The Future of Advanced Aerial Mobility

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VERTICAL

Contributors

Vertical Aerospace would like to thank our whitepaper contributors for their help in drafting this document.

virgin atlantic

AVOLON

Heathrow

Skyports

NATS

1. Foreword

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A new form of flight is coming to our skies – faster than many realise. Vertical Aerospace is here to electrify aviation.

The VA-X4 will be flying, fully certified by 2024. The UK is well-placed to be a global leader in designing, building and deploying Advanced Air Mobility (AAM) aircraft. We have the skills, the technology, and increasing customer orders from around the world. The VA-X4 is helping to revive the legendary British aerospace industry too.

Vertical is not flying solo. The X4 depends on an expert UK ecosystem of partners. Virgin Atlantic will fly them, from major hubs like Heathrow, in airspace designed and managed by NATS, landing at existing sites and new vertiports built by Skyports. This whitepaper describes how we will work together and deliver safe, quiet, low carbon, inexpensive air transport to the UK.

It's a big prize. An estimated 1–2% of GDP, thousands of highly-skilled British jobs and billions in valuable exports. Productivity will grow as congestion falls. New connections emerge, making regions and nations of the UK stronger, driving new levelling-up opportunities. New products and services will enhance lives for everyone in the UK. And for the planet as a whole, we will help the move towards Net Zero – cutting carbon by reducing reliance on short-haul flights and other modes of transport.

The UK can lead this transportation revolution. To build and maintain that lead we need government to support. Clear, pragmatic regulation, guaranteeing safety and encouraging rapid uptake.

The future is coming in for landing.

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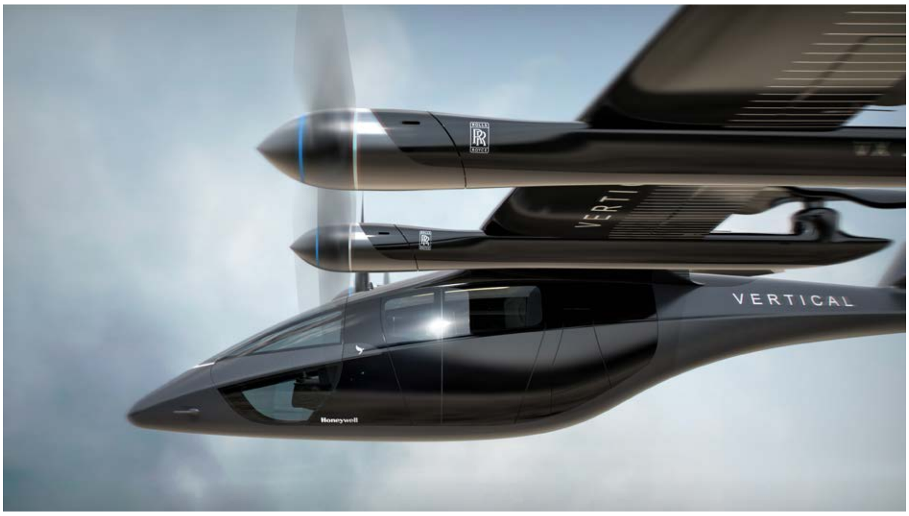
2. Executive Summary

Advanced Aerial Mobility (AAM) is a future transport, enabled by electric Vertical Take-Off and Landing (eVTOL) aircraft flying from existing airports, rural locations, and new inner-city bases.

The VA-X4, engineered by the UK's Vertical Aerospace, is a first-generation AAM aircraft. It carries four passengers and one pilot on intercity journeys at prices comparable to rail or taxi fares.

AAM will deliver huge economic benefits and improve British lives. Journeys won't just become cheaper; they'll become easier, more direct, and cleaner. Stronger connections will help level-up Britain, bringing cities and people closer. Productivity will rise. Transport congestion will ease. The air taxi market is forecast to become a multi-billion-pound industry, and the UK Government predicts it will lift GDP by 1.8% by 2030.

The UK is a world leader in AAM and has the chance to build on that lead. The UK can reclaim its position as an end-to-end designer and manufacturer of commercial aircraft. AAM is a high-tech, high-skill industry with enormous export potential. 88% of our current aerospace jobs are located beyond London and the South East – a truly nationwide opportunity.



Leading aviation industry players and emerging AAM pioneers are collaborating, establishing a UK ecosystem that will realise this new mode of transport – and the socio-economic progress it brings. Stakeholders include Virgin Atlantic, Heathrow, NATS, and new entrants like Skyports. All are developing novel infrastructure and services for this growing industry.

This whitepaper introduces AAM. It is a statement of intent, outlining how commercial eVTOL services will manifest in the UK. It is for airlines, aerospace manufacturers, start-ups, investors, infrastructure providers, and policymakers.

We'd rather talk than write. It's here to engage and spark conversations.

Here are the key topics we cover:

- AAM is becoming a reality – faster than many expect. The past few years have seen rapid acceleration in investment and significant vehicle certification progress
- AAM success depends on a partner ecosystem with a common goal – one single entity won't make it happen
- The UK is well-placed to be a leading developer and adopter of AAM technologies and products; we have a sizable domestic market and all the ecosystem partners

We also highlight the challenges to overcome:

- A lack of government direction on the ambition for AAM risks leading to over complex or fragmented regulation and policy making
- Suitable infrastructure locations (in quality and quantity; both urban and rural) must be made available near passenger demand
- Existing airspace management frameworks must evolve intelligently for the safe incorporation of eVTOL aircraft
- The British public must be brought along as this new mode of transport takes off

Vertical Aerospace is looking forward to collaborating with emerging private sector partners and UK public authorities to surmount any obstacles. The lessons learned and successes in Britain will become the roadmap for similar ecosystems around the world.

3. What is AAM?

Aviation is on the verge of a new revolution, one set to transform the industry just as Whittle's jet engine did ninety years ago. Tomorrow's revolution is propelled by electric motors, energy storage, lightweight composites, digital technologies, and systems integration. They enable an emerging class of electric and hybrid aircraft to operate in both urban and regional environments.
The growing maturity of these technologies means clean sheet aircraft design, with hitherto unseen performance advances.

We're on the cusp of an Advanced Aerial Mobility (AAM) era. A form of transport that makes passenger and cargo missions viable to and from locations that were – until now – impractical or uneconomical to serve by air.

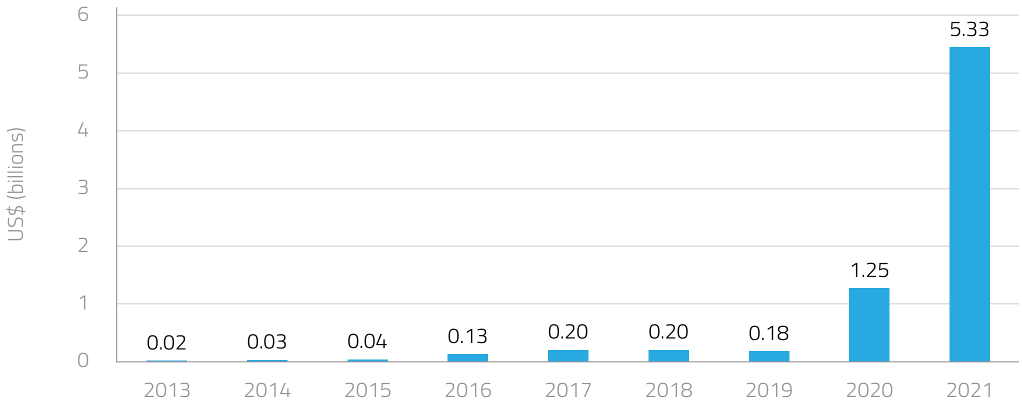
The vehicles enabling these flights will typically be driven by an electric powertrain, powered by batteries or green energy sources. They will be capable of Vertical Take-Off and Landing (VTOL) or Short Take-Off and Landing (STOL). First-generation aircraft will be piloted, paving the way for increasingly automated and potentially autonomous flight.

This new generation aircraft design bridges the gap between communities separated by inconvenient public transport or impassable terrain, facilitating new regional networks. Because, unlike helicopters, they are safe, clean, and quiet, VTOLs will deliver huge benefits for densely populated cities too – more convenience and less congestion. Urban Aerial Mobility (UAM) will provide the air transport links closer to passenger demand – in the city rather than beyond city limits.

In this whitepaper we use Vertical Aerospace's VA-X4 to illustrate the capabilities of the AAM ecosystem and performance characteristics of a first generation eVTOL aircraft. Vertical Aerospace is a leading designer and manufacturer of AAM vehicles and has the most conditional pre-orders of any OEM worldwide. Vertical will certify the VA-X4 in 2024 and deliver aircraft to launch customers such as Virgin Atlantic the following year.

AAM operations will begin trials in early adopter jurisdictions over the next 2–4 years. Commercial passenger and cargo operations are expected to begin from 2025. The pace of investment in the AAM sector has accelerated in recent years, with at least US$6.5 billion of capital flowing to eVTOL aircraft manufacturers and AAM infrastructure and solution providers in 2020 and 2021.

Global Disclosed AAM Sector Investment (2013–2021)[1]



AAM-fuelled change will be profound and far-reaching. Transportation, emergency response and logistics business models will be positively disrupted. The unit economics of the new technology will be favourable upon introduction and improve continuously as technologies mature. Entrepreneurs will identify and seize new opportunities. Established aerospace firms and supply chains will benefit from new markets. AAM is more than new aircraft designs, it is a significant new transport ecosystem with UK-wide socio-economic implications. It is a new industry.

As well as job creation and investment, a flourishing AAM sector aligns closely with UK policy objectives – decarbonisation, cleaner infrastructure, and, helping the nation to "Build Back Better" in a post-Covid world. It boosts regional development, supporting the "Levelling Up" agenda. It tackles urban congestion and realises wider economic benefits and export opportunities.

Jet technology democratised air travel in the mid-20th century. Electric aviation will deliver similar benefits for companies and nations that lead this coming revolution.

1 Lufthansa Innovation Hub AAM Investment Dashboard

4. Why AAM?

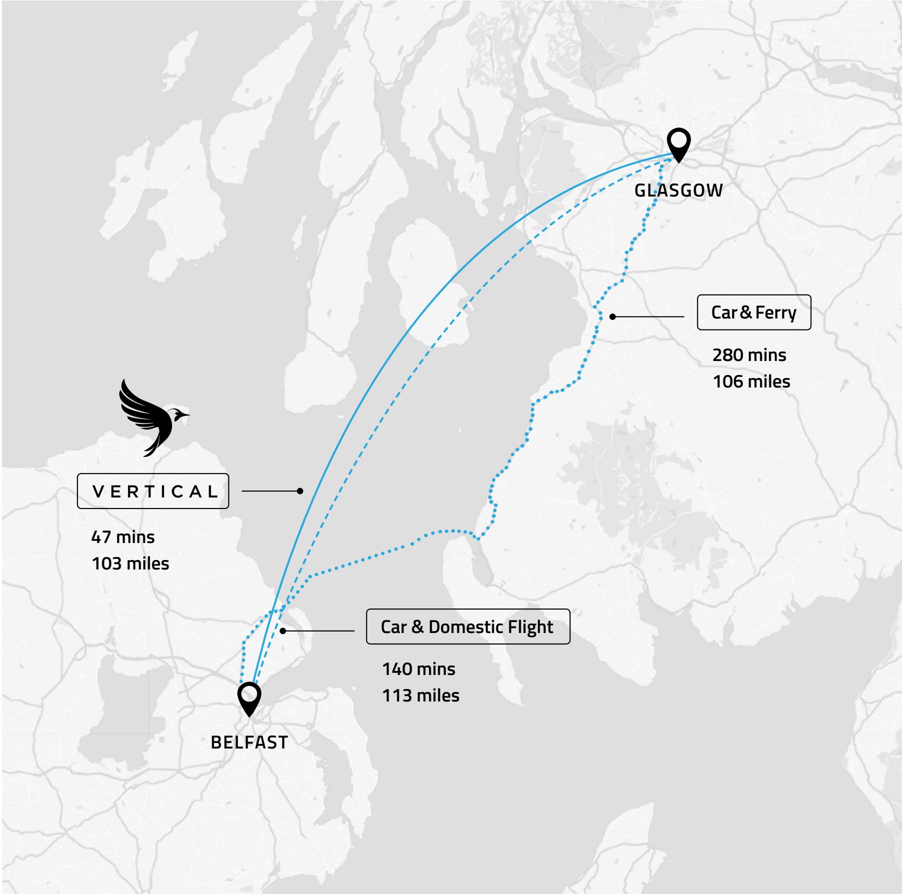
4.1. Cost & Convenience

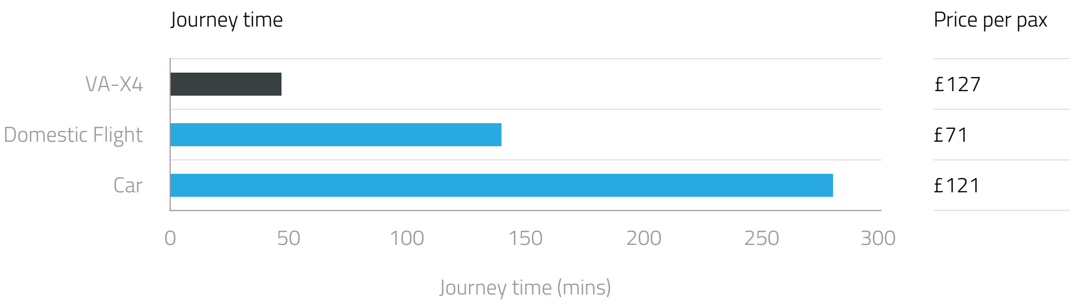
AAM operations enable quick and inexpensive journeys, free of surface infrastructure constraints. eVTOL aircraft like VA-X4 have a cruise speed of around 150 mph (240 kph), far beyond typical road or rail speeds. Flying a near straight line from origin to destination, they take the most efficient route provided by air traffic control. This means unrivalled journey times, at competitive prices, transforming intracity and intercity travel.

We have illustrated the consumer benefits in the UK using five examples. Each of these sample journeys solve specific, real-world travel problems across the UK. These include:

- **Belfast–Glasgow** – Testing travel over large expanses of water, vital for our island geography and improved national connectivity
- **Aberdeen–Edinburgh** – Proving how AAM compares on speed and cost for a relatively straight, economically important route with existing infrastructure
- **Liverpool–Hull** – Showing AAM in the cross-Pennine Northern Powerhouse corridor, currently blighted by transport bottlenecks
- **Cardiff–Plymouth** – Illustrating how AAM plugs gaps in regional transport networks, radiating from London
- **Cambridge–Heathrow** – Connecting key economic nodes while avoiding congestion

Belfast to Glasgow

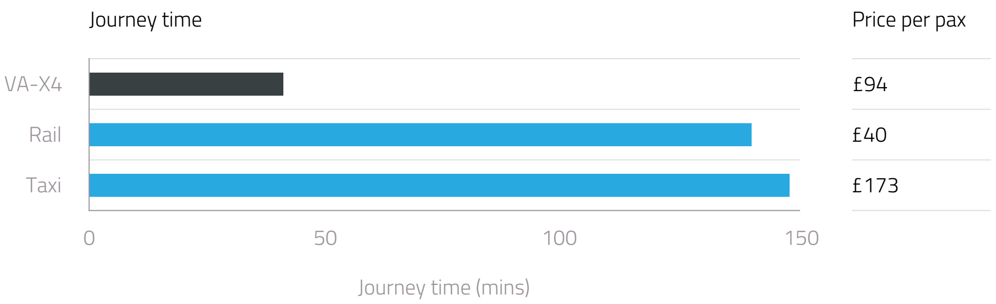




Belfast and Glasgow have long-standing social and economic links. Direct connectivity is currently provided by flights and ferry services across the Irish Sea. Resilient, flexible and affordable connectivity to the rest of the UK is a recurring challenge for Northern Ireland.

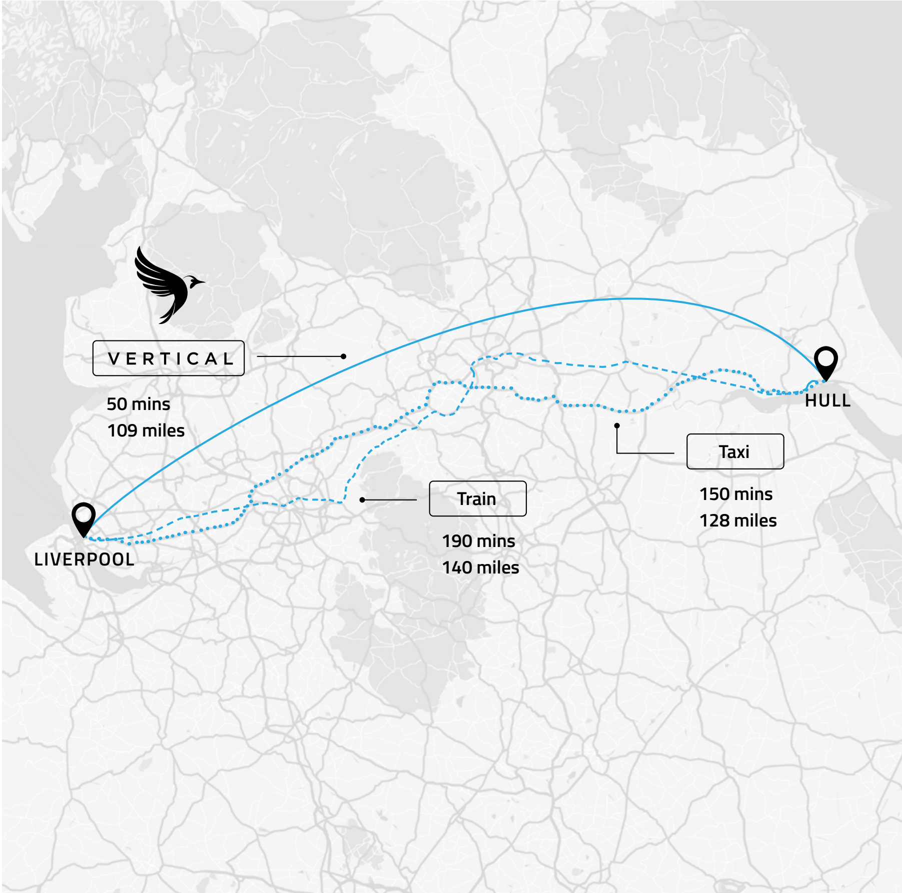
Flight routes to Glasgow and elsewhere have struggled with the economics of full scale civil aircraft. Alternative schemes to enhance links, such as a bridge and tunnel, while technically feasible are challenging in terms of infrastructure costs and time.

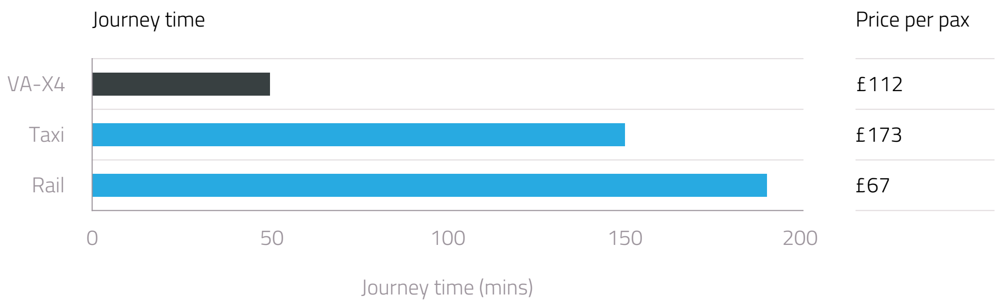
Aberdeen to Edinburgh



Aberdeen is the centre of the Scottish energy industry, a major university town and regional city. Edinburgh, Scotland's capital and financial centre is 128 miles away. They are already joined by a direct road, the M/A90, and served by direct flights and trains too. On journeys like this the VA-X4 still offers material time savings – cutting travel time from city centre-to-city centre by minutes – almost two thirds. Ticket costs would be similar to conventional air or rail tickets.

Liverpool to Hull

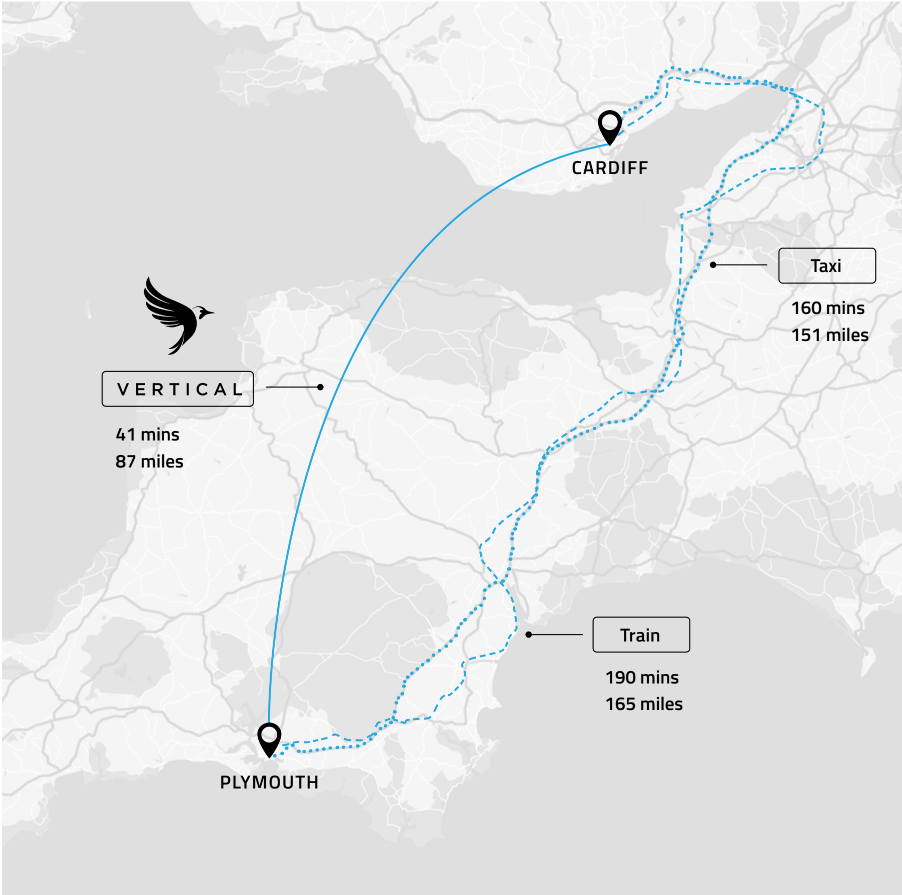


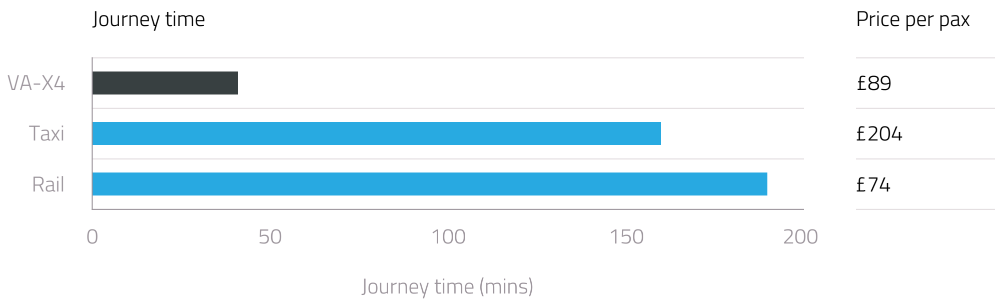


In 2016, the Government's Northern Powerhouse strategy outlined the region's economic challenges. Poor intercity connectivity, caused by the mountainous terrain and inadequate transport infrastructure was cited as a significant obstacle to progress. An eVTOL like Vertical's VA-X4 can traverse the Pennines, flying from Liverpool to Hull in just 45 minutes. Going by road or rail would take almost three hours to complete – if the going was good. Similarly, M62 congestion means it frequently takes over two hours drive the 40 miles between Manchester and Leeds[2]. The VA-X4 would take 22 minutes.

2 HM Government Northern Powerhouse Strategy

Cardiff to Plymouth

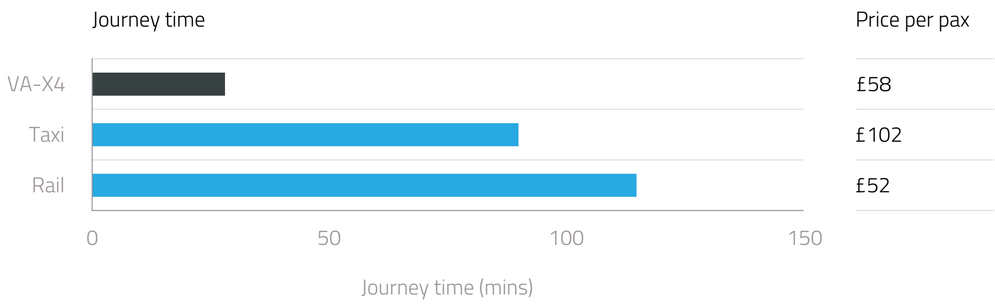




South West England is one of the UK's largest regions and home to five million people. Devon and Cornwall are significantly out of step with the rest of the UK when it comes to productivity[3]. Their relative isolation – poor interregional and intraregional transport links – fuels the disparity. Aircraft like the VA-X4 bridge rugged terrain, expediting travel to regional urban centres.

3 Pennon Group plc: Levelling Up the Great South West: a G7 Legacy

Cambridge to Heathrow



Cambridge is the heart of Britain's high-technology industry, and home to world beating software and bioscience companies. The area has significant long-haul travel demand that only Heathrow Airport can serve. Travel between Cambridge and Heathrow is slow and unpredictable. It takes over 1.5 hours driving around the M25 or on the train via central London. The VA-X4 will cut the journey time by 75%.

4.2. Economic Benefit

4.2a The Air Taxi Market

Morgan Stanley expects the global air taxi application market to be worth $3.7 trillion by 2050[4]. Served by both traditional airlines as well as new shared economy air transport service providers, passenger services will have varying sector lengths, and cover intercity, intracity and regional air taxi services.

The UK can capture a significant proportion of this opportunity. A densely populated collection of islands with high GDP per capita, we have a need for practical and cost effective regional transport to complement relatively slow road connections and sparsely populated regional flights. London, one of the world's wealthiest megacities, has multiple transport chokepoints. These factors create a major opportunity – the launch of UAM services. Management consultants, Roland Berger, believe that ~6,500 VTOLs could be in service in the UK by 2050 across the largest 18 cities.

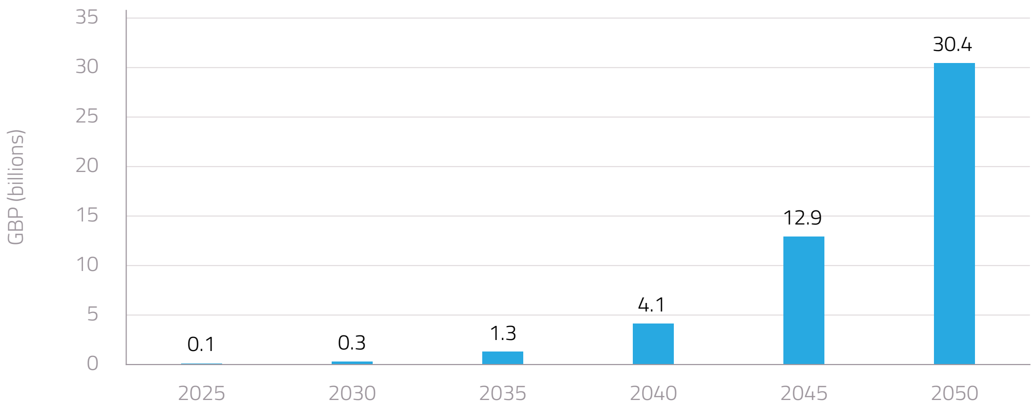
Roland Berger UK VTOL Market Forecast

	2025	2030	2035	2040	2045	2050
VTOLs in Operation	69	321	927	2,060	4,245	6,456
VTOL Flights (000s)	196	1,152	4,212	11,810	30,732	58,795

Extrapolating projections made by Morgan Stanley and Roland Berger, Vertical Aerospace estimates the UK AAM market could be worth over £30 billion in annual revenue by 2050. Market growth will be driven by the displacement of road journeys and trips across highly convoluted public transport routes. AAM will replace regional flying to islands or across large river estuaries. eVTOL aircraft will also stimulate journeys that would not have taken place over existing surface infrastructure, owing to the favourable unit economics and convenience.

4 Morgan Stanley eVTOL/Urban Air Mobility TAM Update

Vertical Aerospace UK Air Taxi Market Forecast



4.2b Improved Connectivity

Transportation networks are key to sustaining economic success. Road, rail, air, and sea links facilitate travel in the UK and with the wider world. This infrastructure connects people with jobs, delivers products to markets, underpins supply chains, and supports international trade. The correlation between improved connectivity and economic growth in the United Kingdom was established by the Eddington Transport Study in 2006[5]. These lessons hold true for developed and developing economies.

Cities are a modern economy's lifeblood. In the UK, cities account for over 80% of the national economic output, and they are host to many of our most important political and cultural institutions. Urban congestion can cost as much as 2–4 percent of national GDP due to lost time, wasted fuel and the increased cost of doing business[6].

Beyond the large metropolises that dominate the national economy, many towns, and cities are stifled by poor connectivity. Travelling from Liverpool to Hull or from Brighton to Bristol require lengthy drives or frustrating train journeys, despite straight line distances being relatively short. Economic potential is hindered by the disproportionately large travel time – an inconvenience affecting students, entrepreneurs and businesspeople.

5 HM Government: The Eddington Transport Study
6 McKinsey: An Integrated Perspective on the Future of Urban Mobility, Part 2

AAM is a new form of connectivity, enabling cost-effective travel that relieves urban centres of congestion and facilitates the nationwide flow of talent and services. This will stimulate the economy as productivity increases and more surface capacity becomes available for freight transport. The government-funded Future Flight Challenge suggests that the introduction of AAM services can increase UK GDP by 1.8% by 2030[7].

4.2c World Leading Aerospace Industry

Since the Second World War, the UK has been at the forefront of the civil aerospace industry. After decades of consolidation, the industry is now concentrated around Airbus and Boeing, the duopoly that manufactures most of the world's passenger aircraft. Both depend heavily on UK-based expertise and supply chains to manufacture parts and subsystems. However the UK has lost a civil aerospace aircraft OEM.

7 UK Research & Innovation: Future Flight Vision and Roadmap, August 2021

AAM represents a once in a generation opportunity for new manufacturers to enter the industry. The open design space and novel operational parameters negate many of the barriers to entry that protect incumbents from competition. Vertical Aerospace is one of a handful of companies in the world and the only UK-based OEM to have flown multiple full-scale eVTOL aircraft and secure a large conditional order book.

Aerospace is a high-growth, high-value industry. With a highly skilled workforce, it contributes substantially to UK exports[8]. National champions such as Rolls-Royce and BAE systems are core to the sector's success in the UK, creating demand for supply chains that involve numerous SMEs across the country. 88% of aerospace jobs are based outside of London and the South East, making the sector an important contributor to the Government's "Levelling Up" agenda[9].

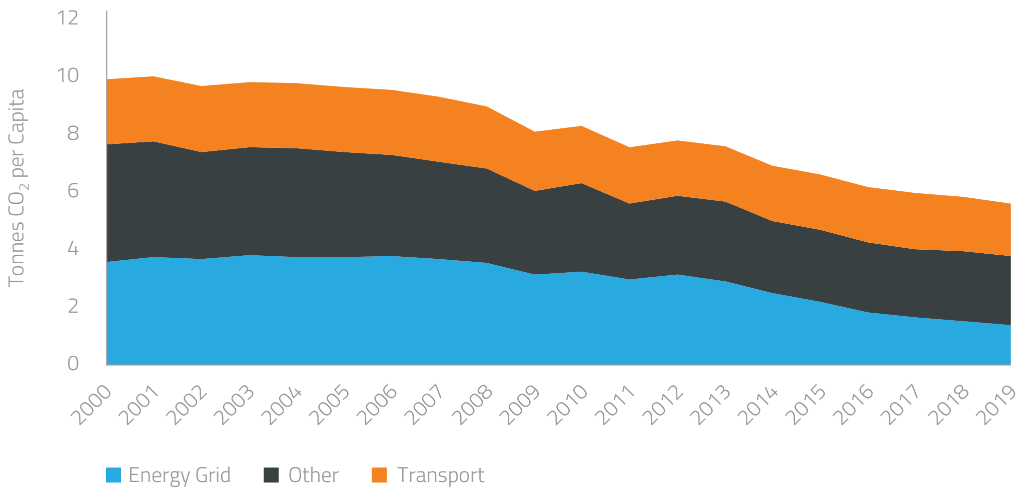
Vertical Aerospace can return the UK to the end-to-end design, manufacture and certification of civil aircraft. This is a complex undertaking that will lead to the creation of thousands of high-quality jobs through direct and indirect economic effects, supporting new high-tech supply chains throughout the UK with enormous export potential. The projected VA-X4 projection run of 10,000 aircraft by 2031 will generate turnover of approximately £30 billion. Up to 80% of this value will be captured by UK-based supply chains.

8 House of Commons Committee on Leaving the EU: Aerospace Sector Report
9 ADS Group: Industry Facts & Figures 2021

4.3 Sustainability

The UK is a global leader in the fight against climate change. The Climate Change Act 2008 saw a cross-party consensus committing Britain to reducing its Kyoto greenhouse gases to 80% of the 1990 baseline by 2050. The UK has since gone further and committed to reaching net zero carbon emissions in the same time frame. Over the past 20 years, UK carbon emissions reduced dramatically. CO_2 emissions per capita have fallen from 9.67 metric tonnes of CO_2 in 2000 to just 5.47 by 2019, a 43% reduction[10 11].

UK Carbon Intensity per Capita by Sector

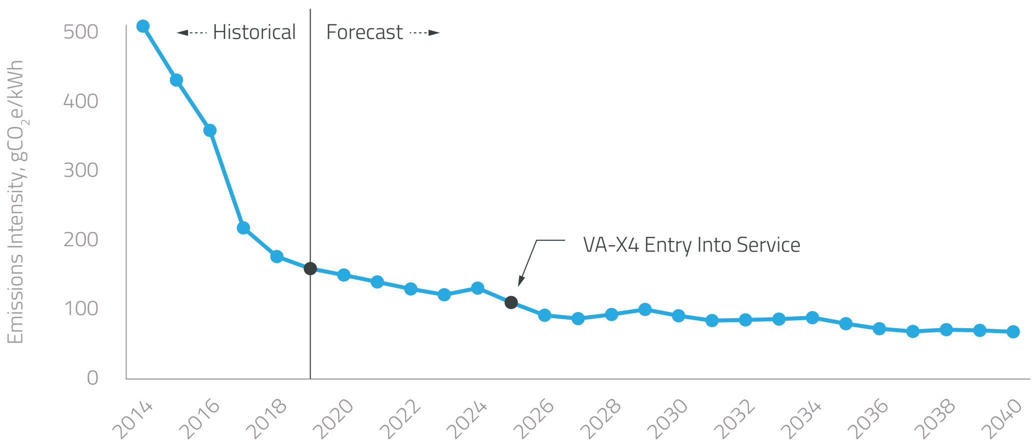


UK energy grid decarbonisation has contributed significantly to the sustained fall in emissions. Since 2000, the grid's carbon intensity has fallen by over 60%. Agricultural and industrial sectors have seen per capita emissions fall by 42% over this period. Transport is the laggard in the UK's drive to decarbonise, with per capita emissions falling by less than 20%. In 2019 transport accounted for 33% of Britain's total annual carbon emissions.

The key to reducing transport sector emissions is transitioning from internal combustion engines to electric motors. Fossil fuel powered modes of transport have marginal year-over-year improvements in efficiency and thus reduction in emissions. But the carbon intensity of electric motors links directly to the carbon intensity of the energy grid from which they draw power. As renewables continue to provide a greater share of our power, UK electricity will continue to become greener.

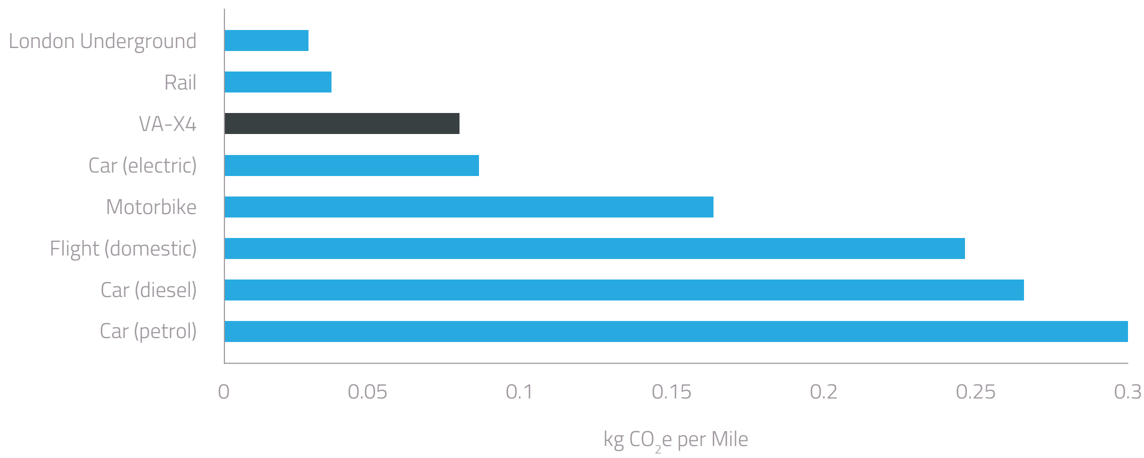
10 UK Greenhouse Gas Emissions National Statistics
11 ONS Population Estimates for the UK (mid-2020)

UK Energy Grid Carbon Intensity Forecast[12]



By 2025, when substantial numbers of the VA-X4 have been delivered to UK customers, energy grid carbon intensity is forecast to fall to just 106 gCO_2/kWh, 30% lower than the last confirmed value in 2019. The Department for Business, Energy and Industrial Strategy (BEIS) forecasts a fall to as low as 67 gCO_2/kWh by 2040, equivalent to a 4% year-over-year decrease. AAM manufacturers can provide a low emission means of travel to displace more polluting modes of transport.

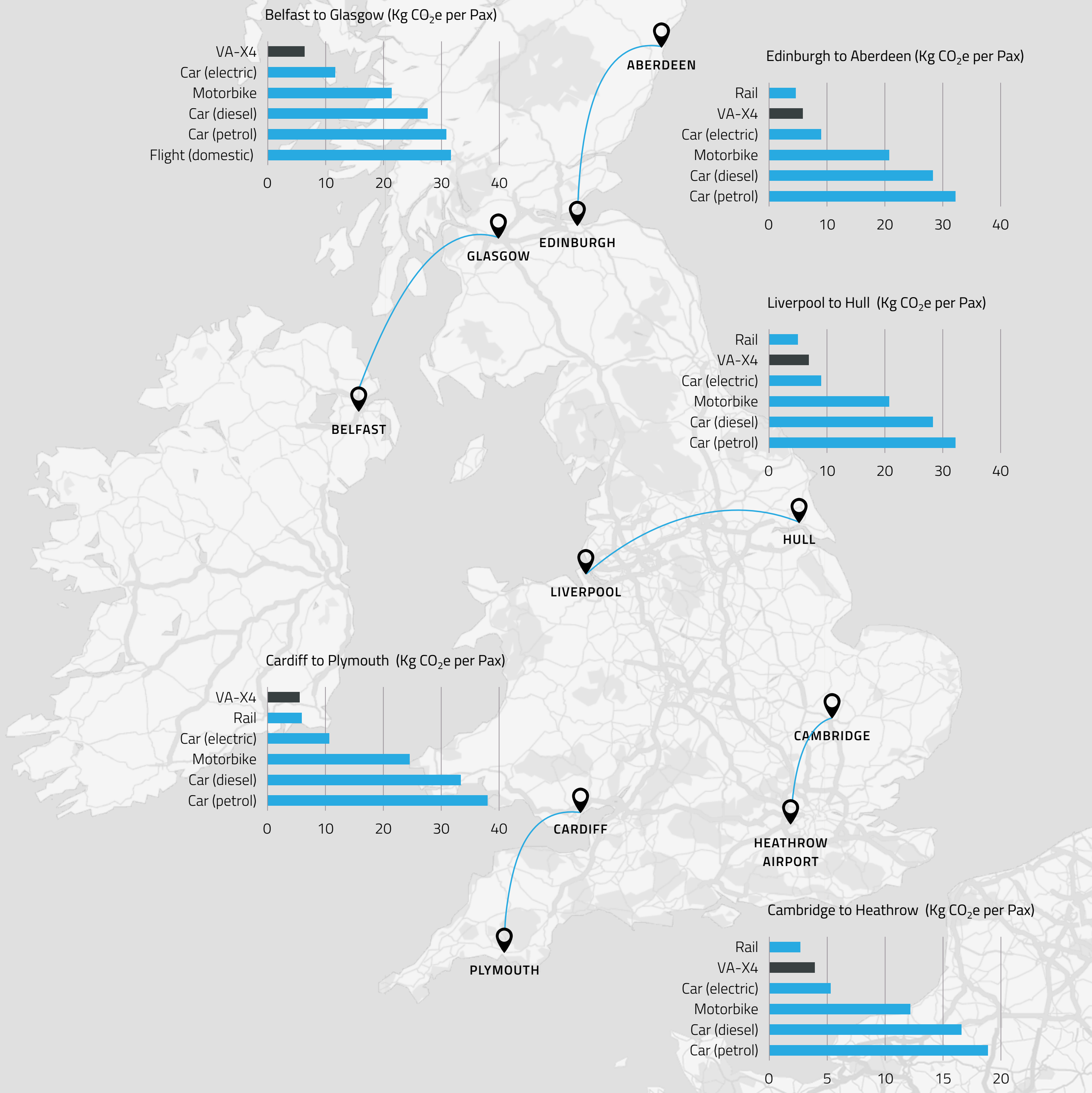
Estimated 2025 Carbon Intensity per Mile by Mode of Transport[13]



Notes: VA-X4 assumes indicative 70 mile journey, 68% load factor (2.7 passengers)
Car assumes 1.2 occupants (UK average for business or commuting use cases)

12 BEIS Energy and Emissions Projections
13 BEIS Greenhouse Gas Reporting: Conversion Factors 2021

Estimated Carbon Emissions per Passenger by Journey Type in 2025



Notes: VA-X4 assumes 68% load factor (2.7 passengers)
Car journeys assume 1.2 occupants (UK average for business or commuting use cases)
All journeys start and end at respective city centres
Belfast to Glasgow air journey assume Car (petrol) journey from city centre to airport
Belfast to Glasgow car journeys assume taking ferry from Larne to Cairnryan

Commercial VA-X4 services will have a carbon footprint on par with an electric car being used for commuting or business travel over the same distance using grid power. This highlights the potential of AAM as a sustainable form of travel in the UK's transport mix. Operators of scheduled AAM services also have the option to power their aircraft with a carbon free source of electricity. This would reduce the carbon emissions per mile travelled to the residual life cycle cost of manufacture and disposal of the vehicle.

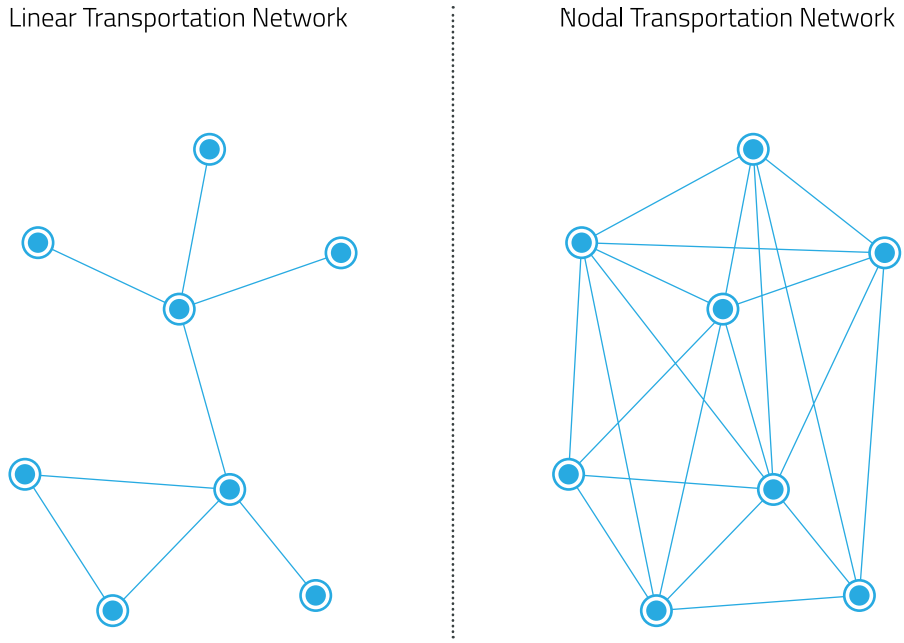
The VA-X4 and other AAM vehicles will become the unrivalled option for decarbonising transport where surface transport is not possible or highly circuitous. Compared to petrol or diesel transportation, the VA-X4 will always reduce carbon emissions. On direct journeys such as Cambridge to Heathrow or Edinburgh to Aberdeen, electrified surface transport has a similar carbon intensity to VA-X4 services, but will take significantly longer. However on journeys such as Belfast to Glasgow or Cardiff to Plymouth, there would be few other options to travel at such a low carbon intensity.

4.4. Resilience

AAM can introduce a far greater resilience into the transport network. Roads and railways form a linear transport network fixed and limited by terrain. They are built at great expense and incur costly maintenance. They have a limited capacity that cannot be flexed to meet fluctuations in demand. Blockages or disruption on arterial motorways or rail trunk routes sees congestion ripple across the network.

Comparison of Linear vs. Nodal Transportation Networks

Linear Transportation Network | Nodal Transportation Network



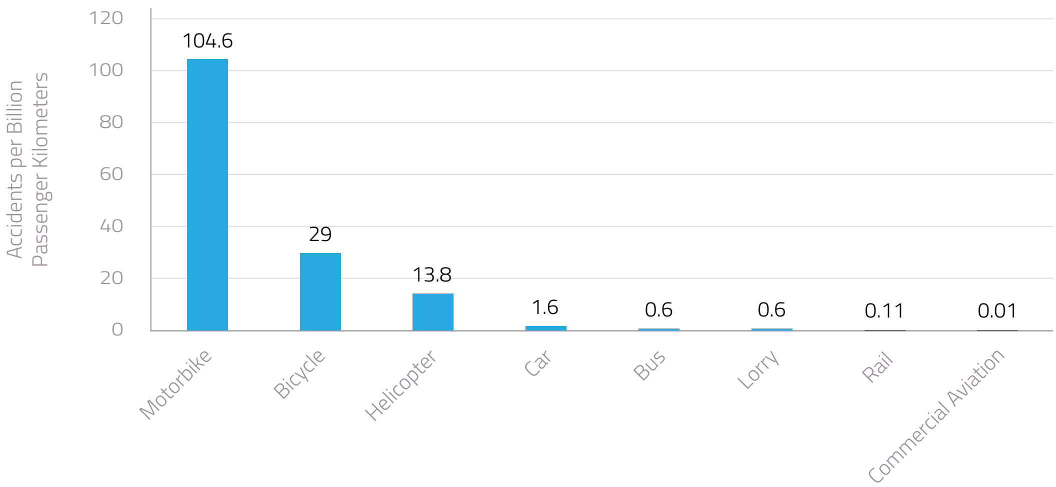
AAM, by contrast, forms a nodal transportation network that is more adaptable to changing market demand and less resource intensive to build. eVTOL aircraft moving directly between any node on the network do not need to traverse physical paths defined by surface infrastructure. Capacity between nodes is easily scaled up or down by adjusting route vehicle numbers. Disruption caused by mechanical issues or damage at a vertiport has limited potential to influence travel between other nodes on the network.

Network nodes are easily added with comparatively little capital investment. Cargo or emergency service providers can reach ad hoc landing sites, less constrained by surface infrastructure. The flexibility provided by AAM ensures that transport networks in the UK remain resilient and reliable, supporting a modern economy and the delivery of vital public services.

4.5 Safety

Commercial air transport is the safest form of travel for both passengers and cargo. In 2019 the global fatality rate was 1 per 884,000 flights[14]. The UK has an even more favourable safety record, with the commercial aviation sector experiencing no loss of life over the past decade[15]. This compares favourably with all other forms of transport[16]. Commercial aviation in Britain is over 100x safer than travelling by car when comparing fatalities per passenger kilometre. It is more than 1000x safer than travelling by helicopter by the same metric.

Accidents per Passenger Kilometre in the United Kingdom



Note: Helicopter data is 1995–2004 average, all other data points from 2019[17]

Why is a flight with an airline so safe? High safety standards and regulatory scrutiny. All aspects of commercial aviation, from aircraft engineering, pilot training, air traffic control and maintenance, have seen decades of development, underpinned by a strong industry-wide culture of safety. Single points of failure have been removed, with all critical systems having multiple points of redundancy.

14 IATA 2019 Safety Report
15 UK DfT and CAA Aviation Accidents and Incidents data
16 Reported Road Casualties in Great Britain: 2019 Annual Report
17 UK Offshore Commercial Air Transport Helicopter Safety Record

With the advent of new AAM vehicles, regulators and the public will expect the same exacting safety standards as they do with jet aircraft, especially as these vehicles will operate over densely populated urban areas.

For this reason, Vertical Aerospace is certifying the design, manufacture, and operation of the VA-X4 to comparable levels of safety stringency as the commercial aviation industry. As people move from road, rail and helicopter to eVTOL aircraft for cross-country journeys, injuries and accidents will fall dramatically.

5. Forging a New Ecosystem

5.1. Original Equipment Manufacturers (OEMs)

VERTICAL

OEMs design, build and achieve regulatory approval for eVTOL aircraft. Vertical Aerospace is working towards EASA certification for its VA-X4 aircraft, enabling it to enter commercial service in 2025. Vertical has chosen an asset-light business model, seeking only to produce and sell the best eVTOL aircraft to operators and asset managers. Other OEMs in the AAM space are considering operating their aircraft and assuming responsibility for establishing infrastructure and managing airspace.

5.2. Operators

virgin atlantic

Operators provide scheduled and charter services using eVTOL aircraft procured directly from an OEM or leased from an asset manager. Network carriers, such as Virgin Atlantic, will utilise aircraft such as the VA-X4 to offer commercial passenger services that complement their existing networks.

Virgin Atlantic are among the very first airlines in the world to announce entry into the eVTOL market, with an option to acquire up to 150 VA-X4s. Virgin Atlantic will fly VA-X4s on the first and last 100 miles of the passenger journey, relieving passengers of the burden of travelling to/from airports via cumbersome or circuitous surface transport.

Regional services beyond hub airports will follow. We expect new shared mobility offers to enter the market over time, taking advantage of the capabilities and unit economics of eVTOL aircraft to launch on-demand air taxi services.

5.3. Asset Managers

AVOLON

Asset managers, commonly referred to as lessors, will own a fleet of eVTOL aircraft and lease them out to operators. This business model is common in commercial aviation due to the significant capital required to purchase a sizable aircraft fleet. Avolon is the first major lessor to enter the eVTOL market, placing orders and options for 500 VA-X4 aircraft.

Lessors like Avolon will accelerate the adoption of eVTOL aircraft by providing investment capital to OEMs and other ecosystem partners, enabling established and start-up operators to have early access to these vehicles. They will enable "asset-light" business models to emerge by allowing these operators to bring aircraft such as the VA-X4 into their fleet without requiring substantial upfront capital.

Today lessors own nearly 50% of global commercial aircraft. eVTOL portability and large addressable market opportunities make them attractive assets to own alongside existing narrowbody and widebody fleets. The ease with which eVTOL aircraft can be upgraded (for example, by swapping older batteries for higher capacity ones) strengthens the case for the presence of experienced commercial asset owners to manage a large proportion of the fleet. Other lessors are likely to enter the market over the coming years.

5.4. Physical Infrastructure Providers

Heathrow

Skyports

Infrastructure providers will offer locations for eVTOL vehicles to take off and land. Terminal facilities will process passengers before embarking and after arrival. They will provide overnight storage facilities and accommodate charging infrastructure.

Large commercial airports and heliports are the current face of aviation infrastructure and will serve the AAM sector. Aircraft such as the VA-X4 will allow smaller aerodromes to attract scheduled services too. Dedicated eVTOL infrastructure, known as "vertiports", will be established in urban and rural locations to bring aerial transport closer to passenger demand.

5.5. Air Navigation Service Providers (ANSP)

NATS

Air Navigation Service Providers coordinate aircraft movement through controlled airspace, preventing collisions and ensuring efficient air traffic flow. The UK already has sophisticated air traffic management systems for directing commercial aircraft through British airspace and around major airports. Commercial providers such as NATS are now developing systems to enable the AAM sector to operate safely in conjunction with existing civil and military users of airspace.

5.6 Regulators & Policymakers

Policymakers will set the frameworks that will govern the launch and growth of eVTOL transportation. Regulators like the UK Civil Aviation Authority (CAA) will implement the regulations set by policymakers and provide certification for eVTOL aircraft design, manufacture and operation. The Department for Transport (DfT) is the UK transport policymaker and will establish national policy that governs how AAM infrastructure and operations are deployed.

5.7. Maintenance, Repair and Overhaul (MRO) Providers

MROs provide maintenance services to operators, ensuring eVTOL aircraft airworthiness. They must rapidly diagnose problems with electromechanical components and implement repairs in accordance with OEM instructions. While a mature network of maintenance providers caters for the commercial aviation industry, new business models must be developed to support a large distributed fleet of smaller, highly utilised aircraft.

New skills are needed to maintain eVTOL aircraft, including battery refurbishments and electric powertrain repair. These are highly transferable skills across the wider aviation and automotive industries as the transition from combustion engines to hybrid and electric propulsion accelerates.

5.8. Flight Schools

Flight schools will train AAM pilots. Many commercial aviation flight schools have started to invest in AAM training products and facilities for the thousands of pilots that will be required.

Vertical Aerospace believes 21,000 pilots will be needed worldwide to operate the cumulative production volume of just the VA-X4 by 2032. This illustrates the substantial number of pilots needed across the entire AAM sector when compared to the 387,000 pilots in active commercial service in 2019.

6. Use Cases

The commercialisation of AAM represents a new mode of transport to complement the UK's existing infrastructure. While the development of vehicles like the VA-X4 remains on-going and the features of any UK AAM network are yet to take shape, the advantages of eVTOL aircraft lend themselves to certain journey types.

6.1. Connecting Airports

The launch of eVTOL aircraft opens new passenger connections with the UK's major airports. Journey times by car or rail to Heathrow, Gatwick and Manchester airports can be over two hours. eVTOL aircraft enable passengers flights from convenient local starting points to vertiports on or next to those airports in an hour or less, with seamless transfers to conventional flights. The UK's leading hub airports will be more accessible, to more people, enabling optimal utilisation of constrained capacity.

Heathrow Hub (100 mile radius)

Illustrative cases

Brighton – LHR

	Mins	Miles
VA-X4	25	47
Car	75	64
Train	120	67

Bristol – LHR

	Mins	Miles
VA-X4	42	91
Car	110	103
Train	120	109

Cambridge – LHR

	Mins	Miles
VA-X4	28	56
Car	90	75
Train	115	75

Oxford – LHR

	Mins	Miles
VA-X4	22	40
Car	55	44
Train	90	55

Portsmouth – LHR

	Mins	Miles
VA-X4	27	52
Car	70	64
Train	140	90

Southampton – LHR

	Mins	Miles
VA-X4	28	55
Car	70	63
Train	130	74

6.2. Connecting Regions

AAM networks will boost connectivity across UK regions via new intercity connections, complementing existing road and rail infrastructure. With comparatively limited infrastructure investment, regional links of up to around 100 miles are possible, such as between Manchester and Hull or Liverpool and Birmingham. eVTOL aircraft like the VA-X4 reduce 100-mile journey times to less than 45 minutes, making air travel more convenient.

The limited infrastructure requirements mean operators can flex capacity to meet demand, ensuring regional networks can react quickly to economic growth. Regional AAM networks can boost the value of current and planned conventional transport infrastructure like HS2, by making major stations such as the Birmingham Interchange more accessible to more people via quick eVTOL flights from their local area.

6.3. Urban air taxis

With safety standards of comparable stringency to commercial airliners, and with a noise profile similar to background urban noise, eVTOL aircraft can serve dense networks within congested urban areas such as London and Manchester. Short distance, on-demand “air taxi” services, hailed via app, will eventually become a new urban transit mode. The ground infrastructure required for urban aerial networks can be built onto existing buildings with appropriate specifications – car parks, new development rooftops , all designed to support and benefit from air taxi services.

6.4. Non-passenger and ad-hoc uses

The safety levels, low noise and low operating costs of eVTOL aircraft make them attractive use cases beyond commercial passenger transport. For example, time-sensitive, high-value cargo deliveries could be made across the UK by connecting distribution centres with airports.

Niche missions to sporting and cultural events would also be possible. Medical transport and deliveries are similarly well-suited to the capabilities of eVTOL operations, with hospital landing infrastructure already present in many cases.

7. Challenges

We believe that AAM offers a huge opportunity for the UK – an opportunity it is very well placed to seize. The UK already has many strong players across the emerging AAM ecosystem, many of whom are already actively working towards launching services.

There are, however, challenges to making AAM a reality in the UK. None are insurmountable, yet cooperation and focussed pragmatism is required.
This section discusses the challenges surrounding the regulatory environment, provision of infrastructure and public acceptance.

Despite these challenges we can see public flights by 2025 and the creation of a significant new industry by 2030.

7.1. Policy & Regulation

AAM will need to operate within a clear policy and regulatory framework.
The safety of the aircraft and operations must be the primary concern. Yet the discussion on such a framework for the AAM sector remains at an early stage.

Policymakers in the UK are yet to provide overarching guidance on establishing an AAM ecosystem. While the private sector can undertake much of the work, a number of areas do require public authorities to set, confirm or clarify the rules.

An overarching UK government position on AAM opportunities would help to align an approach around these questions. There are many ways this could be achieved. The Department for Transport could issue a National Policy Statement (NPS) on AAM infrastructure. The National Policy Planning Framework (NPPF) could be updated to provide guidance to authorities on how to accommodate AAM into local planning.

We should apply existing policy, legislation, regulations, and frameworks where possible. Established procedures have the benefit of safety, familiarity, and predictability. It reduces ecosystem complexity and the immediate burden on policymakers.

However, there are policy framework gaps and issues that will emerge as AAM volumes grow. Government, working closely with the wider ecosystem, must address:

- Definition of electric aircraft classes and categorisation between them as there is convergence with civil aeroplanes and drones
- AAM airspace management over urban areas and at larger volumes of flights, plus effective policy and processes for airspace evolution
- Security requirements for AAM operation for both passenger and airframe security, plus evolving standards over time
- Pilot licensing arrangements, and further into the future (i.e. into the 2030s), autonomous piloting frameworks
- Vertiport aerodrome licensing regulation, particularly as vertiports evolve beyond existing airport, heliport and aerodrome sites
- Planning permission and other environmental permitting rules for vertiports and AAM operation, including defining the decision rights and roles of local authorities

In developing policy on all these fronts, the challenge of decision-makers is to prioritise issues over time. Close and constructive engagement with the entire ecosystem is required. There must be clear focus on outcomes and impacts. There must be a fundamental belief that the UK will benefit from facilitating AAM on a 2–5-year timeframe.

7.2. Infrastructure

New infrastructure must be developed to accommodate a growing fleet of eVTOL aircraft. Current infrastructure has been built around conventional aircraft and a limited number of rotorcraft. Despite analysts projecting tens of thousands of eVTOL deliveries over the next two decades, work on designing and building the required infrastructure remains in its early stages.

Aircraft such as the VA-X4 will have different needs to aircraft deployed by the commercial aviation industry but will in most cases be able to utilise existing airport infrastructure. However, new facilities will be needed to make full use of AAM vehicle capabilities: the so called "vertiport". New capabilities will also be needed to appropriately site infrastructure near sources of passenger demand in a way that synergises with existing transport networks without causing disruption.

7.2a Commercial Airports

Commercial airline operators are planning to use eVTOL aircraft to enhance existing short-haul and long-haul services. To achieve this goal, large airports such as Heathrow, Gatwick and Manchester must determine how to support the movement of tens of vehicles like the VA-X4 every hour.

Processing small passenger volumes entering or leaving the airport by eVTOL aircraft relative to existing numbers is addressed relatively easily. New passenger facilities may be required for specific service models. More challenging is busy airspace, airfield traffic, and limited apron footprints for airports already facing capacity bottlenecks. Local stakeholders must be included in conversations and presented with a convincing case on noise and other impacts.

Large hubs like Heathrow have already begun engaging relevant stakeholders on eVTOL challenges. Commercial VA-X4 services can substantially improve access to the airport and reduce car journeys to and from the airport but integrating novel aircraft into a complex operational environment requires careful planning. Vertical Aerospace is working with large airport operators to test the suitability of the infrastructure for navigation, take-off and landing, parking, and charging.

7.2b Airfields and Heliports

Regional airports will play a role in facilitating interregional UK flights.
These airports vary significantly in the scale of activities taking place. They may see low volume scheduled services or infrequent business jet flights. Many are significantly underutilised in terms of the available runway or on-site parking infrastructure. The surrounding airspace is likely to be congestion-free and the runway located a comfortable distance away from urban areas.

Conversely many such airports have more limited infrastructure for handling passengers and aircraft. High-capacity charging infrastructure is required too. Many airfields have low voltage mains connections – unsuitable for eVTOL aircraft rapid charging. Investing in new infrastructure may be further limited by strained economics, limited passenger numbers and the need to access regional development funding.

AAM can radically transform the business model of these airports by providing a substantial revenue stream to a sometimes-struggling sector. However, in their current state, these airports are furthest behind in being able to facilitate large numbers of eVTOL operations. In the near-term, a turnkey "vertiport in a box" solution may be required to make such locations regulation compliant.

7.2c Vertiports

Vertiport is the catchall term for dedicated infrastructure to accommodate vehicles capable of vertical take-off and landing. These serve as a site of operation for eVTOL aircraft and provide customer services to passengers of AAM services. Many vertiport design and operation concepts have been proposed. They range from temporary structures erected in car parks or fields to dedicated airport-style terminals constructed on the rooftops of train stations or office buildings. Between 3,500–10,000m^2 is required to accommodate a vertiport, including take-off and landing areas, taxiways and vehicle stands, charging infrastructure and areas for passenger handling.

Vertiports are a novel infrastructure concept; significant work must be undertaken by the vertiport provider, eVTOL operators, city planning authorities and the CAA to define how they will operate technically and commercially.
At present there is no design manual or licencing regime in the UK or any other

major market for vertiports. The world's leading civil aviation authorities such as EASA, the Federal Aviation Authority (FAA) and standards setting bodies like the European Organisation for Civil Aviation Equipment (EUROCAE) and ASTM International have been devising appropriate design and operational standards. This licencing regime will presumably set standards for operational procedures, obstacle limitation surfaces, visual aid requirements, and provision of fire-fighting and medical services. The CAA may apply similar guidance once it emerges.

The process for developing new vertiports can be lengthy and complex due to stakeholder numbers. In most cities, building planning and permitting is an expensive, convoluted process, which can take years, particularly for aviation infrastructure projects. The NPPF in the UK will need to set rules for vertiport development and operations before they can be deployed at the scale and speed needed. The estimated timeline for vertiport development can be 3–6 years depending on location sensitivity. As the industry proves itself over time and more data becomes available, it should streamline planning and permitting.

Skyports Vertiport Concept Art

The challenges facing vertiports are different in urban and rural areas. Passenger and public safety in city centre vertiports is the primary challenge. This can be ensured by effective vertiport design and placement to minimise complexity as pilots navigate airspace around the landing site. Highly redundant operational processes must be established to ensure that aircraft can divert to suitable landing sites in the event of equipment failure or a blockage at the destination vertiport.

In rural areas, vertiports may suffer from the problems facing regional airfields. Sites located at motorway service stations or out of town shopping centres will not have space constraints, but they will need investment to develop passenger processing facilities and high capacity charging infrastructure. OEMs must work with third party providers to ensure maintenance capabilities away from major towns and cities to support rural operations.

7.3. Air Space Management

With the advent of AAM, aircraft numbers in our skies are going to grow quickly. Accommodating these aircraft while avoiding disruption to existing aviation requires a new way of managing airspace. Conventional manned aviation is dependent upon Air Traffic Management (ATM) services or a pilot's ability to see and avoid other aircraft. Drones, air taxis and very high-altitude vehicles perform very differently from conventional aviation. In some cases, these vehicles have no onboard pilot to see and avoid other aircraft. The challenge is to reconcile different modes of operation, enabling all aircraft – manned and unmanned – to operate safely and efficiently.

There are multiple efforts underway to modernise airspace management. The primary challenge is to modernise the airspace structure to accommodate today's commercial aircraft capability and tomorrow's new airspace users.
As the main ANSP in the UK, NATS is leading many of these initiatives. It is a key contributor to the UK's Airspace Modernisation Strategy (AMS), which is being led by the CAA to create a sustainable and efficient future for our national airspace infrastructure. NATS is driving the inclusion of AAM and other future technologies ahead of publication of the latest iteration to the AMS.

NATS has invested in Unified Air Traffic Management (UTM) capabilities, such as modern surveillance and information exchange systems, to provide safe and secure air traffic control services. Enhanced communications allow air traffic controllers access to all real-time information about AAM operations. This enables delivery of a common information service to UAM-related airspace users. Increasingly, communications with aircraft will be via digital-data exchanges, such as Controller Pilot Data Link Communications (CPDLC) or System-Wide Information Exchange (SWIM). The need for voice communications will reduce to support only non-standard situations such as aircraft emergencies.

Low-volume AAM operations will initially be handled by traditional air traffic management systems. This is especially true for piloted vehicles like the VA-X4, which from an airspace management perspective, look similar to small single pilot aircraft or rotorcraft. These vehicles operate at low altitudes and cruise at speeds below 200mph. They carry an ADS-B transponder, announcing their position to both air traffic controllers and other vehicles in the same airspace. As the volume of commercial eVTOL services grows, dedicated solutions to manage this traffic must be implemented.

Urban airspace in cities like London is very different to the rest of the country, with the entire space controlled from the ground to the very top of the service ceiling. Until the rise of the AAM industry, the only vehicles that could operate at low altitudes in an urban environment were helicopters which have different safety and noise profiles to future AAM aircraft. High profile helicopter accidents led to strict operational regulation in many jurisdictions around the world.

Existing London Rotorcraft Airspace

In London's airspace, most helicopters must follow set routes been designed to keep them away from obstructions and densely populated areas. The routes incorporate locations that allow pilots to land safely in the event of a mechanical failure. Most London locations are therefore completely inaccessible to rotorcraft. Furthermore, airports such as London City Airport are not allowed to accept rotorcraft due to local concerns over noise. Work is underway to modernise the airspace for the future of aerial mobility, establishing new lanes making more of the city AAM accessible.

Together with Vertical Aerospace and other consortium partners, NATS is leading airspace integration work by creating a Concept of Operations (CONOPS) to enable AAM in London[18]. This is taking place within the CAA's Regulatory Sandbox. Using adapted airspace structures and ATM procedures, NATS has applied advanced modelling and simulation to demonstrate that it is feasible to support AAM operations in the capital while integrating with existing airspace users.

18 The UK UAM Consortium features Atech, Eve Air Mobility, Heathrow Airport, London City Airport, NATS, Skyports, Vertical Aerospace and Volocopter

Airspace outside of urban areas poses far fewer challenges for the operation of AAM vehicles. There is much more uncontrolled airspace where pilots do not have an obligation to inform air traffic control of their presence and do not have to equip a transponder to broadcast their location. Initially the number of AAM vehicles will do little to disturb the status quo, but an increasing volume of regional services could bring congestion to areas of the country that historically had seen very few aircraft movements.

Electronic conspicuity via transponders will help pilots, unmanned aircraft, and air traffic management services see a complete airspace picture. This is relevant even in current segregated airspace, where infringements of controlled airspace are can be of significant concern to public safety. Knowing the position and intention of all airspace users is essential to flight safety in integrated airspace.

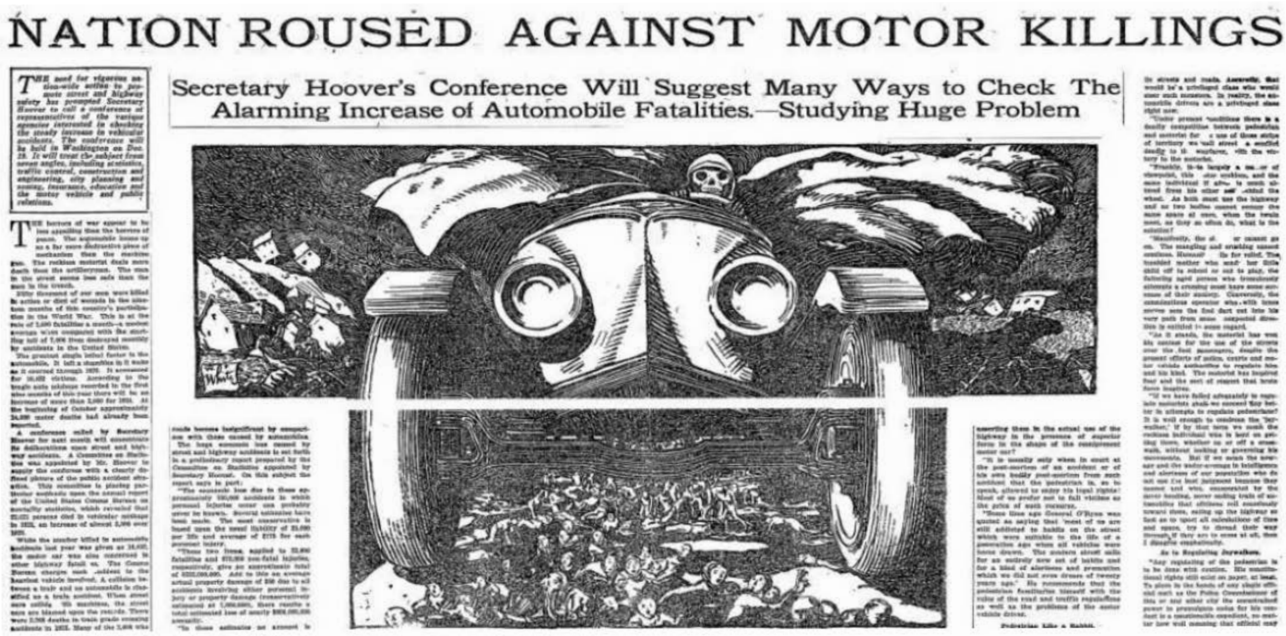
7.4. Public Acceptance

7.4a Overview

An emerging AAM ecosystem will deliver a wide ranging benefits across UK society. Even based on the most pessimistic industry analyst forecasts, an AAM ecosystem will emerge rapidly in countries that embrace the technology. Most stakeholders have not yet grasped how soon this will happen. The speed with which a new paradigm of transit will be deployed across society will be unprecedented.

Most successful transport innovations we now consider to be vital, or even quaint, like the steam locomotive or the automobile, all faced some resistance from sections of the population on their introduction. Some Victorians believed travelling by rail could cause instant insanity. More numerous protestors feared noise, smoke, or the visual impact of railways. As cars proliferated in the 1920s, many people were horrified at the rising number of fatalities caused by what were considered playthings of the rich, rather than a liberating and popular mode of transportation.

Cover of *New York Times*, 23 November 1924

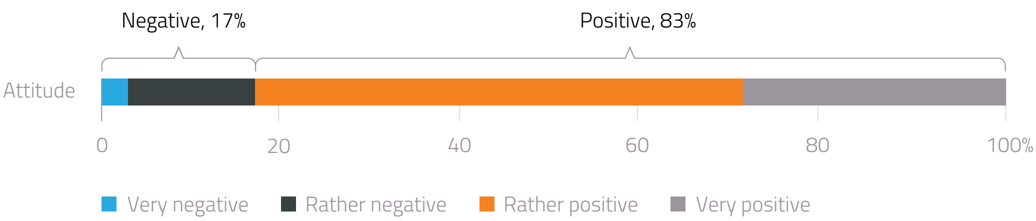


NATION ROUSED AGAINST MOTOR KILLINGS

Secretary Hoover's Conference Will Suggest Many Ways to Check The Alarming Increase of Automobile Fatalities.—Studying Huge Problem

Despite the public's lack of exposure to AAM vehicles and infrastructure, research shows a generally favourable impression of eVTOLs. A recent McKinsey report on behalf of EASA found that 83% of respondents surveyed across a sample of European cities felt positive about the introduction of commercial eVTOL services in urban areas[19]. A large proportion of those surveyed showed an interest in using UAM services.

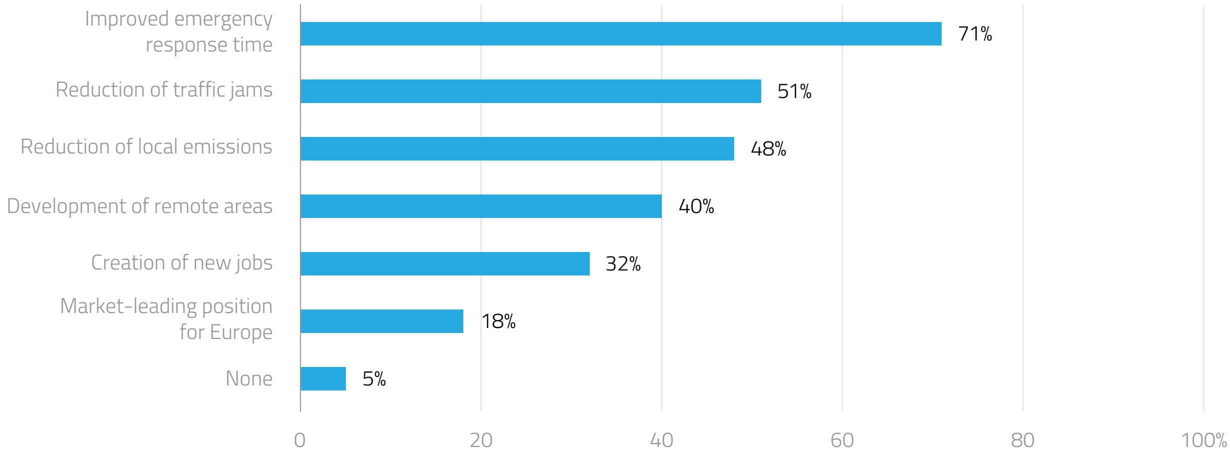
EASA Public Acceptance Survey: Public Acceptance of UAM



Survey respondents also had clear ideas about the benefits that AAM services could deliver to society. A high value was attached to the positive impacts on an individual's security, health, and quality of life. Some respondents also placed value on the economic benefits that would be delivered by such services. UAM was perceived to potentially help citizens gain back green areas because of 'moving' traffic into the air and relieving pressure on the need to build ground infrastructure in the form of roads, bridges, or tunnels.

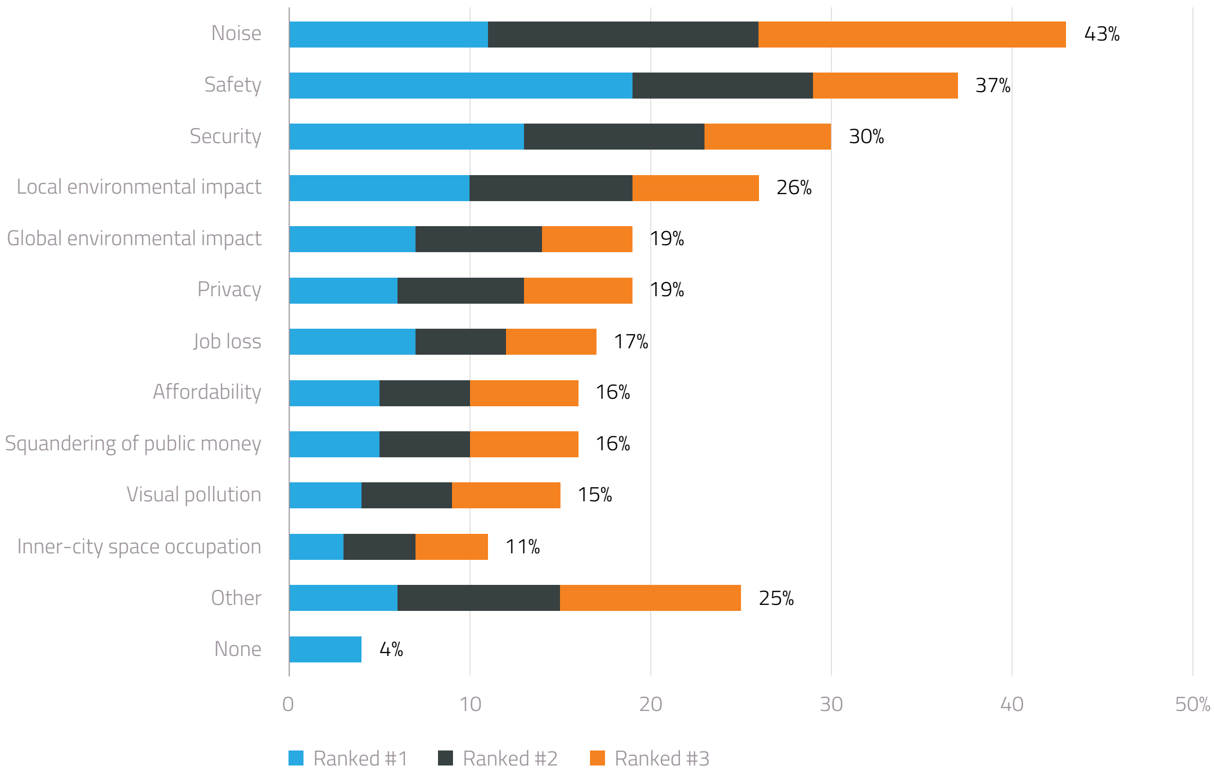
19 EASA: Study on the societal acceptance of Urban Air Mobility in Europe

EASA Public Acceptance Survey: Perceived UAM Benefits



As with previous historical developments in the transport industry, both noise and safety rank highly as public concerns. The EASA survey and other research into attitudes towards AAM consistently find that noise, safety, and security are the biggest concerns. In this context, safety refers to the potential for an accident that causes harm to the public due to technical or human error. Security refers to the potential for an incident caused by criminal organisations or terrorists involving eVTOLs.

EASA Public Acceptance Survey: Top 3 Air Taxi Concerns

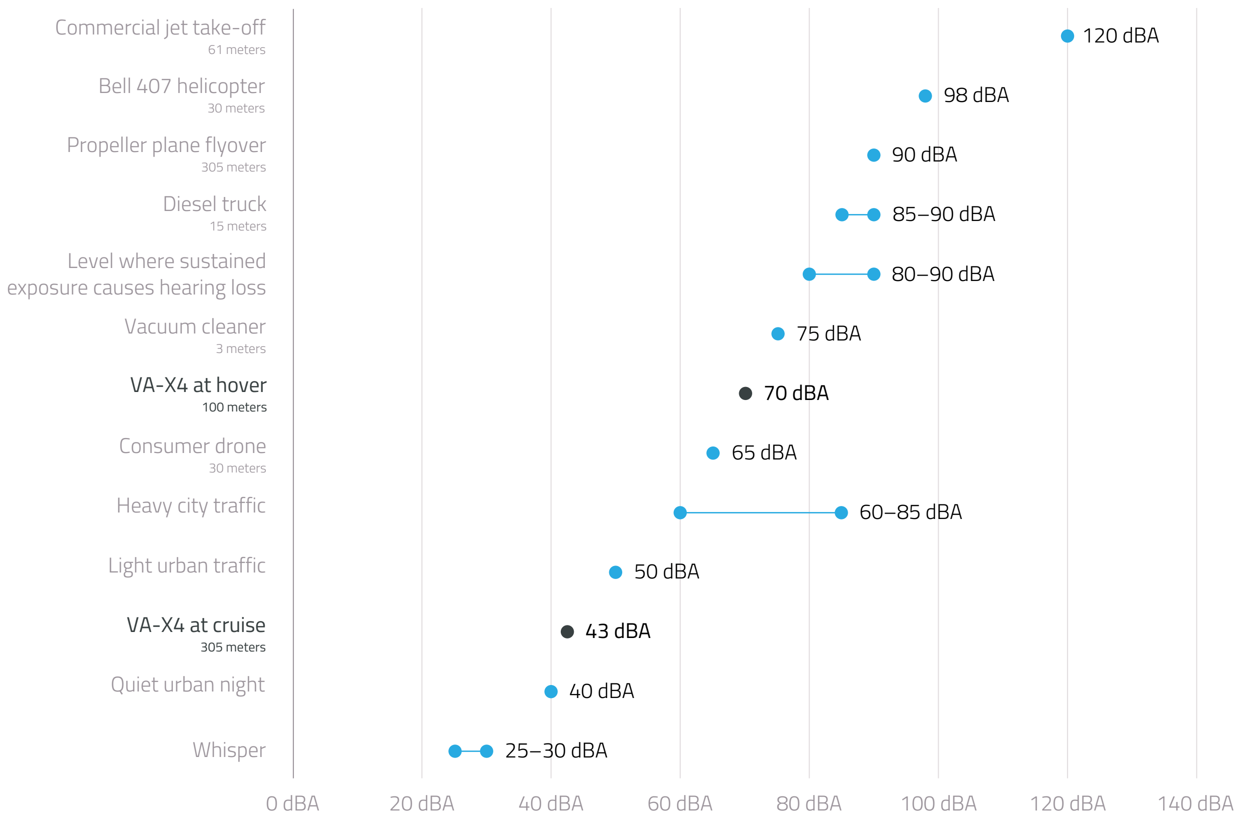


7.4b Noise

Noise is a concern that all eVTOL manufacturers take seriously. Excessive noise is one reason why helicopters are not accepted in urban areas. Helicopter noise is therefore a key benchmark against which OEMs are measuring vehicle performance. eVTOLs with fixed wings have a distinct advantage over helicopters. While helicopters must keep their rotors at a high-power level to provide lift, eVTOLs generate lift using their wing after quickly transitioning from take-off to cruise. As a result, aircraft like the VA-X4 will be barely audible in busy urban environments when flying at cruising altitude.

In built-up areas the public will not just benchmark noise nuisance against helicopters, but other sources of noise in urban environments. As shown below, even the first generation of eVTOLs will compare well to much urban noise – in flight the VA-X4 will be similar to a quiet urban night. This level of noise performance has potential to transform access to both city areas and major airports.

eVTOL Noise Levels Compared to Other Equipment[20 21 22]



20 Kimley-Horn and Associates: Sound Levels of Typical Noise Sources and Noise Environments
21 The Conversation: How loud are drones?
22 Levitate Capital: The Future of the Drone Economy

Noise is not a purely objective phenomenon. The frequency and duration of sound, even at similar levels of intensity, can cause very different levels of irritation to the human ear. Vertical Aerospace is working in cooperation with operators, regulators and infrastructure operators to thoroughly test the acoustic profile of the VA-X4 throughout all stages of flight. This will have implications on the siting of infrastructure and establishment of flight corridors. Vertical continues to invest in technologies to reduce the noise impact of the VA-X4 and subsequent vehicles given the potential for breakthroughs in community impacts.

7.4c Safety

Most respondents to the EASA survey rated safety as their number one concern. The safety record of the civil airline industry speaks for itself. It is orders of magnitude safer than helicopters and all modes of surface transport. Regulators in the UK and Europe are seeking to ensure that similar levels of safety are maintained for any new modes of aerial transport.

The EASA SC-VTOL regulations that will govern aircraft such as the VA-X4 align closely with the existing framework for commercial aircraft on tolerated failure rates and required redundancy. By contrast, regulators in North America have taken a different approach where higher rates of failure are initially being tolerated to stimulate the air taxi market and encourage experimentation with aircraft design and AAM business models.

European & North American VTOL Certification Frameworks[23 24 25]

Regulators	Regulation Name	Equivalent Aircraft	Key certification Requirement
Civil Aviation Authority European Aviation Safety Agency	SC – VTOL	Commercial	1 in 1,000,000,000 failure rate Design Assurance Level-A
Federal Aviation Administration	Part 23	Light Aircraft	1 in 10,000,000 failure rate Design Assurance Level-B
	Part 27	Light Rotor Craft	

23 EASA Special Condition for small-category VTOL aircraft
24 FAA Part 23 Airworthiness Standards: Normal Category Airplanes
25 FAA Part 27 Airworthiness Standards: Normal Category Rotorcraft

Vertical Aerospace takes the view that safety cannot be compromised for go-to-market expediency. As a result, the VA-X4 is being designed and certified to meet the safety stringency standards comparable with the civil aviation industry. It is our intention to maintain the UK's decade-long record of fatality-free scheduled passenger services. By certifying our aircraft to the standards set by the CAA and EASA, the VA-X4 should also see greater acceptance in other countries compared to those under the FAA regime.

Vertical Aerospace will work closely with its ecosystem partners to conduct thorough testing prior to active commercial service. Our partnership with Virgin Atlantic and American Airlines is extremely valuable not only for their expertise on aircraft operating procedure design, but also for ensuring that the public has confidence that the aircraft are airworthy and competently piloted.

7.4d Security

Aviation security is designed to prevent harm to aircraft, passengers and crew from criminals or terrorists. Just as many complementary layers of protection are incorporated into ensuring the safe design, construction and operation of an aircraft, there are many interlocking systems that keep passengers safe from security-related threats. This includes general surveillance and monitoring by national security services, airport security, operator flight crew training and vehicle design.

Although comprehensive regulations governing a future AAM ecosystem have yet to take shape, it is expected that measures like those governing the commercial aviation industry will be required to guarantee the safety of passengers and employees. Passengers will most likely have to present a form of identification before booking a ticket on a scheduled eVTOL service. Many OEMs, including Vertical Aerospace, are also designing the cockpit in line with commercial aviation regulations to prevent incursion from passengers.

8. Roadmap

Party	Action
OEM	▪ Secure Design Organisation Approval (DOA) (2022–23) ▪ Secure Production Organisation Approval (POA) (2022–23) ▪ Conduct certification vehicle test flight campaign (2023–24) ▪ Secure type certification for VA-X4 under EASA SC-VTOL (2024) ▪ Develop OEM approved MRO processes for VA-X4 (2023–24) ▪ Develop OEM approved operating protocols for VA-X4 (2023–24) ▪ Establish manufacturing facility for VA-X4 commercial production volumes (2023–24) ▪ Work with operator and ANSP to conduct sandbox VTOL service trials (2023–24) ▪ Deliver EIS vehicle to operator (2024)
Operator	▪ Hire/train cohort of pilots with VA-X4 type rating (2023–24) ▪ Establish in-house MRO capabilities or relationship with Part 145 organisation with VA-X4 type rating (2023–24) ▪ Collaborate with OEM and ANSP to conduct sandbox service trials (2024) ▪ Define preliminary route network (2024) ▪ Define passenger experience for end user (2024)
Commercial Airports	▪ Evaluate/amend airspace to accommodate increase of VTOL movements (2022–24) ▪ Install rapid charging infrastructure (2023–25)
Regional Airports	▪ Install rapid charging infrastructure (2023–25) ▪ Develop passenger processing facilities (if required) (2024–25)
Vertiport Operators	▪ Finalize vertiport designs (2022–24) ▪ Secure vertiport licenses from CAA (2023–24) ▪ Develop business case and build vertiports in suitable locations (2023–25)
ANSP	▪ Define airspace and procedure design for VTOL aircraft, including Airspace Change Process as applicable (2022–24) ▪ Work with OEM and operator to conduct sandbox service trials (2023–24)
Regulators	▪ Update baseline regulatory documents supporting ATC operations to equip controllers with information to support eVTOL operations (2022–23) ▪ Define if VTOL aircraft are a new class of aircraft (2022–24) ▪ Define security requirements for VTOL services (2022–24) ▪ Develop licensing regime for vertiports (2022–24)
Policymakers	▪ Update National Policy Planning Framework (NPPF) to include guidance on AAM (2022–23) ▪ Publish National Policy Statement (NPS) on AAM infrastructure (2022–23)
MROs	▪ Secure workforce with appropriate training and type rating for VA-X4 maintenance (2024–25)
Flight Schools	▪ Establish VA-X4 training curriculum and related simulator facilities (2023–24)

9. About Vertical Aerospace

Vertical Aerospace is a leading UK-headquartered engineering and aeronautical business founded in 2016 by energy tech entrepreneur Stephen Fitzpatrick to develop electric Vertical Take-Off and Landing aircraft. Vertical is pioneering electric aviation through designing, manufacturing, selling and servicing one of the world's best eVTOL aircraft. The VA-X4 will travel at speeds of up 200mph, be near silent in flight, produce zero operating emissions and operate at a low cost per passenger mile.

Over the past five years, Vertical Aerospace has focused on building an exceptional senior team who have over 1,700 combined years of engineering experience and have certified and supported over 30 different civil and military aircraft and propulsion systems. It has also partnered with some of the most respectable names globally in engineering, aerospace and technology, including Rolls-Royce, Honeywell, Microsoft, GKN and Solvay, to build a truly unique and collaborative ecosystem to enable it to certify the VA-X4 in 2024, allowing commercial services to commence from 2025 onwards.

Vertical Aerospace has received an aggregate of up to 1,350 conditional aircraft pre-orders with launch customers American Airlines, Avolon, Bristow and Iberojet, including conditional pre-order options for Marubeni and Virgin Atlantic, valued in aggregate at $5.4 billion.

Vertical Aerospace is supported by an extremely strong network of strategic investors which includes Microsoft Corporation, American Airlines, Avolon, Honeywell, Rolls-Royce, Rocket Internet and 40 North.

Vertical Aerospace is a contributor to and a member of many panels, committees and organisations seeking to design, enable and build the AAM ecosystem.
In particular, Vertical Aerospace is working with a number of EASA and EUROCAE groups which are defining eVTOL standards including on electrical, lift/thrust, safety, flight and avionics workstreams.

10. Glossary

Terms	Definition
AAM	Advanced Aerial Mobility
AMS	Airspace Modernisation Strategy
ANSP	Air Navigation Service Provider
BEIS	Department for Business, Energy and Industrial Strategy
CAA	UK Civil Aviation Authority
CONOPS	Concept of Operations
CPDLC	Controller Pilot Data Link Communications
dBA	A-weighted decibels
DOA	Design Organisation Approval
EASA	European Union Aviation Safety Agency
EIS	Entry Into Service
EUROCAE	European Organisation for Civil Aviation Equipment
eVTOL	electric Vertical Take-Off and Landing
kWh	Kilowatt hour
MRO	Maintenance, Repair and Overhaul
NPPF	National Policy Planning Framework
NPS	National Policy Statement
OEM	Original Equipment Manufacturer
POA	Production Organisation Approval
RAM	Regional Aerial Mobility
SC-VTOL	Special Condition for Vertical Take-Off and Landing Aircraft
SME	Small and medium-sized enterprises
STOL	Short Take-Off and Landing
SWIM	System-Wide Information Exchange
UAM	Urban Aerial Mobility
UTM	Unified Air Traffic Management
VA-X4	eVTOL aircraft manufactured by Vertical Aerospace
Vertiport	Dedicated take-off and landing site for eVTOLs
VTOL	Vertical Take-Off and Landing

VERTICAL