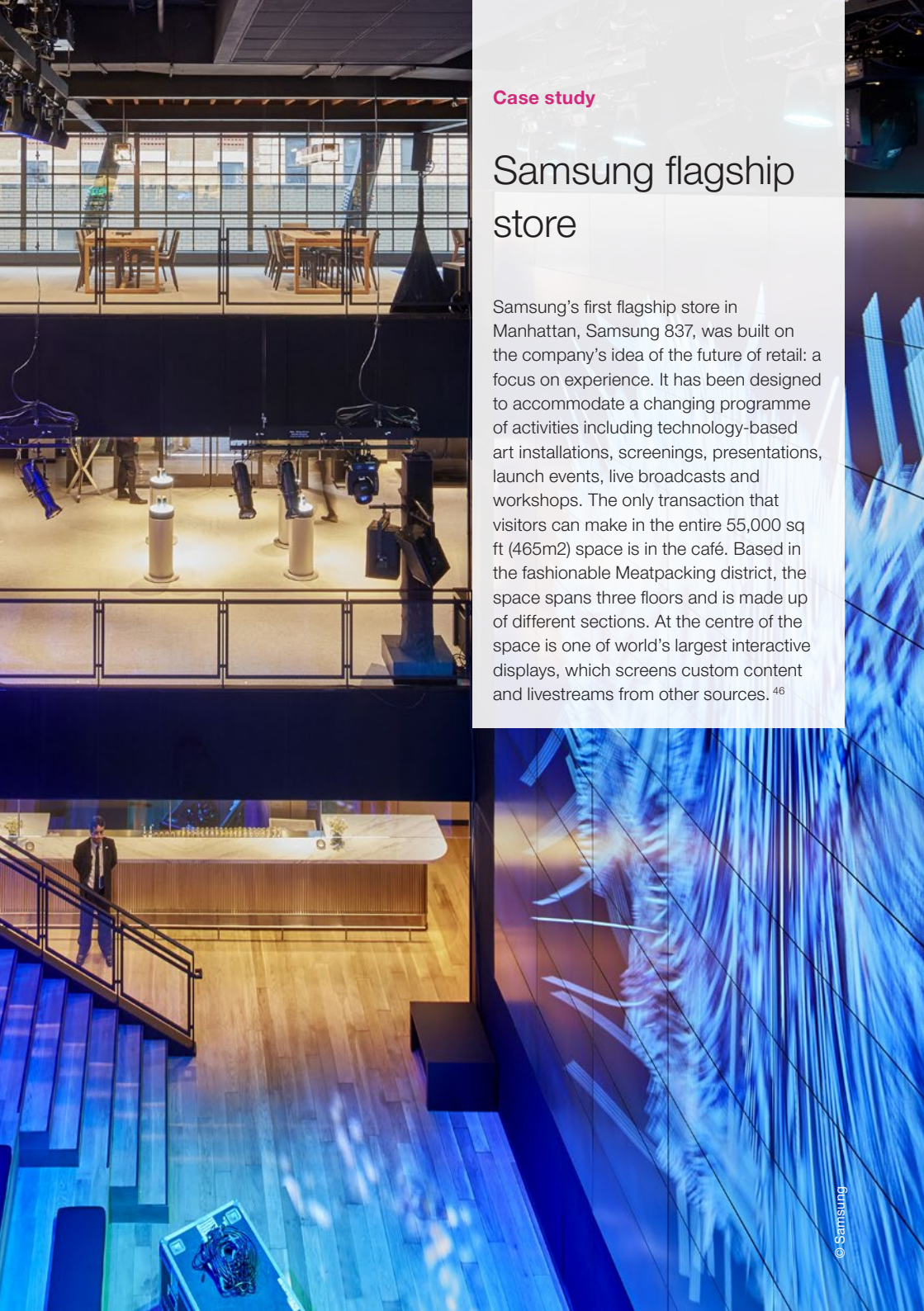
Abu Dhabi's Galleria Mall includes a Fashion3D fitting room which combines body-mapping technology with HD garment rendering, enabling shoppers to 'try on' a virtual wardrobe. Comprising a Kinect motion detector camera, an HD camera and a life-size screen that acts as a virtual mirror, the system takes three seconds to scan the customer before stylists then dress the digital image with a selection of garments. The full-body projection allows users to move through 360 degrees, while viewing the overlaid clothing. As well as speeding-up the decision-making process and reducing waiting times for changing rooms, the system also collects user preference data, allowing retailers to develop personalised clothing suggestions and relevant marketing materials.

Other technologies perform multiple functions. For example, Philips have worked with Carrefour to introduce low-energy LED lighting into their hypermarket in Lille, which uses Visible Light Communication (VLC) to transmit location-based notifications directly to shoppers' mobile phones. The LED-based indoor positioning system allows customers to receive promotions or directions to products, and for staff to use location data analytics to assess store operations and the impact of specific marketing. Carrefour hopes that the technology enhances the shopping experience, making it more interactive and personalised. [45]

Mixed use and dynamic

As retailers compete for footfall, the importance of creating appealing places has never been greater. Retail stores can contribute to richer mixed-use places by achieving a better integration between retail and the wider local environment. Smaller, secondary towns are becoming more focused on placemaking and are developing experiences to draw people to the high street and extend dwell time in the retail space. Many are also looking to attract independent stores, or a carefully considered mix of brands, to create further differentiation and implement a better mix of uses.

The need to maintain customer interest is key to the in-store experience. As a result, interesting hybrid spaces are blurring the lines between retail and lifestyle and entertainment. A diverse, curated mix of retail offerings have become increasingly common, combining traditional in-store retail with other services such as bookshops or cafés. More unconventional combinations are also beginning to appear. Lululemon, the Canadian athletic apparel retailer, has opened a 3,500 sq ft (325m2) community space as part of its flagship store in Manhattan's Flatiron district, including a "retreat space" for shoppers called Hub Seventeen. In addition to regular fitness and yoga workshops, the space will include a pop-up art gallery and a programme of evening dinners called The Gathering, which will bring together industry leaders "to



Case study

Samsung flagship store

Samsung's first flagship store in Manhattan, Samsung 837, was built on the company's idea of the future of retail: a focus on experience. It has been designed to accommodate a changing programme of activities including technology-based art installations, screenings, presentations, launch events, live broadcasts and workshops. The only transaction that visitors can make in the entire 55,000 sq ft (465m2) space is in the café. Based in the fashionable Meatpacking district, the space spans three floors and is made up of different sections. At the centre of the space is one of world's largest interactive displays, which screens custom content and livestreams from other sources. [46]

share, connect, converse, and discover" over meals prepared by celebrated NYC chefs. [47]

These hybrid retail and leisure environments can have a positive impact on the surrounding area, supporting vibrant ecosystems that enhance the shopping experience as well as supporting a blend of associated activities across work, rest and play. Mixed-use environments with designed-in flexibility and a diverse food and drink offer are increasingly seen as vital to a location's success, whether within a neighbourhood or within a building.

Focused on health and wellbeing

As with other parts of the built environment, retail spaces are designed fundamentally for people. As such, they should enhance quality of life and positively impact people's health and wellbeing. A report published by the World Green Building Council, called Health, Wellbeing & Productivity in Retail, suggests that while retailers understand the importance of health, wellbeing and productivity, they need help translating these concepts into designing and managing properties. Retailers know that creating better retail environments leads to better customer experiences, and better experiences lead to increased revenue. However, retailers need to align their properties with this large, currently underutilised, business opportunity.

In many cases, health, wellbeing and productivity are often still detached from the broader retail strategy. While retailers continue to invest in sustainability initiatives, this is often isolated from the main aim of retail – to provide an experience that makes people want to come, stay and spend.

The Framework set out by the World Green Building Council report helps translate these issues into a measurable and manageable set of metrics that can inform better design and management decisions. [48]

Photo: the Dubai Mall entices visitors with unique experiences.

The shopping mall

"By 2020, the entire concept of convenience and value will shift. Convenience won't be defined in the traditional terms of time and ease. The highest currency will be relevance."

– Christian Davies, Executive Creative Director, Americas at FITCH.

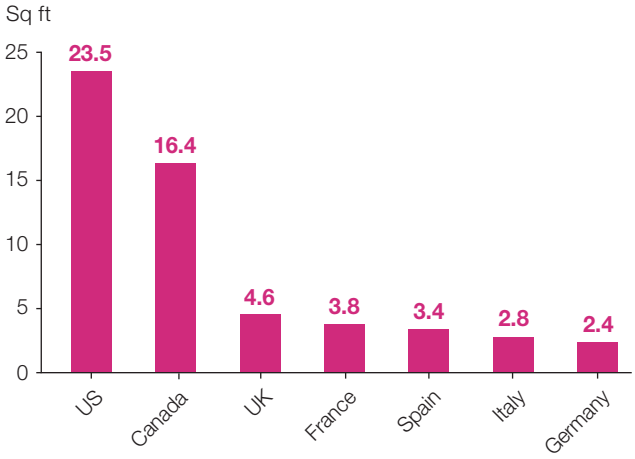
Convenience and lifestyle

E-commerce, new technologies and entertainment alternatives are reshaping consumer expectations, putting traditional large-scale shopping centres under pressure to maintain viability. In the U.S., there were nine retail bankruptcies in the first four months of 2017. A number of large department stores, such as Macy's and JC Penney, have announced hundreds of store closures. Part of the problem is that the U.S. built far too many malls. Shopping centre square footage per capita is five times greater in the U.S. than the U.K. (and 10 times that of Germany). [49]

Some large retailers and department stores are investing in smaller format stores in order to offer a more curated selection of products to targeted segments. With customers prizing convenience and accessibility, large format stores which require customers to search for products are becoming less appealing. Smaller stores are more convenient, and they cost less to open and operate. They are also easier to fit into

Left: the Bullring is Birmingham's No. 1 mall and an iconic urban landmark.

Gross Leasable Area (GLA) per capita [50]



increasingly dense urban environments. This will result in more speciality stores that focus on particular categories of products. [51]

Shopping centres and malls are undergoing a gradual metamorphosis as the focus shifts to providing compelling, immersive and shared entertainment and lifestyle experiences that customers cannot enjoy online or at home. The experiential side of retail is growing, with on-site programming and lifestyle events to appeal to a younger, connected customer. In the future, it is likely that more mall space will be given over to entertainment, food and beverage spaces.

Other strategies being employed by malls include creating floors or zones dedicated to specific services or consumer segments, for example areas with seating for elderly shoppers. This helps promote a more convenient experience for customers who are searching for specific products or service offerings.

Appealing to the needs of families and multiple generations is also an important factor for success at the scale of malls. Many shopping centres are increasingly offering leisure activities and entertainment for children, for instance. These allow parents to take a break from parental duties, to browse

Left: Chengdu Yanlord Landmark Plaza is a premiere destination for life, work, and culture.

Case study

Isetan Mitsukoshi

Japanese department store operator Isetan Mitsukoshi has developed a scaled-down format, opening more than 100 small and medium-sized shops since 2012. Each store attracts specific demographic segments with a bespoke product range. According to the company, the small format stores are more viable as Japanese consumers are buying more on-line or in shopping malls, and the operator needs to attract new customers.

or make purchases. Westfield, for example, which pioneered the destination shopping centre concept, has launched KidZania in London, a child-sized cityscape in which children aged 4-14 can try out a range of jobs such as a surgeon, fireman or fashion stylist. Children are tagged electronically with a bracelet on entry, allowing parents to keep track of them while they relax or go shopping. Children earn credits that they can then spend in the mall. Creating a positive, fun experience can lead to repeat visits.

Technology and data

Much like high street retailers, malls are using technology to interact with their visitors in new ways. The Chinese retail conglomerate Wanda Group, for example, has created an app that provides in-store and parking navigation and restaurant booking services; the Feifan app is currently available in over 350 major shopping malls. Similarly, at some mall locations owned and operated by real-estate investor Macerich in the US, shoppers can text questions to an information desk to get a quick response.

New technologies are shifting the advantage back to physical spaces from the world of online retail. Technologies such as facial recognition, proximity beacons and LED-based indoor positioning systems can offer a more granular view of how people behave, reducing the lead that online companies have had in understanding how their consumers behave.

"The best shopping centres offer a great experience all under one dry roof. Combining easy access, free parking, mix of retail, theatre and offering food and leisure facilities – something for all – premium shopping centres provide the epitome of an experiential destination facility, driving footfall and dwell time."

– David McCorquodale, UK Head of Retail, KPMG. [52]

With greater access to rich consumer data, shopping centres will also generate a much more refined understanding of individual customers. This could open up new data services targeted at anchor and other tenants. For instance, shopping centre operators could make available packaged customer profiling data and analysis, together with detailed footfall analytics, pedestrian flows and derived insights. Similarly, tenants might be willing to share a percentage of online sales with shopping mall owners in return for a lower rent. This would enable both the operator and retailer to embrace the reality of growing e-commerce and showrooming culture.

Amazon has envisaged a future format in which a 2-storey physical retail space is manned with robots, picking out items on the upper floor for shoppers below. This concept, if realised, would radically disrupt traditional approaches to the design and operation of retail spaces, and vastly reduce staffing costs. [53]

Flexible and adaptable spaces

The trade mix in malls is becoming more flexible and dynamic. Some malls are making better use of temporary spaces, to enable a mix of transient offerings including pop-up stores or kiosks to maintain customer interest. New schemes are moving away from closed environments, preferring open air options that enhance the use of space and reduce the service charge for tenants.

£2.3 bn

in sales accounted for by pop-ups in the UK, up 12% compared with the previous year.[55]

However, for many developers, flexibility is viewed as too expensive to design in, preferring to build for shorter timescales. If this is the case, developers should implement resource efficient, environmentally sustainable principles in future schemes.

Pop-ups offer a cost-effective way to test a new product or service. Rather than spend money on market research, a pop-up can be set up quickly and relatively cheaply. Due to the low capital outlay and smaller scale, the risk to the retailer is greatly reduced. And if the idea doesn't generate traction, a pop-up can be closed down just as easily. People enjoy being exposed to chance encounters, new ideas and inspiration. Pop-ups can deliver this at a fraction of the cost, allowing retailers to test a concept and scale it if it catches on.

Flexibility in the design of retail spaces can have a number of benefits over time. For example, the general trend towards greater mobile payments or pay-as-you-shop, may well mean the end of checkout counters and tills, thereby freeing up space for new interior layouts. Similarly shop and ship, where customers can opt to have their purchases delivered, could reduce the need for storage facilities for inventory.

Another more long-term example relates to the provision of parking at big box retail locations or out-of-town retail parks. These vast parking areas could be designed in future so that they can be readily converted into retail or other uses, should autonomous vehicles ultimately reduce the need for parking.

Choosing the right location for a retail space is also important. ZoneSavvy is a web-based platform that empowers small businesses to make data-driven decisions when scouting and selecting retail locations. The platform classifies every neighbourhood in the US based on a range of characteristics and demographics, such as population density, median age, and average income, alongside existing businesses in the area. The system then compares the neighbourhood in question with similar districts, determining the optimum number of businesses the area can support as well as revealing potential commercial opportunities.[56]

The product journey

Transparency and sustainability

Consumers are becoming increasingly aware of the whole product journey and are demanding quality, transparency and sustainability in the products they buy. Details about how the product is sourced, manufactured, distributed and managed at end of life are becoming far more important aspects of purchasing decisions. Brands that have a strong sense of identity as well as good sustainability credentials are likely to have more success.

A growing number of retail companies are putting sustainability high on the agenda, looking to reduce carbon emissions, waste and energy use, and to increase resource efficiency. For example, Patagonia, the outdoor clothing retailer, is committed to working against superfluous consumption, dissuading people from buying things they don't need (including their own products). The company has the four Rs – reduce, repair, reuse and recycle – built into its core operations; this is a significant departure from the standard retail practice of encouraging people to buy as much as possible. Patagonia donates 1% of sales to an Earth Tax to support environmental organisations. To date it has donated US$70m to these initiatives. It also aims to make its facilities more eco-friendly through the use of renewable construction materials and efficient building design. [57] These initiatives differentiate the company by more than just price and quality, and create a strong reputation that appeals to its core consumers. [58]

Sustainability programmes can make business sense too. For M&S, the net financial benefit from its ethical and environmental programme "Plan A" was £185 million in 2015-16. [59] As M&S is responsible for a large property portfolio, it is also working in partnership with its landlords, the Environment Agency (EA), Public Health England and the UK Water Partnership to assess and proactively manage climate-related risks. [60] It is taking action on climate change across its value chain to maximise opportunities and minimise the risks and associated costs from evolving environmental impacts. [61]

Left: Starbucks Shanghai Roastery is designed to demonstrate transparency and sustainability in crafting a coffee experience.

US$70 million

cost savings from Ikea's investments in energy efficiency since 2010.[62]

Despite efforts by a number of retailers, we continue to live in a throw-away society, with increasing carbon emissions and levels of waste. Shoppers globally are using approximately 500 billion single-use plastic bags per year – about 1 million bags every minute.[63] Many countries have implemented policies to reduce or ban the use of plastic bags which is a positive step. However, it isn't the silver bullet to the problem. For example, cotton bags would need to be used 131 times before they are better than a regular plastic bag in terms of limiting global warming. A uniform tax on plastic could be a wider reaching solution.[64] Ultimately, working towards a sustainable future requires a collective effort from business, consumers and governments.

Packaging is an area where we can expect to see a greater focus on sustainability and resource efficiency. Numerous recyclable or biodegradable alternatives to plastic packaging are now available, some of which are corn- or sugar-based. By combining agricultural by-products like cornstalks with mycelium from mushroom roots, the biomaterials company Ecovative can 'grow' custom packaging for consumer products including electronics, furniture, glassware, and industrial equipment including pumps, compressors and automotive components. Production is completed within a couple of days, and once used, the packaging can be composted (its organic make-up adding nutrients to the soil as it biodegrades).

Much plastic packaging can of course be recycled. However, about 30% of plastic packaging will never be reused or recycled without fundamental redesign and innovation.[65] Initiatives like The New Plastics Economy, led by the Ellen MacArthur Foundation, brings together major producers like Unilever, the Coca Cola Company and Danone to re-think and re-design the future of plastics in packaging. The circular economy is a concept that, in contrast to the predominant 'take, make, use, dispose' linear model of production and consumption, aims to design products in such a way as to optimise durability and resource effectiveness. This goes far beyond just recycling. Consumer goods are designed to be repaired, refurbished, disassembled and reused, keeping materials and components at their highest utility and value at all times. This helps to minimise resource use, eliminates waste and reduces pollution.

Case study

Original Unverpackt

© Elizabeth Rush

The Original Unverpackt supermarket in Berlin enables ethical purchase decisions by selling all of its products unpackaged. Part of a wider 'precycling' initiative to reduce food waste and packaging, the supermarket's produce is stored in large containers that can be emptied into the customers' own bottles, bags or glass jars. As well as helping to reduce Germany's 16m tonnes of annual packaging waste, the initiative also reduces food waste as customers only buy what they need. While the model has been shown to support smaller purchases from local environmentally-aware customers, an online shop has helped to expand the supermarket's reach.

Case study

Adidas

© Adidas

In collaboration with Parley for the Oceans, Adidas has launched a concept trainer made from recovered plastic ocean rubbish. The trainers' uppers are made of filaments generated from reclaimed deep-sea fishing nets. Intended to highlight the unsustainability of current production cycles, the shoes are a precursor to an eventual clothing line being developed by the two organisations. They are an example of the potential commercialisation of waste stream recovery and cradle-to-cradle reuse practices.

The transition to a circular retail economy requires behavioural change on the part of producers and consumers. Companies such as Renault, Philips, Ikea, Kingfisher, H&M, Steelcase and Tetra Pak are leading the way through their membership of the Circular Economy 100 group, a multi-stakeholder platform that enables collaboration across member organisations around the circular economy.

Efficient delivery

Logistics is another area where retailers can differentiate themselves on value and sustainable practices. Once a product has been chosen and ordered, customers expect to receive it at speed. This has resulted in a move towards next day and same day shipping. Time-poor customers want to have items delivered to the most convenient location, and at the most convenient time, leading to ever-shortening time windows for fulfilment and delivery. Data driven logistics and fulfilment using smart tracking, accurate data and analytics can deliver better real-time solutions, more efficient inventory planning and improved customer service.

Other initiatives are focusing on reducing the need for excessive delivery of goods. Near St is a UK startup that aims to optimise convenience and minimise the need to ship goods more than is necessary, by reconnecting shoppers to local retailers. Underscoring this approach is a belief

Case study

Fetchr

Fetchr is a Dubai based logistics app developed by two e-commerce entrepreneurs that enables customers to send or receive anything, anywhere in the Middle East. The easy-to-use app uses the customer's mobile phone number to deliver packages using its GPS location, similar to how Uber locates a customer for pick up. The aim is for same day delivery within the region and to deliver items to people based on where they are, and not where they live or work.

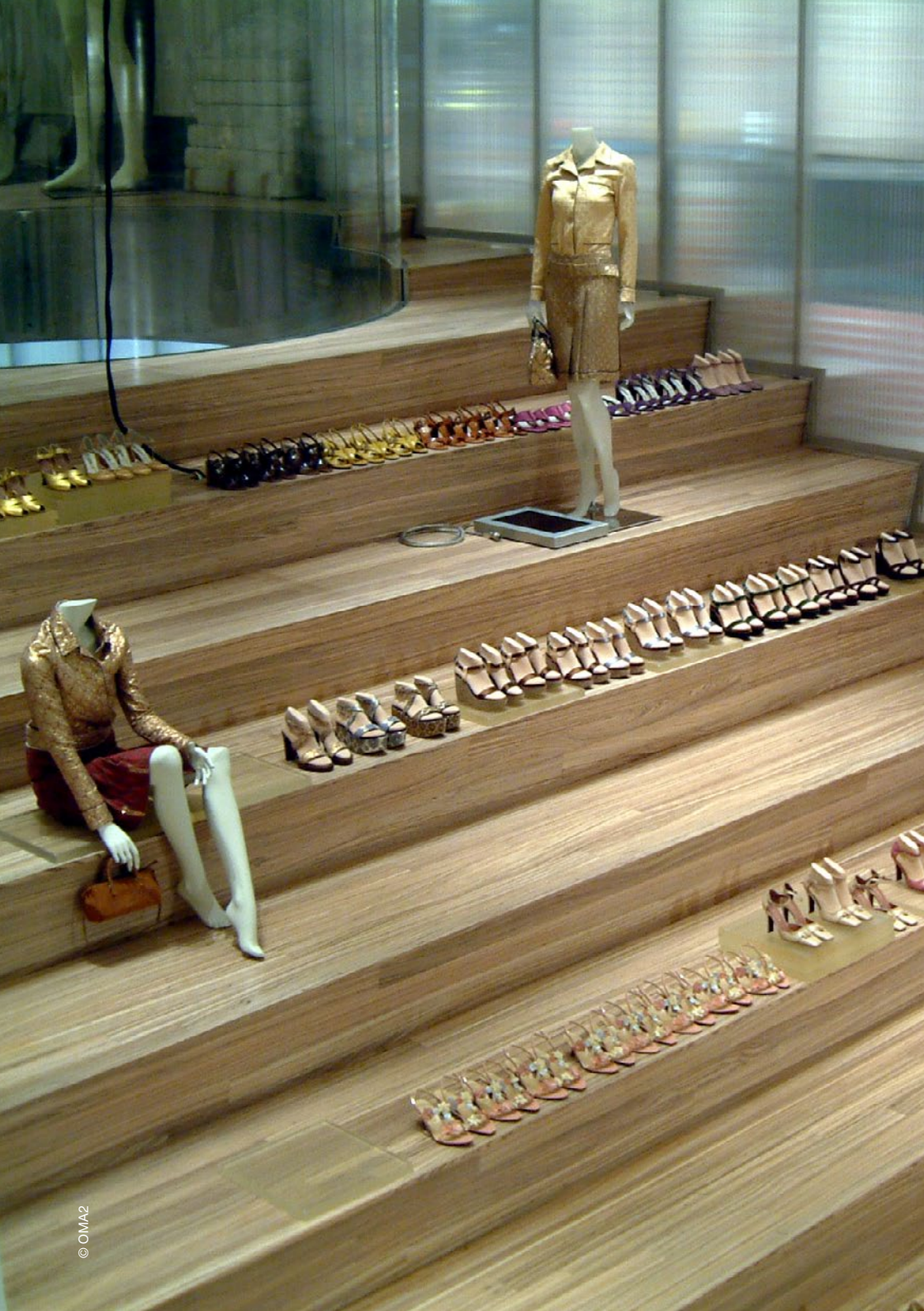
that finding and buying something from a local shop should be faster and easier than ordering it online.

A similar concept has been applied to business to business (B2B) logistics. Arup developed measures to reduce the volume of delivery vehicles along Regent Street in central London – where delivery vans and lorries accounted for 35% of all peak hour traffic. Through the use of a retail consolidation centre, Regent Street retailers now consolidate deliveries from their suppliers at one easily accessible point outside of London's congestion charging zone. Deliveries to multiple stores on Regent Street are then grouped into one consignment and delivered at a pre-arranged time via an electric truck. As well as providing a more cost-effective way to manage stock, the scheme has helped to drive footfall by reducing localised congestion and air pollution during peak retail periods. Since the scheme has been implemented there has been an 80% reduction in lorry movements associated with participating retailers on Regent Street, with 21 retailers operating from 36 stores signing up to the scheme including Armani, LK Bennett, Browns, Fenwicks and New Look.

Arup has since developed an approach called 'virtual consolidation', which similarly reduces van and lorry traffic in targeted retail districts by having a consortium of local retailers contract out to one preferred supplier for a range of goods and services, from office supplies to waste collection. Such a coordinated procurement model has not only been proven to reduce costs for participating retailers, but also to reduce congestion and carbon emissions.

Looking further into the future, an intriguing implication of autonomous vehicles could be that they act as moving retail stores. Autonomous, roving retail vehicles could deliver goods to people on demand at all times of day.[66] Other, unthought-of technologies could transform retail even more dramatically. As a result, retailers and developers will need to stay abreast of rapid changes and be adaptable enough to transform more quickly than in the past.

Photo: the physical store will remain at the centre of a total retail experience.



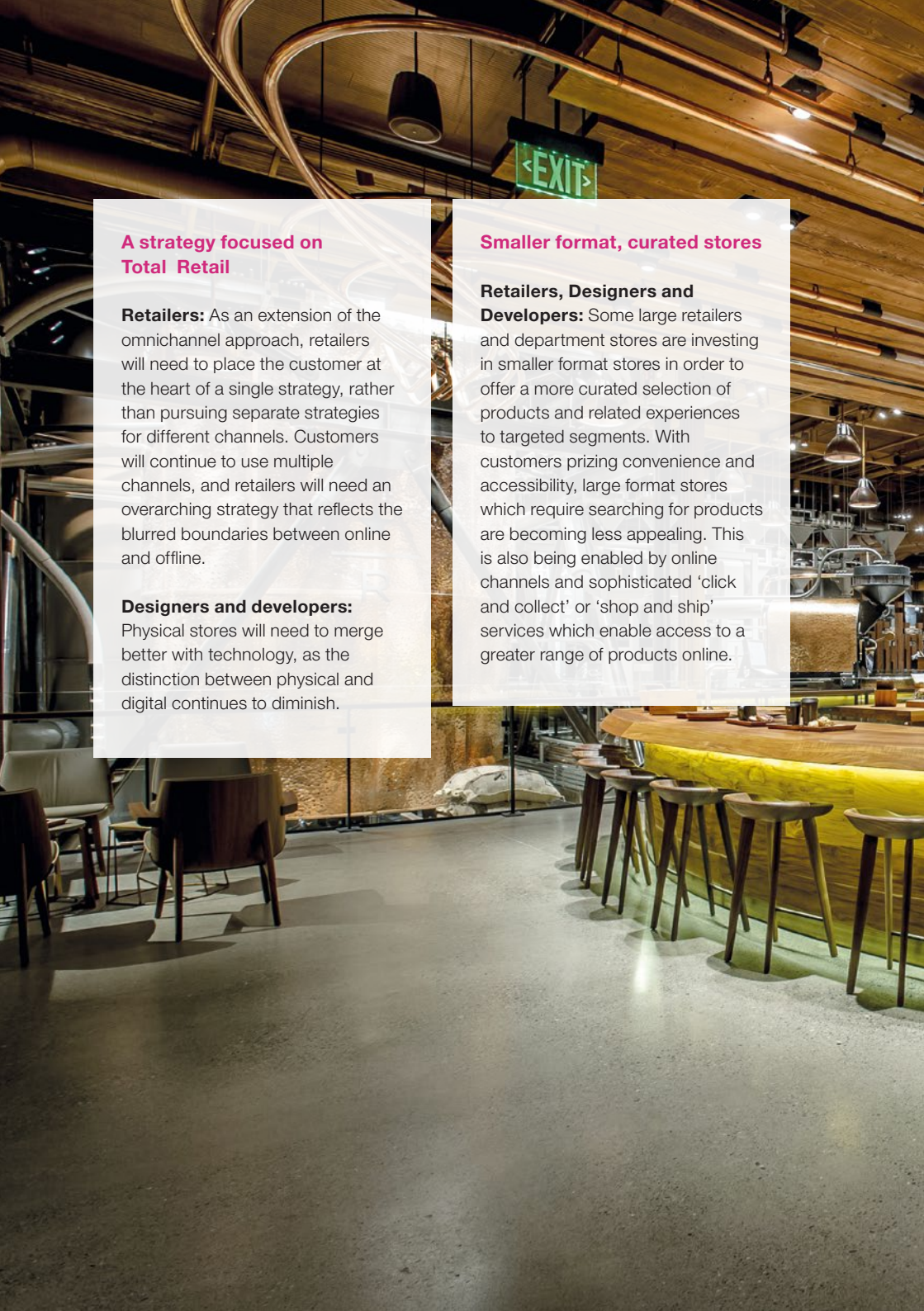
Conclusions

As e-commerce continues along its growth trajectory, retailers will need to fine tune a Total Retail strategy that embraces the growing number of channels used by consumers to browse, shop and return goods. Retailers will need to consider the increasingly blurred boundaries across online and offline experiences, where in-store technology unlocks new services, opportunities and experiences.

The rise of online shopping does not mean that the physical store is obsolete. Instead, the store is evolving to fulfil different needs by providing unique experiences and better quality customer service. Improved data analytics and greater access to more data will enable retailers to generate a much more complete picture of the customer, taking into account income and demographic fragmentation as well as individual preferences, decision-making patterns and behaviours. This will continue to improve the quality of a retailer's engagement with customers and encourage long-term loyalty.

The trends discussed in this report have a number of key implications for designers, developers and retailers. These are summarised in the following two pages.

Left: a distinctive environment at Prada New York Epicentre, which will remain critical to the future of the physical store.



A strategy focused on Total Retail

Retailers: As an extension of the omnichannel approach, retailers will need to place the customer at the heart of a single strategy, rather than pursuing separate strategies for different channels. Customers will continue to use multiple channels, and retailers will need an overarching strategy that reflects the blurred boundaries between online and offline.

Designers and developers: Physical stores will need to merge better with technology, as the distinction between physical and digital continues to diminish.

Smaller format, curated stores

Retailers, Designers and Developers: Some large retailers and department stores are investing in smaller format stores in order to offer a more curated selection of products and related experiences to targeted segments. With customers prizing convenience and accessibility, large format stores which require searching for products are becoming less appealing. This is also being enabled by online channels and sophisticated 'click and collect' or 'shop and ship' services which enable access to a greater range of products online.

New configurations in physical stores

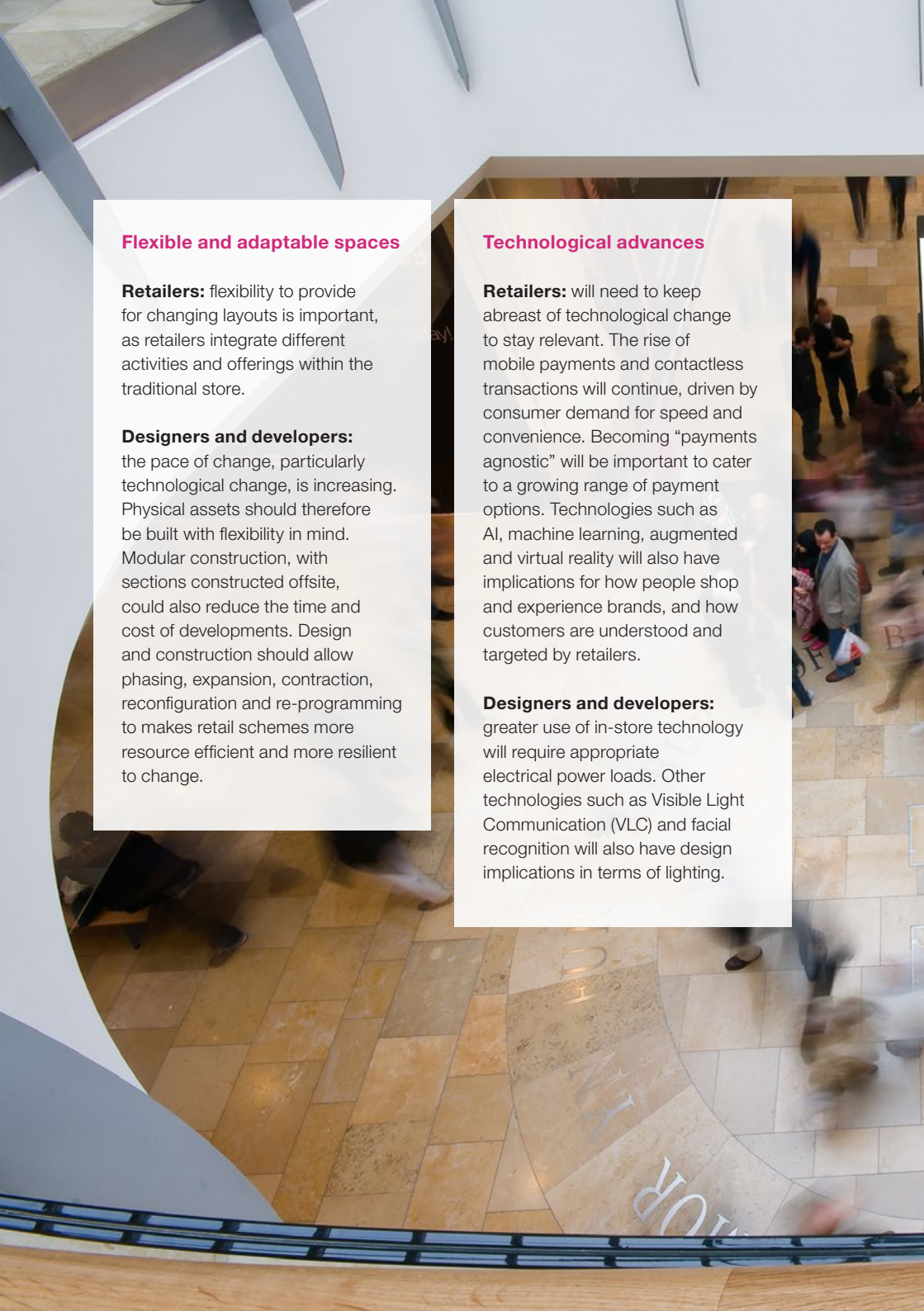
Retailers: The increased focus on experience means that retailers will dedicate more space to services, showcases and curated events, with reduced merchandise on floors and less need for inventory. In addition, with people living longer, retailers will increasingly need to cater to a wider range of ages.

Designers and developers: With the trend towards new forms of payment and checkout-free stores, more valuable floorspace can be given over to other uses and functions. Spaces and experiences will also need to be designed for a range of generations including Generation Z, Millennials, Generation X, Generation Y, Baby Boomers and Seniors.

A focus on placemaking

Retailers: as retailers compete for footfall, the importance of creating appealing places has never been greater. Retail stores can contribute to richer mixed-use places by achieving a better integration between retail and the wider local environment.

Designers and developers: in the future, the 'anchor' for shopping malls is more likely to be the quality of the place itself and the experiences it offers for a wider range of customer segments, including the elderly. Most new schemes will focus on the integration of diverse food and beverage options, daylighting and landscaping, open streets or external areas that provide a more natural environment and reduce the cost of building.



Flexible and adaptable spaces

Retailers: flexibility to provide for changing layouts is important, as retailers integrate different activities and offerings within the traditional store.

Designers and developers: the pace of change, particularly technological change, is increasing. Physical assets should therefore be built with flexibility in mind. Modular construction, with sections constructed offsite, could also reduce the time and cost of developments. Design and construction should allow phasing, expansion, contraction, reconfiguration and re-programming to makes retail schemes more resource efficient and more resilient to change.

Technological advances

Retailers: will need to keep abreast of technological change to stay relevant. The rise of mobile payments and contactless transactions will continue, driven by consumer demand for speed and convenience. Becoming "payments agnostic" will be important to cater to a growing range of payment options. Technologies such as AI, machine learning, augmented and virtual reality will also have implications for how people shop and experience brands, and how customers are understood and targeted by retailers.

Designers and developers: greater use of in-store technology will require appropriate electrical power loads. Other technologies such as Visible Light Communication (VLC) and facial recognition will also have design implications in terms of lighting.

Sustainability makes business sense

Retailers: investments in energy efficiency, better logistics systems, minimising resource use, eliminating waste and reducing pollution can result in cost savings and also appeals to customers. As shoppers become increasingly aware of the whole product journey, many will demand greater quality, transparency and sustainability in the products and services they consume. Retailers that have good sustainability credentials are more likely to be successful over the long term.

Designers & Developers: The application of sustainability and circular economy principles to design and construction can reduce waste and improve efficiency.

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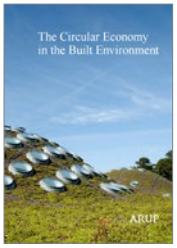
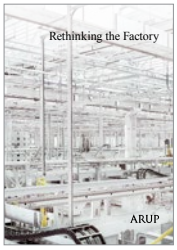
Publications

Living workplace considers a broad spectrum of research and trends relevant to this transforming typology, including digital services, emerging business models and workforce wellbeing. By analysing what aspects need immediate attention and action, the report aims to help developers, tenants and designers better understand the forces shaping the workplace of the future.

Reimagining property in a digital world highlights that the property sector has not yet fully committed to operating digital property portfolios. Individual initiatives are often isolated, and as a result the full benefits are not realised. The message for developers and corporate real estate executives is that every business will need its own digital strategy if it wants to achieve improved operational performance, a better end user experience and consequently higher long term valuations.



The circular economy in the built environment identifies how the circular economy can benefit Arup, our clients, and the built environment sector. We reflect on the economic, social and environmental advantages of employing circular principles. We propose strategies to progress our offering, deliver new services, engage a wider network of stakeholders and unlock opportunities for all parties in the value chain.



Rethinking the factory describes the emerging trends, processes and technologies that will transform the manufacturing landscape. The inevitable shift to leaner, smarter and more flexible forms of production will have a range of impacts on how the factory is designed, how supply chains operate, how people experience changing operational environments and how the future spaces of production will be organised.

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About Arup

Arup is the creative force at the heart of many of the world's most prominent projects in the built environment and across industry. We offer a broad range of professional services that combine to make a real difference to our clients and the communities in which we work.

We are truly global. From 100 offices in 38 countries our 11,000 planners, designers, engineers and consultants deliver innovative projects across the world with creativity and passion.

Founded in 1946 with an enduring set of values, our unique trust ownership fosters a distinctive culture and an intellectual independence that encourages collaborative working. This is reflected in everything we do, allowing us to develop meaningful ideas, help shape agendas and deliver results that frequently surpass the expectations of our clients.

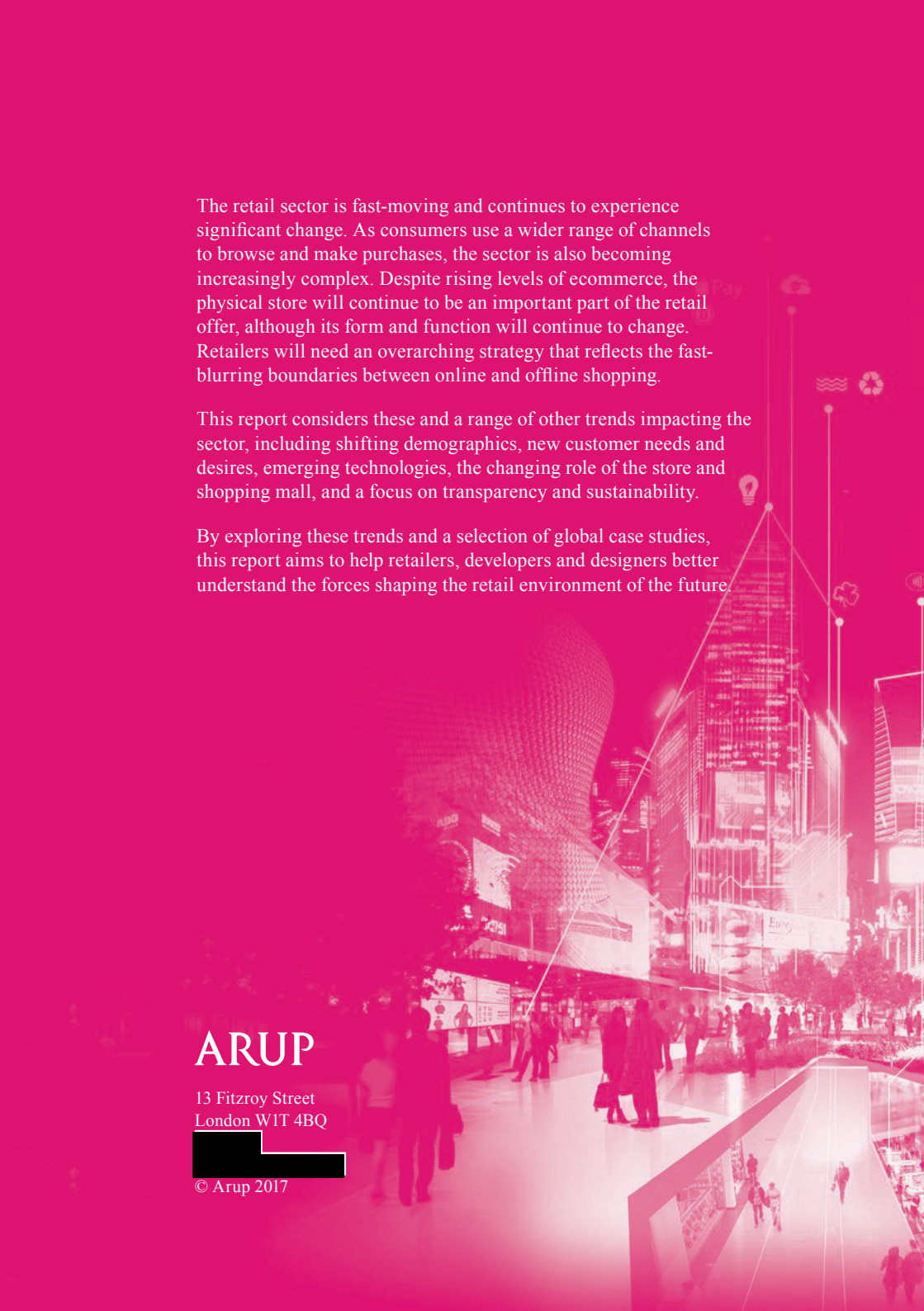
The people at Arup are driven to find a better way and to deliver better solutions for our clients.

We shape a better world.

The retail sector is fast-moving and continues to experience significant change. As consumers use a wider range of channels to browse and make purchases, the sector is also becoming increasingly complex. Despite rising levels of ecommerce, the physical store will continue to be an important part of the retail offer, although its form and function will continue to change. Retailers will need an overarching strategy that reflects the fast-blurring boundaries between online and offline shopping.

This report considers these and a range of other trends impacting the sector, including shifting demographics, new customer needs and desires, emerging technologies, the changing role of the store and shopping mall, and a focus on transparency and sustainability.

By exploring these trends and a selection of global case studies, this report aims to help retailers, developers and designers better understand the forces shaping the retail environment of the future.



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